Traffic Impact Study

Brechin Quarry

December 2023 | Project # 2453

LCP Quarry Limited

TYLin

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1 INTRODUCTION

1.1 Scope and Objective

T.Y. Lin International Canada Inc. (TYLin) was retained by LCP Quarry Limited ("the Client") to complete a Traffic Impact Study for a proposed quarry, ("Brechin Quarry") generally located southwest of the intersection of Highway 12 and Concession Road 2 in the Township of Ramara ("the Township"), within the County of Simcoe ("the County"). An application under the Aggregate Resources Act for a Class A Licence and applications to amend the Township's Official Plan and Zoning By-law are required. The proposed quarry will generally be bounded by Concession Road 2 to the north, Concession Road 1 to the south, Highway 12 to the east, and the western property boundary that is approximately 600 metres east of Ramara Road 47.

The proposed quarry has an approximate licence area of 151.4 hectares (374 acres) and an extraction area of 91.5 hectares (226 acres).

The quarry is anticipated to be operational in 2025 and have an annual extraction limit of 2 million tonnes of aggregate. An asphalt or concrete processing plant is not proposed as part of the quarry's operations. The quarry access is proposed to be located on Concession Road 2, approximately 450 metres west of Highway 12. Quarry operations are proposed as follows:

- Aggregate Maximum Annual Shipping Limit (Licence application) = 2,000,000 tonnes
- Loading and Shipping hours of 5:30 a.m. to 6:00 p.m. (12.5 hours) from Monday to Friday and 7:00 a.m. to 12:00 p.m. (5.0 hours) on Saturday. No shipping will occur on Sundays and statutory holidays.

The purpose of this study is to determine the site traffic volumes (especially truck volumes) anticipated to be generated by the proposed quarry during the weekday a.m., p.m., and Saturday mid-day peak hours in order to assess the impact of the traffic volumes on the existing and future road network. Through analysis of existing and future traffic conditions, potential improvements to the road network to accommodate the projected traffic will be recommended as needed.

A detailed scope was submitted by TYLin to the Ontario Ministry of Transportation (MTO) and Township of Ramara for review and comment. Correspondence with the reviewing agencies is included in **Appendix A.**

1.2 Study Area Intersections

As per consultation with Township and MTO Staff, the following existing intersection has been included in the study area:

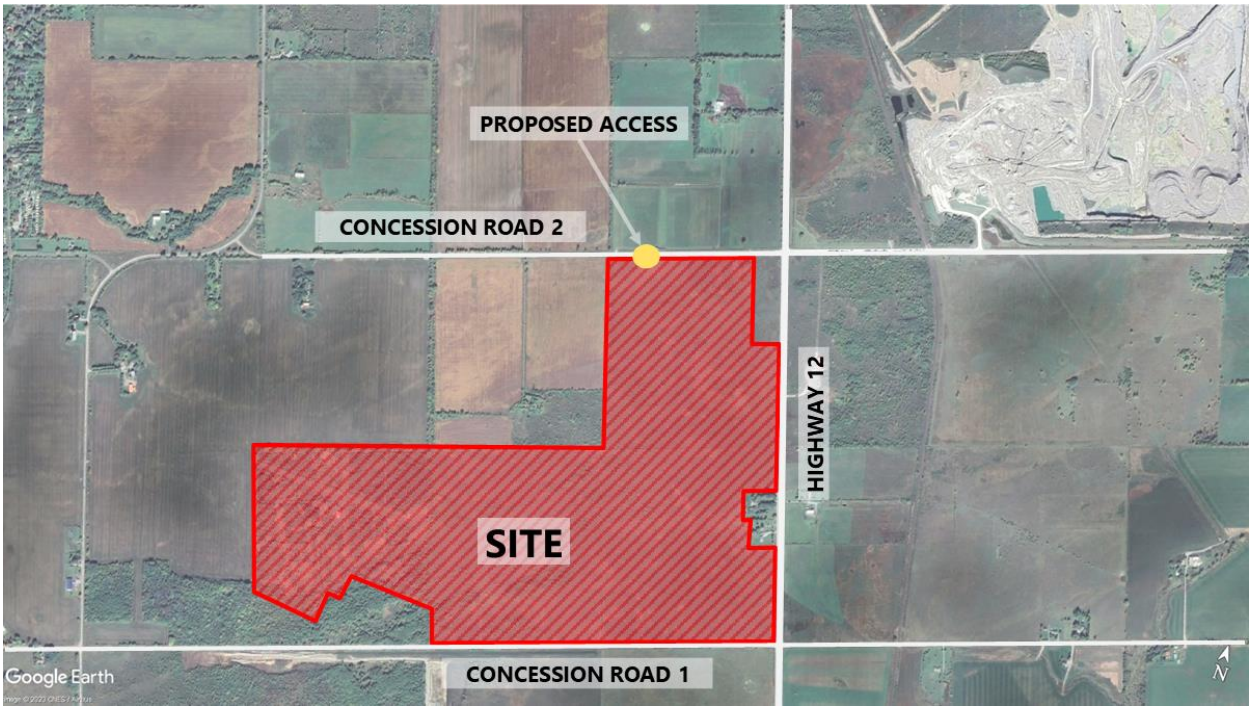
- Highway 12 (Trans-Canada Highway) at Concession Road 2 (unsignalized)

The following site access intersection is included in the study area under future total conditions:

- Concession Road 2 at proposed Site Access (unsignalized)

Figure 1-1 Illustrates the extents of the study area, the approximate location of the proposed quarry, and the current location of the proposed site access.

Figure 1-1 Study Area



2 SITE CHARACTERISTICS

2.1 Study Environment

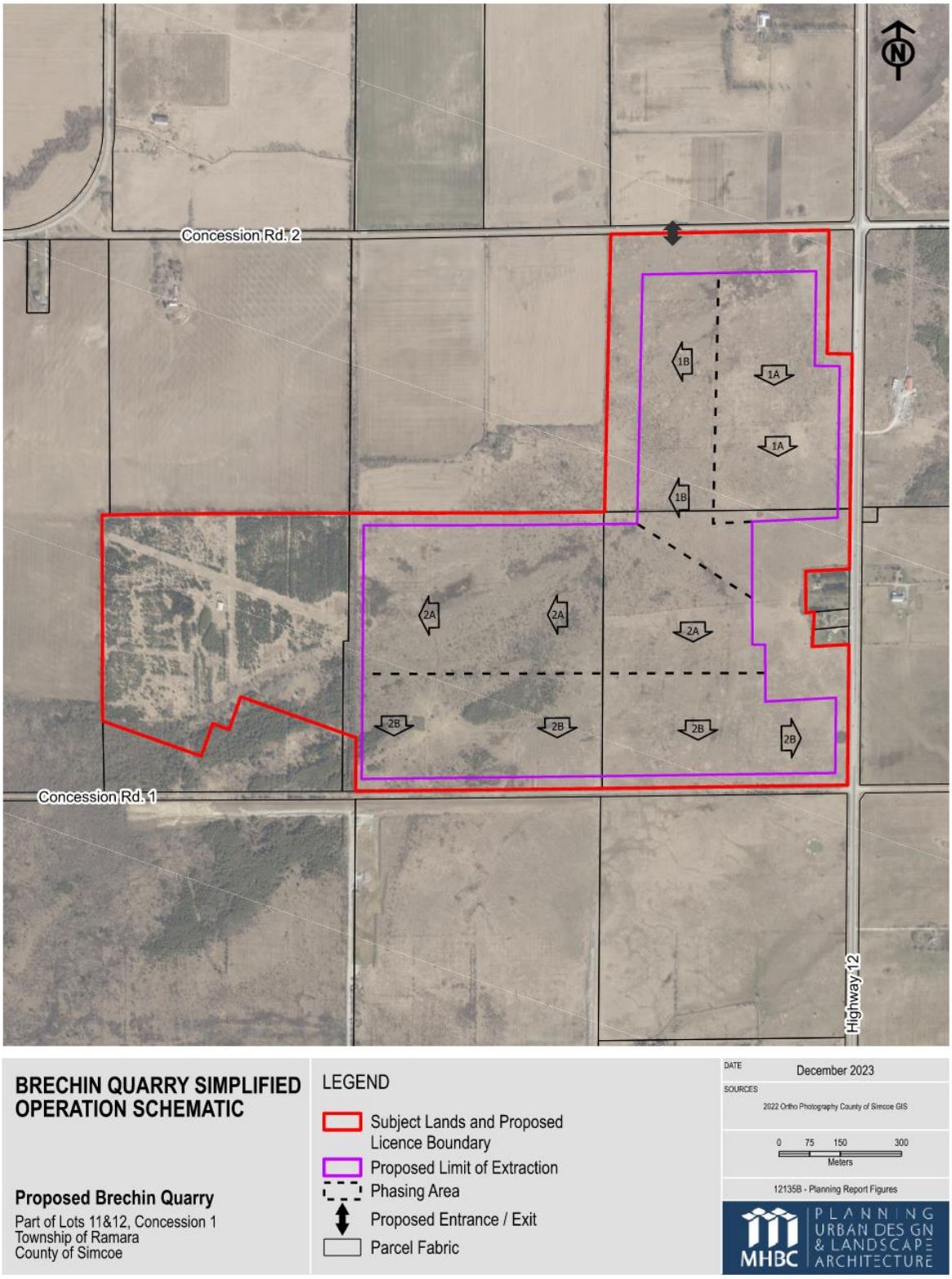
The proposed Brechin Quarry and is generally located west of Highway 12, east of Ramara Road 47, south of Concession Road 2, and north of Concession Road 1 in Ramara Township. The site and surrounding lands are largely undeveloped, consisting of agricultural lands and existing quarries to the south and northeast of the site.

2.2 Development Context

The proposed quarry has an approximate licence area of 151.4 hectares (374 acres) and an extraction area of 91.5 hectares (226 acres). The site will incorporate setbacks of 30 metres along the majority of the east boundary, the western portion of the north boundary, and the entire south boundary. Setbacks of 15 metres will be provided along the southern portion of the western boundary. Setbacks of 80 metres will be provided along the northern portion of the western boundary and setbacks of 100 metres will be provided along the eastern portion of the north boundary to relocate an on-site watercourse and to create natural features within the setback. Finally, 150 metre setbacks are proposed from off-site dwellings located along Highway 12 on the east side of the site.

The proposed extents of the quarry's licence boundary and the location of the proposed site access are shown in **Figure 2-1** and also is provided in **Appendix B**.

Figure 2-1 Site Plan



2.3 Proposed Quarry Access Location

The quarry access is currently proposed to be located on Concession Road 2, approximately 450 metres west of Highway 12.

The proposed quarry access location satisfies the Ontario Ministry of Transportation's (MTO) Highway Corridor Management Manual's (April 2022) access offset spacing criteria from an intersection with a provincial highway. As per Figure 4.6.9 in Section 4.6.5 of the MTO Highway Corridor Management Manual, a minimum distance of 45 metres is required between a private access on a public road and the intersection of that public road with a provincial highway. The proposed access location exceeds the minimum distance of 45 metres as well as the MTO's desirable distance of 85 metres.

In addition to meeting MTO standards, the proposed quarry access location also satisfies the suggested minimum corner clearance of 25 metres between an access and a major intersection, as per Figure 8.8.2 in Chapter 8 of the Transportation Association of Canada's (TAC) Geometric Design Guide.

Of note, the portion of Concession Road 2 that will be used by aggregate trucks to travel between the future quarry access and Highway 12 will likely require structural upgrades in order to accommodate truck traffic without undue deterioration of the road surface. It is recommended that LCP Quarry Limited, in consultation with the Township, perform a review of the existing load capacity (geotechnical assessment) of Concession Road 2 and determine what upgrades would be required to accommodate quarry truck traffic to and from Highway 12 via Concession Road 2.

During the review of Concession Road 2's load capacity and design, the existing flare (paved shoulder) on Highway 12 for southbound right-turning traffic should also be reviewed for its capacity to accommodate aggregate trucks. The possibility of extending the length of the existing taper/portion of paved shoulder should also be reviewed. The taper could help shift southbound right-turning aggregate trucks partially off of the southbound shared through/right lanes to allow passenger vehicles to pass the slowing trucks, as needed, to alleviate any potential blocking of the southbound through traffic.

However, it should be noted that as per **Figure 5-1** in **Section 5.2** of this report, it is estimated that only two aggregate trucks will make the southbound right turn during the study peak hours, as minimal aggregate is expected to ship to/from the north. Given the relatively low volume of aggregate trucks predicted to complete the turn, it is recommended that the existing southbound right-turn taper be upgraded to accommodate aggregate traffic instead of constructing an exclusive right-turn lane.

