Road Safety Impact Study
Final Report

Proposed Reid Road Reservoir Quarry (RRRQ) Haul Route
Milton, Ontario, Canada

Prepared for:

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[06.21.20] : Intus Road Safety Engineering Incorporated

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1. Introduction

1.1 ***Intus Road Safety Engineering Incorporated*** was retained by James Dick Construction Limited to undertake a road safety impact study for the haul route of a proposed quarry located on Part of Lot 7, Concession 2 in the Town of Milton, Regional Municipality of Halton, Ontario (i.e., at the western terminus of Reid Side Road and west of Twiss Road (see Figure 1). The proposed development will be referred to as the Reid Road Reservoir Quarry (RRRQ) hereinafter.

FIGURE 1: Study Location

1.2 This report documents the study process and findings.

1.3 The road safety impact study was carried out by Gerry Forbes, M.Eng, P.Eng, PTOE, at the office of ***Intus Road Safety Engineering Incorporated*** in Burlington, Ontario, between October 1, 2019 and April 7, 2020. A site visit was undertaken on October 8, 2019. The analysts resume is contained in Appendix A.

1.4 This report is a complement to the *Reid Road Reservoir Quarry Transportation Impact Study (Updated)* completed by Paradigm Transportation Solutions Limited, dated April 2020, which addresses traffic operations along the haul route.

1.5 The materials made available to Intus to conduct the safety impact study are listed in Appendix B.

2. Proposed Development

2.1 James Dick Construction Ltd is proposing to develop a quarry on a site located west of Twiss Road approximately opposite Reid Side Road (see Figure 2). Approximately 29 hectares of the site is proposed to be used for extraction of aggregate material. The quarry would extract a maximum of 990,000 tonnes of aggregate material annually.

2.2 Shipping from the quarry will be from 0600h to 1800h, Monday to Saturday (depending on demand), excluding public holidays. The site will ship/process material approximately 303 days per year.

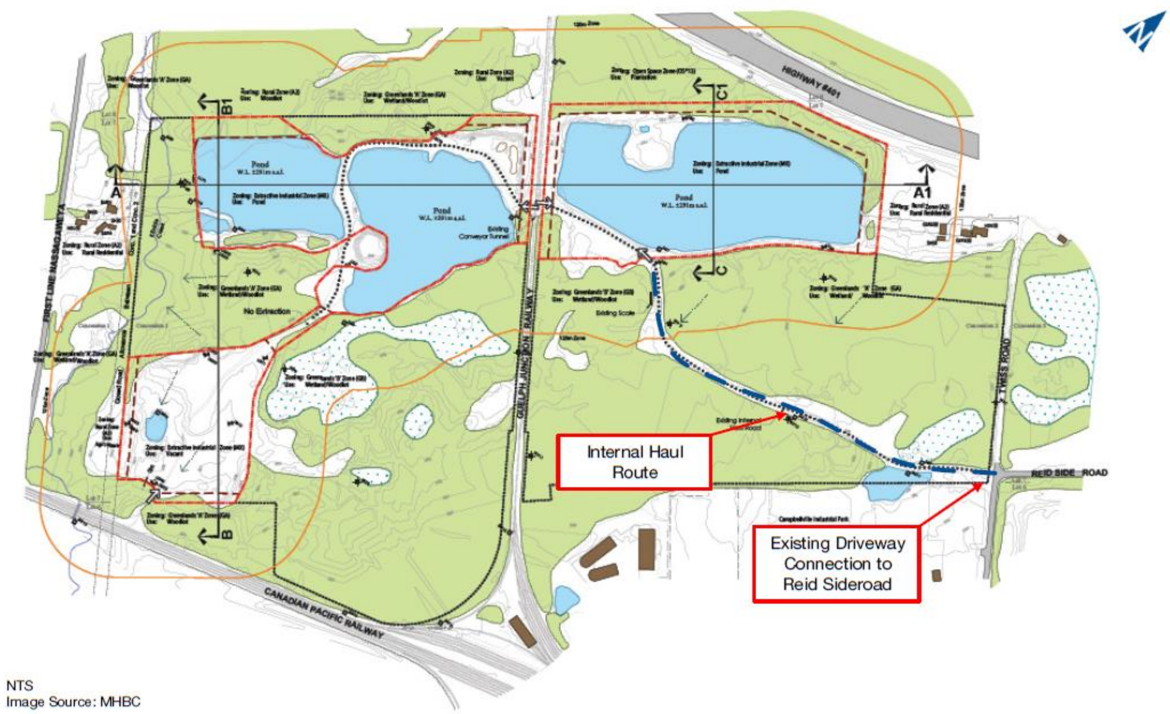

FIGURE 2: Site Plan

2.3 Access to the site will be provided by a full-movement driveway on Twiss Road opposite Reid Side Road. The driveway will consist of one entrance and one exit lane. The driveway will form the fourth leg of an intersection that will be operating under two-way stop control (with STOP signs facing the site driveway and Reid Side Road).

2.4 The average load for trucks shipping materials to/from the proposed site will be 33 tonnes. Based on the maximum allowable annual aggregate production, the days of operation, and the average load, the quarry is anticipated to generate an average of 140 trucks per day[1]. Taking into account daily and seasonal variations that are inherent in the demand from aggregate, the expected range of production is 22 to 184 trucks per day.[2] Quarry operations are expected to be consistent from year-to-year over the 20-year service life of the quarry.

2.5 According to the applicant's updated Transportation Impact Study (April 2020), the material will be shipped off-site via Reid Side Road, with all product travelling east on Highway 401 (see Figure 3). Therefore, the road safety impact study of the haul route addresses road safety on the facilities shown in Table 1.

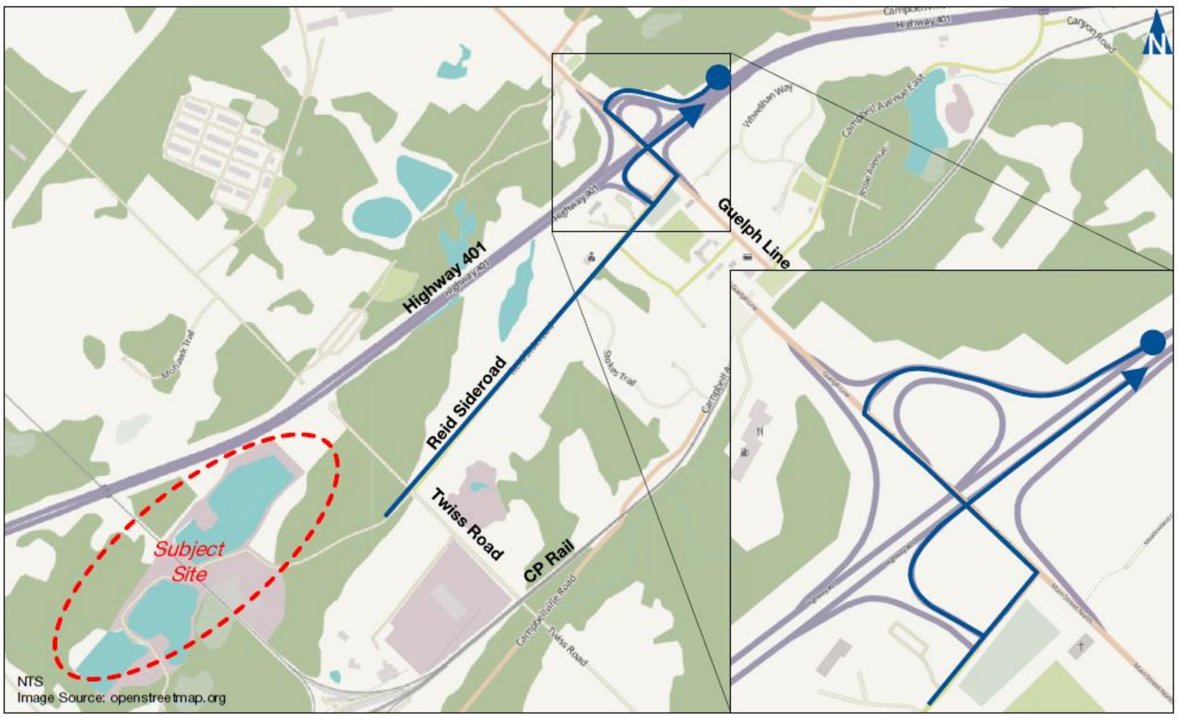

FIGURE 3: Haul Route for the Proposed RRRQ

TABLE 1: Study Area Routes

Facility	From	To	Owner
Reid Side Road	Twiss Road	Guelph Line	Town of Milton
Guelph Line	Reid Side Road	E-S ramp of Hwy 401	Halton Region
E-S Ramp of Hwy 401 at Guelph Line Interchange (Ramps 61 and 63)	Hwy 401	Guelph Line	MTO
E/W-E Ramp of Hwy 401 at Guelph Line Interchange (Ramp 35)	Reid Side Road	Hwy 401	MTO

[1] See Table 3.3, Reid Road Reservoir Quarry Transportation Impact Study (Updated), by Paradigm Transportation Solutions Ltd., April 2020.
[2] See Table 3.2, Reid Road Reservoir Quarry Transportation Impact Study (Updated), by Paradigm Transportation Solutions Ltd., April 2020.

3. The Road System in the Study Area

3.1 Highway 401 is an east/west controlled-access freeway that provides inter-regional travel between Windsor and the Ontario-Quebec border. Within the immediate study area, the highway has six lanes with a concrete median barrier and a posted speed limit of 100 km/h. The interchange ramps that provide access to/from Reid Side Road and Guelph Line are one-lane ramps with stop-controlled terminals on the municipal streets. Pedestrians and cyclists are prohibited from using Highway 401 and its ramps.

3.2 Guelph Line is a north/south major arterial Regional roadway with a two-lane cross-section and a speed limit of 50 km/h. The road is essentially straight and has a crest vertical curve with an apex that is generally coincident with centreline of Highway 401. There are no private accesses along Guelph Line in the study area. The intersection with Reid Sideroad is signalized with auxiliary turn lanes provided on all approaches. A sidewalk is present along the west side of Guelph Line from south of Reid Sideroad to the Highway 401 bridge. Guelph Line has paved shoulders on both sides of the road, except south of the Highway 401 bridge, where there is no shoulder on the west side of the road.

3.3 Reid Sideroad is a two-lane, east/west, local roadway. The roadway was constructed in conjunction with the approval of the former Springbank Pit in the late 1970's. The posted speed limit from Guelph Line to approximately 400 metres west of Guelph Line is 60 km/h. The posted speed limit of Reid Side Road elsewhere in the study area is 70 km/h. The lower speed limit is posted for the section of Reid Side Road that is within the Hamlet of Campbellville. The road is, for all intents and purposes flat and straight. Reid Side Road has a rural cross-section – with open ditches at the roadside. Access is uncontrolled along Reid Side Road, although travel along Reid Side Road is uninterrupted except at Twiss Road (stop-controlled) and Guelph Line (signal-controlled). There are no pedestrian or cycling facilities on Reid Side Road.

3.4 While truck traffic is permitted to use the Ministry highways, and Guelph Line, truck traffic is prohibited from using Reid Side Road by regulation[3]. Having stated that, it is acknowledged that the truck prohibition on Reid Side Road has a caveat that stipulates the prohibition does not apply to trucks engaged in making a delivery to, or collecting from, a premises which cannot be reached except by way of a road or portion of road where heavy trucks are prohibited. Truck and/or heavy vehicles are permitted to travel on Reid Side Road if it is unavoidable in getting to/from a premise. Trucks accessing the RRRQ would fall under this exemption. This is similar to trucks currently visiting the *Campbellville Industrial Park* located adjacent to the southern boundary of the proposed quarry.

4 Methods and Measures

4.1 There are no project-specific terms of reference for the haul route road safety study. The Town of Milton and Halton Region have stated that the road safety impact study of the proposed haul route must address road safety as outlined in the Halton Region ***Transportation Impact Study***

[3] Schedule 26 in Town of Milton's Uniform Traffic Control By-law No. 1984-1

Guidelines (January 2015). The MTO has not provided any direction concerning the methods, materials, or issues that need to be addressed from a road safety perspective.

4.2 The Transportation Impact Study Guidelines of Halton Region provide the following general guidance concerning the safety impacts of a proposed development:

> *Potential safety or operational issues associated with the following, as applicable, should be identified:*
>
> - *Weaving;*
> - *Merging;*
> - *Transit operational conflicts;*
> - *Corner clearances;*
> - *Sight distances;*
> - *Vehicle-pedestrian conflicts;*
> - *Traffic infiltration;*
> - *Access conflicts;*
> - *Cyclist movements;*
> - *Heavy truck movement conflicts;*
> - *Queuing*

The Halton guidelines also direct proponents as follows:

> *Where the development is adjacent to an area with identified problems, existing collision data (available from the Region) should be reviewed and an assessment of the impact of the proposed development provided. Such information may be helpful to minimize any additional problems through the design or location of access points.*

4.3 In addition to the above, the following issues have been identified as road safety concerns requiring consideration:

Joint Agency Review Team Comments (August 2019)

- ***Pedestrian-truck and cyclist-truck interactions:*** where the heaviest and largest road users may be in conflict with the smallest and most vulnerable road users.

- ***Increase in crash frequency and severity*** due to the increase in the number of heavy trucks using the haul route.

- ***Increase in risky manoeuvres by motorists*** when in traffic congestion, as predicted by the traffic analysis.

- ***Unspecified safety issues*** resulting from (unwarranted) signalization of the intersection of Reid Side Road and the Highway 401 ramps.

- ***Delays in emergency response times*** for first responders located at the Milton Fire Station and Regional EMS Station on Reid Side Road due to increased truck volumes.

ACTION (Association of Citizens Together in Our Nassagaweya)[4]

- ***Increased risk to pedestrians, school children, cyclists, local traffic and commuters*** from the site-generated truck traffic.

- ***Crash risk on area roads*** when Highway 401 is congested and truck drivers opt for an alternative haul route, including Guelph Line and other rural roads.

4.4 The Halton Region Transportation Impact Study Guidelines express a need to assess the road safety impacts of a proposed development but, offer no clear direction or specific guidance on how that evaluation is to take place[5]. There is no information on an acceptable evaluation methodology, appropriate evaluation criteria, or what constitutes "reasonable" or "acceptable" in terms of a road safety impact. Given the above, this road safety impact study is being carried out in general accordance with the guidelines for road safety impact studies generated by the Road Safety Committee of Ontario, and as outlined in this section.

4.5 A road safety impact study is an examination of traffic and infrastructure data associated with a development to identify the potential effects of the development on the crash risk of the site and the adjacent road system, and to recommend modifications to the site plan and the street system to deliver the maximum level of safety practicable, within the available constraints.

4.6 The objectives of a road safety impact study are to:

- *Ensure that existing safety issues and concerns are not exacerbated (and in some instance are mitigated) by the proposed development;*
- *Assess the proposed development and determine if there are alternative designs that would increase the level of safety without unduly affecting other objectives; and*
- *Prevent safety problems from being introduced to the road system by identifying and mitigating these issues at the planning stage – avoiding less effective retrofitting.*

4.7 With respect to evaluation criteria, the industry-accepted measure of traffic safety is crash occurrence and severity (collectively known as "crash risk"). Crash risk is comprised of probability, severity, and exposure – therefore, the impact of the proposed development on safety is measured by an increase in any either the probability of crash, the severity of crashes, or exposure to crashes. This study will not address perceived safety, feelings of personal security (e.g., fear of being mugged), and/or structural safety (e.g., slope stability, pavement condition, etc.).

4.8 With respect to methodology, a road safety impact study examines the safety performance of the existing roads and looks at anticipated changes in safety performance based on the proposed development. Hence, the study uses a mix of quantitative and qualitative methods in order to

[4] Source: https://www.actionmilton.ca/issue, accessed on October 22, 2019
[5] Beyond providing a limited "checklist " of potential road safety issues and mentioning a need to review current safety performance of facilities in the study area.

examine the increase in crash risk presented by a particular development, and to identify mitigating measures. It is a blend of an in-service road safety review and a road safety audit.

4.9 This study includes four distinct ways of measuring the road safety impacts of the proposed development:

a) ***Identifying existing safety problems (if any) that may be exacerbated by the proposed development:*** The current safety performance of the facilities in the study area are assessed by conducting a review of the most recent five-year crash data available. Any facilities that are experiencing a worse than expected safety performance are identified, causes of the poor safety performance are pinpointed (if possible), and the potential for the proposed development to exacerbate the safety issue are assessed.

b) ***Conducting a quantitative, planning-level risk analysis of the proposed haul route:*** Crash prediction models (also known as safety performance functions) are used to estimate the crash risk at the 10-year planning horizon with and without the proposed RRRQ to determine if the level of crash risk is significantly impacted by the development.

c) ***Completing a safe systems assessment of the proposed haul route:*** A road safety audit of the haul route to identify any features of the haul route that may lead to undue crash risk.

d) ***Addressing road safety issues identified by various stakeholders and interested parties:*** Each of the specific road safety issues mentioned by the various parties is examined.

5 Preface to the Analysis

5.1 The main road safety issue concerning the RRRQ development is the ability of the haul route to handle the additional truck traffic. This issue may be succinctly restated as: Will the addition of traffic generated by the RRRQ make the public road system ***unsafe***? If the answer, to this question is "yes", then an ensuing question is raised – Can changes be made to the proposed development, or the street system that will make the system ***safe***?

5.2 Defining Safety

5.2.1 The road safety community often asserts that there are no safe roads. This is because safe is colloquially defined as being free of hazard or danger – and this condition is not possible under the current system of motor vehicle travel. While this assertion is academically correct, it is not useful to practicing engineers. Roads are built for the traveling public and road authorities, in this instance the Town of Milton, Halton Region and the MTO, implicitly or explicitly set a (discretionary) safety threshold that they use to delineate safe from unsafe infrastructure.

5.2.2 Road authorities define road safety as the "state of the highway system when considering the risk of loss associated with its use, within a given societal context."[6] This definition recognizes and

[6] TAC (2009) Canadian Road Safety Engineering Handbook – Road Safety Engineering Management.

incorporates the two basic principles concerning road safety mentioned previously – that no road is absolutely safe (zero risk) unless it is out-of-service, and "safe" is contextual.

5.2.3 The appropriate and industry-accepted metric for "risk of loss" in a road safety analysis is crash occurrence and severity (collectively known as "crash risk"). This includes motor vehicle crashes, pedestrian trip and falls, cyclist spills, etc. Safety is not defined by a user's perception of safety, feeling of safety, or convenience of use. In the instance of a municipal street, one must consider motor vehicle crash risk as well as pedestrian and cyclist risks.

5.2.4 Municipal road authorities in Ontario generally use the performance-based metric of crash rate or expected crash frequency (using an Empirical Bayes analysis) to quantify and determine the relative safety of facilities under their control. If the observed or anticipated crash frequency/rate for a road is less than or equal to the expected or average frequency/rate for similar facilities, then the road is considered "safe". Conversely, an observed crash frequency/rate that is higher than the expected frequency/rate would make the road "unsafe" and in need of remedial measures. Whether a frequency or rate-based analysis is undertaken is dependent on the road authority. Both methods are technically sound foundations on which to make road safety decisions. Halton Region and the Town of Milton employ expected crash frequency as the metric for road safety.

5.2.5 Road authorities also use an economic metric to assess road safety. In this case, the safety of the road is assessed by considering not only the crash risk (or risk of loss), but also the burden of further reducing the risk. In short, can the road be made safer with little effort? This economic concept is articulated in the following equation:

$$B > PL$$

Where: *B = Burden of prevention (financial, environmental, societal, etc.)*
P = Probability of a crash
L = Loss (property or injury) created by the crash

5.2.6 The equation means that the road authority should be improving safety and reducing crash risk if the cost/burden of prevention is less than the expected losses from the crash. If crashes are relatively inexpensive to prevent, they ought to be prevented.