3 EXISTING CONDITIONS

3.1 Road Network

Based on road network connectivity and proposed access to the quarry, the quarry's haul route will consist of Concession Road 2 and Highway 12 . Access to the quarry is proposed via Concession Road 2. The existing roads within the study area are described as follows:

- **Highway 12** (Trans-Canada Highway) is a rural two-lane highway classified as a King's Highway, under the jurisdiction of the Ontario Ministry of Transportation (MTO). It is generally oriented in the north-south direction, with a posted speed limit of 80 km/h within the study area. In the vicinity of the subject site, Highway 12 provides a connection to Simcoe County Road 169 to the north and Durham Regional Highway 48 to the south. There are no sidewalks on either side of the roadway, in the vicinity of the study intersection.
- **Concession Road 2** is a rural local road located approx. 2.5 kilometres south of the community of Brechin, and is generally oriented in an east-west direction. It has a two-lane cross section with a posted speed limit of 60 km/h east of Highway 12, and an unposted speed limit of 60 km/h west of Highway 12. It is under the jurisdiction of Ramara Township. It provides a connection to Ramara Road 47 to the west, and forms a dead end beyond Side Road 5 to the east. There are no sidewalks on either side of the roadway in the vicinity of the subject site.

The intersection of Highway 12 at Concession Road 2 was selected as the existing study intersection for the purposes of this traffic study, as per consultation with Township and MTO Staff. It is currently a Two-Way-Stop-Controlled (TWSC) intersection. The north and south approaches on Highway 12 operate under free-flow conditions while the east and west approaches on Concession Road 2 operate under 'stop control'.

An existing lane configuration diagram is provided as **Figure 3-1**.

3.2 Existing Traffic Volumes

Turning movement counts were commissioned by TYLin for the intersection of Highway 12 at Concession Road 2. Traffic count data was collected on March 30, 2023 during the weekday a.m. and p.m. peak periods, and the Saturday mid-day peak period traffic data was collected on April 1, 2023. Count data collected at the existing study intersection is provided in **Appendix C**.

Existing weekday a.m., p.m., and Saturday mid-day peak hour volumes are provided in **Figure 3-2**. If a volume is not shown on the figure for a given movement, or during a certain peak hour, this

indicates that zero vehicles were recorded to complete the movement.

Figure 3-1 Existing Lane Configurations

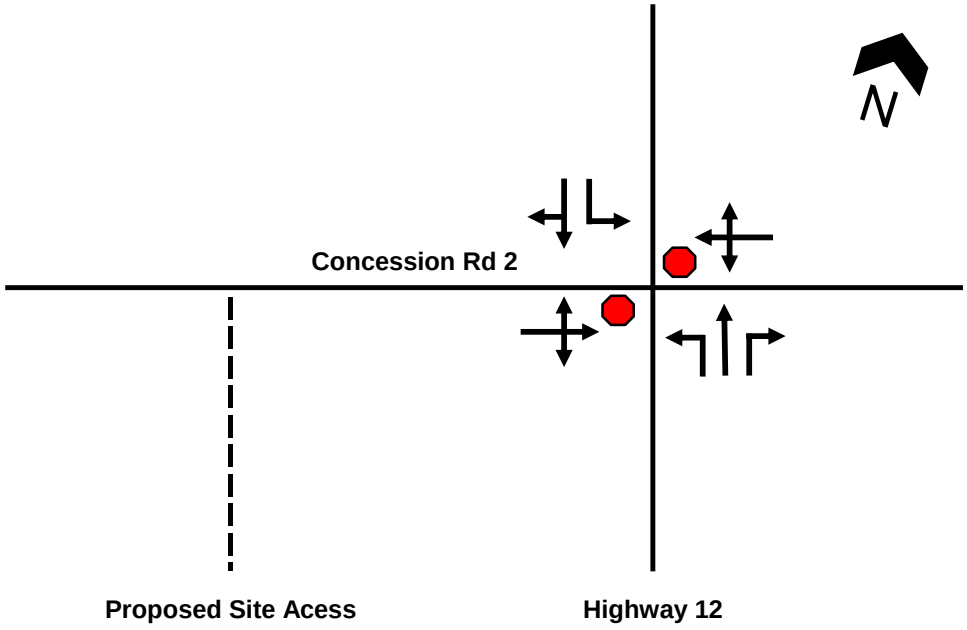


Figure 3-2 Existing Traffic Volumes

Legend

xx	A.M. Peak Hour Traffic
(xx)	P.M. Peak Hour Traffic
{xx}	Saturday Peak Hour Traffic

4 FUTURE BACKGROUND CONDITIONS

4.1 Study Horizon Years

For analysis purposes, it is assumed that the proposed Brechin Quarry will be fully operational by the 2025 study horizon year. Future traffic conditions were analyzed for the planning horizon years of 2025, 2030, and 2035, corresponding to the opening year of the quarry and the 5 and 10 year post-opening horizons.

4.2 Study Area Road Network Improvements

There are no changes to the existing study area road network planned within the study horizon years.

4.3 Future Background Developments

There are no future developments proposed within the immediate vicinity of the study area.

4.4 Future Background Growth

MTO's historical AADT data was used to determine the growth rate at the intersection of Highway 12 and Concession Road 2. Historical AADT data was used from the two intersections immediately north and south of the existing study intersection:

- Highway 12 and County Rd 169/Concession Rd 6
- Highway 12 and Ramara Rd 51/Concession Rd A

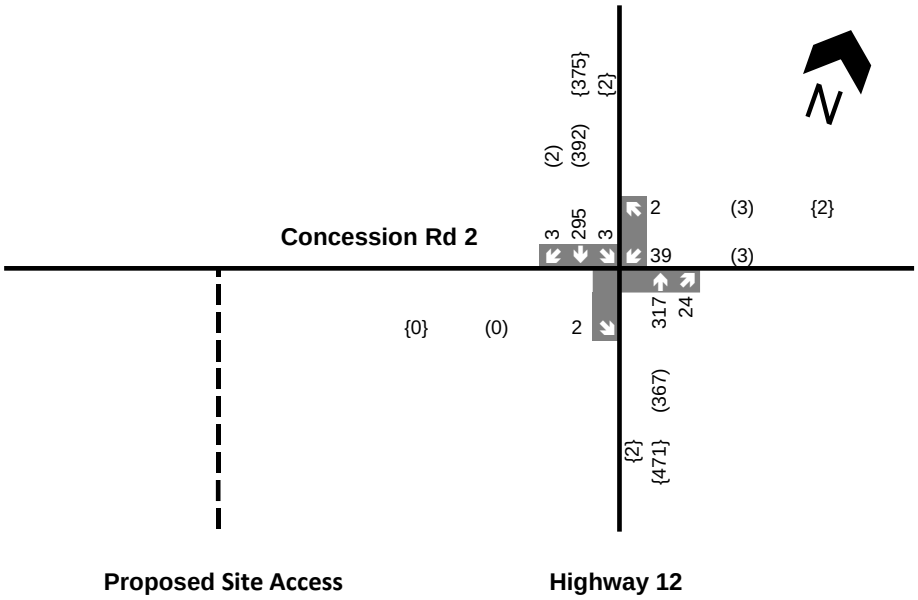
The MTO's historical AADT data and the growth rate calculations are included in **Appendix D**. The calculated growth rate of 1.2 % per annum was applied to all movements at the intersection of Highway 12 and Concession Road 2.

4.5 Future Background Traffic Volumes

The 2023 existing traffic volumes were grown to produce the 2025, 2030 and 2035 future background weekday a.m., p.m., and Saturday mid-day peak hour traffic volumes.

The future background weekday a.m., p.m., and Saturday mid-day peak hour traffic volumes for the 2025, 2030, and 2035 horizon years are provided in **Figure 4-1**, **Figure 4-2**, and **Figure 4-3**, respectively.

Figure 4-1 2025 Future Background Traffic Volumes



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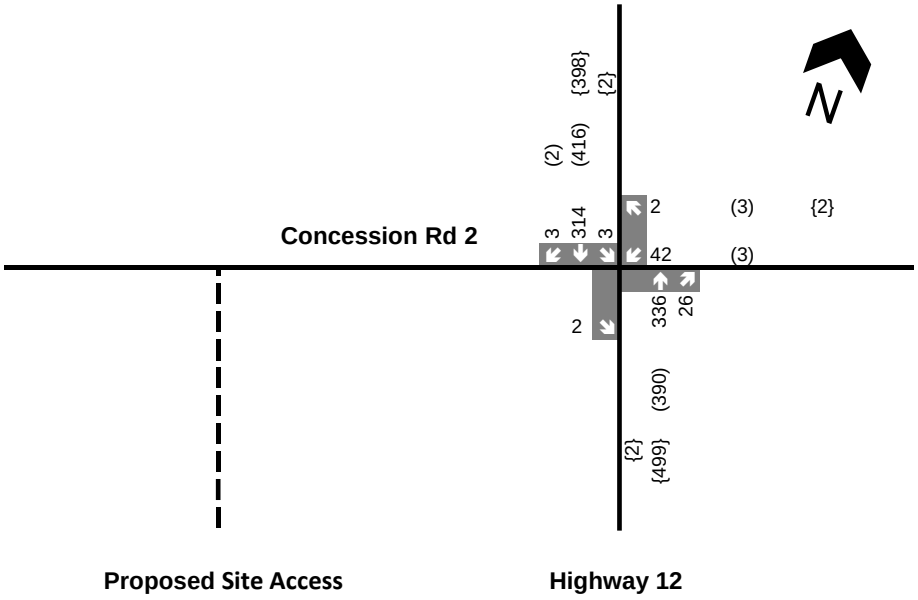
xx	A.M. Peak Hour Traffic
(xx)	P.M. Peak Hour Traffic
{xx}	Saturday Peak Hour Traffic

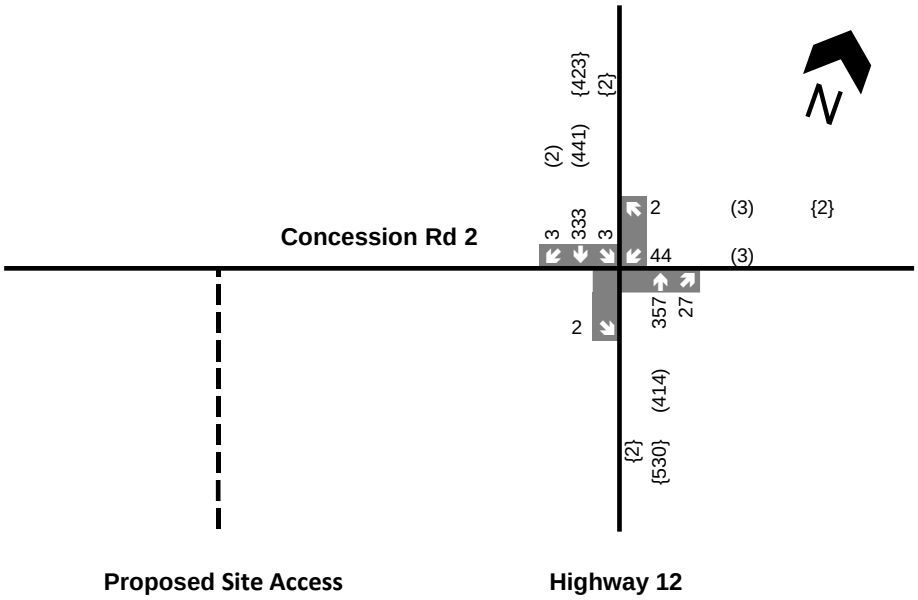
Figure 4-2 2030 Future Background Traffic Volumes



Legend

xx	A.M. Peak Hour Traffic
(xx)	P.M. Peak Hour Traffic
{xx}	Saturday Peak Hour Traffic

Figure 4-3 2035 Future Background Traffic Volumes



Legend

xx	A.M. Peak Hour Traffic
(xx)	P.M. Peak Hour Traffic
{xx}	Saturday Peak Hour Traffic

5 SITE GENERATED TRAFFIC

For analysis purposes, it was assumed that the proposed Brechin Quarry will be fully operational by the 2025 study horizon year. It is understood that operations will begin lower than the maximum annual limit when quarry operations start at the surface. Over time, once operations are deeper into the quarry, annual extraction levels are anticipated to increase and approach the maximum annual extraction limit. Accordingly, truck traffic from the quarry will increase over time to eventually meet the maximum operations outlined in this report.

However, to evaluate the impact of site truck traffic on road network when the quarry is operating at its maximum annual limit, it was conservatively assumed that maximum operations (i.e. maximum annual amount of material allowed to be extracted will also be shipped) will commence by the 2025 study horizon year.

5.1 Site Trip Generation

In order to generate the estimated site truck traffic associated with the proposed Brechin Quarry, the following assumptions and base data have been adopted:

- Aggregate Maximum Annual Shipping Limit (Licence application) = 2,000,000 tonnes
- Quarry operations proposed as follows:
  - Loading and Shipping hours of 5:30 a.m. to 6:00 p.m. (12.5 hours) from Monday to Friday and 7:00 a.m. to 12:00 p.m. (5.0 hours) on Saturday. No shipping will occur on Sundays and statutory holidays.
- For analysis purposes, a 12-hour shipping day was adopted for weekdays (Monday-Friday), resulting in a total of 65 shipping hours a week, or an average of 282 hours a month
- Average truck capacity of 35 tonnes

Although loading and shipping will be permitted from 5:30 a.m. to 6:00 p.m. (12.5 hours) from Monday to Friday, for analysis purposes it was assumed that shipping specifically will occur for a shorter duration from approximately 6:00 a.m. to 6:00 p.m. (12.0 hours). The assumed 12-hour shipping days result in overall higher truck trips per hour compared to if the same amount of peak month aggregate was shipped during the full 12.5-hour loading and shipping period on weekdays.

The quarry is proposed to operate year-round from January to December with variable amounts of material extraction and shipping depending on the month. Based on historical shipping data records archived by TYLin, peak shipping generally occurs during the 'construction season' between the months of May and October. **Table 5-1** summarizes the average monthly breakdown

of material extraction based on archived historical data from existing quarry operations in southern Ontario. The estimated percentage of total annual material shipped per month was applied to the 2,000,000-tonne annual shipping limit.

Table 5-1 Monthly Material Shipping Estimates

Month	Material Volume Per Month (Percent of Total)
January	3%
February	4%
March	5%
April	7%
May	12%
June	13%
July	11%
August	10%
September	12%
October	10%
November	7%
December	6%
Total	100%

To account for the occasional periods of higher-volume trucking that is likely to occur during high-construction activity (typically between May and October), the trip generation used in the analysis of quarry-generated traffic impacts is based on the peak level of shipping / trucking activity during these busy summertime periods. Based on **Table 5-1**, June represents the peak month during the peak construction season, with approximately 13% of the total annual material shipped during that month. As a conservative measure, an additional 5% was added onto the peak month percentage to account for potential fluctuations in monthly material shipped due to variations in market demand from year to year. A total of 18% was applied to the annual Brechin Quarry extraction limit, resulting in 360,000 tonnes of the annual aggregate material estimated to be extracted during the peak summer month. This equates to 1,278 tonnes of material per hour based on an average of 282 shipping hours per month. With a capacity of approximately 35 tonnes per truck, 1,278 tonnes of material extraction generates approximately 37 outbound loaded aggregate truck trips per hour (plus the same number of returning trucks).

It is expected that only one weigh scale will service all outbound loaded trucks. Based on TYLin's experience, one truck on average can typically be weighed every three minutes, resulting in an average throughput of 20 trucks/hour. Accordingly, 37 aggregate trucks trips per hour to be applied to the traffic analysis is considered to be a higher than average estimate of the number of trucks that will be able to leave the quarry each hour.

It is expected that during the a.m. peak hour, truck traffic surges occur shortly after haulage hours begin because the trucks will often arrive at quarries prior to when shipping hours commence and are permitted to pre-load, pre-weigh, and pre-permit before entering the road network external to the site. Such 'pre-loaded' trucks will wait on-site until shipping hours commence. Therefore, to reflect this once-a-day morning 'surge', the study has assumed increasing the adjusted peak hourly activity by 50% (i.e., 37 X 1.5 = 56 outbound loaded truck trips per hour) for the a.m. peak hour. However, for the p.m. peak hour, since there is no such 'surge', the calculated peak of 37 outbound loaded truck trips per hour (plus a commensurate volume of returning trucks) has been maintained.

Aggregate recycling will be part of the tonnage limit under the new Aggregate Resources Act. These loads are already accounted for in the analysis. Extracted aggregate and recycled aggregate will be limited to 2,000,000 tonnes per year.

With adoption of the various peaking factors described above and employed in the regular aggregate shipping activity estimates, we have portrayed a high trucking activity level of site-related traffic flows, and therefore impacts on the abutting street system.

It is assumed that approximately 5 employees will be working at the quarry per shift. Therefore, a total of 5 inbound a.m. peak hour and 5 outbound p.m. peak hour employee trips were generated. As the Saturday mid-day adjacent street peak hour is 11:15 a.m. – 12:15 p.m. (as per TMCs) and the quarry is proposed to operate from 7:00 a.m. to 12:00 p.m. on Saturdays, 5 outbound Saturday employee trips were also assumed to be generated.

A total of 98 two-way site trips (truck and employee), consisting of 42 inbound and 56 outbound trips, are predicted to be generated by the subject site during the weekday a.m. peak hour. A total of 79 two-way site trips, consisting of 37 inbound and 42 outbound trips, are predicted to be generated by the subject site during both the weekday p.m. and Saturday mid-day peak hours.

5.2 Site Trip Distribution and Assignment

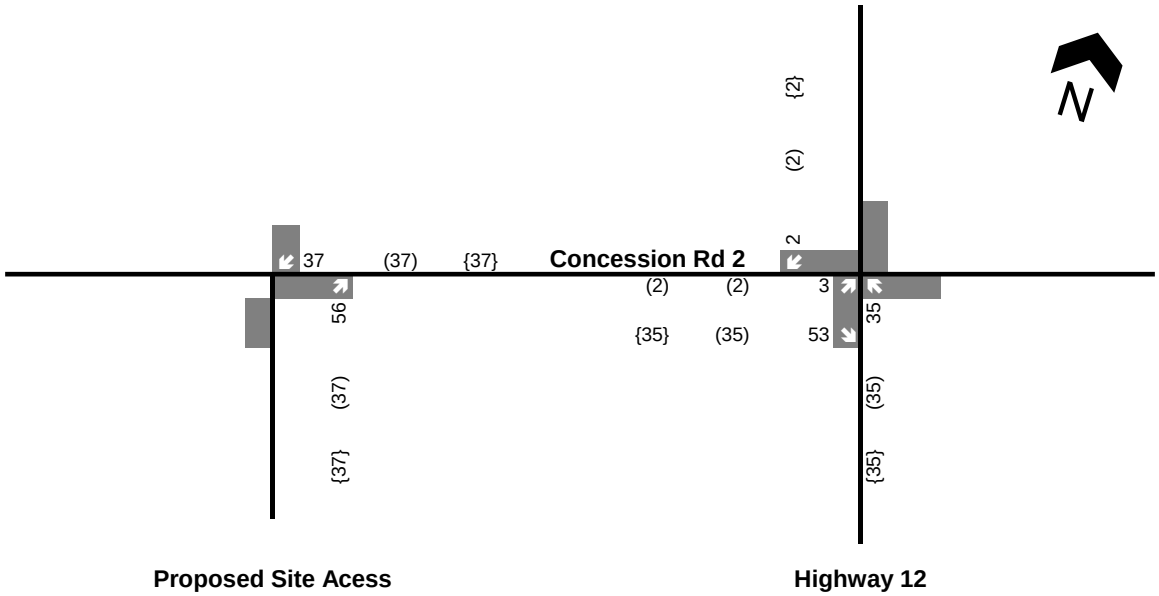
TYLin was provided the expected distribution of aggregate trips, and it is expected that 5% of the extracted aggregate will be transported north and 95% will be transported south on Highway 12. The quarry employee passenger vehicle trips were also assigned to the road network using the same distribution as the site truck trips. A summary of the directional distribution of truck and employee traffic for the proposed Brechin Quarry is provided in **Table 5-2**.

Table 5-2 Site Trip Distribution

Direction To / From	% Distribution
North via Highway 12	5%
South via Highway 12	95%
Total	**100%**

The estimated truck and employee site trips for each of the study peak hours are provided in **Figure 5-1** and **Figure 5-2,** respectively. The estimated truck and employee site trips were combined to produce the total site trips, which are provided in **Figure 5-3.**

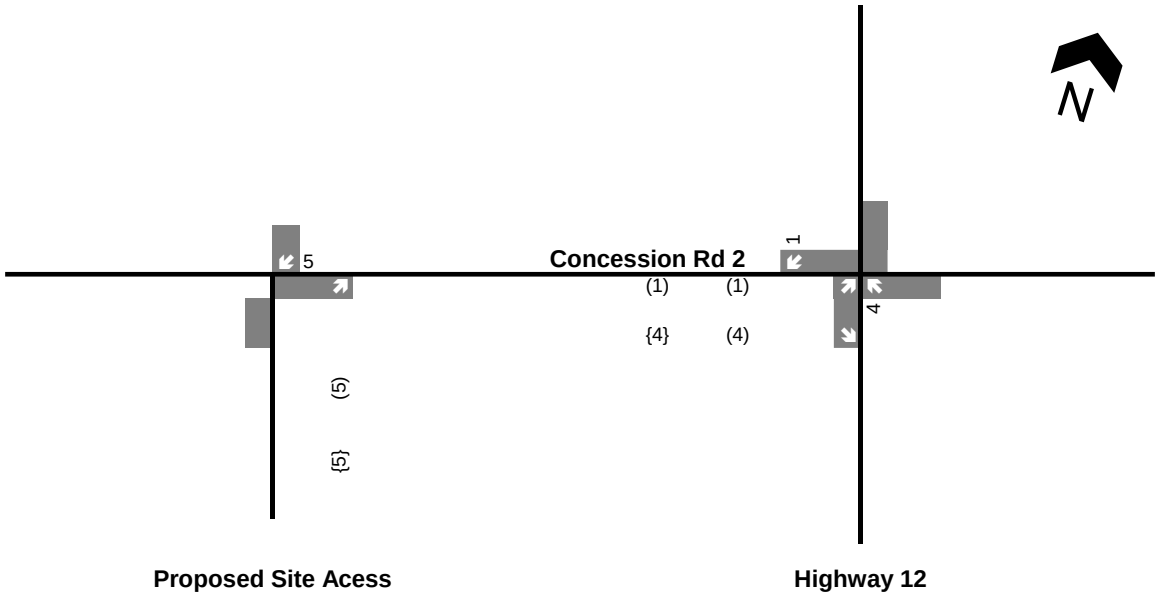
Figure 5-1 Site Traffic Volumes: Truck Trips



Legend

xx	A.M. Peak Hour Traffic
(xx)	P.M. Peak Hour Traffic
{xx}	Saturday Peak Hour Traffic

Figure 5-2 Site Traffic Volumes: Employee Automobile Trips



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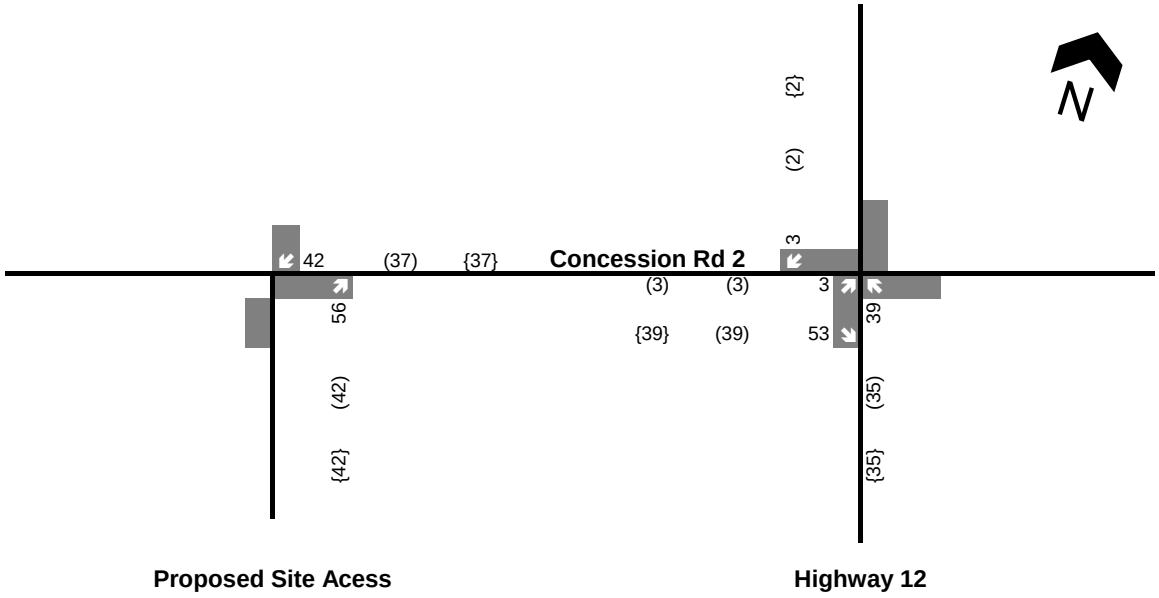
xx	A.M. Peak Hour Traffic
(xx)	P.M. Peak Hour Traffic
{xx}	Saturday Peak Hour Traffic

Figure 5-3 Site Traffic Volumes: Total Trips



Legend

xx	A.M. Peak Hour Traffic
(xx)	P.M. Peak Hour Traffic
{xx}	Saturday Peak Hour Traffic

6 FUTURE TOTAL TRAFFIC VOLUMES

The future total traffic volumes for the 2025, 2030, and 2035 planning horizons were derived by combining the projected future background traffic with the corresponding estimate of the total site generated traffic (quarry trucks and employee passenger vehicles).