5.2.7 This approach to defining "safe" is also known as the ALARP (As Low As Reasonably Practicable) principle of risk management. In the plethora of literature available on risk management for differing activities and situations, this is the most widely accepted method of defining acceptable risk. In short, unless the risk is as low as reasonably practicable then the risk is unacceptable[7].

5.2.8 A main difficulty with implementing the concept of safety expressed by the above economic measure is one of personal perspective on costs. For example, an arterial road is viewed from many perspectives – the road user, the nearby community, and the general population. For the user, efficient travel and safety are paramount concerns. At the same time, the community is

[7] Because the impacts of any road design project are specific to the project, the ALARP principle is contextual. What may be considered an acceptable risk in one situation may be unacceptable in another.

generally more concerned about local aesthetic, social, and economic impacts. The general population tends to be interested in how successful a particular facility functions as part of the overall transportation system, and how much of available capital resources it consumes.

5.2.9 There is clearly a difference in what constitutes an acceptable cost depending on the perspective of the assessor. There is no formula or specific process that can be applied to reconcile the different viewpoints. Any discussion concerning the safety of a particular facility must consider the context of the project.

5.2.10 Every decision made by a road authority has an impact on safety, performance, and cost. There are no pure safety decisions – all design decisions cost money, effect safety and operational performance, and the practitioner must find the balance in every decision. Recognizing that context is a critical component of delineating between safe and unsafe and must be the starting point for discussion on the safety of the project.

5.2.11 In this context ***reasonably practicable*** means mitigating any increases in crash risk that are caused by the project except where the "cost" of doing so is grossly disproportionate to the reduction in the risk. The term cost refers to financial burden of mitigation, as well as any other societal or environmental impacts associated with the mitigation.

5.2.12 It is logical and equitable to extend the performance and economic criteria mentioned above to the road safety impacts of a proposed private development.

5.2.13 The once common practice of complying with the minimum standards or guidelines is no longer the benchmark for safe road design. This has been the case since at least 1997 when the Professional Engineers of Ontario, in examining the design of Highway 407 concluded that:

> *Applying standards and practices without considering prevailing circumstances is no substitute for judgment, and brings no assurance of an acceptable [safe] end product. [PEO, 1997]*

Simply comparing a road design to the current guidelines is insufficient to establish whether a road design affords an acceptable level of safety.

5.3 Pedestrians and Cyclists

5.3.1 The majority of crashes that are ultimately used to determine the safety performance of a facility are ordinarily motor vehicle crashes. The crash frequency of pedestrians and cyclists is far lower, and while these are the more vulnerable road users their level of safety may not be properly reflected in an overall crash rate.

5.3.2 Maximizing safety for ***all travel modes and users*** means providing a system with the lowest net crash risk. However, such a system might include certain features that provide a significant reduction in motor vehicle crashes at the expense of a small increase in pedestrian and/or cyclist crashes. For example, providing right-turn channelization at signalized intersections is generally regarded as providing a safety improvement for motorized traffic, but a safety disbenefit to pedestrians.

5.3.3 Deciding on "safety equity" among user groups is not an area that is addressed in the engineering literature except for the classical risk management approach, which is to convert the expected crashes to a monetary value using societal costs of crashes and use an economic analysis to determine the most favourable benefit-cost ratio. The two areas of concern with this approach are: it assumes that crashes can be accurately predicted for a reliable analysis; and the frequency of pedestrian crashes is typically extremely low and is overwhelmed by motorist risk simply because of exposure (i.e., volume of traffic).

5.3.4 There is no orderly way of overcoming the difficulties with establishing safety equity among road users and still remain completely objective, scientific, and quantitative. It remains a policy decision on how to maintain equity among road users.

6 Safety Performance of the Existing Road System

6.1 The haul route crash data supplied by the various road authorities are shown in Table 2.

TABLE 2: Haul Route Crash Data

Agency	Facility	Crash Data
Town of Milton	Reid Side Road - Twiss Road to Guelph Line	2014-2018
Region of Halton	Guelph Line - Reid Side Road to the E-S Ramp from Hwy 401	2014-2018
MTO	All ramps	2013-2017

All crash data were supplied in summary reports and included the general location of each crash, along with the date of the crash, the severity of the crash, the initial impact type, the environment, light and road conditions.

6.2 According to the available records, there were 31 reported crashes on the proposed haul route during the five-year analysis period. This is an average of about six crashes/year.

6.3 None of the reported crashes in the study area resulted in a fatality during the analysis period. During this same period 23% of the crashes resulted in a casualty with the remainder of the crashes causing only property damage. This severity distribution is "as expected", since 20% of all crashes in Milton from 2010 to 2016 were casualty crashes[8].

6.4 It is noted that there was a fatal, motor vehicle crash in February 2017 that occurred off-road (i.e., on private property) near the intersection of Twiss Road and Reid Side Road that is not reflected in the data provided by the road authorities. Private property crashes are not typically included in reported crash data, and the absence of this crash will not impact the analysis.

[8] Table 4.1, page 59, Ontario Road Safety Annual Reports from 2010 to 2013.

6.5 There were no pedestrian-involved crashes and no cyclist-involved crashes in the reported crashes.

6.6 Only one of the crashes in the analysis period involved a truck. This crash occurred at the intersection of Guelph Line at the E-S ramp terminal and involved an automobile turning left from the ramp to Guelph Line, failing to yield the right-of-way to a southbound truck on Guelph Line. The crash resulted in property damage only (i.e., no personal injuries).

6.7 This rate of involvement of trucks in crashes in the study area is better than expected, given the provincial average is 4% of all crashes involve at least one truck[9].

6.8 The locations of the reported motor vehicle crashes along the proposed haul route are shown in Figure 4. The vast majority of the crashes are occurring at four locations – the intersection of Reid Side Road and Twiss Road, the intersection of Reid Side Road and Main Street North, the intersection of Guelph Line at the E-S ramp terminal, and along the E-N/S ramp.

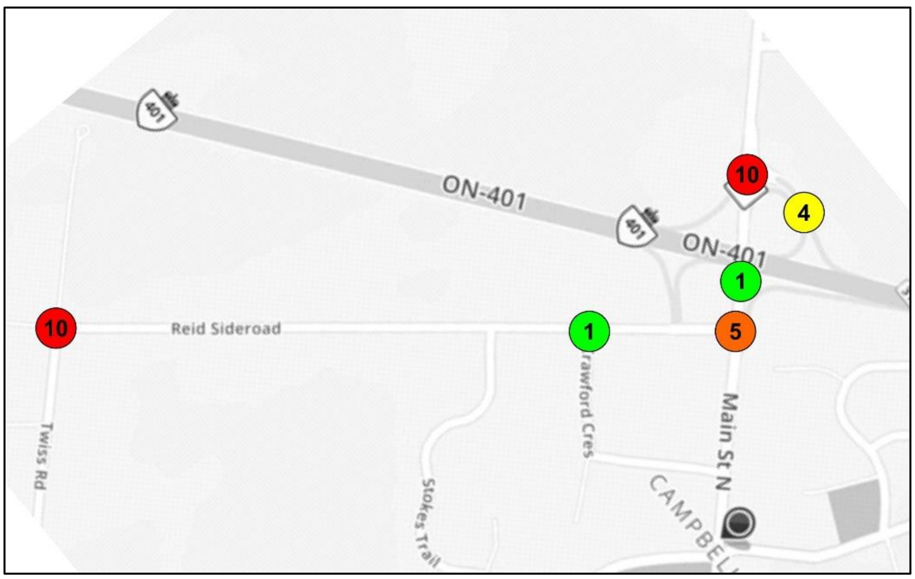

FIGURE 4: Location of Crashes on the Haul Route

6.9 Halton Region regularly conducts a review of the regional road network to identify locations with a higher than expected crash risk using an Empirical Bayes network screening methodology. The most recent network screening yielded the results in Table 3.

6.10 A potential for safety improvement (PSI) of greater than 0.0 is an indication that the observed number of crashes occurring at a site is more than expected. Typically, jurisdictions that conduct network screening only investigate locations with a PSI rank of one to 20. The results of the Halton Region network screening indicate that the Regional roads and intersections on the

[9] Table 5.1, page 74, Ontario Road Safety Annual Report 2013

proposed haul route are performing well from a safety perspective, and that there are no latent road safety issues that may be exacerbated by traffic generated by the proposed RRRQ.

TABLE 3: Network Screening Results from Halton Region

Location	**Potential for Safety Improvement (PSI) Rank**	**PSI**		
		PDO	**Severe**	**All**
Main Street North at Reid Side Road	295	0.0	0.0	0.0
Guelph Line at the E-S Ramp terminal	280	0.0	0.0	0.0
Guelph Line from Reid Side Road to S-W Ramp	366	0.0	0.0	0.0
Guelph Line from S-W Ramp to the E-S Ramp terminal	496	0.0	0.0	0.0

6.11 The Town of Milton does not conduct any network screening (although they are planning do start this exercise in the near future). As a result, there is no ranking or assessment of the safety performance of Reid Side Road, and its intersections. Consequently, a more general approach to assessing the safety performance of these existing facilities is undertaken. Specifically, the crash records of the Town facilities are benchmarked against the following *rules of thumb* for the safety assessment of local streets:

- *Intersections should average no more than one crash per year;*
- *Intersections should have no more than one crash per million-vehicles-entering the intersection; and*
- *Road sections should average no more than one crash per year per kilometre.*

6.12 Given the above, the intersection of Reid Side Road at Twiss Road is a location with a potentially undue crash risk. The crash frequency of two crashes per year and a crash rate of 2.0 crashes per million-vehicles-entering are relatively high. The collision diagram for the intersection of Reid Side Road at Twiss Road is shown in Figure 5. All of the crashes involve westbound vehicles, and all of the crashes are single motor vehicle crashes except one rear-end crash. The majority (80%) of the crashes at this location occurred in the off-peak, overnight period (1900h to 0700h).

6.13 Because the crash information is supplied in a summary report, and individual motor vehicle accident reports are not available, it is difficult to determine the cause(s) of the elevated crash risk at the intersection of Reid Side Road and Twiss Road. Nonetheless, because the majority of the crashes occur in the overnight period, it suggests that the crashes are likely due to poor driving rather than deficient infrastructure. The site visit confirms that the infrastructure on the Reid Side Road approach to the intersection is generally compliant with prevailing standards and guidelines. The exception to the above is visibility of the STOP sign (see Figure 6). Roadside vegetation is partially obscuring the STOP sign during the approach and may be a causal factor in the elevated crash risk at this location. This is a municipal road maintenance issue.

6.14 In the end, the elevated crash risk at this location is not expected to be impacted by the proposed development. The RRRQ will be operational from 0600h to 1800h – which is outside of the times when crashes tend to occur at the Reid Side Road and Twiss Road intersection.

6.15 The crash data indicate that the roads and intersections along the proposed haul route are performing well from a safety perspective, except for the intersection of Reid Side Road at Twiss Road. There is an elevated crash risk at the aforementioned intersection, however, truck traffic does not appear to be contributing to the elevated crash risk. The rate of involvement of trucks in crashes along the proposed haul route is lower than the provincial average and suggests that trucks are not creating any undue crash risk in the study area. Furthermore, there were no pedestrian-involved or cyclist-involved crashes in the study area.

7 Quantitative Safety Analysis at a Planning Level

7.1 Base Data and Models

7.1.1 The impact of the proposed development on crash risk may be quantified using crash prediction models and traffic volume projections for the background, site-generated, and total traffic conditions at a 10-year planning horizon.

7.1.2 Crash prediction models for the various facilities along the proposed haul route were obtained from the various road authorities in order to estimate the frequency and severity of crashes resulting from the proposed quarry. The models employed for this safety study are shown in Table 4.

7.1.3 All of the prediction models use annual daily traffic volume(s) as the dependent variable(s). For the purposes of this haul route safety impact study, the annual daily traffic volumes for the 10-year horizon are used. The daily traffic volumes were approximated from the peak hour volumes used in the updated Transportation Impact Study for this project [Paradigm Transportation Solutions Ltd., 2020] as follows:

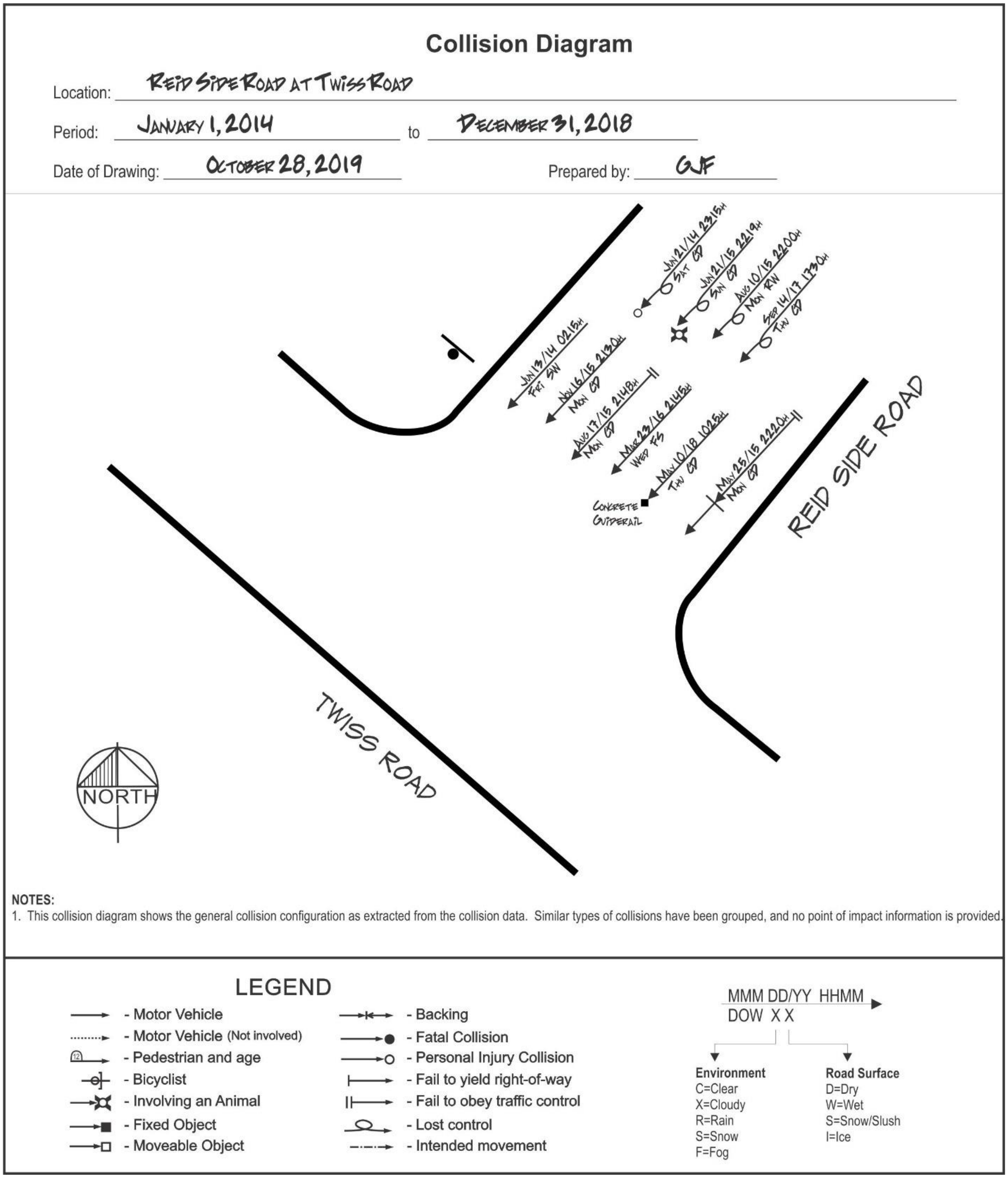

FIGURE 5: Collision Diagram for Reid Side Road at Twiss Road

FIGURE 6: Reid Side Road Approach to Twiss Road

$$AADT = \frac{AM + PM}{2} * 10$$

Where: *AADT = Annual average daily traffic*
AM = AM peak hour traffic volume
PM = PM peak hour traffic volume

7.1.4 The analysis presented in this section is a broad-brushed approach to estimating safety. Nonetheless, it is one that is appropriate for a planning level comparative analysis.

7.1.5 The analysis uses the supplied crash prediction models to estimate the total number of reportable crashes based on daily traffic volumes. The breakdown of each estimate by crash severity is completed using the severity distributions for Ontario crash data shown in Table 5.

Table 5: Crash Severity Distribution[10]

	Fatal	Injury	PDO
Non-intersection	0.33%	17.09%	82.58%
Intersection	0.22%	29.57%	70.21%

[10] Table 3.13 of Ontario Road Safety Annual Reports 2010-2016

TABLE 4: Crash Prediction Models

Location	Crash Severity	Model Form	Model Parameters					Source
			Ln(a)	b	c	d	k	
Rural Two-lane Roads Guelph Line Reid Side Road	All	$N = a * AADT^{b} * Length^{C}$	-11.4827	0.5993	0.8990	---	0.5358	1
	Severe	$N = a * AADT^{b} * Length^{C}$	-14.3765	0.6742	1.0000	---	0.4615	1
Signalized 3-leg intersections Guelph Line at Reid Side Road	All	$N = a * AADT_{maj}^{b} * AADT_{min}^{b}$	-6.4328	0.3525	0.4349	---	0.9588	1
	Severe	$N = a * AADT_{maj}^{b} * \left(\frac{AADT_{min}^{b}}{AADT_{tot}}\right)^{c}$	-6.6653	0.6611	0.4845	---	0.9344	1
Unsignalized 3-leg intersection (stop on minor road) Reid Side Road at Stokes Trail Reid Side Road at Crawford Crescent	All	$N = a * AADT^{b} * Length^{C}$	-10.5973	0.6174	0.5776	---	1.3896	1
	Severe	$N = a * AADT^{b} * Length^{C}$	-12.7558	1.2953	0.7304	---	2.3955	1
Unsignalized 4-leg intersection (stop on minor road) Reid Side Road at Twiss Road	All	$N = a * AADT^{b} * Length^{C}$	-6.9670	0.2183	0.6383	---	0.9747	1
	Severe	$N = a * AADT^{b} * Length^{C}$	-9.9009	0.3725	0.6627	---	1.4790	1
Ramp Terminals Reid Side Road at 401 On/Off Ramps Guelph Line at 401 Off ramp	All	$N = a * AADT_{maj}^{b} * AADT_{min}^{c} * e^{(d*Split)}$	-9.0654	0.4784	0.5538	-1.2735	0.3908	2
	Severe	$N = a * AADT_{maj}^{b} * AADT_{min}^{c} * e^{(d*Split)}$	0.7174	0.1047	0.0903	0.1673	0.3802	2
On-ramp Ramp 35	All	$N = a * AADT^{b} * Length$	-5.4088	0.7333	---	---	0.6418	2
	Severe	$N = a * AADT^{b} * Length$	-7.6000	0.7715	---	---	0.5136	2
Off-ramp Ramps 61 and 63	All	$N = a * AADT^{b} * Length$	-5.4912	0.7781	---	---	0.5311	2
	Severe	$N = a * AADT^{b} * Length$	-6.6297	0.5602	---	---	0.5368	2

N = Number of crashes per year
$AADT_{maj}$ = Average annual daily traffic on the major road
$AADT_{min}$ = Average annual daily traffic on the minor road
$AADT_{tot}$ = $AADT_{maj}$ + $AADT_{min}$
Length = Length of the road section in kilometres
Split = 1 if the approach is a split ramp, 0 otherwise

Sources:
1- The Regional Municipality of Halton, Safety Performance Function Update – March 2017
2- MTO Safety Performance Functions, https://files.ontario.ca/opendata/safety_performance_functions.csv, accessed on October 29, 2019

7.2 Single Unit Truck Crash Frequency

7.2.1 Almost all of the traffic generated by the proposed development will be single-unit trucks and truck-trailer combinations. As a result, the crash predictions from general safety performance models need to be adjusted for both crash frequency and crash severity to better reflect the RRRQ situation.