The quarry access is proposed to be located on Concession Road 2, approximately 450 metres west of Highway 12. The resulting intersection will be a T-intersection with the site driveway forming the south leg. The quarry's access will be under stop control. The future study area lane configurations are shown in **Figure 6-1**.

The future total weekday a.m., p.m., and Saturday mid-day peak hour traffic volumes for the 2025, 2030, and 2035 horizon years are provided in **Figure 6-2**, **Figure 6-3**, and **Figure 6-4**, respectively.

Figure 6-1 Proposed Lane Configurations

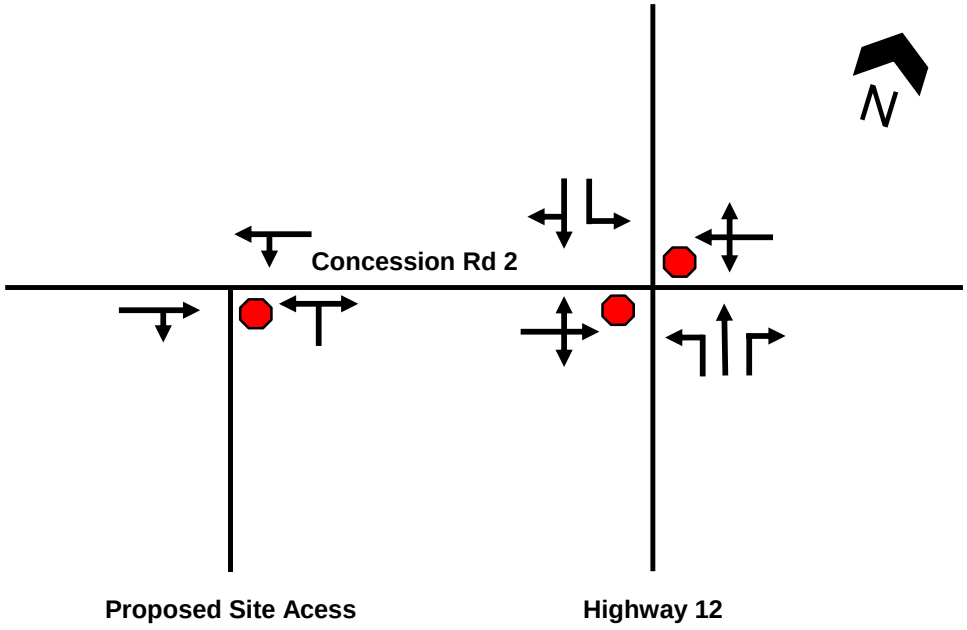
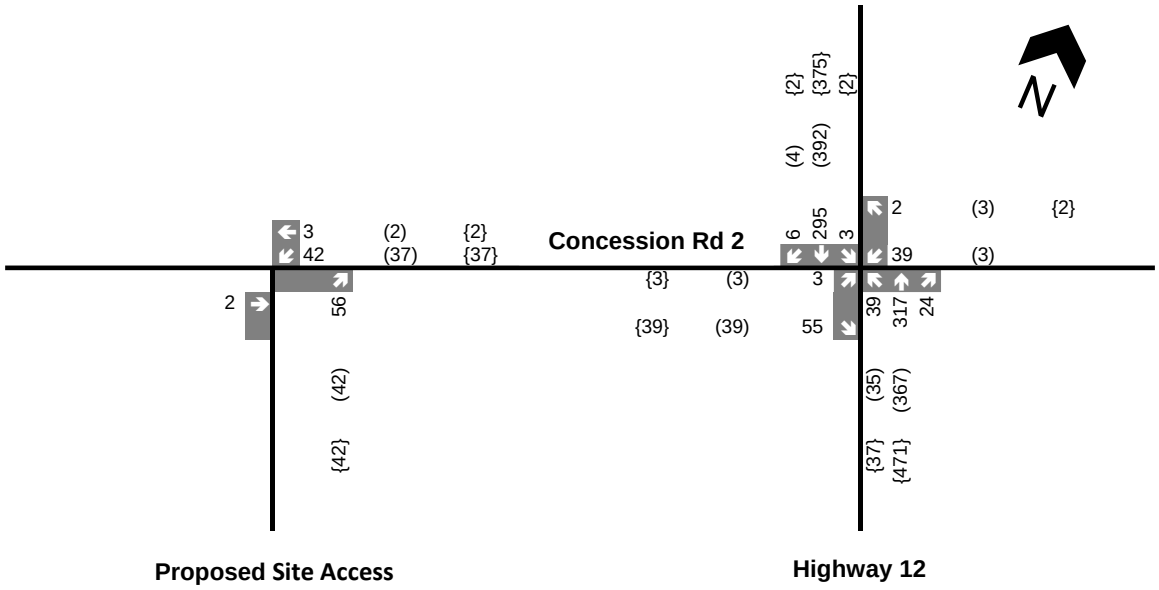


Figure 6-2 2025 Future Total Traffic Volumes



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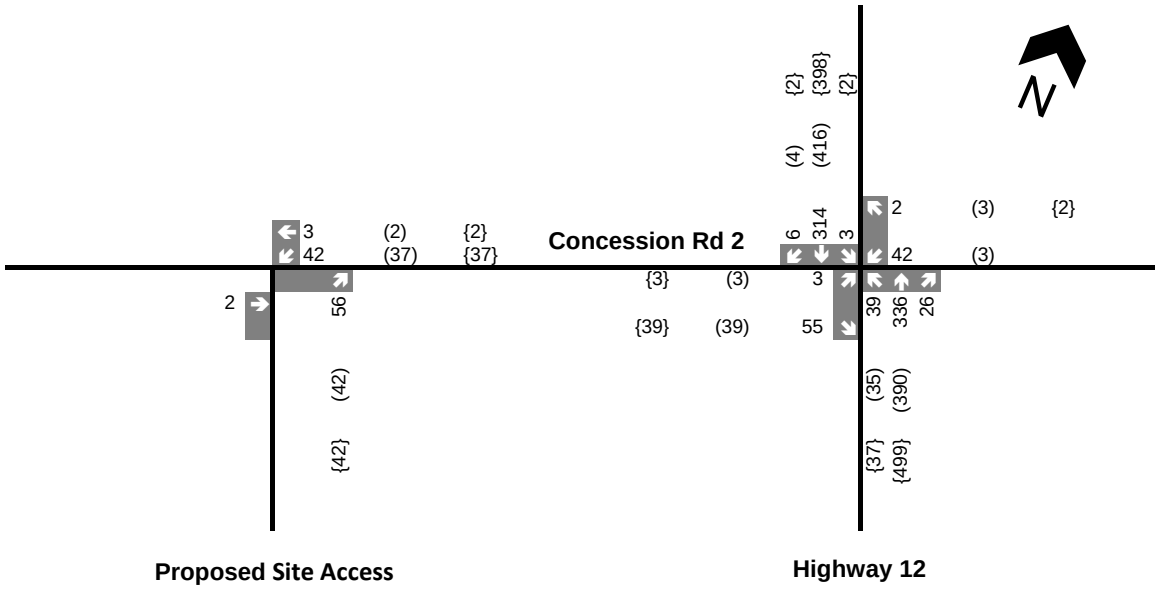
xx	A.M. Peak Hour Traffic
(xx)	P.M. Peak Hour Traffic
{xx}	Saturday Peak Hour Traffic

Figure 6-3 2030 Future Total Traffic Volumes



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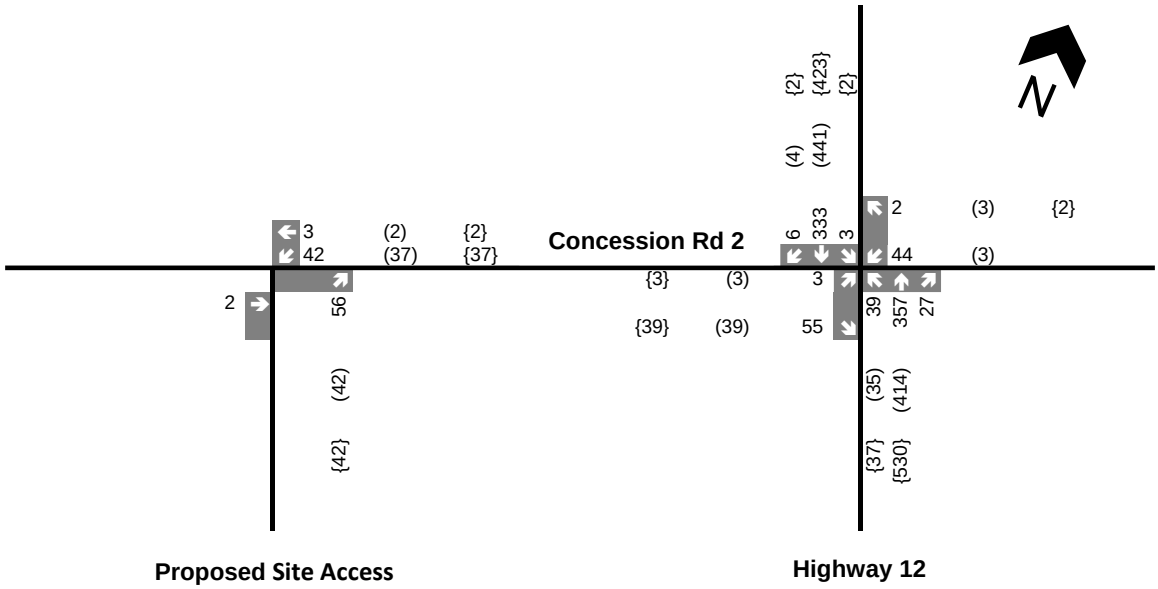
xx	A.M. Peak Hour Traffic
(xx)	P.M. Peak Hour Traffic
{xx}	Saturday Peak Hour Traffic

Figure 6-4 2035 Future Total Traffic Volumes



Legend

xx	A.M. Peak Hour Traffic
(xx)	P.M. Peak Hour Traffic
{xx}	Saturday Peak Hour Traffic

7 TRAFFIC CAPACITY ANALYSIS

The traffic capacity analysis identifies how well the study intersections and access driveways are operating and how they are expected to operate in the future. The analysis contained in this report utilized the Highway Capacity Manual (HCM) 2000 methodology within the Synchro Version 11 Software package. The reported intersection volume-to-capacity ratios (v/c) are a measure of the saturation volume for each turning movement, while the levels-of-service (LOS) are a measure of the average delay for each turning movement.

For the purpose of the future capacity analysis, the heavy vehicle percentages calculated from the existing turning movement counts were updated for the 2025, 2030, and 2035 future total scenarios. The heavy vehicle percentages were increased for individual movements throughout the study area to which the estimated Brechin Quarry site traffic will be added to. The future heavy vehicle percentages were calculated by estimating the volume of heavy vehicles performing a given movement for each study horizon year under future background conditions (existing heavy vehicle percentage assumed), adding the estimated volume of heavy vehicle site traffic, and finally dividing the future total heavy vehicle volumes by the total mixed-traffic volume for each movement.

The analysis includes identification of all intersections and for all movements; v/c ratios, LOS indicators and 95th percentile queue lengths. Critical intersections and movements shall be highlighted (bolded), as will the queue length of an individual movement that is projected to exceed available turning lane storage at the 95th percentile.

As per the MTO's General Guidelines for the Preparation of Traffic Impact Studies, 'critical' movements are defined as a movement at a signalized intersection that has a v/c ratio of 0.85 or greater:

The following tables summarize the HCM capacity results for the study intersections during the weekday a.m., p.m., and Saturday mid-day peak hours under existing (2023), future background (2025, 2030, 2035) and future total (2025, 2030, 2035) traffic conditions. Detailed Synchro reports are provided in **Appendix E**.

7.1 Existing Conditions

The traffic capacity analysis results for the existing study intersection are summarized in **Table 7-1** for the weekday a.m., p.m., and Saturday mid-day peak hours under existing traffic conditions.

Table 7-1 Existing 2023 Capacity Analysis Summary

Intersection	Movement	Weekday AM Peak Hour			Weekday PM Peak Hour			Saturday Peak Hour		
		v/c	Delay (s)	LOS	v/c	Delay (s)	LOS	v/c	Delay (s)	LOS
Highway 12 at Concession Road 2	EBLTR	0.00	10	A	0.00	0	A	0.00	0	A
	WBLTR	0.14	20	C	0.01	14	B	0.00	11	B
	NBL	0.00	0	-	0.00	0	-	0.00	8	A
	NBT	0.19	0	-	0.23	0	-	0.30	0	-
	NBR	0.01	0	-	0.00	0	-	0.00	0	-
	SBL	0.00	9	A	0.00	0	-	0.00	8	A
	SBTR	0.18	0	-	0.24	0	-	0.24	0	-

Under existing conditions all movements are operating with reserve capacity. For all peak hours, movements operate with v/c ratios of 0.30 or less and LOS 'B' or better with the exception of the shared westbound left/through/right movement that operates at LOS 'C' during the weekday a.m. peak hour. Overall, under existing conditions, the study network is expected to operate well.

7.2 Future Background Conditions

7.2.1 2025 Future Background

The traffic capacity analysis results for the study area intersections are summarized in **Table 7-2** for the weekday a.m., p.m., and Saturday mid-day peak hours under 2025 future background conditions.

Table 7-2 2025 Future Background Capacity Analysis

Intersection	Movement	Weekday AM Peak Hour			Weekday PM Peak Hour			Saturday Peak Hour		
		v/c	Delay (s)	LOS	v/c	Delay (s)	LOS	v/c	Delay (s)	LOS
Highway 12 at Concession Road 2	EBLTR	0.00	10	A	0.00	0	A	0.00	0	A
	WBLTR	0.15	20	C	0.01	14	B	0.00	12	B
	NBL	0.00	0	-	0.00	0	-	0.00	8	A
	NBT	0.19	0	-	0.23	0	-	0.31	0	-
	NBR	0.01	0	-	0.00	0	-	0.00	0	-
	SBL	0.00	9	A	0.00	0	-	0.00	8	A
	SBTR	0.18	0	-	0.25	0	-	0.25	0	-

Under 2025 future background conditions, all individual movements are expected to continue operating with reserve capacity. For all peak hours, movements are expected to operate with v/c ratios of 0.31 or less and LOS 'B' or better with the exception of the shared westbound left/through/right movement that operates at LOS 'C' during the weekday a.m. peak hour.

Overall, the study network is expected to operate well under 2025 future background conditions with minimal increases in delay compared to existing conditions.

7.2.2 2030 Future Background

The traffic capacity analysis results for the study area intersections are summarized in **Table 7-3** for the weekday a.m., p.m., and Saturday mid-day peak hours under 2030 future background conditions.

Table 7-3 2030 Future Background Capacity Analysis

Intersection	Movement	Weekday AM Peak Hour			Weekday PM Peak Hour			Saturday Peak Hour		
		v/c	Delay (s)	LOS	v/c	Delay (s)	LOS	v/c	Delay (s)	LOS
Highway 12 at Concession Road 2	EBLTR	0.00	10	B	0.00	0	A	0.00	0	A
	WBLTR	0.17	21	C	0.02	15	B	0.00	12	B
	NBL	0.00	0	-	0.00	0	-	0.00	8	A
	NBT	0.21	0	-	0.25	0	-	0.33	0	-
	NBR	0.02	0	-	0.00	0	-	0.00	0	-
	SBL	0.00	9	A	0.00	0	-	0.00	9	A
	SBTR	0.19	0	-	0.26	0	-	0.26	0	-

Under 2030 future background conditions, all individual movements are expected to continue operating with reserve capacity. For all peak hours, movements are expected to operate with v/c ratios of 0.33 or less and LOS 'B' or better with the exception of the shared westbound

left/through/right movement that operates at LOS 'C' during the weekday a.m. peak hour.

Overall, the study network is expected to operate well under 2030 future background conditions with minimal increases in delay compared to existing conditions.

7.2.3 2035 Future Background

The traffic capacity analysis results for the study area intersections are summarized in **Table 7-4** for the weekday a.m., p.m., and mid-day Saturday peak hours under 2035 future background conditions.

Table 7-4 2035 Future Background Capacity Analysis

Intersection	Movement	Weekday AM Peak Hour			Weekday PM Peak Hour			Saturday Peak Hour		
		v/c	Delay (s)	LOS	v/c	Delay (s)	LOS	v/c	Delay (s)	LOS
Highway 12 at Concession Road 2	EBLTR	0.00	10	B	0.00	0	A	0.00	0	A
	WBLTR	0.20	23	C	0.02	15	C	0.00	12	B
	NBL	0.00	0	-	0.00	0	-	0.00	8	A
	NBT	0.22	0	-	0.26	0	-	0.35	0	-
	NBR	0.02	0	-	0.00	0	-	0.00	0	-
	SBL	0.00	9	A	0.00	0	-	0.00	9	A
	SBTR	0.21	0	-	0.28	0	-	0.28	0	-

Under 2035 future background conditions, all individual movements are expected to continue operating with reserve capacity. For all peak hours, movements are expected to operate with v/c ratios of 0.35 or less and LOS 'B' or better with the exception of the shared westbound left/through/right movement that operates at LOS 'C' during the weekday a.m. and p.m. peak hours.

Overall, the study network is expected to operate well under 2035 future background conditions with minimal increases in delay compared to existing conditions.

7.3 Future Total Conditions

The study area road network under future total conditions consists of the existing intersection of Highway 12 at Concession Road 2 and the intersection of the proposed quarry access with Concession Road 2. The proposed site access will operate as an unsignalized T-intersection with Concession Road 2, and the south leg, the site driveway, will operate under stop control.

7.3.1 2025 Future Total

The traffic capacity analysis results for the study area intersections are summarized in **Table 7-5** for the weekday a.m., p.m., and Saturday mid-day peak hours under 2025 future total conditions.

Table 7-5 2025 Future Total Capacity Analysis

Intersection	Movement	Weekday AM Peak Hour			Weekday PM Peak Hour			Saturday Peak Hour		
		v/c	Delay (s)	LOS	v/c	Delay (s)	LOS	v/c	Delay (s)	LOS
Highway 12 at Concession Road 2	EBLTR	0.12	13	B	0.10	14	B	0.11	15	B
	WBLTR	0.22	29	D	0.02	16	C	0.00	12	B
	NBL	0.05	9	A	0.05	10	A	0.05	10	A
	NBT	0.19	0	-	0.23	0	-	0.31	0	-
	NBR	0.01	0	-	0.00	0	-	0.00	0	-
	SBL	0.00	9	A	0.00	0	-	0.00	8	A
	SBTR	0.18	0	-	0.25	0	-	0.25	0	-
Concession Road 2 at Site Access	EBTR	0.00	0	-	0.00	0	-	0.00	-	-
	WBLT	0.04	8	A	0.03	8	A	0.03	8	A
	NBLR	0.07	10	A	0.05	9	A	0.05	9	A

Under 2025 future total conditions, all individual movements are expected to continue operating with reserve capacity. For all peak hours, movements are expected to operate with v/c ratios of 0.31 or less and LOS 'B' or better with the exception of the shared westbound left/through/right movement that operates at LOS 'D' and 'C' during the weekday a.m. and p.m. peak hours, respectively.

The intersection of Concession Road 2 and the proposed Quarry Access is expected to operate well with minimal delays and significant reserve capacity. The introduction of site traffic results in relatively minor increases in predicted delay for the eastbound and westbound shared left/through/right movements at the intersection of Highway 12 and Concession Road 2 compared to 2025 future background conditions.

Overall, it is expected that the introduction of site traffic to the study area road network will have a minor impact on future operations based on the differences between 2025 future total and future background capacity results.

7.3.2 2030 Future Total

The traffic capacity analysis results for the study area intersections are summarized in **Table 7-6** for the weekday a.m., p.m., and Saturday mid-day peak hours under 2030 future total conditions.

Table 7-6 2030 Future Total Capacity Analysis

Intersection	Movement	Weekday AM Peak Hour			Weekday PM Peak Hour			Saturday Peak Hour		
		v/c	Delay (s)	LOS	v/c	Delay (s)	LOS	v/c	Delay (s)	LOS
Highway 12 at Concession Road 2	EBLTR	0.12	13	B	0.11	15	B	0.12	15	C
	WBLTR	0.25	32	D	0.02	17	C	0.00	12	B
	NBL	0.05	9	A	0.05	10	B	0.06	10	B
	NBT	0.21	0	-	0.25	0	-	0.33	0	-
	NBR	0.02	0	-	0.00	0	-	0.00	0	-
	SBL	0.00	9	A	0.00	0	-	0.00	9	A
	SBTR	0.20	0	-	0.27	0	-	0.26	0	-
Concession Road 2 at Site Access	EBTR	0.00	0	-	0.00	0	-	0.00	-	-
	WBLT	0.04	8	A	0.03	8	A	0.03	8	A
	NBLR	0.07	10	A	0.05	9	A	0.05	9	A

Under 2030 future total conditions, all individual movements are expected to continue operating with reserve capacity. For all peak hours, movements are expected to operate with v/c ratios of 0.33 or less and LOS 'C' or better with the exception of the shared westbound left/through/right movement that operates at LOS 'D' during the weekday a.m. peak hour.

The intersection of Concession Road 2 and the proposed Quarry Access is expected to continue to operate well with minimal delays and significant reserve capacity under 2030 future total conditions. The introduction of site traffic results in moderate, and expected, increases in predicted delay for the eastbound and westbound shared left/through/right movements at the intersection of Highway 12 and Concession Road 2 compared to 2030 future background conditions.

Overall, it is expected that the introduction of site traffic to the study area road network will have a minor impact on future operations based on the differences between 2030 future total and future background capacity results.

7.3.3 2035 Future Total

The traffic capacity analysis results for the study area intersections are summarized in **Table 7-7** for the weekday a.m., p.m., and Saturday mid-day peak hours under 2035 future total conditions.

Table 7-7 2035 Future Total Capacity Analysis

Intersection	Movement	Weekday AM Peak Hour			Weekday PM Peak Hour			Saturday Peak Hour		
		v/c	Delay (s)	LOS	v/c	Delay (s)	LOS	v/c	Delay (s)	LOS
Highway 12 at Concession Road 2	EBLTR	0.12	14	B	0.11	15	C	0.12	16	C
	WBLTR	0.29	35	D	0.02	18	C	0.00	12	B
	NBL	0.05	10	A	0.05	10	B	0.06	10	B
	NBT	0.22	0	-	0.26	0	-	0.35	0	-
	NBR	0.02	0	-	0.00	0		0.00	0	-
	SBL	0.00	9	A	0.00	0	-	0.00	9	A
	SBTR	0.21	0	-	0.28	0	-	0.28	0	-
Concession Road 2 at Site Access	EBTR	0.00	0	-	0.00	0	-	0.00	0	-
	WBLT	0.04	8	A	0.03	8	A	0.03	8	A
	NBLR	0.07	10	A	0.05	9	A	0.05	9	A

Under 2035 future total conditions, all individual movements are expected to continue operating with reserve capacity. For all peak hours, movements are expected to operate with v/c ratios of 0.35 or less and LOS 'C' or better with the exception of the shared westbound left/through/right movement that operates at LOS 'D' during the weekday a.m. peak hour.

The intersection of Concession Road 2 and the proposed Quarry Access is expected to continue to operate well with minimal delays and significant reserve capacity under 2035 future total conditions. The introduction of site traffic results in moderate, and expected, increases in predicted delay for the eastbound and westbound shared left/through/right movements at the intersection of Highway 12 at Concession Road 2 compared to 2035 future background conditions.