7.2.2 With respect to crash frequency, the research provides the following guidance:

- Montufar examined the crash rate of different vehicle types on the Large Commercial Vehicle network in Alberta using data from 1999-2005 and found that straight trucks, and straight truck with bobtail units had a crash rate of 123 crashes/100 MVK[11], versus 74 crashes/100 MVK for all vehicles. The relative risk (RR) for a straight truck crash is 1.66.

- Saskatchewan statistics from 1980 indicate that single-unit trucks on the provincial highway system had a crash rate of 1.271 crashes/MVK, whereas all vehicles had a crash rate of 1.484 crashes/MVK. (RR=0.86)

- United States data from the 1997-2017 indicate that single-unit trucks have a crash rate of 210.45 crashes/100 MVM versus 208.91 crashes/100 MVM for all vehicles. (RR=1.01)

7.2.3 The above results provide mixed results. One study indicates single-unit trucks have higher crash rates than the general traffic stream, one study indicates single-unit trucks have lower crash rates than the general traffic stream, and one study indicates single-unit trucks have about the same crash rate as the general traffic stream. These conflicting results can perhaps be reconciled if the data is disaggregated by setting. Specifically, Crabtree and Agent (1982) examined crash rates by vehicle type and road type, and produced the results shown in Table 6. Based on these results, it is clear that single-unit trucks have a higher crash risk than the general traffic stream in urban settings, and a comparable crash rate to the general traffic stream in rural settings.

7.2.4 The Town of Milton Official Plan (2008 version) classifies Reid Side Road as a local road, and Guelph Line as a major arterial road. If the rural cross-section and sparse development along Reid Side Road and Guelph Line are considered, then the relative risk of the truck traffic is 1.05 and 1.15, respectively. Nonetheless, the analysis employs a conservative approach, and uses a factor of 1.5 to account for the increased crash frequency due to truck traffic from the RRRQ site.

7.3 Single Unit Truck Crash Severity

7.3.1 With respect to crash severity, Table 7 shows the most-recent crash statistics in Ontario for truck-involved and all crashes.

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[11] MVK = Million vehicle kilometres; MVM = Million vehicle miles

7.3.2 Based on the summary statistics, what is apparent from the above data is that the truck-involved crashes result in a higher risk of fatal crashes, a lower risk of injury crashes, and a slightly higher percentage of property damage only crashes (see Table 8). Therefore, to account for the site generated traffic being entirely trucks, the predicted number of crashes resulting from site generated traffic are adjusted using the relative risk in Table 8.

TABLE 6: Crash Rates for Single-Unit Trucks and All Vehicles by Road Type

	Crash Rate (crashes/MVM)		
Road Type	**Single Unit Trucks**	**All Traffic**	**Relative Risk**
Rural, principal arterial	250	218	1.15
Rural, minor arterial	373	350	1.07
Rural, major collector	381	383	0.99
Rural, minor collector	337	374	0.90
Rural, local	353	337	1.05
Urban, principal arterial	1706	944	1.81
Urban, minor arterial	1495	920	1.63
Urban, collectors	1314	737	1.78
Urban, local	959	437	2.19
Rural	301	276	1.09
Urban	1253	707	1.77
All	489	414	1.18
Urban, 2-lane	1247	873	1.43
Rural, 2-lane	377	360	1.05

TABLE 7: Crash Severity by Vehicle Type

	Trucks				**All Vehicles**			
Year	**Fatal**	**Injury**	**PDO**	**All**	**Fatal**	**Injury**	**PDO**	**All**
2010	106	2227	11756	14089	885	83910	316025	400820
2011	103	2252	11791	14146	831	82675	236893	320399
2012	97	2225	11465	13787	854	81570	230688	313112
2013	92	2477	12594	15163	787	80932	262897	344616
2014	115	2729	13998	16842	869	72648	331306	404823
2015	88	2416	12913	15417	834	77000	338870	416704
2016	110	2319	11994	14423	947	75029	315568	391544
2010-2016	711	16645	86511	103867	6007	553764	2032247	2592018

[Sources: Table 5.1 of the Ontario Road Safety Annual Reports for 2010 to 2016, inclusive]

TABLE 8: Adjustments to Crash Severity for Truck Only Traffic

Crash Severity	No. Crashes (2010-2016)		Percentage of Crashes (2010-2016)		Relative Risk
	Trucks	**All Vehicles**	**Trucks**	**All Vehicles**	
Fatal	711	6 007	0.68%	0.23%	2.95
Injury	16 645	553 764	16.03%	21.36%	0.75
PDO	86 511	2 032 247	83.29%	78.40%	1.06
All	103 867	2 592 018	100.0%	100.0%	---

7.4 Results

7.4.1 The predicted number of crashes for the haul route facilities under the 10-year background traffic conditions, site-generated traffic, and total traffic conditions are shown in Tables 9, 10 and 11, respectively.

7.4.2 In order to fairly compare the crash risk, and the impact if the RRRQ trucks on road safety along the haul route, the crash predictions are mapped to a risk matrix that accounts for crash severity and frequency in an ordinal scale (see Figure 7).[12] This is a more appropriate method for articulating a 10-year prediction of crash risk, as the numerical prediction implies a greater level of precision than should be ascribed to the estimate.

FIGURE 7: Crash Risk Matrix

		Crash Frequency				
		More than one per year	One every 1-4 years	One every 5-10 years	One every 10-100 years	Less than on every 100 years
Crash Severity	Fatal	**Very High**	High	High	Medium	Low
	Injury	High	High	Medium	Low	Low
	Property Damage Only	Medium	Medium	Low	Low	Low

[12] The risk matrix is sourced from the Institution of Highways & Transportation, "Road Safety Audit", ISBN 978-0-902933-40-8, October 2008

TABLE 9: Annual Crash Frequency Under Background Traffic at a 10-year Horizon

Location	Background Traffic			
	All	**Fatal**	**Injury**	**PDO**
Reid Side Road at Twiss Road	0.465	0.001	0.137	0.326
Reid Side Road - Twiss to Stokes	0.001	0.000	0.000	0.001
Reid Side Road at Stokes Trail	0.054	0.000	0.016	0.038
Reid Side - Stokes to Crawford	0.000	0.000	0.000	0.000
Reid Side Road at Crawford Crescent	0.059	0.000	0.017	0.041
Reid Side - Crawford to Hwy 401 Ramps	0.000	0.000	0.000	0.000
Reid Side Road at Hwy 401 Ramps	0.841	0.002	0.249	0.591
Reid Side Road - Hwy 401 Ramps to Guelph Line	0.000	0.000	0.000	0.000
Guelph Line at Reid Side Road	1.905	0.004	0.563	1.337
Guelph Line - Reid Side to Hwy 401 off ramp	0.001	0.000	0.000	0.001
Guelph Line at Hwy 401 off ramp	0.330	0.001	0.098	0.232
Ramp 61 (E-N/S)	0.898	0.003	0.153	0.742
Ramp 63 (E-S)	0.078	0.000	0.013	0.064
Ramp 35 (E/W-E)	0.361	0.001	0.062	0.298
TOTAL	**4.995**	**0.013**	**1.309**	**3.673**

The number of decimal places shown is intentional due to the small numbers, and does not imply a level of precision

TABLE 10: Annual Crash Frequency Under Site-Generated Traffic

Location	Site			
	All	**Fatal**	**Injury**	**PDO**
Reid Side Road at Twiss Road	0.095	0.001	0.021	0.070
Reid Side Road - Twiss to Stokes	0.000	0.000	0.000	0.000
Reid Side Road at Stokes Trail	0.004	0.000	0.001	0.003
Reid Side - Stokes to Crawford	0.000	0.000	0.000	0.000
Reid Side Road at Crawford Crescent	0.004	0.000	0.001	0.003
Reid Side - Crawford to Hwy 401 Ramps	0.000	0.000	0.000	0.000
Reid Side Road at Hwy 401 Ramps	0.023	0.000	0.005	0.017
Reid Side Road - Hwy 401 Ramps to Guelph Line	0.000	0.000	0.000	0.000
Guelph Line at Reid Side Road	0.009	0.000	0.002	0.007
Guelph Line - Reid Side to Hwy 401 off ramp	0.000	0.000	0.000	0.000
Guelph Line at Hwy 401 off ramp	0.006	0.000	0.001	0.005
Ramp 61 (E-N/S)	0.036	0.000	0.005	0.032
Ramp 63 (E-S)	0.008	0.000	0.001	0.007
Ramp 35 (E/W-E)	0.017	0.000	0.002	0.015
TOTAL	**0.202**	**0.002**	**0.039**	**0.158**

The number of decimal places shown is intentional due to the small numbers, and does not imply a level of precision

TABLE 11: Annual Crash Frequency Under Total Traffic at a 10-year Horizon

Location	**Total Traffic**			
	All	**Fatal**	**Injury**	**PDO**
Reid Side Road at Twiss Road	0.559	0.002	0.158	0.397
Reid Side Road - Twiss to Stokes	0.001	0.000	0.000	0.001
Reid Side Road at Stokes Trail	0.058	0.000	0.017	0.041
Reid Side - Stokes to Crawford	0.000	0.000	0.000	0.000
Reid Side Road at Crawford Crescent	0.063	0.000	0.018	0.044
Reid Side - Crawford to Hwy 401 Ramps	0.000	0.000	0.000	0.000
Reid Side Road at Hwy 401 Ramps	0.864	0.002	0.254	0.608
Reid Side Road - Hwy 401 Ramps to Guelph Line	0.000	0.000	0.000	0.000
Guelph Line at Reid Side Road	1.914	0.004	0.565	1.344
Guelph Line - Reid Side to Hwy 401 off ramp	0.001	0.000	0.000	0.001
Guelph Line at Hwy 401 off ramp	0.336	0.001	0.099	0.237
Ramp 61 (E-N/S)	0.934	0.003	0.158	0.773
Ramp 63 (E-S)	0.086	0.000	0.014	0.071
Ramp 35 (E/W-E)	0.378	0.001	0.064	0.313
TOTAL	**5.196**	**0.014**	**1.349**	**3.831**

The number of decimal places shown is intentional due to the small numbers, and does not imply a level of precision

7.4.3 The crash risks for each facility (i.e., Reid Side Road, Guelph Line, and the individual ramps to/from Highway 401) that arise from the site-generated traffic are as shown in Table 12.[13] The site generated traffic is expected to be a low risk for all severities on all routes.

TABLE 12: Crash Risk of Site-Generated Traffic

	Fatal		Injury		PDO	
	Crashes/year	Years between Crashes	Crashes/year	Years between Crashes	Crashes/year	Years between Crashes
Reid Side Road	0.001	1122	0.030	33	0.100	10
Guelph Line	0.000	9722	0.003	290	0.012	86
Ramp 61 (E-N/S)	0.000	2838	0.005	216	0.032	32
Ramp 63 (E-S)	0.000	8639	0.002	428	0.011	88
Ramp 35 (E/W-E)	0.000	3165	0.007	139	0.032	31

[13] The crash frequencies for each road is the sum of all crash frequencies for the intersections and midblock sections along the proposed haul route. For example, the Guelph Line crash frequency is the sum of the crash frequencies for the intersection of Guelph Line at Reid Side Road, the section of Guelph Line from Reid Side Road to the E-S ramp, and the intersection of Guelph Line at the E-S ramp. Note that the crash frequency for the intersection of Guelph Line at Reid Side Road is also included in the overall crash frequency for Reid Side Road (i.e., it is double counted). This results in an over-estimate of crash frequency but is a more conservative approach to estimating the road safety impact of the proposed development.

7.4.4 The crash risks for each facility under 10-year horizon, background and total traffic conditions are as shown in Tables 13 and 14. The site generated traffic is not expected to alter the overall risk for any severity on any of the roads along the proposed haul route.

TABLE 13: Crash Risk of 10-year Horizon Background Traffic

	Fatal		Injury		PDO	
	Crashes/year	Years between Crashes	Crashes/year	Years between Crashes	Crashes/year	Years between Crashes
Reid Side Road	0.007	134	0.983	1	2.335	0.4
Guelph Line	0.005	200	0.661	2	1.570	1
Ramp 61 (E-N/S)	0.003	337	0.153	7	0.742	1
Ramp 63 (E-S)	0.001	1003	0.111	9	0.296	3
Ramp 35 (E/W-E)	0.003	325	0.310	3	0.547	2

TABLE 14: Crash Risk of 10-year Horizon Total Traffic

	Fatal		Injury		PDO	
	Crashes/year	Years between Crashes	Crashes/year	Years between Crashes	Crashes/year	Years between Crashes
Reid Side Road	0.008	120	1.013	1	2.436	0.4
Guelph Line	0.005	196	0.665	2	1.582	1
Ramp 61 (E-N/S)	0.003	302	0.158	6	0.773	1
Ramp 63 (E-S)	0.001	899	0.113	9	0.308	3
Ramp 35 (E/W-E)	0.003	295	0.318	3	0.921	1

7.4.5 The crash risks presented by the RRRQ traffic are expected to be low and are not expected to alter the overall crash risk of the area roads within the 10-year planning horizon. Furthermore, traffic generated by the RRRQ is expected to mainly travel during daylight hours (i.e., 0600h to 1800h), with the bulk of the aggregate being hauled during the Ontario construction season. Both of these operating characteristics of the site lessen the road safety risks of the proposed development.[14] These safety positive features of the site operation are not reflected in the quantitative risk analysis, and are expected to lower any increases in the predicted crash risk resulting from the additional truck traffic.

[14] With respect to the hours of operation, road safety gains are realized because trucks will not be operating during hours of darkness, when collisions tend to be over-represented. Similarly, the number of trucks hauling aggregate is substantially reduced during the winter months when inclement weather results in increase collision occurrence.

8 Safe System Assessment

8.1 The Safe System approach to road safety asserts that no road user should be killed or seriously injured in the event of a crash. There are four elements to a Safe System: safer ***vehicles***, safer ***speeds***, safer ***roads*** and safer ***road users***. A Safe System Assessment (SSA) is concerned mainly with the safer roads and safer speeds elements. A SSA examines proposed amendments to the road system and identifies infrastructure and speed-related factors that are likely to contribute to a higher risk of fatal and serious injury crashes. If critical elements are identified, the SSA also recommends changes that will better align the proposal with Safe System principles.

8.2 A site visit was conducted on October 8, 2019 with a purpose of conducting a safe systems assessment of the proposed haul route and identifying site-specific features that may lead to undue increases in crash risk presented by the proposed development. Despite the weather being relatively mild for October, it is acknowledged that pedestrian and cyclist activity ***may*** be significantly lower than might be expected in the summer months.

8.3 The results of the SSA are documented in Appendix C of this report. The salient findings are as follows:

- Roadside vegetation is restricting visibility at some driveways and intersections along Reid Side Road. This is an ongoing maintenance issue.
- The CHECKERBOARD sign on Guelph Line facing the E-S ramp indicates that motorists may turn right or left on Guelph Line when they are only permitted to turn left. This may cause some motorist to turn right illegally.
- The NO PEDESTRIANS/CYCLISTS sign for the N-W ramp is erected too far upstream of the bullnose (about 20 metres south of the bullnose) and may mislead road users into believing that pedestrians and cyclists are prohibited from proceeding north on Guelph Line.
- The width of the bridge on Guelph Line over Highway 401 is constrained and does not allow pedestrians, cyclists and motorists to be laterally separated to the same extent as other area roadways. However, pedestrian and cyclist demand across Highway 401 is relatively low and forward visibility is adequate for road users to see and react to other road users on Guelph Line.
- There is a pavement edge drop off developing on the south side of Reid Side Road opposite the Highway 401 ramps being created by left-turning traffic. This appears to be an ongoing road maintenance issue.

8.4 The site visit and SSA did not reveal any pertinent safety concerns that would be created or exacerbated by the RRRQ. There are some annual roadside maintenance issues and minor signing issues that could be undertaken to improve safety performance. The width of the

Guelph Line bridge over Highway 401 is less than desirable, but sufficient given the low pedestrian and cyclist demand and the excellent forward visibility along Guelph Line.

9 Identified Safety Issues

9.1 The following issues have been identified by the Joint Agency Review Team and the Association of Citizens Together in Our Nassagaweya:

- ***Pedestrian-truck and cyclist-truck interactions:*** where the heaviest and largest road users may be in conflict with the smallest and most vulnerable road users.
- ***Increase in crash frequency and severity*** due to the increase in the number of heavy trucks using the haul route.
- ***Increase in risky manoeuvres by motorists*** when in traffic congestion, as predicted by the traffic analysis.
- ***Unspecified safety issues*** resulting from (unwarranted) signalization of the intersection of Reid Side Road and the Highway 401 ramps.
- ***Delays in emergency response times*** for first responders located at the Milton Fire Station and Regional EMS Station on Reid Side Road due to increased truck volumes.

ACTION (Association of Citizens Together in Our Nassagaweya)[15]

- ***Increased risk to pedestrians, school children, cyclists, local traffic and commuters*** from the site-generated truck traffic.
- ***Crash risk on area roads*** when Highway 401 is congested and truck drivers opt for an alternative haul route, including Guelph Line and other rural roads.

9.2 Each of these issues is addressed below.

9.3 Conflicts and Interactions with Cyclists

9.3.1 Cyclists are permitted on Guelph Line and on Reid Side Road and are prohibited from using the ramps to/from Highway 401. According to the Milton Transportation Master Plan, cyclists on Guelph Line are to be eventually accommodated by an on-road paved shoulder. There are no cycling facilities planned for Reid Side Road (see Figure 8).

9.3.2 Based on the recommendation in the Milton Transportation Master Plan, Reid Side Road is a local, rural road and the speed and volume of motorized traffic, and the demand for cycling do not warrant separate cycling facilities. The volume of additional traffic from/to the RRRQ site is

[15] Source: https://www.actionmilton.ca/issue, accessed on October 22, 2019

relatively low and would not alter the long-term plan of not providing physically-separated cycling facilities along Reid Side Road.

9.3.3 Arterial roads, such as Guelph Line, are generally preferred by both cyclists and trucks because they are direct routes that offer relatively uninterrupted travel. While trucks and cyclists (because of their differences in mass) are generally considered to be incompatible road users, Guelph Line along the proposed haul route is reasonably safe for cyclists under existing conditions for the following reasons:

- The crash record of Guelph Line indicates that the existing facility is accommodating both heavy goods vehicles and cyclists safely.
- The sight lines and forward visibility along the Guelph Line portion of the haul route affords each road user ample opportunity to see and react to other users.
- The 50 km/h speed limit on Guelph Line is appropriate for the mix of road users.

There is no reason to expect that RRRQ-generated traffic will materially impact on the safety performance of Reid Side Road or Guelph Line with respect to cycling.

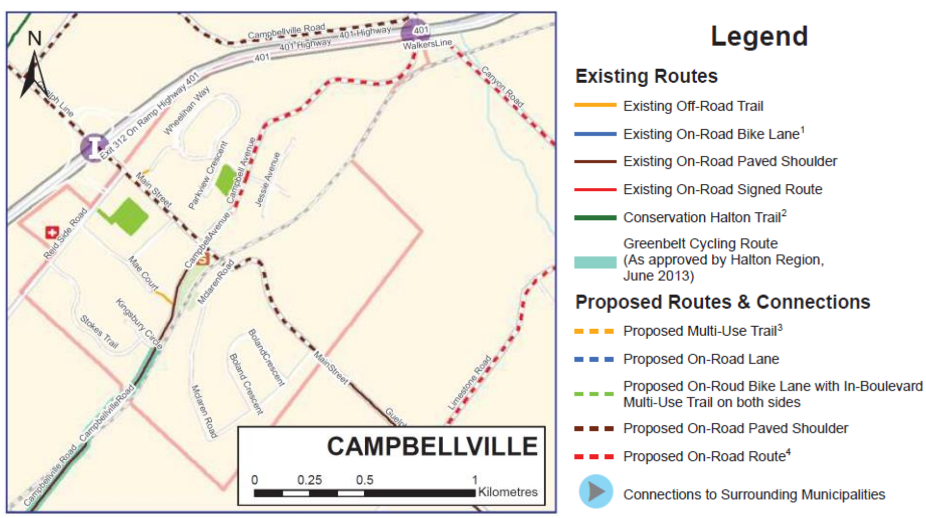

FIGURE 8: Planned Cycling Network in Campbellville
[Source: Map 1a Milton Transportation Master Plan, Appendix A, Active Transportation Strategy, April 2018]

9.3.4 Despite the fact that cyclist safety along Guelph Line is not expected to be materially impacted by the RRRQ traffic, the typical opportunities to improve cycling safety are also examined. These include rerouting one of the user groups to another street, providing lateral separation between cyclists and trucks, and/or reminding road users of the need to share the road with other user types. In this instance, rerouting either user group to a parallel street (thus spatially separating any conflicts) is not possible as Guelph Line is the only crossing of Highway 401 in the immediate vicinity. Furthermore, increasing the lateral separation between cyclists and trucks is not feasible without widening the Highway 401 structure, as the motorized traffic lanes on the structure are currently at or near the minimum recommended widths of 3.3 metres.

9.3.5 The only viable option with respect to cycling, is to maintain the *status quo* and let trucks and cyclists share the road using the existing platform width. Signing (i.e., share the road) and pavement markings (i.e., sharrows) may be used to highlight that the haul route accommodates both modes of travel. While these measures are expected to provide a nominal improvement to cycling safety, they are not required to accommodate the RRRQ traffic, and should only be implemented if they are in accordance with municipal and regional policies.

9.3.6 Trucks sharing the road with cyclists can result in aerodynamic forces that increase sideswipe crash risk. A sideswipe crash between a truck and a cyclist is not always the result of a trucker or a cyclist selecting a speed and path combination that places the two users in conflict. In some instances, a crash can result when a fast-moving truck passes close to a cyclist, and the wind turbulence created by the truck essentially "sucks" the cyclist towards the truck, resulting in a crash. The magnitude of the aerodynamic effect is proportional to the size of the truck, the speed of the truck, and the lateral separation between the truck and the cyclist.

9.3.7 Figure 9 provides design information on the aerodynamic effects of trucks. Given the maximum speed limit along the haul route is 70 km/h speed limit (on Reid Side Road), the expected side force on cyclist from passing trucks is lower than the maximum tolerable limit. Therefore, the aerodynamic effects of passing trucks on cyclists in the study area is not a material safety concern for the RRRQ traffic.

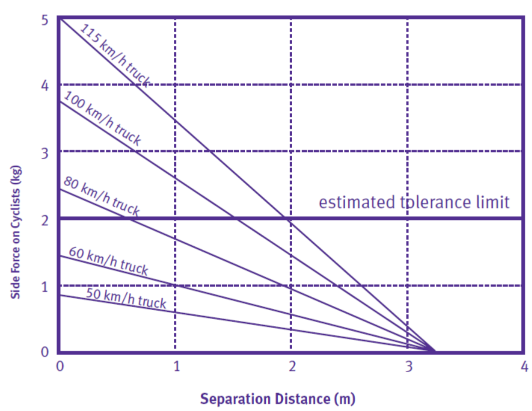

FIGURE 9: The Aerodynamic Effect of Trucks on Cyclists[16]

9.3.8 Another pertinent safety concern along haul routes where heavy goods vehicles are turning right is that of visibility (in this case the intersection of Guelph Line at Reid Side Road). Compared to the car, the blind spots associated with a truck (i.e., the areas where the driver has an impaired field of view) are considerably greater. The extent of the vision impairment for truck drivers is in part due to the higher seating, and in part due to the design of the vehicle.

[16] See Chapter 7 - Cross Section in the Road Planning and Design Manual, for Main Roads of Western Australia, 2001.

The blind spots can be in front of, adjacent to and behind the truck (see Figure 10). The ability of a trucker to detect other road users depends on the size of the user and her/his position in relation to the truck. One of the problems with the larger blind spots associated with trucks is that other road users are not aware of the extent of the impaired vision, and other users underestimate the ability of truck drivers to see them and evolving situations.

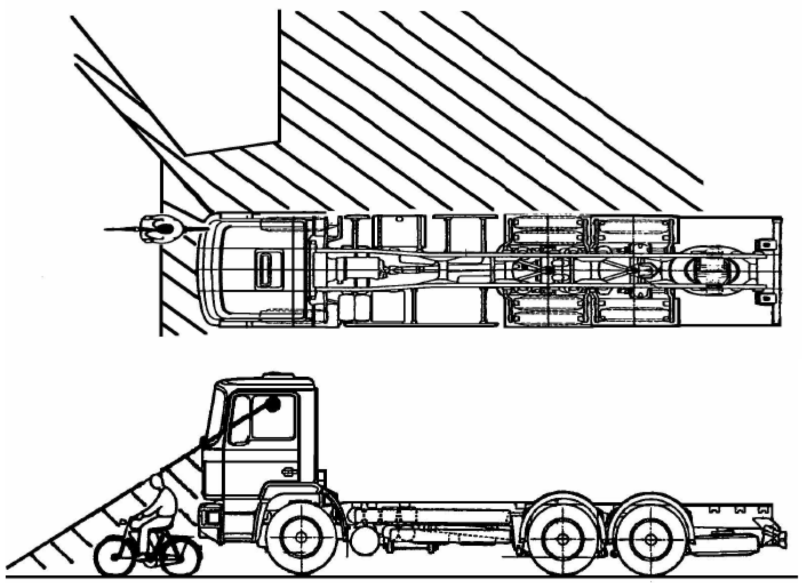

FIGURE 10: Truck Driver Blind Spots

9.3.9 Blind spots are a fundamental safety issue between trucks and the unprotected road users at intersections and other points of conflict. When cyclists/pedestrians have the right-of-way, they assume that the truck driver can see them and assume that they will yield the right of way. This incorrect assumption concerning the truck driver's ability to see what is going on around the truck can end in a serious crash.

9.3.10 For the most part, the issue of truck blind spots is a known and accepted risk. Significant reductions in crash risk due to blind spots during truck turning movements are mostly likely to come from improved vehicle design and better driver training/education. These are safety improvement options that are considered impractical for a specific development and a specific location. From an infrastructure perspective, advance stop lines or bike boxes, are available, but are not normally used along a route that does not have separate cycling facilities. These measures and are not needed or recommended for the intersection of Guelph Line and Reid Side Road.

9.4 Conflicts and Interactions with Pedestrians

9.4.1 Because of the disparity in size and weight between trucks and pedestrians, a unique safety concern is created for the latter user group. Specifically, truck-pedestrian crashes tend to result in casualties. This causes concern over interactions between these user groups, particularly where children and school-aged road users are present.

9.4.2 The haul route for the RRRQ traffic is the most direct route from the proposed site to the freeway. As such, it is the most desirable route in that it minimizes the number of vehicle-kilometres of travel on the local street system. Still, vulnerable road users are permitted to use Reid Side Road and Guelph Line, so there is the potential for truck-pedestrian interactions on the haul route.

9.4.3 The typical manner of establishing a need for protection measures when considering an interaction between two user groups is to examine the exposure to user interactions. The exposure is measured by truck and pedestrian volumes. This being the case, the safety review of RRRQ traffic as it relates to vulnerable road user safety is to focus on areas that generate pedestrian traffic and examine whether the increase in truck traffic warrants any remedial measures[17].

9.4.4 The traffic engineering community uses three basic techniques for managing the safety of truck-pedestrian interactions: spatial separation of user groups, temporal separation of user groups, and speed management. With respect to spatial separation, this is typically used for longitudinal movements along the street where pedestrians are physically separated from motor vehicle traffic. Temporal separation is used most often at signalized intersections, where pedestrian crossings and motor vehicle movements are separated in time. Speed management is usually manifested in speed limits, traffic calming, and community safety zones.

9.4.5 With respect to spatial separation of pedestrians and truck traffic (i.e., sidewalks, multiuse paths, etc.), the Milton Transportation Master Plan states:

> *All road classifications should include sidewalks, except for laneways. On higher order arterial roads or those in rural areas, sidewalks may not be appropriate. However, sidewalks would be appropriate in urban areas where development is present or roads create access to major pedestrian destinations such as schools or community centres. In these areas, sidewalks are necessary to support pedestrian-scaled activity, support pedestrian comfort and a vibrant public realm, and to encourage walking.*

9.4.6 The Master Plan is not definitive in this instance. Reid Side Road is a local road, but mainly traverses a rural area and has no marked pedestrian demand. Guelph Line is an arterial road, but also traverses a (mainly) rural area and has no significant pedestrian generators. There is a parkette located on the southwest corner of Guelph Line at Reid Sideroad. However, this is a small-scale green space with very few amenities.

9.4.7 The long-term plan for pedestrian facilities in Campbellville is outlined in the Milton Transportation Master Plan (see Figure 11). There are no sidewalks proposed for either street and paved shoulders proposed for Guelph Line. Having stated that, the additional traffic that

[17] Since the RRRQ development proposal does not produce any changes in pedestrian or cyclist traffic volume, the impacts of the RRRQ development with respect to pedestrian and cyclist safety is a result increased truck volumes only.

would be generated by the RRRQ development is not sufficient to accelerate the implementation of the paved shoulders beyond the Region's current schedule (if any) for this work.

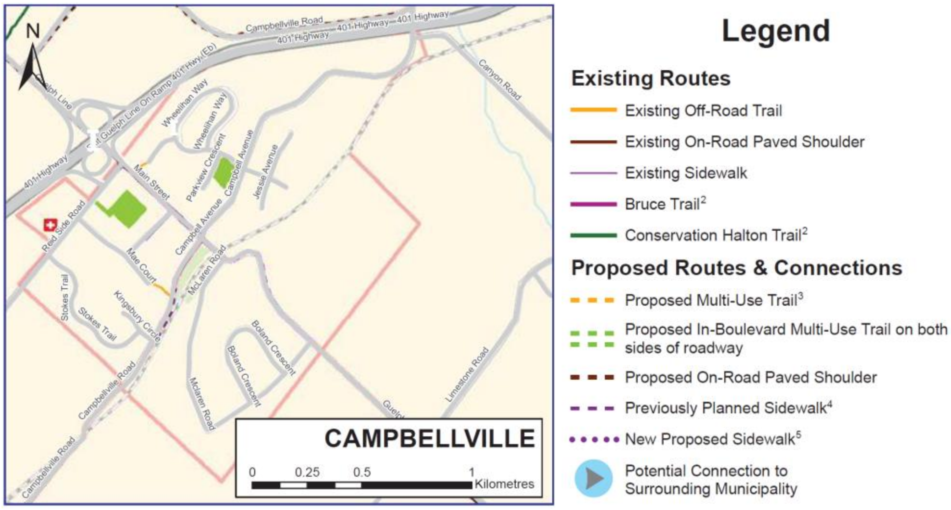

FIGURE 11: Planned Pedestrian Network in Campbellville
[Source: Map 2a Milton Transportation Master Plan, Appendix A, Active Transportation Strategy, April 2018]

9.4.8 Pedestrians walking along the edge of a road is commonplace on rural roads and small settlements in Ontario. The Highway Traffic Act governs the actions of each party and dictates that

> *Where sidewalks are not provided on a highway, a pedestrian walking along the highway shall walk on the left side thereof facing oncoming traffic and, when walking along the roadway, shall walk as close to the left edge thereof as possible.*

9.4.9 Given the good forward visibility along the haul routes and pedestrians who elect to walk along the any street along the proposed haul route should be able to do so in relative safety. Therefore, the quarry traffic is not expected to materially impact on pedestrian/cyclist safety in this regard.

9.4.10 With respect to pedestrian crossings of the road, the current intersection controls available along the haul route and forward visibility are sufficient to provide an adequate level of safety for and/or temporal separation between road users. The RRRQ traffic is not expected to materially impact on the safety of pedestrians crossing the road along the haul route.

9.4.11 Speed management is discussed in detail in the analysis on "Crash Severity".

9.5 Crash Frequency and Severity

9.5.1 The expected increase in crash frequency and severity has already been addressed in the quantitative safety assessment presented in Section 7 of this report. The crash risk presented by

RRRQ generated traffic is expected to be low, will not change the risk profile at the 10-year horizon, and no remedial measures are recommended or required.

9.5.2 Having stated the above, because the RRRQ generated traffic will be almost exclusively heavy good vehicles, a further analysis of crash severity is presented herein.

9.5.3 An increase in truck traffic ***can*** impact crash severity along a haul route because a primary determinant of crash severity is the kinetic energy that is dissipated in the crash. Kinetic energy is directly related to the mass of the vehicles/users involved in the crash, and the square of the speed of the vehicles at the time of impact. Trucks having a higher mass than passenger cars, have a higher kinetic energy and an increased crash severity.

9.5.4 Both Reid Side Road and Guelph Line in the study area are already accommodating a significant volume of truck traffic without any undue safety impacts. The crash frequencies in the study area are acceptable, from a statistical perspective, and crash severity is as expected, when compared to the overall statistics for Milton. Furthermore, trucks in the study area are involved in fewer crashes than expected. The additional trucks from the proposed development will not add any new crash risks.

9.5.5 The above notwithstanding, the fact that heavy goods vehicles are being routed along the edge of Campbellville is somewhat concerning from a safety perspective. Since alternative routes are not really feasible for quarry-generated traffic, the only practical option for reducing crash severity in the study area is through managing speed.

9.5.6 Travel speeds are a critical variable within a safe road system, where allowable speeds on any part of the network is dependent on the vehicle types (and their protective features), the forgiving and protective nature of the infrastructure and roadsides, the restrictions upon roadside access to the roadway, and the presence of vulnerable road users. All of these factors need to be factored into selecting the maximum vehicle speed that will be permitted on each section of the network. The most effective way to minimize (or eliminate) fatal or serious injury crashes is through active management of crash energy, so that no individual road user is exposed to crash forces that are not survivable. A key strategy is in this regard is to set posted speed limits that are commensurate with the road infrastructure, the vehicles, and the traffic mix, so that users are afforded the necessary level of protection. Under a safe system approach to road design and operation, safety trumps mobility and speeds are set for reasons of safety first and mobility second.

9.5.7 The upshot of the above discussion is that pedestrians and trucks are, generally speaking, a poor mix. The mass and speed differences between these two user groups can result in kinetic energies that produce serious injuries and fatalities, when a crash occurs. In areas where the interaction between trucks and pedestrians is inevitable, then the speed of trucks should be kept as low as possible to increase the probability of pedestrian survival in the event of a crash. In this context, the speed limit on Reid Side Road and Guelph Line were examined using the Transportation Association of Canada's *Canadian Guidelines for Establishing Posted Speed Limits* (see Appendix D). The results are as follows:

Road	From	To	Length (m)	Speed Limit (km/h)	
				Current	Recommended
Reid Sideroad	Twiss Road	65 m west of Stokes Trail	880	70	60
Reid Sideroad	65 m west of Stokes Trail	Guelph Line	600	60	50
Guelph Line	Reid Sideroad	Campbellville Road	610	50	60

9.5.8 Based on the analysis, the speed limit on Reid Sideroad should be reduced by 10 km/h. The lower recommended speed limits for Reid Sideroad are primarily due to the local road function and the setting (i.e., rural and settlement areas) and not a result of vehicle mix and traffic composition. Therefore, the speed limit reduction is not a measure that must be implemented in order for the RRRQ development to proceed. Rather the current speed limits are operating safely, and the reduction in the speed limit is a measure that will improve an already acceptable safety performance.

9.5.9 The current 50 km/h speed limit on Guelph Line in the study area is lower than the TAC-recommended speed limit of 60 km/h. This does not imply that the speed limit on Guelph Line should be raised by 10 km/h. Rather it is an indication that Halton Region is actively managing speed on Guelph Line, and that crash severity is mitigated through the existing speed limit. The existing 50 km/h speed limit is acceptable from a safety perspective.

9.5.10 A commonly used measure that is available to municipal road authorities to manage speed and mitigate crash severity is the community safety zone (CSZ). CSZs are a legislative/ enforcement tool where sections of road are designated by municipal by-law as areas where the financial penalties for moving violations are double the conventional fines. As such, CSZs identify sections of roadway where public safety is of special concern, which may include roadways near schools, day care centres, playgrounds, parks, hospitals and senior citizen residences. They may also be used for crash-prone areas within a community. Typically, CSZs are used sparingly to ensure that they are respected by road users as areas of “special concern”.

9.5.11 There are no warrants for CSZs in the Ontario Traffic Manual. Rather, each municipality is free to implement CSZs at their discretion. In practice, many municipalities use two criteria to determine is a CSZ is warranted, both of which must be satisfied. The first criterion is that the road be an area of special consideration – usually vicinal to a park, school, hospital, or other pedestrian-generating land use. The second criterion is a risk/safety assessment that considers the available infrastructure, the traffic mix, operating speeds, etc. The land uses along the haul route do not warrant a CSZ.

9.5.12 At any rate, there is no evidence that CSZs are “effective in reducing vehicle speeds, collisions or increasing the overall traffic safety”.[18]

[18] Community Safety Zones – Status Report, Town of Milton Report No. COMS-003-03, https://www.milton.ca/MeetingDocuments/Council/agendas2003/rpts2003/COMS-003-03%20Community%20Safety%20Zones.pdf, accessed on February 12, 2020.

9.5.13 CSZs are not recommended as a measure for mitigating crash severity along the proposed haul route.

9.5.14 The conclusion of the above analysis on crash severity is that the Town of Milton should consider reducing the speed limit on Reid Sideroad to 60 km/h from Twiss Road to 65 metres west of Stokes Trail, and to 50 km/h from 65 metres west of Stokes Trail to Guelph Line. This initiative is not considered an antecedent to opening of the RRRQ development.

9.6 Risky Driver Manoeuvres in Congestion

9.6.1 While an increase in congestion may cause some motorists to undertake risky (or riskier) manoeuvres, there is no substantive basis on which to conclude that this result will also increase crash risk.

9.6.2 Firstly, the Levels of Service under total traffic conditions (with mitigation) for a 10-year horizon are A to C for all intersections and movements.[19] These Levels of Service are considered *uncongested conditions* and is a strong indication that RRRQ-generated traffic has no material impact on congestion, and therefore no change in crash risk. While there may be a decline in Level of Service over the 10-year period from RRRQ opening to the 10-year horizon, the decline is mainly the results of background traffic and not the RRRQ development.

9.6.3 More importantly, research on the link between traffic congestion and crash risk in urban and semi-urban areas concludes that the crash risk in congested conditions is less than half the risk in uncongested conditions.[20] In other words, despite changes in behaviour, which are considered to be potentially dangerous, these changes have not resulted in increases in crash risk.

9.7 Unwarranted Signalization of Reid Side Road at the Highway 401 Ramps

9.7.1 The Transportation Impact Study for the proposed RRRQ development examines the operational impact of installing an *unwarranted* traffic signal at the intersection of Reid Side Road at the Highway 401 ramps. The signal is intended to reduce delay and queuing for certain intersection movements.

9.7.2 It is a long-held belief in the traffic engineering community that erecting traffic signals when they do not meet the accepted warrants will result in a degradation of safety. Specifically, signalization will result in a significant increase in rear-end crashes. To test this hypothesis at the subject locations, the alternative crash warranting methodology that uses Empirical Bayes techniques to estimate the safety impacts of signalization, as outlined in Ontario Traffic Manual (OTM) Book 12, was used.