Overall, it is expected that the introduction of site traffic to the study area road network will have a minor impact on future operations based on the differences between 2035 future total and future background capacity results.

8 QUEUEING ANALYSIS

8.1 Study Intersection Queueing Analysis

Queueing analysis of the study intersections was undertaken to identify potential queues spill backs or spill overs. The queueing reports were prepared using SimTraffic microsimulation software using the following methodology: 10 minutes seeding time, one-hour recording, and 5 simulation runs. A summary of the predicted 95th percentile queues for the weekday a.m., p.m., and Saturday mid-day peak hours under existing, future background, and future total traffic conditions is provided in the **Table 8-1**, **Table 8-2**, and **Table 8-3**, respectively. The detailed SimTraffic queueing reports are provided in **Appendix F**.

Of note, any queue length results that are reported as seven metres or less should be considered as equivalent to a queue of one passenger vehicle.

Table 8-1 Existing Queueing Analysis

Intersection	Movement	Available Storage (m)	95th Percentile Queue Length (m)		
			2023 Existing		
			AM	PM	SAT
Highway 12 at Concession Road 2	EBLTR	325	3	-	-
	WBLTR	-	24	4	2
	NBL	60	-	-	1
	NBT	-	-	-	-
	NBR	75	-	-	-
	SBL	75	4	-	2
	SBTR	-	-	-	-

Under existing conditions, the 95th percentile queue lengths at the intersection of Highway 12 at Concession Road 2 are minimal and are able to be accommodated by the existing available storage length for each movement during the weekday a.m., p.m., and Saturday mid-day peak hours.

Table 8-2 Future Background Queueing Analysis

Intersection	Movement	Available Storage (m)	95th Percentile Queue Length (m)								
			2025 Future Background			2030 Future Background			2035 Future Background		
			AM	PM	SAT	AM	PM	SAT	AM	PM	SAT
Highway 12 at Concession Road 2	EBLTR	325	4	-	-	4	-	-	4	-	-
	WBLTR	-	25	5	2	29	4	2	28	4	2
	NBL	60	-	-	1	-	-	3	-	-	3
	NBT	-	-	-	-	-	-	-	-	-	-
	NBR	75	-	-	-	-	-	-	-	-	-
	SBL	75	4	-	2	5	-	2	6	-	2
	SBTR	-	-	-	-	-	-	-	-	-	-

Under future background conditions, the predicted 95th percentile queue lengths are comparable to those recorded under existing conditions, with minimal to no changes in results. The predicted 95th percentile queue lengths are able to be accommodated by the existing available storage length for each movement during the weekday a.m., p.m., and Saturday mid-day peak hours.

Table 8-3 Future Total Queueing Analysis

Intersection	Movement	Available Storage (m)	95th Percentile Queue Length (m)								
			2025 Future Total			2030 Future Total			2035 Future Total		
			AM	PM	SAT	AM	PM	SAT	AM	PM	SAT
Highway 12 at Concession Road 2	EBLTR	325	29	25	24	28	26	25	28	24	25
	WBLTR	-	27	5	4	30	6	3	32	6	2
	NBL	60	21	21	19	23	22	20	22	21	21
	NBT	-	-	-	-	1	-	-	1	-	-
	NBR	75	-	-	-	-	-	-	-	-	-
	SBL	75	4	-	2	2	-	3	2	-	3
	SBTR	-	2	2	1	2	2	1	1	2	2
Concession Road 2 at Site Access	NBLR	-	29	25	24	28	26	25	27	25	25

Under future total conditions, the predicted 95th percentile queue lengths are comparable to those recorded under future background conditions, with minimal increases in predicted queue lengths with the exception of the shared eastbound left/through/right movement and the northbound left movement. Both movements are predicted to have their 95th percentile queues range from 19 to 29

metres, depending on the peak hour and horizon year. However, the increased 95th percentile queue lengths for movements impacted directly by future site traffic are reasonable, and are equivalent to approximately 3 to 5 vehicles waiting for gaps in traffic at the unsignalized intersection of Highway 12 at Concession Road 2.

The outbound, northbound left/right movement at the future quarry access on Concession Road 2 are considered reasonable and will be contained within the proposed quarry's property limits. Inbound queues were not recorded for the westbound left movement based on SimTraffic's queueing results. Internal inbound queueing on-site is discussed in **Section 8.2**.

The predicted 95th percentile queue lengths are able to be accommodated by the available storage length for each movement during the weekday a.m., p.m., and Saturday mid-day peak hours.

8.2 Internal Queueing Analysis

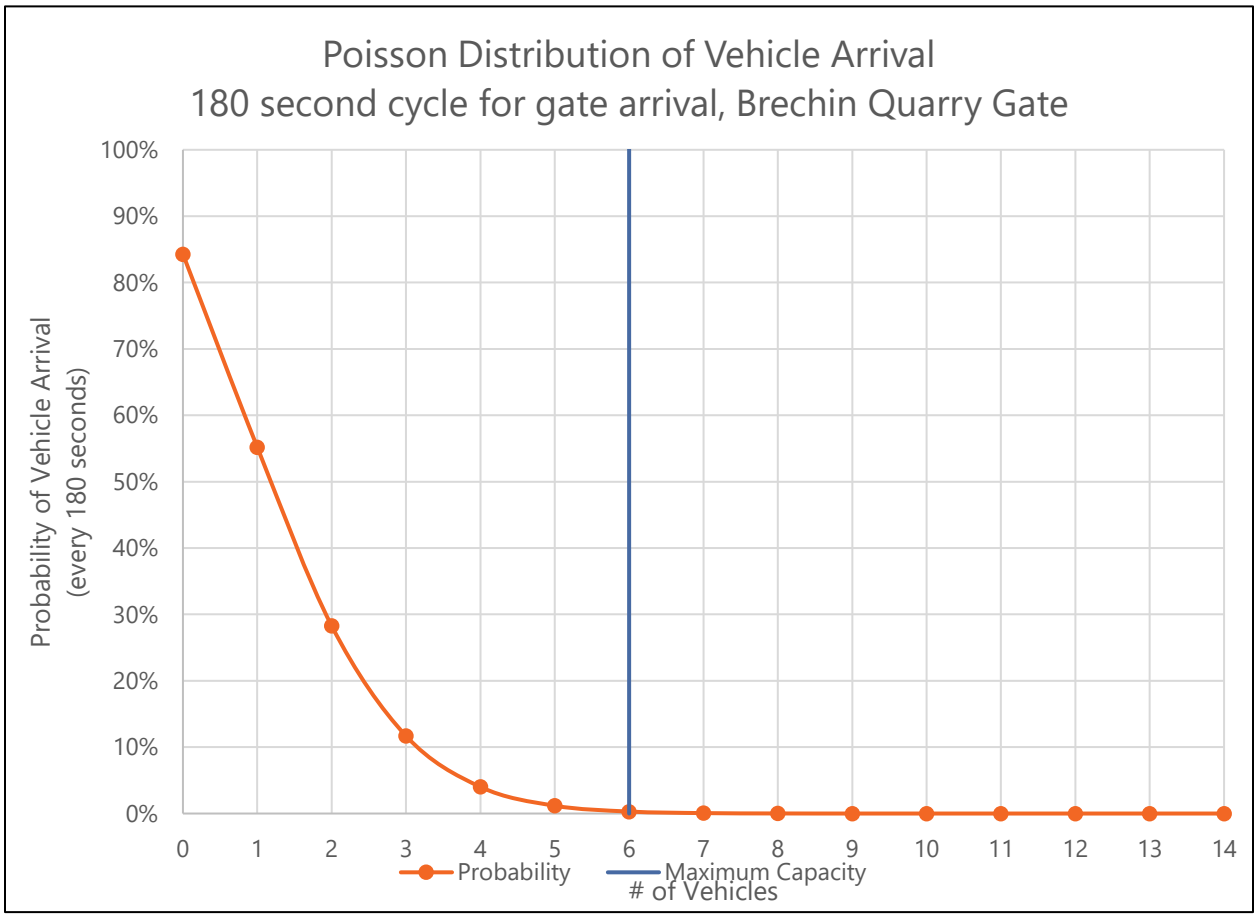
In addition to analyzing external queueing at each study area intersection, TYLin completed a review of the aggregate truck queueing internal to the proposed Quarry.

It is assumed that aggregate trucks will need to travel at least 100 metres internally after entering the site from the Concession Road 2 quarry access before reaching the quarry's gatehouse and weigh station.

Based on the estimated trip generation for the proposed quarry, a maximum of 37 aggregate trucks are expected to enter quarry per hour during each of the study peak hours. Based on TYLin's experience analyzing similar pits and quarries in Ontario, the average dwell time at the gatehouse was estimated as three minutes per aggregate truck, resulting in a gatehouse typically being able to accommodate approximately 20 trucks per hour. Assuming the arrival of aggregate trucks to the quarry would follow a Poisson distribution, the probability of a certain number of aggregate trucks arriving every three minutes is shown in **Figure 8-1.** Calculations used to determine the arrival distribution are provided in **Appendix G**.

For the purposes of converting the maximum number of aggregate trucks expected to arrive and queue up at a given time during the peak hours, the length of a typical aggregate truck was based on the standard DESIGNATED TRUCK 3 — 3-AXLE TRUCK PLUS AUXILIARY AXLE, as outlined in Ontario Regulation 413/05 (O.Reg 413/05), which has a total length of 12.5 metres. Since the aggregate trucks have an assumed length of 12.5 metres, and if 1.0 metre of spacing is assumed in front of and behind each truck, a total truck length of 14.5 metres was used for the purposes of the internal queueing analysis.

Figure 8-1 Poisson Distribution of Aggregate Truck Arrivals



As per the Poisson distribution results in **Figure 8-1**, the probable 95th percentile number of trucks queueing at the proposed quarry's gatehouse within a three minute period is estimated to be four trucks, which equates to a 58 metre long internal queue. Accordingly, the assumed 100 metres of distance between the gatehouse and Concession Road 2 would be adequate to accommodate internal queueing, and a spillback of the internal queue onto Concession Road 2 would not be anticipated during the study peak hours.

9 TRAFFIC WARRANT ANALYSIS

9.1 Signal Warrant Analysis

A signal warrant was conducted for the intersection of Highway 12 and Concession Road 2 for all future horizon years (2025, 2030, 2035) under future background and future total traffic conditions to determine if the projected increase in future traffic volumes would justify the installation of a traffic signal. Based on Justification 7 of Book 12 of the Ontario Traffic Manual (OTM), 2012, it was found that none of the estimated future background or future total traffic volumes fulfill the justification for the implementation of traffic signals.

Detailed signal warrant summaries for each horizon year are provided in **Appendix H**.

10 CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations for the analysis associated with the proposed Brechin Quarry are as follows:

- The quarry's site access is proposed to be located on Concession Road 2, approximately 450 metres west of Highway 12 satisfies access. The proposed access location satisfies and exceeds MTO and TAC minimum intersection spacing requirements.
- It is estimated that the quarry will generate 56 outbound and 37 inbound truck trips during the weekday a.m. peak hour. During the weekday p.m. and Saturday mid-day peak hours, the proposed quarry is estimated to generate 37 inbound and 37 outbound truck trips. A total of 5 inbound employee (passenger vehicle) trips were assumed during the a.m. peak hour, while 5 outbound employee trips were assumed for the p.m. and Saturday mid-day peak hours.
- Highway 12 is proposed to be the main haul route for the quarry due to its close proximity to the site. 95% of all the site generated trips are expected to travel south on Highway 12 while the remaining 5% will travel north.
- The existing intersection of Highway 12 and Concession Road 2 operates well under existing conditions, with all individual movements operating with v/c ratios of 0.30 or less, and LOS 'C' or better during all study peak hours. The existing intersection is expected to continue to operate well under future background conditions, with individual movements operating with v/c ratios of 0.35 or less, and LOS 'C' or better.
- Overall, it is expected that the introduction of site traffic to the study area road network will have a minor impact on future operations based on the differences between the future total and future background capacity results for each future horizon year. Under 2035 future total traffic conditions, individual movements are expected to operate with v/c ratios of 0.35 or less and LOS 'C' or better at all study intersections with the exception of the shared westbound left/through/right movement at the intersection of Highway 12 and Concession Road 2 that operates at LOS 'D' during the weekday a.m. peak hour.
- The predicted 95th percentile queue lengths at both study intersections are able to be accommodated by the available storage length for each movement during the weekday a.m., p.m., and Saturday mid-day peak hours for all horizon years under existing, future background, and future total conditions, as applicable.
- A review of the potential for internal queueing to extend from the proposed quarry's gatehouse to Concession Road 2 was conducted based on a Poisson distribution of the probability of a certain number of aggregate trucks arriving every three minutes during a peak hour. It was found that the probable maximum number of trucks queueing at the

proposed quarry's gatehouse at any given time is estimated to be six trucks, which equates to an 87 metre long internal queue (14.5 metres assumed per aggregate truck). The 95th percentile queue was identified to be approximately 4 trucks, resulting in a 58 metre long internal queue. Accordingly, it is recommended that the quarry's gatehouse be located 100 metres from Concession Road 2, which would be more than adequate to accommodate internal queueing. A spillback of the internal queue onto Concession Road 2 is not anticipated during the study peak hours.