9.7.3 The OTM methodology employs safety prediction models and the existing crash record to estimate the expected number and severity of crashes under stop and signal control. For the

[19] Table 5.2 in the Reid Road Reservoir Quarry Transportation Impact Study (Updated), June 2020.
[20] Brownfield J, Graham A, Eveleigh H, Maunsell F, Ward H, Robertson S, Allsop R (2003) "Congestion and accident risk", Department for Transport: London, Road Safety Research Report No. 44.

purposes of this analysis it was assumed that the traffic signal would become operational in 2020, that the existing traffic volumes in the Transportation Impact Study (updated) were for the year 2020. Average daily traffic volumes entering the intersection were estimated as 10 times the sum of the AM and PM peak hour volumes divided by two.

9.7.4 Signalization of the intersection of Reid Side Road and the Highway 401 ramps is expected to increase crash risk (see Appendix E). The predicted increase is 0.043 to 0.055 property damage only equivalent crashes per year assuming traffic has been increasing at 0.5% and 3.0% per annum, respectively. This is roughly equivalent to one crash every 18 to 23 years and is considered a low crash risk (see Figure 8).

9.7.5 The operational benefits of signalization may be such that they compensate for the increase in crash risk. This is a policy decision to be made by the MTO. Nonetheless, there is no substantive safety reasons to contraindicate signalization at subject location.

9.8 Emergency Response Times

9.8.1 The concern is that emergency responders from the Milton Fire Station and Regional EMS Station on Reid Side Road will be delayed due to increased congestion resulting from the RRRQ generated truck traffic. This concern can be segmented into two parts: emergency responders not being able to exit the station driveway; and emergency responders being caught in congestion while *en route* to a call.

9.8.2 Built in 2003, this station is serviced by part-time firefighters. The service area for the Campbellville Fire Station is shown in Figure 12.

9.8.3 With respect to the driveway exit, there is no material concern. The distance from a (possible) future eastbound stop line on Reid Side Road at the Highway 401 ramps to the centreline of the EMS Station driveway is about 280 metres. The 95th percentile queue for eastbound, left-turning traffic under signal control at the Reid Side Road and Highway 401 ramps intersection, at the 10-year planning horizon, is 43 metres.[21] If the intersection remains as a stop-controlled intersection, vehicle queuing will be less severe. Vehicle queuing is not expected to extend back to the Station driveway under any reasonable scenario.

9.8.4 With respect to responding while *en route* to a call, there is a correlation between traffic congestion and response times – traffic slows down emergency responders arriving at the scene of an emergency.[22] The two response routes along the proposed haul route that are expected to be impacted the most by the RRRQ traffic are: a westbound callout along Reid Side Road and through the intersection of Reid Side Road and Twiss Road; and an eastbound callout along Reid Side Road and north along Guelph Line. The effect of traffic on response times can be estimated from the data provided in the Transportation Impact Study for the proposed development. For the purposes of comparison, the 10-year planning horizon is used.

[21] Table 5.2, Reid Road Reservoir Quarry Transportation Impact Study (Updated), April 2020
[22] Beland LP and Brent D (2018) "Traffic Congestion, Transportation Policies, and the Performance of First Responders", https://www.lpbeland.com/uploads/7/8/7/5/7875420/trafficfires_.pdf, accessed on March 4, 2020

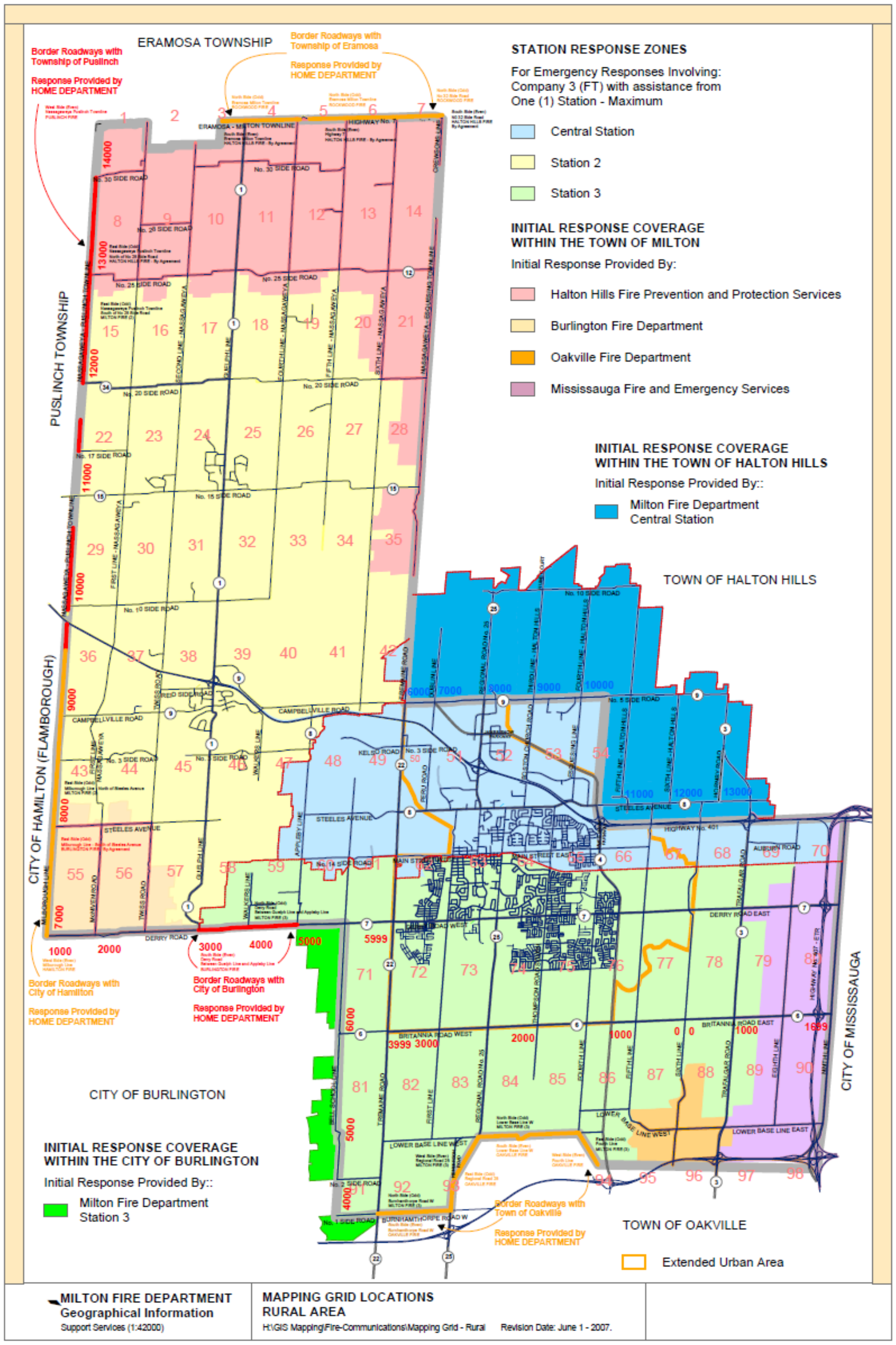

FIGURE 12: Milton Fire Department Service Areas

- ***Westbound Callout:*** *The delay for westbound traffic at Twiss Road is increased from 10 seconds to 12 seconds in the AM peak hour, as a result of RRRQ generated traffic. The two second increase in delay is a relatively insignificant impact on emergency response times. There is a one second increase in the emergency response time headed west in the PM peak hour.*[23]

- ***Eastbound Callout:*** *Without the RRRQ traffic, the delay for eastbound traffic travelling straight on Reid Side Road through the Carpool Lot driveway, straight through the Highway 401 ramp terminal, turning left onto Guelph Line, and continuing straight through the Highway 401 ramp terminal on Guelph Line is 18 seconds and 21 seconds in the AM and PM peak hours, respectively. These delays increase with the RRRQ-generated traffic and the proposed mitigation to 33 seconds and 36 seconds in the AM and PM peak hours, respectively.*[24] *The additional delay is due to the proposed signalization of Reid Side road at the Highway 401 tamp terminal and Guelph Line at the Highway 401 ramp terminal. While signalization is proposed as part of the traffic impact study, the background traffic operational conditions suggest that signalization will likely occur without RRRQ traffic, and it is not the RRRQ-generated traffic, per se, that will increase in delay in emergency response times. At any rate, the additional 15 seconds of delay is a nominal increase, is only expected during the two peak hours of travel, and it is doubtful that resulting* ***overall*** *response times would be outside of the accepted guidelines.*

9.8.5 The above analysis indicates that the traffic generated by the RRRQ will have a no or minimal impact on emergency response times.

9.9 Risk to Pedestrians, School Children, and Local Traffic

9.9.1 The crash risk imposed on pedestrians from site-generated traffic is addressed in Section 9.4 and 9.5 of this report.

9.9.2 With respect to school children, there are no schools within walking distance of the proposed haul route. As a result, there would be no school children walking along the haul route. Those students that are bussed to school would be passengers and subject to the same crash risks as general-purpose traffic (addressed throughout this report). Should school buses be required to stop on the haul route to collect/discharge school children, the additional risk imposed by RRRQ traffic is proportional to other traffic. School bus drivers are required to activate vehicle-mounted, red, flashing lights when stopped, and sightlines along the haul route are more than adequate to permit quarry (and other) traffic to perceive and react to the flashing lights.

9.9.3 The crash risks presented to local traffic from site-generated traffic is addressed throughout this report. There is no undue risk presented to local traffic along the proposed haul route.

9.10 Crash Risk on Area Roads

9.10.1 There is a concern that RRRQ-generated trucks will seek alternative routes in the vicinity of the quarry when Highway 401 is congested.

[23] Tables 4.3 and 5.2, Reid Road Reservoir Quarry Transportation Impact Study (Updated), June 2020
[24] Tables 4.3, 4.6 and 5.2, Reid Road Reservoir Quarry Transportation Impact Study (Updated), June 2020

9.10.2 Minimizing travel time makes economic sense for many truck operators and seeking the optimum route for collection and delivery of goods makes business sense. Nonetheless, municipal road authorities, such as the Town of Milton and Halton Region, understand that only certain roads are suitable for accommodating heavy goods vehicles and these authorities establish a truck route system to regulate truck movements within the jurisdiction. In other words, trucks are restricted to using roads in the truck route system unless they are making a local delivery or pickup that cannot be accommodated by any other road. In these latter instances, the truck driver must use the shortest distance off of the truck route and return to the truck route the same way.

9.10.3 There is no reason to expect that RRRQ traffic will use the local road system to circumvent Highway 401 congestion. The local roads in Campbellville and the surrounding area are not continuous and/or do not offer a reasonably direct and swift alternative route to Highway 401. Should RRRQ-generated trucks stray from the truck route system, enforcement is the usual mitigation measure. In addition to enforcement, the quarry operators may also provide reminders to truck drivers that they must remain on the truck route network, penalize operators of proponent-owned trucks who stray from the truck route, and/or refuse to service operators of independent trucks who stray from the truck route system.

9.10.4 ***If*** trucks from the RRRQ seek alternatives to Highway 401 when it is congested, the RRRQ trucks will not be making a local delivery and they are restricted to the Milton truck route system (see Figure 13). In that case, reasonable east-west alternative routes are Derry Road to the south and Campbellville Road to the north.

9.10.5 It seems extremely unlikely that Derry Road would be a viable alternative. It requires a significant amount of out-of-way travel to the south and routes trucks into the urban area of Milton before they are able to access Highway 401. There is no measurable time saving by using this alternative route.

9.10.6 The Campbellville Road alternative is a more direct route and a more attractive alternative than Derry Road. Campbellville Road roughly parallels Highway 401 and offers an alternative that does not include significant out-of-the-way travel, and largely avoids urban areas. Campbellville Road is a truck route, with no significant pedestrian or cyclist generators from Guelph Line to Regional Road 25 and is a suitable and safe alternative for RRRQ trucks during times of congestion. There is no substantive safety concern with trucks using Campbellville Road as an alternative route to a congested Highway 401.

9.10.7 Having stated the above, seeking alternative routes to avoid congested conditions is not exclusive to truck drivers. Other motorists also seek alternative routes during congested conditions, and a delay-equilibrium is quickly reached along all reasonable alternative routes. In essence, the delay on Highway 401 that causes motorists to divert to Campbellville Road will cause the delay on Campbellville Road to increase until the delay on both routes are roughly equivalent. Once equilibrium is reached, the time-savings offered by the alternative route disappears and truck drivers are likely to stay on Highway 401, despite the congestion.

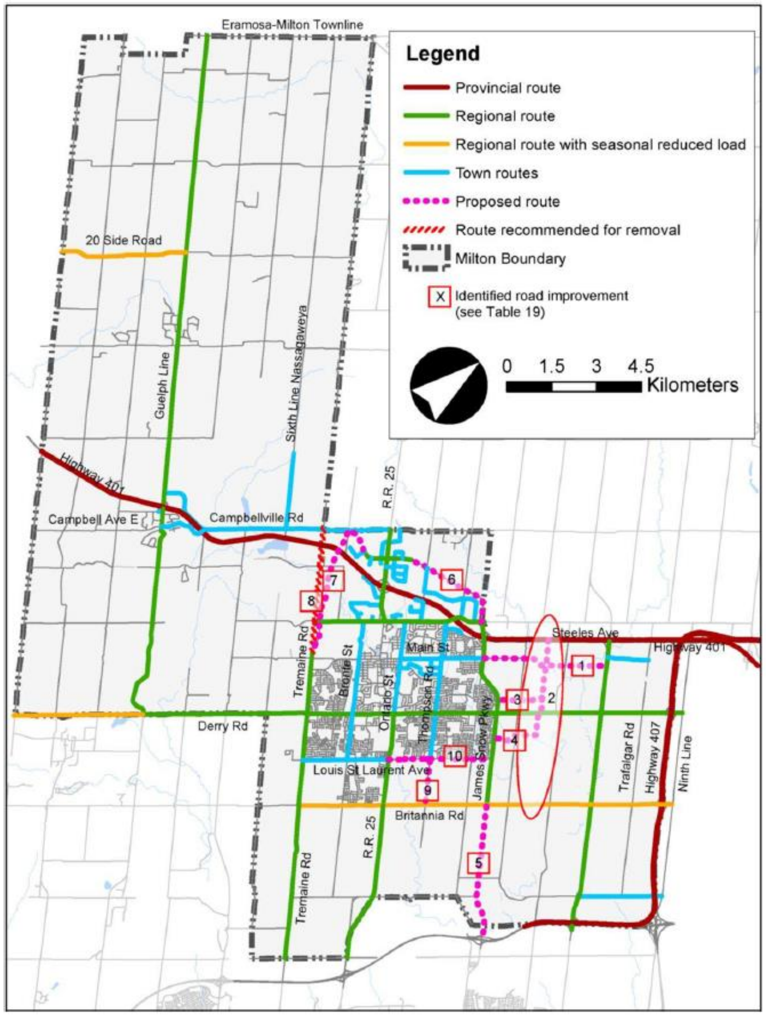

FIGURE 13: Milton's Truck Route System

10 Conclusions

10.1 James Dick Construction Ltd. is proposing to develop a quarry on a site located west of Twiss Road approximately opposite Reid Side Road in the Town of Milton that would extract a maximum of 990,000 tonnes of aggregate material annually.

10.2 The material will be shipped off-site via Reid Side Road to Highway 401, with an estimated 100 percent of the product travelling east on Highway 401. The proposed haul route includes Reid Side Road from Twiss Road to Guelph Line and Guelph Line from Reid Side Road to the E-S ramp of Highway 401.

10.3 Reid Side Road and Guelph Line are owned, operated and maintained by the Town of Milton and Halton Region, respectively.

10.4 The crash data indicate that the existing safety performance of the proposed haul is as expected or better than expected for similar facilities, except for the intersection of Twiss Road at Reid Side Road. At this intersection, truck traffic does not appear to be contributing to the elevated crash risk and the RRRQ will not exacerbate the elevated crash risk. The rate of involvement of trucks in crashes along the proposed haul route is lower than the provincial average during the analysis period. This suggests that trucks are not currently creating any undue crash risk on the proposed haul route. There were no pedestrian-involved, cyclist-involved, or fatal crashes along the proposed haul route during the analysis period.

10.5 The risk of crashes presented by the RRRQ is expected to be low. Furthermore, the RRRQ traffic is not expected to change the crash risk profile of facilities along the proposed haul route at the 10-year planning horizon. No remedial measures are required to accommodate the RRRQ, from a road safety perspective.

10.6 A safe systems assessment of the proposed haul route indicates that ongoing annual maintenance and some minor traffic signing changes would enhance the safety performance of the proposed haul route. None of these changes are antecedent to opening the RRRQ.

10.7 Given the low demand, and the lack of pedestrian and cyclist generators in the area, pedestrians and cyclists are safely accommodated on the existing facilities. SHARE THE ROAD signs and sharrow pavement markings may be used highlight that the proposed haul route is accommodating cyclists and motorized traffic.

10.8 Based on the prevailing guidelines, the speed limit of Reid Side Road may be lowered by 10 km/h along its length.

10.9 An unwarranted traffic signal, if installed, at the intersection Reid Side Road and the Highway 401 ramps would result in an additional crash every 18 to 23 years. This is considered a low crash risk and does not preclude the installation of a traffic signal if significant operational benefits are attained via signalization. The decision to implement an unwarranted signal is a policy decision to be made by the MTO. In any event, signalization is not an antecedent to opening the RRRQ, from a safety perspective.

10.10 Emergency response times are not expected to materially change as a result of the RRRQ-generated traffic.

10.11 It is not expected that the RRRQ-generated traffic will result in an elevated crash risk because of risky driver behaviours resulting from increased congestion along the proposed haul route. Furthermore, it is unlikely that safety will be unduly affected by trucks deviating from the proposed haul route during times that Highway 401 is congested.

APPENDIX A

Resume of Gerry Forbes

GERRY FORBES, M.Eng., P.Eng., P.T.O.E.

President & Chief Engineer

Intus Road Safety Engineering Incorporated
Burlington, Ontario, CANADA
905.332.9470 gerry@intus.ca

PROFESSIONAL **COMPETENCIES**

Geometric roadway design
Traffic control devices (traffic signals, signs and markings)
Human factors and positive guidance
Road user (pedestrian, cyclist, and motorist) and community traffic safety
Roadside safety
Roadway rehabilitation and maintenance, including winter maintenance and minimum maintenance standards

EXPERT **TESTIMONY**

Qualified as an expert in traffic engineering, road design, human factors, traffic control devices, and road maintenance in the Ontario Superior Court of Justice

Qualified as an expert in traffic engineering, road design, human factors, and traffic control devices in the Supreme Court of British Columbia

Qualified as an expert witness in traffic safety at the Local Planning Appeal Tribunal and the Ontario Municipal Board

Qualified as an expert in road design, traffic control devices, and road safety at a New Brunswick Human Rights Tribunal Hearing

AWARDS & **ACCOMPLISHMENTS**

McMaster University, Top 150 Graduates from the Faculty of Engineering (2017) – Recognized as one of the top 150 graduates since the Faculty's inception in 1958 who played a role in shaping Canada and the world.

Institute of Transportation Engineers, Coordinating Council Best Project Award – Awarded on multiple occasions for the best technical engineering report of the year based on the significance of the contribution to the transportation engineering profession.

- **2016** - *Survey of Guidelines to Select Sidewalk Locations*
- **2015** - *Sight Triangle and Corner Clearance Policies at Intersections and Driveways*
- **2013** - *Methods and Practices for Setting Speed Limits*

Institute of Transportation Engineers, Transportation Safety Council Edmund R. Ricker Award for an Individual (2014) – Recognized as a leader in the field of traffic safety for safety activities in professional organizations, the community or through the performance of traffic engineering, and given to individuals who have completed significant projects or demonstrated a strong commitment to improving transportation safety.

Transportation Association of Canada Distinguished Service Award (2013) – Recognized for an exceptional long-term contribution to the Association and to the transportation sector.

Transportation Person of the Year (2012) – Canadian Transportation Awards Program – Awarded for assuming leadership roles that have contributed to the improvement or advancement of the transportation industry.

Transportation Association of Canada Committee Chair's Award (2007) – Recognized for contributing to the Association and the betterment of transportation in Canada.

McMaster University Student Union Teaching Awards (1993) – Received a faculty finalist certificate for teaching excellence and outstanding contributions to undergraduate education.

Institute of Transportation Engineers Past President's Award for Merit in Transportation (1991) – Awarded for independent and original research conducted by a younger member of the ITE in the field of transportation engineering.

The Simon McNally Scholarship (1984/85) – McMaster University – Awarded a Civil Engineering scholarship based on academic achievements and evidence of practical engineering experience.

Natural Sciences and Engineering Research Council of Canada (NSERC) Undergraduate Student Research Award (1984) – Received an NSERC award based on academic record and research aptitude.

WORK **EXPERIENCE**

Intus Road Safety Engineering Incorporated, Burlington, Ontario
January 2001-Present: President & Chief Engineer

Elsevier Publishing, Accident Analysis and Prevention Journal
May 2015-Present: Volunteer Peer Reviewer

Synectics Transportation Consultants Inc., St. Catharines, Ontario
1998-December 2000: Vice-President

Region of Hamilton-Wentworth, Hamilton, Ontario
1995-1998: Project Manager, Special Projects Office, Roads Division, Transportation Department

City of Hamilton, Hamilton, Ontario
1989-1995: Traffic Operations Engineer, Traffic Department

McMaster University, Hamilton, Ontario
1991-2001: Special Lecturer, Department of Civil Engineering
1991-1992: Researcher, Department of Civil Engineering

Allen Traffic Analysis Services Inc., Carlisle, Ontario
1994: Engineering Consultant

Town of Milton, Milton, Ontario
1987-1989: Manager of Engineering Services, Public Works Department

PROFESSIONAL **ASSOCIATIONS**

Association of Professional Engineers and Geoscientists of BC (Member)

Professional Engineers Ontario (Member)

Canadian Association of Road Safety Professionals (Member)

Transportation Professional Certification Board, Inc. (Professional Traffic Operations Engineer)

Institute of Transportation Engineers (Fellow)
Transportation Forensics and Risk Management Council
Transportation Safety Council
Transportation Engineers Council

Transportation Association of Canada (Member)
Member and Former Chair of the Road Safety Standing Committee
Member of the Geometric Design Standing Committee
Former Co-chair of the Subcommittee for the Canadian Road Safety Engineering Handbook
Representative to the Canadian Global Road Safety Committee (2011-2015)

Road Safety Committee of Ontario (Member)

Human Factors and Ergonomics Society (Member)

EDUCATION & **TRAINING**

McMaster University, Hamilton, Ontario
Master of Engineering, 1993
Bachelor of Engineering, 1985

Northwestern University, Evanston, Illinois
Identification and Treatment of High Hazard Locations
Low-Cost Improvements for Two-Lane Highways

Canadian Association of Technical Accident Investigators and Reconstructionists
Certificate of Training

Transportation Research Board
Human Factors Workshop - Speeding
Capacity Analysis and Urban Design Workshop

Institute of Transportation Engineers
Planning and Design of Bikeways Seminar
New Tools for Traffic Safety Seminar
Context Sensitive Solutions Webinar
Speed Management Noteworthy Practices Webinar

Transportation Association of Canada
Intelligent Transportation Systems and Road Safety Seminar
1999 Update to the Geometric Design Guidelines for Canadian Roads Seminar
Road Network Screening for Identifying and Prioritizing Safety Improvements Workshop

Federal Highway Administration
Web-Based Training for FHWA Roadway Lighting Workshop
- Roadway Lighting Design Overview
- Lighting Hardware and Light Source Considerations for Roadway Lighting
- Street and Roadway Lighting Design
- Other Roadway Lighting Topics

Insurance Corporation of British Columbia
Road Safety Audit Seminar

National Highway Traffic Safety Administration
Driver Distraction Internet Forum

Ontario Ministry of Transportation
Global Web Conference on Aggressive Driving Issues

Transport Canada
Road Safety as a Social Construct Internet Forum

Smartrisk Learning Series
Risk Homeostasis Seminar
Developing Logic Models
Addressing the Challenges in Evaluating the Impact of Injury Prevention Programs

National Transportation Operations Coalition
Seminar on Transportation Operations: The Impact on States, Municipalities, and Regional Agencies

Australian Road Research Board
Debunking the Myths of "Low Level" Speeding, Webinar
Safe System Assessment Framework for Road Infrastructure Projects, Webinar
Talking Sense - Why Language is the Key to Safety, Webinar

American Planning Association
Why Everybody Talks About Transportation Safety, But Nobody Does Anything About It, Webinar

International Road Federation
Safety Diagnosis Tools When Data is Scarce, Incomplete, or Uncertain, Webinar

Governors Association for Highway Safety
Autonomous Vehicles Meet Human Drivers: Traffic Safety Issues for States, Webinar

National Academy of Engineering and American Association of Engineering
Ethics and Autonomous Vehicles, Web Broadcast

National Association of City Transportation Officials
The Near Miss Project: Quantifying Cyclist Comfort and Safety, Webinar

Society of Automotive Engineers
Autonomous Vehicles and Roadway Marking Evaluation Systems, Webinar

Ontario Good Roads Association
Minimum Maintenance Standards Training, Webinar

Pedestrian and Bicycle Information Center (University of North Carolina)
Lighting Strategies to Improve Pedestrian Safety, Webinar

World Health Organization
Road Safety Legislation Course (Certificate)

PAPERS & PUBLICATIONS

Forbes G (In press) "Visual Grouping and It's Application to Road Design and Traffic Control", Transactions on Transport Sciences.

Forbes G (2018) "Is Speeding an Addiction? Saving Lives Through Roadway Planning and Design", ITE Journal, June 2018, Volume: 88(6), pp 44-49.

Forbes G (2016) "Speed Management Guide", Book 9 of the Canadian Road Safety Engineering Handbook, Transportation Association of Canada, Ottawa, ON.

Forbes G (2016) "A Case Study on School Crossing Guard Duty Times", ITE Journal 86(9), Institute of Transportation Engineers, Washington, DC, pp 44-49.

Forbes G as Chair of ITE Technical Council Committee 107-02 who prepared and authored "Survey of Guidelines Used to Select Sidewalk Locations", Report No. IR-139-E an Informational Report of the Institute of Transportation Engineers, 2015.

Rempel G, Montufar J, **Forbes G**, Dewar R "Digital and Projected Advertising Displays: Regulatory and Road Safety Assessment Guidelines", Transportation Association of Canada, 2015.

Forbes G as a member of ITE Technical Council Committee 111-03 who prepared and authored "Lines, Signs, Signals...What Do People Really Know and Do", Report No. IR-141-E an Informational Report of the Institute of Transportation Engineers, 2015.

Forbes G as a member of ITE Technical Council Committee 111-02 who prepared and authored "Sight Triangle and Corner Clearance Policies at Intersections and Driveways", Report No. IR-138-E, an Informational Report of the Institute of Transportation Engineers, 2014.

Rempel G, Montufar J, Dewar R, **Forbes G** (2014) "Guiding Principles for Developing Digital and Projected Advertising Display Regulations", Paper prepared for presentation at the Role of Human Factors in Road Safety Session of the 2014 Annual Conference of the Transportation Association of Canada, Montreal, QC.

Rempel G, Montufar J, Dewar R, **Forbes G** (2014) “Method for Assessing the Road Safety Impact of Digital and Projected Advertising Displays in Canada”, Paper prepared for presentation at the Role of Human Factors in Road Safety Session of the 2014 Annual Conference of the Transportation Association of Canada, Montreal, QC.

Rempel G, Montufar J, Dewar R, **Forbes G** (2014) “Road Safety Regulations for Digital and Projected Advertising Displays: Issues to Consider for Consistent Practice”, Session 5B: Distracted Driving, 24th Canadian Multidisciplinary Road Safety Conference, June 1–4, 2014, Vancouver, BC.

Richardson D, Parker M, McLaughlin D, **Forbes G** (2014) “Steering the Cycling Revolution”, Paper prepared for presentation at the Best Practices in Urban Transportation Planning Session of the 2014 Annual Conference of the Transportation Association of Canada, Montreal, QC.

Forbes G (2014) “Transportation in Canada: Transforming the Fabric of Our Land”, Chapter titled: Road Safety: Saving Lives, E-Book produced by Transportation Association of Canada.

Richardson D, McLaughlin D, Parker M, **Forbes G** (2014) “Ontario Traffic Manual Book 18 – A New Spin on Cycling”, Compendium of Papers, 2014 Institute of Transportation Engineers Annual Meeting, Waterloo, Ontario.

Forbes G, Dewar R, Hanscom F, Alexander G (2013) “Applied Human Factors Guide for Road Safety Engineering”, Transportation Association of Canada, Ottawa, ON.

Rempel G, Moshiri M, Montufar J, Dewar R, **Forbes G** (2013) “Considerations for Assessing the Road Safety Impact of Digital and Projected Advertising Displays in Canada”, Paper prepared for presentation at the Road Safety Strategies and Intelligent Transportation Systems (ITS) Session of the 2013 Annual Conference of the Transportation Association of Canada, Winnipeg, MB.

Forbes G (2012) “Human Factors, Safety and the Impacts of Speed”, paper and presentation at the 2012 Annual Conference of the Transportation Association of Canada in Fredericton, NB.

Hildebrand E, Morrall J, **Forbes G**, Wilson F (2012) “Road Safety Audits: Lessons Learned from the Pre-Opening Stage”, paper and presentation at the 2012 Annual Conference of the Transportation Association of Canada in Fredericton, NB.

Forbes G (2012) “Global Approaches to Setting Speed Limits”, paper and presentation at the 2012 Annual Conference of the Transportation Association of Canada in Fredericton, NB.

Forbes G, Gardner T, McGee H, Srinivasan R (2012) “Methods and Practices for Setting Speed Limits: An Informational Report”, FHWA Report No. FHWA-SA-12-004, United States Department of Transportation, Washington, DC.

Forbes G (2011) “Recommended Practices for LED-Embedded Traffic Signs (LETS)”, Transportation Association of Canada, Ottawa, ON.

Forbes G (2011) “Speed Reduction Techniques for Rural High-to-Low Speed Transitions”, NCHRP Synthesis 412, Transportation Research Board, National Academies of Science, Washington, DC.

Forbes G (2011) “Ramp Speed Signing Guidelines”, Transportation Association of Canada, Ottawa, ON.

Forbes G (2009) “Reducing Litter on Roadsides”, NCHRP Synthesis 394, Transportation Research Board, National Academies of Science, Washington, DC.

Forbes G (2009) "What is Acceptable Risk in Cycling Infrastructure?: What We Should Learn From Legal Actions", Compendium of Papers for the 2009 Annual Conference of the Transportation Association of Canada, Transportation Association of Canada, Ottawa, ON.

Forbes G (2009) "Traffic Safety Impact Studies: A Proposed Framework", OT Magazine, Fall 2009 Edition, the Ontario Traffic Conference, Toronto, ON.

Forbes G (2009) "Safety Impact Studies for Private Developments", Transportation Safety Council (Summer 2009) Newsletter, Institute of Transportation Engineers, Washington, DC.

Forbes G (2008) "Practicing What We Preach: The Case for Evidence-based Road Safety", accepted for publication in ITE Journal on the Web, Institute of Transportation Engineers, Washington, DC.

Forbes G (2007) "Rural Road Safety Survey – 2007", Transport Canada and the Canadian Council of Motor Vehicle Transport Administrators, Ottawa, ON.

Forbes G (2007) "Traffic Management in Rural Settlements" Compendium of Papers, 2007 Canadian ITE Annual Meeting, Toronto, ON.

Forbes G (2007) "Developing Traffic Engineering Guidelines and Standards" Compendium of Papers, 2007 Canadian ITE Annual Meeting, Toronto, ON.

Forbes G (2006) "Passing Sight Distance Design and Marking Study", Project No. T8080-04-0338, Transport Canada, Ottawa, ON.

Forbes G, Robinson J (2004) "The Safety Impact of Vehicle-related Road Debris", AAA Foundation for Traffic Safety, Washington, DC.

Forbes G (2003) "Synthesis of Safety for Traffic Operations", Report No. TP 14224 E, Transport Canada, Road Safety and Motor Vehicle Regulation Directorate, Ottawa, ON.

Belluz L, **Forbes G** (2003) "Synthesis of Safety for Traffic Operations", Paper prepared for presentation at the Traffic Operations Research and Applications Session of the 2003 Annual Conference of the Transportation Association of Canada, St. John's, NL.

Forbes G (2001) "Introducing Road Safety Audits" Municipal World, July 2001.

Forbes G, Jordan PW (2000) "Integrating Road Safety Audits into the Design Process", Institute of Transportation Engineers 2000 Conference: Transportation Operations: Moving into the 21st Century: April 2-5, 2000, Irvine, California.

Forbes G (1999) "Planning for Safety: The Process and Its Perils", Enhancing Transportation Safety in the 21st Century: New Tools for Transportation Professionals: ITE International Conference, March 28-31, 1999, Kissimmee, Florida.

Malone B, **Forbes G** (1999) "Reducing Crashes in Multiple Turn Lanes on One-Way Streets", Compendium of Technical Papers: 69th Annual Meeting: Transportation Frontiers for the Next Millennium: Las Vegas, August 1-4, 1999.

Forbes G (1998) "Vital Signs: Circulation in the Heart of the City - An Overview of Downtown Traffic" ITE Journal 68(8), pp 26-29.

Forbes G (1992) "Identifying Incident Congestion", ITE Journal, June 1992, Volume: 62, pp 17-22.

Forbes G (1990) "The Origin of Minimum Passing Sight Distances for No-Passing Zones", ITE Journal, December 1990, Volume:60, pp 20-24.

APPEARANCES AND **PRESENTATIONS**

Forbes G (2013) "The Human Factors of Speed Transition Zones", presentation at the Transportation Research Board Webinar on High to Low Speed Transition Zone Design and Mitigation, August 8, 2013.

Forbes G (2012) "Methods and Practices for Setting Speed Limits", presentation at the Institute of Transportation Engineers/Federal Highway Administration Webinar on USLIMITS2 and Methods and Practices for Setting Speed Limits, September 20, 2012.

Forbes G (2006) "Cold Case Files" presentation made to the National Capital Section of the Institute of Transportation Engineers (District 7), Nepean, Ontario.

Forbes G (2005) "Cold Case Files: Rural Road Safety" presentation made to the Toronto Section of the Institute of Transportation Engineers (District 7) and the Ontario Traffic Conference, Markham, Ontario.

Forbes G (2005) "Arterial Speed Management" presentation made to the Ontario Traffic Conference, 55th Annual Convention, Burlington, Ontario.

Forbes G (2004) "Road Safety Engineering – Injury Preventions Middle Child" presentation made to the Ontario Injury Prevention Conference, "Moving from Here to There Safely", Toronto, Ontario.

Forbes G (2002) "Are Your Roads an Accident Waiting to Happen?" presentation made at the Annual Conference of the Ontario Good Roads Association, Toronto, Ontario.

Forbes G (2001) "Highway Design: The Silent Partner in Road Safety" presentation made at the 2001 Road Safety Forum.

TYPICAL **PROJECT EXPERIENCE**

Policy & Manual Development

Refreshing the Ottawa Road Safety Programs – City of Ottawa (programs for Network screening, in-service road safety reviews, road safety audits, and road safety measures evaluation)

Recommended Warrant and Policy for Sidewalks in Hamlets/Rural Residential Areas – Haldimand County

Manual of Uniform Traffic Control Devices for Canada – Update Scoping Study – Transportation Association of Canada

Ontario Bikeways Design Manual – Road Safety Audit – Ministry of Transportation

Ontario Traffic Manual Book 18: Cycling Facilities – Road Safety Audit – Ministry of Transportation and the Ontario Traffic Council

Traffic Control Device Manual for Work Zones – Road Safety Audit – Saskatchewan Highways (Subconsultant to TranSafe Consulting)

Canadian Guide to Road Safety Audits – Transportation Association of Canada (Member of the National Working Group)

Canadian Guide to Conducting In-service Road Safety Reviews – Transportation Association of Canada (Member of the Consulting Team)

Canadian Capacity Guide for Signalized Intersections (Third Edition) – Canadian Institute of Transportation Engineers (Contribution to Section 4.10: Safety at Traffic Signals)

OTM Book 1C: Positive Guidance Applications – Ministry of Transportation (Technical Advisory Team)

OTM Book 11: Pavement and Delineation Markings – Ministry of Transportation (Technical Advisory Team)

Guide to Intersection Safety Reviews – Municipality of Anchorage, AK

Policy on Active Advance Warning Flashers – Region of Halton, ON

Speed Limit Policies – City of Hamilton, Regions of Halton and York

Community Safety Zone Warrants – Region of Niagara

Ontario Manual of Uniform Traffic Control Devices – Sections of Regulatory Signs, Warning Signs, and Pavement Markings – Ministry of Transportation (Member of Technical Advisory Team)

Road Safety Audits & Reviews

Yonge Street Rapidway (vivaNext), York Region, ON – York RapidLINK Constructors – Preliminary design, detailed design, construction, and pre-opening safety audits on the reconstruction of sections of Yonge Street in Richmond Hill and Newmarket to include median-running bus lanes, new on-street cycling facilities, and enhanced pedestrian amenities.

Southwest Calgary Ring Road – Work Zone Traffic Accommodation for the Weaselhead Road Detour, Calgary, AB – Parsons – Work zone road safety audit of the plan and profile drawings, and the signs and markings drawings for a multi-stage, temporary traffic detour.

Thunder Bay Expressway from Arthur Street to Balsam Street, Thunder Bay, ON – Ontario Ministry of Transportation – A human factors assessment of existing conditions to identify safety and operational improvements (i.e., modifications to signing, roundabouts, visibility improvements, etc.) and recommend improvements.

Homer Watson Boulevard at Block Line Road Roundabout, Kitchener, ON – Region of Waterloo – Crash causation assessment using human factors techniques such as road scene analysis and task analysis leading to the identification of suitable crash countermeasures.

Right Honourable Herb Gray Parkway, Windsor, ON – Infrastructure Ontario – Provide independent, qualified road safety advice to the Province of Ontario during the pre-opening phase of the project.

Route 1 Gateway from St. Stephen to River Glade (New Brunswick) – Dexter Construction Company – Preliminary design, detailed design, construction, and pre-opening road safety audits on construction of 55 kilometres of new four lane highway and selected upgrades along Route 1.

Smythe Street Roundabout, Fredericton, NB – City of Fredericton – Preliminary design road safety audit of a proposed roundabout for a high-speed, divided arterial with a wide median.

Highway 16 at Marquis Drive, Saskatoon, SK – City of Saskatoon and Saskatchewan Highways – In-service road safety review and human factors analysis.

Highway 11 at Warman Road, Saskatoon, SK – Saskatchewan Highways – Human factors review and safety analysis.

Dundas Street from Ninth Line to Trafalgar Road, Oakville, ON – Region of Halton – Pre-opening road safety audit of temporary transit stops to be used during the reconstruction of Dundas Street.

Circle Drive South at Idylwyld Drive, Saskatoon, SK – Saskatchewan Highways – Independent highway safety review of the Ramp 13 entrance terminal design.

GTA West Corridor connection to Highway 401, Oakville, ON – Ministry of Transportation – Road safety assessment of two alternative interchanges configurations.

Guelph Transit Terminal, Carden Street, Guelph, On – City of Guelph – Detailed design stage road safety audit.

Highway 11 from Washago to Gravenhurst, ON – Ministry of Transportation – Road safety review to identify interim improvements before undertaking a full reconstruction.

Highway 401 from Warden Avenue to Brock Road – Ministry of Transportation – Human factors review of a proposed design including a detailed task analysis of movements by motorists from interchange ramps to express-collector transfer lanes.

Highway 6 Whitechurch Road to Chippewa Road, Hamilton, ON – Ontario Ministry of Transportation – Human factors review of a proposed center turn lane on a high speed, four lane, rural roadway.