- A traffic signal warrant analysis was conducted for the existing intersection of Highway 12 and Concession Road 2 according to Justification 7 in OTM Book 12. It was concluded that a traffic signal is not warranted for any future horizon year (2025, 2030, and 2035) under future background or future total traffic conditions.
- The portion of Concession Road 2 that will be used by aggregate trucks to travel between the future quarry access and Highway 12 will likely require structural upgrades in order to accommodate truck traffic without undue deterioration of the road surface. It is recommended that LCP Quarry Limited in consultation with the Township perform a review of the existing load capacity (geotechnical assessment) of Concession Road 2 and determine what upgrades would be required to accommodate quarry truck traffic to and from Highway 12 via Concession Road 2.
- The existing flare (paved shoulder) on Highway 12 for southbound right-turning traffic should be reviewed for its capacity to accommodate aggregate trucks. The possibility of extending the length of the existing taper/portion of paved shoulder should also be reviewed. Given the relatively low volume of aggregate trucks predicted to complete the turn, it is recommended to upgrade the existing southbound right-turn taper to accommodate aggregate traffic instead of constructing an exclusive right-turn lane.

Additionally, recommendations to be included on the Aggregate Resources Act Site Plan for the proposed Brechin Quarry are as follows:

- Prior to shipping, the Licensee shall enter into an agreement with the MTO to upgrade the southbound right-turn taper on Highway 12 at Concession Road 2.
- Prior to shipping, the Licensee shall enter into an agreement with the Township of Ramara to upgrade Concession Road 2 from Highway 12 to the proposed quarry access.
- The proposed quarry's gatehouse/scale shall be located 100 m from Concession Road 2 to accommodate queuing of trucks on-site.

Appendix A:
Pre-Consultation Correspondence

TMIG
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MEMORANDUM

DATE	December 1, 2020
TO	Deb McCabe, Township of Ramara
CC:	James Newlands, MHBC Planning Brian Zeman, MHBC Planning Scott Kirby, LCP Quarry Limited Moreen Miller
SUBJECT	Terms of Reference, Haul Route Assessment and Transportation Impact Study, Proposed Brechin Quarry Project
FROM	Michael Dowdall, Jordan Hart-Bishop TMIG
PROJECT NUMBER	2453

The Municipal Infrastructure Group Ltd., a T. Y. Lin Company (TMIG | TYLI) is pleased to present this draft Terms of Reference describing the proposed work program for the Haul Route Assessment and Transportation Impact Study to be prepared in support of the upcoming ARA & Rezoning of the lands owned by Talisker Corporation in the Township of Ramara.

Terms of Reference

The Municipal Infrastructure Group Ltd., a T. Y. Lin Company (TMIG | TYLI) was retained by MHBC Planning, Urban Design & Landscape Architecture to assist with the Aggregate Resources Act Category 2, Class A New Licence application as well as applications to amend the Township's Official Plan and Zoning By-law for lands located at the southwestern quadrant of Highway 12 and Concession Road 2 in the Ramara Township.

In order to properly scope this project, we ask that Ramara Township and the MTO provide comments on the following scope of work and confirm if there are any additional items required as part of the study.

1. Collect road inventory information about the study area road network. Due to the established hauling activities in the area, our study is focused on the intersection of Highway 12 and Concession Road 2, and the segment of Concession Road 2 from the highway to the proposed site access. Data will be collected for three weekdays and one Saturday during the construction season to understand the current traffic patterns in the area. The counts will be conducted to include the proposed operating hours of the quarry.
2. The collected counts will be used to create a baseline for AM, PM and Saturday peak hour traffic operations.
3. Obtain from the Township land use and traffic generation information for any relevant nearby proposed developments, and any potential/committed future road or intersection improvements, that will be on-stream within the development horizon of the Brechin Quarry. This information will inform the 'future background' traffic condition against which to measure site traffic impacts.
4. Create a traffic operations model (using Synchro/SimTraffic v.10) to test the effects of the proposed quarry traffic on the existing and future study area roadway system. It is typical for these types of studies to emulate a horizon of ten years beyond initial opening year (to be confirmed).
5. Prepare trip generation estimates for the proposed Quarry based on the annual extraction license and proposed operating days/hours. Distribute/assign the resultant peak hour trips to the primary/alternate haul route(s) for comparative and detailed operational assessments.
6. Township and MTO to confirm an acceptable annual growth rate applied to planning horizons along Highway 12 and Concession Road 2.
7. Prepare peak hour operational analyses to investigate and document the impacts of the proposed quarry traffic. This will include a review of intersection turning movement delays, volume to capacity ratios, and vehicular queuing. This will also include recommendations for the proposed site access lane configurations and a conceptual layout for same.

8. Present the effects of the traffic generated by the proposed quarry along with mitigation measures necessary along the haul route(s) to accommodate the additional traffic load, which would include conceptional designs of any roadway modifications inline with town standards. Recommendations on traffic control measures at all affected haul route intersections as well as the proposed site access will be included.
9. The above would all be documented in a TIS which would include a haul route assessment for submission to the Township and MTO.

Furthermore, see below a list of items and data (if available): we kindly request from the Township/MTO for use in our transportation study:

1. Historic turning movement counts at study area intersections
2. Average Annual Daily Traffic (AADT) volumes along road segments in study area
3. Capital roadworks planned on study area network (and when to expect construction)
4. Collision statistics for study area network
5. Other future development application details (land uses and development stats) proposed within influence of the study area

For you reference, attached is an image showing the study area.

Please do not hesitate to contact us should you have any questions.

Gaurav Chauhan

From: Dorton, Peter (MTO) <Peter.Dorton@ontario.ca>
Sent: Wednesday, January 27, 2021 3:44 PM
To: Jordan Hart-Bishop
Cc: Michael Dowdall; dmccabe@township.ramara.on.ca; MacKinnon, John (MTO); Yanez-Flores, Giovanni (MTO); Janke, Aaron (MTO); Blaney, Cameron (MTO)
Subject: FW: Brechin Quarry Traffic Study Terms of Reference
Attachments: Traffic Data.zip; Figure 1 - Preliminary Limit of Extraction - Lands Under Ownership - Jul....pdf; 2453 - Brechin Quarry Terms of Reference Memo_20201201_v1.0.pdf

Hi Jordan:

Please see below in red our comments for the Traffic Study Terms of Reference for the proposed quarry southwest of Hwy 12 and Concession Rd 2. The points correspond to those in the attached December 1, 2020 Memo.

1. Collect road inventory information about the study area road network. Due to the established hauling activities in the area, our study is focused on the intersection of Highway 12 and Concession Road 2, and the segment of Concession Road 2 from the highway to the proposed site access. Data will be collected for three weekdays and one Saturday during the construction season to understand the current traffic patterns in the area. The counts will be conducted to include the proposed operating hours of the quarry.

2. The collected counts will be used to create a baseline for AM, PM and Saturday peak hour traffic operations.

3. Obtain from the Township land use and traffic generation information for any relevant nearby proposed developments, and any potential/committed future road or intersection improvements, that will be on-stream within the development horizon of the Brechin Quarry. This information will inform the 'future background' traffic condition against which to measure site traffic impacts.

4. Create a traffic operations model (using Synchro/SimTraffic v.10) to test the effects of the proposed quarry traffic on the existing and future study area roadway system. It is typical for these types of studies to emulate a horizon of ten years beyond initial opening year (to be confirmed).

   The use of Synchro/SimTraffic is acceptable for the analysis. The Ministry requires future background planning horizon analysis for 5 and 10 years after the full build out date of the development.

5. Prepare trip generation estimates for the proposed Quarry based on the annual extraction license and proposed operating days/hours. Distribute/assign the resultant peak hour trips to the primary/alternate haul route(s) for comparative and detailed operational assessments.

   The volume of traffic generated by the proposed development should be estimated using the procedures described in ITE's Trip Generation Handbook. If local data is available, or an alternative methodology for trip generation is proposed justification should be contained in the TIS on why it is considered to more appropriate than ITE trip rates.

6. Township and MTO to confirm an acceptable annual growth rate applied to planning horizons along Highway 12 and Concession Road 2.

   Please use a growth rate based on historical AADT data. The selected growth factor must be approved by the Ministry and, where available, may be determined by a regional macroscopic transportation model. Historical AADT data can be accessed via the link below.

   https://www.library.mto.gov.on.ca/SydneyPLUS/TechPubs/Portal/tp/TechnicalPublications.aspx

7. Prepare peak hour operational analyses to investigate and document the impacts of the proposed quarry traffic. This will include a review of intersection turning movement delays, volume to capacity ratios, and vehicular queuing. This will also include recommendations for the proposed site access lane configurations and a conceptual layout for same.

   In addition to the analysis methodology described above, the peak hour analysis should be undertaken for full development and for all interim stages, if applicable (with and without the relevant transportation improvements) as well as for:

   - Existing traffic conditions
   - Existing traffic conditions plus background growth
   - Existing traffic conditions plus background growth plus site generated traffic

8. Present the effects of the traffic generated by the proposed quarry along with mitigation measures necessary along the haul route(s), including Highway 12, to accommodate the additional traffic load, which would include conceptional designs of any roadway modifications inline with town and MTO standards, where applicable. Recommendations on traffic control measures at all affected haul route intersections as well as the proposed site access will be included.

9. The above would all be documented in a TIS which would include a haul route assessment submission to the Township and MTO.

Furthermore, see below a list of items and data (if available): we kindly request from the Township/MTO for use in our transportation study:

1. Historic turning movement counts at study area intersections

   The latest available turning movement count and mainline volume counts near the study area are attached.

2. Average Annual Daily Traffic (AADT) volumes along road segments in study area

   The use of MTO data is preferred. As previously mentioned, historical and recent AADT volume information for provincial highways can be obtained from the Ministry of Transportation website.

   https://www.library.mto.gov.on.ca/SydneyPLUS/TechPubs/Portal/tp/TechnicalPublications.aspx

3. Capital roadworks planned on study area network (and when to expect construction).

There are no highway works programmed in the south Brechin area.

4. Collision statistics for study area network

Use the Accident Rate (AR) found in in the document accessible via the link below.

https://www.library.mto.gov.on.ca/SydneyPLUS/TechPubs/Portal/tp/TechnicalPublications.aspx

5. Other future development application details (land uses and development stats) proposed within influence of the study area.

Please confirm with the Township, as there are potential residential subdivision developments in Brechin as well as vacant sites within the Ramara Industrial Park in south Brechin that, if developed within planning horizon of this TIS, will generate additional through traffic on Highway 12 at Concession Rd. 2.

Please feel free to contact me if you have any questions.

Thanks,
Peter Dorton
Senior Project Manager
Ministry of Transportation
Central Operations, Highway Corridor Management Section
159 Sir William Hearst Avenue, 7th Floor
Toronto, ON M3M 0B7
Cell: (437) 833 - 9396
E-Mail: peter.dorton@ontario.ca
Web: www.mto.gov.on.ca/english/engineering/management/corridor

---

From: Dorton, Peter (MTO) <Peter.Dorton@ontario.ca>
Sent: January 20, 2021 1:12 PM
To: Yanez-Flores, Giovanni (MTO) <Giovanni.Yanez-Flores@ontario.ca>
Cc: Janke, Aaron (MTO) <Aaron.Janke@ontario.ca>; Blaney, Cameron (MTO) <Cameron.Blaney@ontario.ca>
Subject: FW: Brechin Quarry Traffic Study Terms of Reference

Giovanni, just a reminder I am awaiting your comments on Terms of Reference, including request for data / info.
Applicant just sent us a reminder this morning.
I'm a little surprised nothing programmed for this stretch of Hwy 12, as pavement seems to be in poor condition, but not our call!
Thanks,
Peter D.