Highway 21 (Alvanley) at the Grey/Bruce Line – Ministry of Transportation – Comparative road safety review of different intersection control options (i.e., roundabout, traffic signal, etc.) at a high-speed rural intersection.

Fielding Road/Kantola Road Interchange on the Sudbury Southwest By-pass (Highway 17), Sudbury, ON – Ministry of Transportation – Comprehensive road safety review of a proposed interchange located in close proximity to a second interchange on a proposed four-lane divided freeway.

Queens Quay from Spadina Avenue to Bay Street, Toronto, ON – Waterfront Toronto – detailed design stage road safety audit for the reconstruction of an urban street that accommodates motor vehicles, TTC vehicles, pedestrians, and the Martin Goodman Trail.

Highway 6 (Hanlon Expressway), Stone Road Interchange, Guelph, ON – Ministry of Transportation – Conceptual design stage safety assessment of different interchange configurations.

Detroit River International Crossing, Windsor, ON – Ministry of Transportation – Conceptual design stage safety assessment, and preliminary design road safety audit of access roads (i.e., the Highway 401 extension through Windsor) and border plazas for a new Detroit River crossing.

Intersection of Highway 7/12 at Durham Regional Road 13, Scugog, ON – Ministry of Transportation – Safety performance assessment of a recently signalized intersection.

Port Hope Area Initiative Traffic Safety Impact Study – Atomic Energy of Canada Limited – Road safety specialist conducting a detailed assessment of the road safety impacts of a multi-year effort to excavate and dispose of soil with low level radiation by heavy commercial vehicles operating in and around the Municipality of Port Hope.

Bronson Avenue Road Safety Audit – City of Ottawa – Principal Investigator for a road safety audit of a functional design for the reconstruction of Bronson Avenue, and a comparative road safety assessment of the different cross-section alternatives.

Trim Road from the Proposed Blackburn Hamlet By-pass to Innes Road, Road Safety Audit (Preliminary Design Stage) – City of Ottawa – Lead road safety auditor for the review of an urban arterial road including a systematic and numerical analysis of median treatment for the proposed four-lane facility.

Interstate I87 and State Route 11 Interchange, Watertown, NY – New York State Department of Transportation – Providing road safety input to the Value Engineering Team responsible for examining interchange design and bridge replacement options.

Preliminary Design Stage Road Safety Audit Fourth Line from North Service Road to Wyecroft Road – Town of Oakville – The Lead Auditor on a road safety audit of Fourth Line from the North Service Road to Wyecroft Road in the Town of Oakville.

Wildwood Road from Oak Park Street to Confederation Street – Town of Halton Hills – Preliminary design stage road safety audit.

Kicking Horse Canyon Highway Improvement Project Phase 2 – Brybil Projects Limited – Preliminary design stage road safety audit for a four-lane arterial road in mountainous terrain.

Intersection Safety Reviews, Anchorage, AK – Municipality of Anchorage – Project Manager for the safety review of five intersections identified in the State Farm “Dangerous Intersections Program”.

Traffic Safety and Access Review of 599 Lyons Lane – Creekbank Developments – Road safety specialist undertaking a road safety and access review of a proposed condominium development in Oakville, Ontario.

Centreport Canada Way, Winnipeg, MB – Brybil Projects Limited – Preliminary design stage road safety audit for an urban arterial road including a systematic and numerical analysis of median treatment for the proposed four-lane facility.

Cariboo Highway No. 97 from Likely Road to 148 Mile – British Columbia Ministry of Transportation and Highways – Road safety audits of the existing design and value engineering proposals for this two lane rural arterial roadway (upgrading to four-lanes).

Intersection of Williams Parkway and North Park/Howden, Brampton, ON – City of Brampton – In-service road safety review.

Highway 403 (Eastbound) at Highway 407, Burlington, ON – Ontario Ministry of Transportation – Post-opening safety assessment and review of a newly reconfigured interchange.

Interstate I390 at State Route 17, Rochester, NY – New York State Department of Transportation – Providing road safety input to the Value Engineering Team responsible for examining interchange design and bridge replacement options for three closely-spaced interchanges on an urban freeway.

Estevan Truck Bypass, Estevan, SK – Saskatchewan Highways – Providing road safety input to the Value Engineering Team responsible for examining alignment and design options for a high-speed two-lane rural road intended to divert trucks around the town.

Rail Safety

Light Rail Transit Project, Ottawa, ON – City of Ottawa – Road safety assessment of two LRT options in downtown Ottawa.

Hardy Road Railroad Crossing, Brantford, ON – City of Brantford – Preliminary design stage road safety auditor for a CN rail crossing with two proximate intersections.

Britannia Road At-grade Rail Crossing, Milton, ON – Region of Halton – Detailed safety assessment.

Trafalgar Road At-grade Rail Crossing, Halton Hills, ON – Region of Halton – Detailed safety assessment.

Parkside Drive At-grade Rail Crossing, Waterdown, ON – City of Hamilton – Detailed safety assessment.

Active Transportation

Albert Street from Brickhill Street to City Centre Avenue, Ottawa, ON – City of Ottawa – In-service stage pedestrian safety audit.

Carling Avenue at Highway 417, Ottawa, ON – City of Ottawa – Pre-opening road safety assessment of the pedestrian crossing of the ramp to westbound Highway 417 on Carling Avenue.

Kingsway at The Queensway Interchange, Toronto, ON – City of Toronto – In-service stage pedestrian and cycling safety audit.

Safety Assessment of Bike Lanes, Edge Lines, and Vehicular Lane Widths – City of Burlington – Analysis of bicycle lane widths, and retrofit policies using collision analysis, and human factors principles.

A Review of the Cycling Infrastructure Recommendations from the Transportation Master Plan Study – Region of Halton – Safety assessment of the cycling-related recommendations in the Region's transportation master plan, including a comparison of bicycle lanes and wide outside lanes.

Regional Niagara Bikeway Master Plan – Region of Niagara – Integrating safety conscious planning and assisting in the development of design guidelines for Niagara cycling facilities.

Shifting Gears: The Hamilton-Wentworth Community Cycling Survey – Region of Hamilton-Wentworth – Residential survey to determine the extent and latent demand for cycling in the Region of Hamilton-Wentworth.

The Bicycle Master Plan Update – Region of Hamilton-Wentworth – Identifying priorities and developing programmes and initiatives for education, enforcement, encouragement and engineering as they affect cycling in the Region.

Road Safety Impact Studies

Hidden Quarry, Guelph-Eramosa, ON – James Dick Construction Limited – Road safety impact study for traffic generated by a proposed gravel pit.

Port Hope Area Initiative, Port Hope, ON – Atomic Energy of Canada Limited – Road safety impacts study of a town-wide clean-up of radioactive waste.

Codrington Gravel Pit, Brighton, ON – County of Northumberland – Peer review of various road safety impact studies produced for a proposed gravel pit on a two-lane rural road.

Arbour Farms Gravel Pit, Mulmur, ON – Arbour Farms – Road safety impact study for traffic generated by a proposed gravel pit.

Highway 144 from Chelmsford to Dowling, ON – Ministry of Transportation – A comparative road safety review of various alignment alternatives for a redesigned Highway 144.

Highway 17 from Sudbury to Markstay, ON – Ministry of Transportation – A comparative road safety review of various alignment alternatives for a redesigned Highway 17.

Teaching & Training

Human Factors in Road Safety and Highway Design Seminar – Saskatchewan Highways – Two-day seminar on the basics and practical applications of human factors in road design and traffic engineering.

Road Safety Audits – City of Ottawa – One-day classroom seminar and one-day desktop audit.

Geometric Highway Design Course – McMaster University – Instructor
Introduction to Transportation Engineering Course – McMaster University – Instructor
Land Use and Transportation Course – McMaster University – Instructor

Arterial Speed Management Seminar – One-day seminar on educational, enforcement and engineering opportunities for managing speed on arterial roadways.

Intersection Operational Safety Reviews – City of Toronto – One-day classroom seminar and one-half day field training.

Intersection Safety Reviews – Municipality of Anchorage, Alaska – One-day classroom seminar.

Road Safety Audit I Seminar – Transportation Association of Canada – One-day seminar.

Road Safety Audit II Seminar – Transportation Association of Canada – One-day seminar.

In-service Road Safety Reviews Seminar – Transportation Association of Canada – One-day seminar.

Road Safety Audit I, Road Safety Audit II, and In-service Road Safety Reviews Seminars – Transportation Association of Canada – Seminars commissioned by the Technical Services Section of the City of Toronto Department of Works and Emergency Services.

Design Vehicles and Intersection Sight Distance - Ontario Good Roads Association – Instructor

Human Factors in Municipal Traffic – Ontario Good Roads Association – Instructor

Road Safety Engineering – Ontario Good Roads Association – Instructor

The Road System – Ontario Good Roads Association – Instructor

Public Involvement – Ontario Good Roads Association – Instructor

APPENDIX B

Materials Made Available for Review

In preparation of this report, I have reviewed or relied upon the following documents:

- James Dick Construction Limited - Reid Road Reservoir Quarry Aggregate Resources Act Application Summary – Plain Language Description of the Project, http://www.jamesdick.com/reid-road-reservoir-quarry/#toggle-id-1, accessed on February 14, 2020.

- Peak Truck Traffic Simulation Video, http://www.jamesdick.com/reid-road-reservoir-quarry/#toggle-id-3, accessed on February 14, 2020.

- Reid Road Reservoir Quarry, ARA Site Plans, prepared by MHBC Planning, Urban Design & Landscape Architecture for James Dick Construction Limited, Revision date: Jul 20, 2018, five drawings, http://www.jamesdick.com/ara-site-plans-july-2018/, accessed on February 14, 2020.

- A Brief History of the Guelph Line/401 Interchange and how the Proposed JDCL RRRQ Built the 401, the Springbank Haul Road (now known as Reid Side Road) and how community concerns with Traffic Safety were resolved, author unknown, undated.

- Springbank Road Agreement, between the Corporation of the Town of Milton, Springbank Sand & Gravel Company Limited, and the Regional Municipality of Halton, dated December 12, 1977, 6 pages.

- Reid Sideroad Quarry – response to JART Traffic Comments re: On Site driveway and truck queuing, November 20, 2019, 16 pages, author unknown.

- Geotechnical Considerations, Pavement Structure Evaluation, Reid Sideroad – from Guelph Line to Twiss Road, Campbellville [Milton], Ontario, from Ian Shaw of Soil-Mat Engineers & Consultants Ltd. to Leigh Mugford of James Dick Construction Limited, December 6, 2019, six pages.

- Reid Road Reservoir Quarry – JART Comment – Passenger Car Equivalent (PCE) Response, prepared by Stew Elkins of Paradigm Transportation Solutions Limited for Greg Sweetnam of James Dick Construction Limited, February 20, 2020, 112 pages.

- Reid Road Reservoir Quarry – Transportation Impact Study by Paradigm Transportation Solutions Limited, June 2018

- Reid Road Reservoir Quarry – Transportation Impact Study (Updated) by Paradigm Transportation Solutions Limited, April 2020

- Reid Road Reservoir Quarry – Transportation Impact Study (Updated) by Paradigm Transportation Solutions Limited, June 2020

- Technical sources and other references as cited in the body and footnotes of this report.

APPENDIX C

Safe Systems Assessment Checklist

SAFE SYSTEMS ASSESSMENT CHECKLIST

Project: PROPOSED REID ROAD RESERVOIR QUARRY HAUL ROUTE – ROAD SAFETY IMPACT STUDY
Auditor: GERRY FORBES
Audit date: 08-OCT-19

Issue			Yes	No	Comment
Road alignment and cross-section					
	Visibility; sight distance				
		Is sight distance adequate for the speed of traffic using the route?	X		
		Is adequate sight distance provided for intersections and crossings? (for example, pedestrian, cyclist, cattle, railway)		X	ROADSIDE VEGETATION RESTSTRICTS VISIBILITY AT SOME LOCATIONS
		Is adequate sight distance provided at all private driveways and property entrances?		X	ROADSIDE VEGETATION RESTSTRICTS VISIBILITY AT SOME LOCATIONS
	Design speed				
		Is the horizontal and vertical alignment suitable for the (85th percentile) traffic speed?	X		NO CURVES ON THE HAUL ROUTE. ALL RAMPS SIGNED AND MARKED IN ACCORDANCE WITH THE OTM
		If not:			
		are warning signs installed?			
		are advisory speed signs installed?			
		Are the posted advisory speeds for curves appropriate?			
	Speed limit/speed zoning				
		Is the speed limit compatible with the function, road geometry, land use and sight distance?		X	THE SPEED LIMIT ON REID SIDE ROAD IS HIGH FOR A LOCAL, RURAL ROAD
	Overtaking				
		Are safe overtaking opportunities provided?	X		
	Readability by drivers				
		Is the road free of elements that may cause confusion? For example:			
		is alignment of the roadway clearly defined?	X		
		has disused pavement (if any) been removed or treated?			N/A
		have old pavement markings been removed properly?			N/A
		do tree lines follow the road alignment?	X		
		does the line of street lights or the poles follow the road alignment?	X		
		Is the road free of misleading curves or combinations of curves?	X		
	Widths				
		Are medians and islands of adequate width for the likely users?			N/A
		Are lane and road widths adequate for the traffic volume and mix?	X		
		Are bridge widths adequate?		X	NO PROVISION FOR PEDESTRIANS ON THE EAST SIDE OF GUELPH LINE OVER HWY 401
	Shoulders				
		Are shoulders wide enough to allow drivers to regain control of errant vehicles?	X		
		Are shoulders wide enough for broken-down or emergency vehicles to stop safely?	X		
		Are shoulders paved?		X	
		Are shoulders trafficable for all vehicles and road users? (i.e. are shoulders in good condition)	X		
		Is the transition from road to shoulder safe? (no drop-offs)	X		
	Crossfalls				
		Is appropriate superelevation provided on curves?			N/A
		Is any adverse crossfall safely managed (for cars, trucks, etc.)?			N/A

		Do crossfalls (road and shoulder) provide adequate drainage?	✗		
	Roadside slopes				
		Are side slopes traversable by cars and trucks that run off the road?		✗	Steep roadside slopes are protected by suitable barriers
	Drains				
		Are roadside drains and culvert end walls traversable?	✗		
Auxiliary lanes					
	Tapers				
		Are starting and finishing tapers located and aligned correctly?	✗		
		Is there sufficient sight distance to the end of the auxiliary lane?	✗		
	Shoulders				
		Are appropriate shoulder widths provided at merges?	✗		
		Have shoulder widths been maintained beside the auxiliary lane?	✗		
	Signs and markings				
		Have all signs been installed in accordance with the appropriate guidelines?	✗		
		Are all signs conspicuous and clear?	✗		
		Do all pavement markings conform with the guidelines?	✗		
		Is there advance warning of approaching auxiliary lanes?	✗		
	Turning traffic				
		Have left turns from the through lane been avoided?		✗	Left turn lanes are implemented where appropriate
		Is there advance warning of turn lanes?			N/A
Intersections					
	Location				
		Are all intersections located safely with respect to the horizontal and vertical alignment?	✗		
		Where intersections occur at the end of high-speed environments (for example, at approaches to towns), are there traffic control devices to alert drivers?			N/A
	Visibility; sight distance				
		Is the presence of each intersection obvious to all road users?	✗		
		Is the sight distance appropriate for all movements and all road users?		✗	Vegetation needs trimming
		Is there stopping sight distance to the rear of any queue or slow-moving turning vehicles?	✗		
		Has the appropriate sight distance been provided for entering and leaving vehicles?	✗		
	Controls and delineation				
		Are pavement markings and intersection control signs satisfactory?	✗		
		Are vehicle paths through intersections delineated satisfactorily?		✗	The CHECKERBOARD facing the E-S ramp indicates motorists may proceed left or right, when they can only turn left – confusing
		Are all lanes properly marked (including any arrows)?	✗		
	Layout				
		Are all conflict points between vehicles safely managed?	✗		
		Is the intersection layout obvious to all road users?	✗		
		Is the alignment of curbs obvious and appropriate?	✗		
		Is the alignment of traffic islands obvious and appropriate?	✗		
		Is the alignment of medians obvious and appropriate?	✗		
		Can all likely vehicle types be accommodated?	✗		
		Are merge tapers long enough?	✗		
		Is the intersection free of capacity problems that may produce safety problems?	✗		Site visit was conducted during off-peak hours of travel
	Miscellaneous				

		Particularly at rural sites, are all intersections free of loose gravel?	✗		
Signs and lighting					
	Lighting				
		Has lighting been adequately provided where required?	✗		
		Is the road free of features that interrupt illumination? (for example, trees or overbridges)	✗		
		Is the road free of lighting poles that are a fixed roadside hazard?	✗		
		Are frangible or slip-base poles provided?		✗	NOT REQUIRED – POLES OUTSIDE OF CZ
		Ambient lighting: if it creates special lighting needs, have these been satisfied?			N/A
		Is the lighting scheme free of confusing or misleading effects on signals or signs?	✗		
		Is the scheme free of any lighting black patches?	✗		
	General signs issues				
		Are all necessary regulatory, warning and direction signs in place? Are they conspicuous and clear?	✗		
		Are the correct signs used for each situation, and is each sign necessary?	✗		
		Are all signs effective for all likely conditions? (for example, day, night, rain, fog, rising or setting sun, oncoming headlights, poor lighting)	✗		
		If restrictions apply for any class of vehicle, are drivers adequately advised?	✗		RAMPS HAVE NO PED/CYCLIST SIGNS. NO PED/CYCLIST SIGN FOR THE N-W RAMP IS UPSTREAM OF THE BULLNOSE – MAY BE CONFUSING
		If restrictions apply for any class of vehicle, are drivers advised of alternative routes?			N/A
	Sign legibility				
		In daylight and darkness, are signs satisfactory regarding visibility and clarity of message?	✗		
		readability/legibility at the required distance?	✗		
		Is sign retroreflectivity or illumination satisfactory?	✗		
		Are signs able to be seen without being hidden by their background or adjacent distractions?	✗		
		Is driver confusion due to too many signs avoided?	✗		
	Sign supports				
		Are sign supports out of the clear zone?	✗		
		If not, are they:			
		frangible?			N/A
		shielded by barriers (for example, guard fence, crash cushions)?			N/A
Markings and delineation					
	General issues				
		Is the line marking and delineation:			
		appropriate for the function of the road?	✗		
		consistent along the route?	✗		
		likely to be effective under all expected conditions? (day, night, wet, dry, fog, rising and setting sun position, oncoming headlights, etc.)	✗		
		Is the pavement free of excessive markings? (for example, unnecessary turn arrows, unnecessary barrier lines, etc.)	✗		
	Centrelines, edgelines, lane lines				
		Are centrelines, edgelines, lane lines provided? If not, do drivers have adequate guidance?	✗		
		Have RPMs been installed where required?	✗		
		If RPMs are installed, are they correctly placed, correct colours, in good condition?			N/A
		Are profiled (audible) edgelines provided where required?	✗		
		Is the pavement marking in good condition?	✗		
		Is there sufficient contrast between linemarking and pavement colour?	✗		
	Guideposts and reflectors				

		Are guideposts appropriately installed?	✗		
		Are delineators clearly visible?	✗		
		Are the correct colours used for the delineators?	✗		
		Are the delineators on guard fences, crash barriers and bridge railings consistent with those on guideposts?	✗		
	Curve warning and delineation				
		Are curve warning signs and advisory speed signs installed where required?			N/A
		Are advisory speed signs consistent along the route?			N/A
		Are the signs correctly located in relation to the curve? (i.e. not too far in advance)			N/A
		Are the signs large enough?			N/A
		Are chevron alignment signs installed where required?			N/A
		Is the positioning of chevrons satisfactory to provide guidance around the curve?			N/A
		Are the chevrons the correct size?			N/A
		Are chevrons confined to curves? (not used to delineate islands, etc)			N/A
Crash barriers and clear zones					
	Clear zones				
		Is the clear zone width traversable? (i.e. drivable)	✗		
		Is the clear zone width free of rigid fixtures? (if not, can all of these rigid fixtures be removed or shielded?)		✗	Bridge railings are protected by barriers
		Are all power poles, trees, etc., at a safe distance from the traffic paths?	✗		
		Is the appropriate treatment or protection provided for any objects within the clear zone?	✗		
	Crash barriers				
		Are crash barriers installed where necessary?	✗		
		Are crash barriers installed at all necessary locations in accordance with the relevant guidelines?	✗		
		Are the barrier systems suitable for the purpose?	✗		
		Are the crash barriers correctly installed?	✗		
		Is the length of crash barrier at each installation adequate?	✗		
		Is the guard fence attached correctly to bridge railings?	✗		
		Is there sufficient width between the barrier and the edge line to contain a broken-down vehicle?		✗	Guelph Line bridge over Hwy 401 has no space for a disabled vehicle, but forward visibility is adequate for users to see the disabled vehicle
	End treatments				
		Are end treatments constructed correctly?	✗		
		Is there a safe run-off area behind breakaway terminals?	✗		
	Fences				
		Are pedestrian fences frangible?			N/A
		Are vehicles safe from being speared by horizontal fence railings located within the clear zone?			N/A
	Visibility of barriers and fences				
		Is there adequate delineation and visibility of crash barriers and fences at night?	✗		
Traffic signals					
	Operations				
		Are traffic signals operating correctly?	✗		
		Are the number, location and type of signal displays appropriate for the traffic mix and traffic environment?	✗		
		Where necessary, are there provisions for visually impaired pedestrians? (for example, audio-tactile push buttons, tactile markings)	✗		Low volume of visally impaired pedestrians
		Where necessary, are there provisions for elderly or disabled pedestrians? (for example, extended green or clearance phase)	✗		Low volume of elderly and disabled pedestrians

		Is the controller located in a safe position? (i.e. where it is unlikely to be hit, but maintenance access is safe)	✗		
		Is the condition (especially skid resistance) of the road surface on the approaches satisfactory?	✗		No polishing of pavement surface
	Visibility				
		Are traffic signals clearly visible to approaching motorists?	✗		
		Is there adequate stopping sight distance to the ends of possible vehicle queues?	✗		
		Have any visibility problems that could be caused by the rising or setting sun been addressed?	✗		
		Are signal displays shielded so that they can be seen only by the motorists for whom they are intended?	✗		
		Where signal displays are not visible from an adequate distance, are signal warning signs and/or flashing lights installed?			N/A
		Where signals are mounted high for visibility over crests, is there adequate stopping sight distance to the ends of traffic queues?	✗		
Pedestrians and cyclists					
	General issues				
		Are there appropriate travel paths and crossing points for pedestrians and cyclists?	✗		Guelph Line bridge over Hwy 401 is constrained – but low ped and cyclist demand
		Is a safety fence installed where necessary to guide pedestrians and cyclists to crossings or overpasses?	✗		
		Is a safety barrier installed where necessary to separate vehicle, pedestrian and cyclist flows?			N/A
		Are pedestrian and bicycle facilities suitable for night use?	✗		
	Pedestrians				
		Is there adequate separation distance between vehicular traffic and pedestrians on sidewalks?			N/A
		Is there an adequate number of pedestrian crossings along the route?	✗		Low pedestrian demand
		At crossing points is fencing oriented so pedestrians face oncoming traffic?			N/A
		Is there adequate provision for the elderly, the disabled, children, wheelchairs and baby carriages? (for example, holding rails, curb and median crossings, ramps)	✗		
		Are adequate hand rails provided where necessary? (for example, on bridges, ramps)	✗		
		Is signing about pedestrians near schools adequate and effective?			N/A
		Is signing about pedestrians near any hospital adequate and effective?			N/A
		Is the distance from the stop line to a cross walk sufficient for truck drivers to see pedestrians?	✗		Installed per OTM Book 11
	Cyclists				
		Is the pavement width adequate for the number of cyclists using the route?	✗		
		Is the bicycle route continuous? (i.e. free of squeeze points or gaps)	✗		
		Are drainage pit grates bicycle safe?	✗		
	Public transport				
		Are bus stops safely located with adequate visibility and clearance to the traffic lane?			No transit along the haul route. GO parking lot located adjacent to ramps
		Are bus stops in rural areas signposted in advance?			N/A
		Are shelters and seats located safely to ensure that sight lines are not impeded? Is clearance to the road adequate?			N/A
		Is the height and shape of the curb at bus stops suitable for pedestrians and bus drivers?			N/A
Bridges and culverts					
	Design features				
		Are road widths over bridges and culverts consistent with approach conditions?		✗	
		Is the approach alignment compatible with the 85th percentile travel speed?	✗		

		Have warning signs been erected if either of the above two conditions (i.e. width and speed) are not met?	✗		SIGNED ACCORDINGLY
	Crash barriers				
		Are there suitable traffic barriers on bridges and culverts and their approaches to protect errant vehicles?	✗		
		Is the connection between barrier and bridge safe?	✗		
		Is the bridge free of curbing that would reduce the effectiveness of barriers or rails?		✗	WEST SIDE OF GUELPH LINE OVER HWY 401 HAS A RAISED CURB IN FRONT OF A BARRIER
	Miscellaneous				
		Are pedestrian facilities on the bridge appropriate and safe?	✗		LOW PEDESTRIAN DEMAND
		Is fishing from the bridge prohibited? If not, has provision been made for safe fishing?			N/A
		Does delineation continue over the bridge?	✗		
Pavement					
	Pavement defects				
		Is the condition of the pavement edges satisfactory?	✗		
		Is the transition from pavement to shoulder free of dangerous edge drop offs?	✗		A PAVEMENT EDGE DROP OFF IS DEVELOPING IN THE SOUTH SHOULDER OF REID SIDE ROAD OPPOSITE THE HWY 401 RAMPS (CAUSED BY LEFT-TURNING VEHICLES)
		Is the pavement free of defects (for example, excessive roughness or rutting, potholes, loose material, etc.) that could result in safety problems (for example, loss of steering control)?	✗		
	Skid resistance				
		Does the pavement appear to have adequate skid resistance, particularly on curves, steep grades and approaches to intersections?	✗		NO PAVEMENT POLISHING OBSERVED
		Has skid resistance testing been carried out where necessary?			N/A
	Ponding				
		Is the pavement free of areas where ponding or sheet flow of water could contribute to safety problems?	✗		
	Loose stones/material				
		Is the pavement free of loose stones and other material?	✗		
Parking					
	General issues				
		Are the provisions for, or restrictions on, parking satisfactory in relation to traffic safety?	✗		
		Is the frequency of parking turnover compatible with the safety of the route?	✗		
		Is there sufficient parking for delivery vehicles so that safety problems due to double parking do not occur?	✗		
		Are parking manoeuvres along the route possible without causing safety problems? (for example, angle parking)	✗		
		Is the sight distance at intersections and along the route, unaffected by parked vehicles?	✗		
Provision for heavy vehicles					
	Design issues				
		Are overtaking opportunities available for heavy vehicles where volumes are high?	✗		
		Does the route generally cater for the size of vehicle likely to use it?	✗		
		Is there adequate manoeuvring room for large vehicles along the route, at intersections, roundabouts, etc.?	✗		
		Is access to rest areas and truck parking areas adequate for the size of vehicle expected? (consider acceleration, deceleration, shoulder widths, etc.)			N/A
	Pavement/shoulder quality				
		Are shoulders paved at curves to provide additional pavement for long vehicles?	✗		NO CURVES ON THE HAUL ROUTE; RAMPS

		Is the pavement width adequate for heavy vehicles?	✗		
		In general, is the pavement quality sufficient for the safe travel of heavy and oversized vehicles?	✗		TO BE CONFIRMED BY PAVEMENT DESIGN ENGINEER
		On truck routes, are reflective devices appropriate for truck drivers' eye heights?	✗		
Floodways and causeways					
	Ponding, flooding				
		Are all sections of the route free from ponding or flow across the road during wet weather?	✗		
		If there is ponding or flow across the road during wet weather, is there appropriate signposting?			N/A
		Are floodways and causeways correctly signposted?			N/A
	Safety of devices				
		Are all culverts or drainage structures located outside the clear roadside recovery area?		✗	
		If not, are they shielded from the possibility of vehicle collision?	✗		
Miscellaneous					
	Landscaping				
		Is landscaping in accordance with guidelines? (for example, clearances, sight distance)	✗		
		Will existing clearances and sight distances be maintained following future plant growth?		✗	ROADSIDE VEGETATION WILL REQUIRE ANNUAL TRIMMING
		Does the landscaping at roundabouts avoid visibility problems?			N/A
	Temporary works				
		Are all locations free of construction or maintenance equipment that is no longer required?			N/A
		Are all locations free of signs or temporary traffic control devices that are no longer required?			N/A
	Headlight glare				
		Have any problems that could be caused by headlight glare been addressed? (for example, a two-way service road close to main traffic lanes, the use of glare fencing or screening)			N/A
	Roadside activities				
		Are the road boundaries free of any activities that are likely to distract drivers?	✗		
		Are all advertising signs installed so that they do not constitute a hazard?	✗		NO PERMANENT ADVERTISING SIGNS
	Errant vehicles				
		Is the roadside furniture on the boulevards and roadside free of damage from errant vehicles that could indicate a possible problem, hazard or conflict at the site?	✗		
	Other safety issues				
		Is the embankment stability safe?			NOT ASSESSED
		Is the route free of unsafe overhanging branches?	✗		
		Is the route free of visibility obstructions caused by long grass?		✗	TRIMMING OF SOME ROADSIDE VEGETATION IS REQUIRED
		Are any high-wind areas safely dealt with?			N/A
	Rest areas				
		Is the location of rest areas and truck parking areas along the route appropriate?	✗		CAR POOL LOT
		Is there adequate sight distance to the exit and entry points from rest areas and truck parking areas at all times of the day?	✗		CAR POOL LOT
	Animals				
		Is the route free from large numbers of animals? (for example, cattle, deer, moose, etc.)	✗		
		If not, is it protected by animal-proof fencing?			N/A
	Safety aspects for heavy vehicles not already covered				
		Have all other matters which may have a bearing on safety for heavy vehicles been addressed?	✗		

APPENDIX D

Speed Limit Analyses

Automated Speed Limit Guidelines

FORM A - Automated Speed Limit Guidelines Spreadsheet

Version: 10-Apr-09

Name of Corridor:	Guelph Line				
Segment Evaluated:	Reid Side Road	to	Campbellville Road		
Geographic Region:	Halton Region				
Road Agency:	Town of Milton				
Road Classification:	Arterial	Length of Corridor:	610	m	
Urban / Rural:	Rural	Design Speed: (Required for Freeway, Expressway, Highway)		km/h	
Divided / Undivided:	Undivided	Current Posted Speed: (For information only)	50	km/h	
Major / Minor:	Major	Prevailing Speed: (85th Percentile - for information only)		km/h	
# Through Lanes Per Direction:	1 lane	Policy: (Maximum Posted Speed)			

		RISK	Score
A1	**GEOMETRY (Horizontal)**	Lower	3
A2	**GEOMETRY (Vertical)**	Lower	3
A3	**AVERAGE LANE WIDTH**	Medium	6
B	**ROADSIDE HAZARDS**	Higher	9
C1	**PEDESTRIAN EXPOSURE**	Lower	2
C2	**CYCLIST EXPOSURE**	Higher	9
D	**PAVEMENT SURFACE**	Lower	3
E1	**NUMBER OF INTERSECTIONS WITH PUBLIC ROADS**	*Number of Occurrences*	20
	STOP controlled intersection	0	
	Signalized intersection	2	
	Roundabout or traffic circle	0	
	Crosswalk	0	
	Active, at-grade railroad crossing	0	
	Sidestreet STOP-controlled or lane	0	
E2	**NUMBER OF INTERSECTIONS WITH PRIVATE ACCESS DRIVEWAYS**	*Number of Occurrences*	2
	Left turn movements permitted	2	
	Right-in / Right-out only	0	
E3	**NUMBER OF INTERCHANGES**	*Number of Occurrences*	3
	Number of interchanges along corridor	1	
F	**ON-STREET PARKING**	Lower	1

Total Risk Score:

61

Recommended Posted Speed Limit (km/h):

As determined by road characteristics

60

As determined by policy

The recommended posted speed limit may be checked against the prevailing speeds of the roadway and the road's safety performance.

Comments:

Automated Speed Limit Guidelines

FORM A - Automated Speed Limit Guidelines Spreadsheet

Version: 10-Apr-09

Name of Corridor:	Reid Side Road			
Segment Evaluated:	Twiss Road	to	65 m west of Stokes Trail	
Geographic Region:	Halton Region			
Road Agency:	Town of Milton			
Road Classification:	Local	Length of Corridor:	880	m
Urban / Rural:	Rural	Design Speed: (Required for Freeway, Expressway, Highway)		km/h
Divided / Undivided:	Undivided	Current Posted Speed: (For information only)	70	km/h
Major / Minor:	Minor	Prevailing Speed: (85th Percentile - for information only)		km/h
# Through Lanes Per Direction:	1 lane	Policy: (Maximum Posted Speed)		

		RISK	Score
A1	**GEOMETRY (Horizontal)**	Lower	2
A2	**GEOMETRY (Vertical)**	Lower	2
A3	**AVERAGE LANE WIDTH**	Medium	2
B	**ROADSIDE HAZARDS**	Lower	3
C1	**PEDESTRIAN EXPOSURE**	Medium	2
C2	**CYCLIST EXPOSURE**	Higher	3
D	**PAVEMENT SURFACE**	Lower	3
E1	**NUMBER OF INTERSECTIONS WITH PUBLIC ROADS**	*Number of Occurrences*	1
	STOP controlled intersection	1	
	Signalized intersection	0	
	Roundabout or traffic circle	0	
	Crosswalk	0	
	Active, at-grade railroad crossing	0	
	Sidestreet STOP-controlled or lane	0	
E2	**NUMBER OF INTERSECTIONS WITH PRIVATE ACCESS DRIVEWAYS**	*Number of Occurrences*	2
	Left turn movements permitted	4	
	Right-in / Right-out only	0	
E3	**NUMBER OF INTERCHANGES**	*Number of Occurrences*	0
	Number of interchanges along corridor	0	
F	**ON-STREET PARKING**	Lower	1

Total Risk Score: 21

Recommended Posted Speed Limit (km/h):

As determined by road characteristics: 60

As determined by policy:

The recommended posted speed limit may be checked against the prevailing speeds of the roadway and the road's safety performance.

Comments:

APPENDIX E

Unwarranted Traffic Signal Crash Prediction

Proposed Collision Justification (Justification 5A)

Return to Justifications 1- 6

INPUT

a.- Intersection type (no input required): 3

b.- What year is the intersection being considered for traffic signals? 2020

c.- What is the collision history and annual average daily traffic over the past few years? (Please fill in table below)

Year	Traffic Volume		Impact Type/Year						
	Major AADT	Minor AADT	Approach-ing	Angle	Rear end	Sideswipe	Turning movement	SMV	Other
2014	8926	4936	0	2	0	0	0	0	0
2015	9015	4986	0	1	1	0	0	0	0
2016	9105	5036	0	1	0	0	0	0	0
2017	9196	5086	0	5	0	0	0	0	0
2018	9288	5137	0	0	0	0	0	0	0

d.- If known, please enter the expected traffic volume after signals are introduced. Otherwise, leave the cell blank.

Year	Main AADT	Minor AADT
2020	9475	5240

ANALYSIS

Reducible Collisions

	2014	2015	2016	2017	2018		2020 (Signal)
Total Number of Crashes Per Year	2	1	1	5	0		---
Parameter k	0.81	0.81	0.81	0.81	0.81		0.60
Model Prediction	1.17	1.18	1.19	1.21	1.22		1.25
$C_{i,y}$	0.956	0.966	0.978	0.989	1.000		1.023
Comp. Ratio for Period	4.888						1.023

Non-reducible Collisions

	2014	2015	2016	2017	2018		2020 (Signal)
Total Number of Crashes Per Year	0	1	0	0	0		---
Parameter k	1.47	1.47	1.47	1.47	1.47		1.19
Model Prediction	0.92	0.93	0.94	0.94	0.95		0.96
$C_{i,y}$	0.976	0.982	0.988	0.994	1.000		1.012
Comp. Ratio for Period	4.939						1.012

	Reducible Collisions	Non-reducible Collisions
Total Number of Historical Crashes	9	1
Expected Annual Crashes without Signalization based on SPF	1.220	0.948
Expected Annual Crashes without Signalization	1.807	0.385
Variance of Expected Annual Crashes without Signalization	0.326	0.059
Expected Annual Crashes after Signalization based on SPF	1.550	1.440
Expected Annual Crashes after Signalization	2.297	0.585
Variance of Expected Annual Crashes after Signalization	8.797	0.288

	Reducible Collisions	Non-reducible Collisions
Weights for Unsignalized Intersections	0.27	0.18
Weights for Signalized Intersections	0.29	0.25

RESULTS

Justification	Compliance		Signal Justified? YES	Signal Justified? NO
5. Collision Experience	Net Safety Change	0.255	☐	☑
	Total Collisions will after this intersection is signalized	***Increase***		

Proposed Collision Justification (Justification 5A)

Return to Justifications 1- 6

INPUT

a.- Intersection type (no input required): 3

b.- What year is the intersection being considered for traffic signals? 2020

c.- What is the collision history and annual average daily traffic over the past few years? (Please fill in table below)

Year	Traffic Volume		Impact Type/Year						
	Major AADT	Minor AADT	Approach-ing	Angle	Rear end	Sideswipe	Turning movement	SMV	Other
2013	3399	1838	0	0	0	0	0	0	0
2014	3501	1893	0	0	0	0	0	0	0
2015	3606	1949	0	0	0	0	0	0	0
2016	3714	2008	0	0	0	0	0	0	0
2017	3825	2068	0	0	0	0	0	0	0

d.- If known, please enter the expected traffic volume after signals are introduced. Otherwise, leave the cell blank.

Year	Main AADT	Minor AADT
2020	4180	2260

ANALYSIS

Reducible Collisions

	2013	2014	2015	2016	2017		2020 (Signal)
Total Number of Crashes Per Year	0	0	0	0	0		---
Parameter k	0.81	0.81	0.81	0.81	0.81		0.60
Model Prediction	0.38	0.39	0.41	0.42	0.43		0.48
Ci,y	0.874	0.904	0.935	0.967	1.000		1.107
Comp. Ratio for Period	4.679						1.107

Non-reducible Collisions

	2013	2014	2015	2016	2017		2020 (Signal)
Total Number of Crashes Per Year	0	0	0	0	0		---
Parameter k	1.47	1.47	1.47	1.47	1.47		1.19
Model Prediction	0.50	0.51	0.52	0.53	0.54		0.57
$C_{i,y}$	0.929	0.946	0.964	0.982	1.000		1.057
Comp. Ratio for Period	4.821						1.057

	Reducible Collisions	Non-reducible Collisions
Total Number of Historical Crashes	0	0
Expected Annual Crashes without Signalization based on SPF	0.435	0.542
Expected Annual Crashes without Signalization	0.137	0.206
Variance of Expected Annual Crashes without Signalization	0.021	0.027
Expected Annual Crashes after Signalization based on SPF	0.834	0.556
Expected Annual Crashes after Signalization	0.263	0.211
Variance of Expected Annual Crashes after Signalization	0.115	0.038

	Reducible Collisions	Non-reducible Collisions
Weights for Unsignalized Intersections	0.27	0.18
Weights for Signalized Intersections	0.29	0.25

RESULTS

Justification	Compliance		Signal Justified?	
			YES	NO
5. Collision Experience	Net Safety Change	0.055	☐	☑
	Total Collisions will *Increase* after this intersection is signalized			