From: Yanez-Flores, Giovanni (MTO) <Giovanni.Yanez-Flores@ontario.ca>
Sent: January 11, 2021 2:12 PM
To: Dorton, Peter (MTO) <Peter.Dorton@ontario.ca>
Cc: Janke, Aaron (MTO) <Aaron.Janke@ontario.ca>
Subject: RE: Brechin Quarry Traffic Study Terms of Reference

Hey Peter,

Please find attached the details regarding future MTO work plans in the area of Highway12 near Concession Rd 2.

Regards,

From: Dorton, Peter (MTO) <Peter.Dorton@ontario.ca>
Sent: January 5, 2021 2:23 PM
To: Yanez-Flores, Giovanni (MTO) <Giovanni.Yanez-Flores@ontario.ca>
Cc: Janke, Aaron (MTO) <Aaron.Janke@ontario.ca>
Subject: FW: Brechin Quarry Traffic Study Terms of Reference

Giovanni, please note also on p.2 they are asking for info from us.
I'm not familiar with any MTO work plans for the area, so please maybe check with P&D and let me know.
Thanks,
Peter D.

From: Janke, Aaron (MTO) <Aaron.Janke@ontario.ca>
Sent: January 5, 2021 2:18 PM
To: Yanez-Flores, Giovanni (MTO) <Giovanni.Yanez-Flores@ontario.ca>
Cc: Dorton, Peter (MTO) <Peter.Dorton@ontario.ca>
Subject: Fw: Brechin Quarry Traffic Study Terms of Reference

Hello Giovanni,

Please review.

Regards,

Aaron Janke
Traffic Supervisor
Traffic Engineering Central 1, York/Simcoe
Design & Engineering | Ministry of Transportation
159 Sir William Hearst Avenue | 6th Floor
North York, Ontario | M3M 0B7
Cell: (437) 778-4021
Email: Aaron.Janke@ontario.ca

From: Dorton, Peter (MTO) <Peter.Dorton@ontario.ca>
Sent: January 5, 2021 1:58 PM
To: Janke, Aaron (MTO) <Aaron.Janke@ontario.ca>
Cc: Blaney, Cameron (MTO) <Cameron.Blaney@ontario.ca>; Greto, Kaitlyn (MTO) <Kaitlyn.Greto@ontario.ca>; Della Mora, Dan (MTO) <Dan.DellaMora@ontario.ca>; Hewitt, Tom (MTO) <Tom.Hewitt@ontario.ca>
Subject: FW: Brechin Quarry Traffic Study Terms of Reference

Aaron, please review attached TIS terms of reference for proposed new quarry SW of Hwy 12 / Conc. Rd. 2, just south of Brechin.

Access will be on Conc. Rd. 2 about 200m west on Hwy 12; Hwy12 / Conc. Rd. 2 intersection already has turn lanes and SB acceleration lane for the LaFarge pit in NE corner.

Thanks,
Peter D.

From: Akhtar, Usman (MTO) <Usman.Akhtar@ontario.ca>
Sent: January 5, 2021 10:28 AM
To: Dorton, Peter (MTO) <Peter.Dorton@ontario.ca>
Subject: FW: Brechin Quarry Traffic Study Terms of Reference

Usman Akhtar
Corridor Management Officer
Ministry of Transportation
416-276-0704

From: Jordan Hart-Bishop <JHartBishop@tmig.ca>
Sent: January 5, 2021 10:25 AM
To: Akhtar, Usman (MTO) <Usman.Akhtar@ontario.ca>
Cc: Michael Dowdall <MDowdall@tmig.ca>
Subject: Brechin Quarry Traffic Study Terms of Reference

Hello Usman,

We are going to complete a traffic study for a quarry located in Ramara Township, on Concession Road 2 off Highway 12. We received your contact information from Deb McCabe from the Township of Ramara as their local MTO contact.

Our client had completed a pre-consultation meeting with the Township, where they requested a traffic study. We have prepared a TOR for review of both the Township and the MTO. The TOR is attached as well as the location of the lands that would be subject of their application.

Please let us know if you have any comments on our proposed study approach.

Thank you,

Jordan Hart-Bishop, M.A.Sc, P.Eng
Project Manager

TMIG | **TYLI**
The Municipal Infrastructure Group Ltd.
a T.Y. Lin International Company

8800 Dufferin Street, Suite 200 | Vaughan ON Canada L4K 0C5
p: +1.905.738.5700 x350
tmig.ca | tylin.com

Gaurav Chauhan

From: Tim Collingwood <tcollingwood@tathameng.com>
Sent: Wednesday, January 20, 2021 3:07 PM
To: Deb McCabe; Jordan Hart-Bishop; Jordan Hart-Bishop
Cc: Michael Dowdall; James Newlands; skirby@symphonygolf.com; Moreen Miller; Brian Zeman
Subject: RE: Brechin Quarry Traffic Study Terms of Reference - our file 319911
Attachments: L - D. McCabe - ToR Review.pdf

Good afternoon Deb,

Attached are comments on the Terms of Reference prepared by TMIG.

Regards,

Tim Collingwood, B.A.Sc., P.Eng.
Director, Manager – Orillia Office

Tatham Engineering Limited
10 Diana Drive, Building 8, Unit 7 | Orillia | Ontario | L3V 8K8
T 705-325-1753 x2014 | **C** 705-323-6004 | tcollingwood@tathameng.com | tathameng.com

---

From: Deb McCabe <DMcCabe@ramara.ca>
Sent: January 4, 2021 9:34 AM
To: Jordan Hart-Bishop <JHartBishop@tmig.ca>; Jordan Hart-Bishop <jhartbishop@municipalinfgroup.onmicrosoft.com>; Tim Collingwood <tcollingwood@tathameng.com>
Cc: Michael Dowdall <MDowdall@tmig.ca>; James Newlands <jnewlands@mhbcplan.com>; skirby@symphonygolf.com; Moreen Miller <mmiller@vianet.ca>; Brian Zeman <bzeman@mhbcplan.com>
Subject: RE: Brechin Quarry Traffic Study Terms of Reference

Good Morning:

I have included our engineering consultant, Tatham Engineering on this email to provide the input you are looking for.

Our local MTO contact is as follows:

Usman Akhtar
Ministry of Transportation
Corridor Management Planner/ Peel & Si...

(416) 235-3509 Work
usman.akhtar@ontario.ca

159 Sir William Hearst Avene., 7th Floor
Downsview, Ontario
M3M 0B7

Regards

Deb McCabe, CPT, ACST
Planning Supervisor/Zoning Administrator
Secretary Treasurer, Committee of Adjustment
OACA Director
705-484-5374, ext. 243
705-238-0496
dmccabe@ramara.ca

Effective December 26th, all Township facilities and buildings, including the Township Administration building, are closed to the public.

Have you signed up for Reach Out Ramara? Its our NEW Community Engagement Platform that allows the community to share, participate and engage. Click here to sign up today!

From: Jordan Hart-Bishop <JHartBishop@tmig.ca>
Sent: January 4, 2021 9:23 AM
To: Jordan Hart-Bishop <jhartbishop@municipalinfgroup.onmicrosoft.com>; Deb McCabe <DMcCabe@ramara.ca>
Cc: Michael Dowdall <MDowdall@tmig.ca>; James Newlands <jnewlands@mhbcplan.com>; skirby@symphonygolf.com; Moreen Miller <mmiller@vianet.ca>; Brian Zeman <bzeman@mhbcplan.com>
Subject: RE: Brechin Quarry Traffic Study Terms of Reference

Hello Deb,

I wanted to follow-up on the attached TOR and local MTO contact.

Thank you,

Jordan Hart-Bishop, M.A.Sc, P.Eng
TMIG | **TYLI**
+1.905.738.5700 x350

From: Jordan Hart-Bishop <jhartbishop@municipalinfgroup.onmicrosoft.com>
Sent: Tuesday, December 1, 2020 6:19 PM
To: dmccabe@ramara.ca
Cc: Michael Dowdall <MDowdall@tmig.ca>; James Newlands <jnewlands@mhbcplan.com>; skirby@symphonygolf.com; Moreen Miller <mmiller@vianet.ca>; Brian Zeman <bzeman@mhbcplan.com>
Subject: Brechin Quarry Traffic Study Terms of Reference

Hello Deb,

Please find our proposed Terms of Reference for review. From the pre-consultation minutes, we also understand that MTO will be a reviewer for any completed traffic study. Do you have a local area contact for the MTO?

Looking forward to hearing from you.

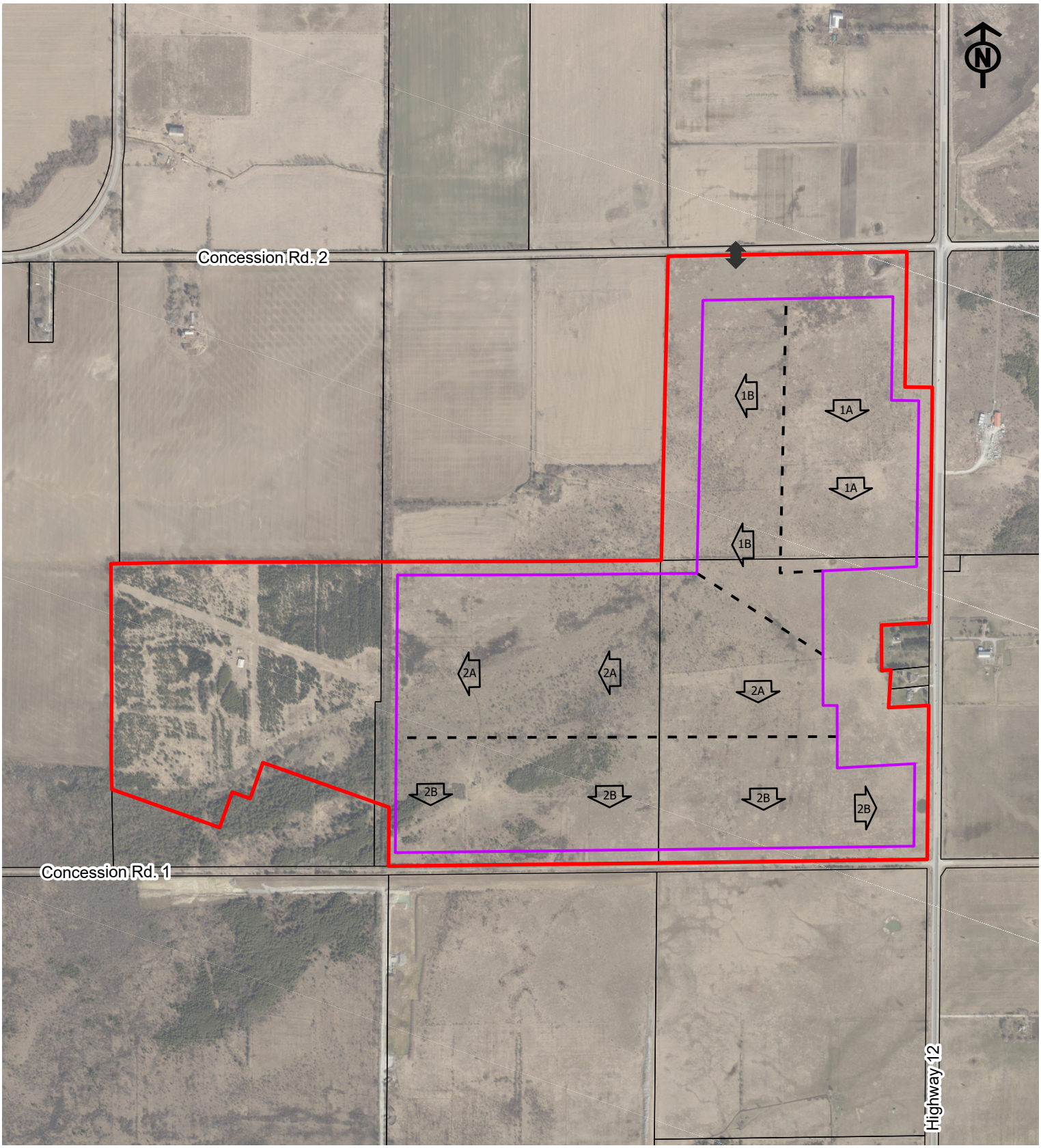
Regards,

Jordan Hart-Bishop, M.A.Sc, P.Eng
Project Manager

TMIG | **TYLI**
The Municipal Infrastructure Group Ltd.
a T.Y. Lin International Company

8800 Dufferin Street, Suite 200 | Vaughan ON Canada L4K 0C5
p: +1.905.738.5700 x350
tmig.ca | tylin.com

Appendix B:
Site Plan



BRECHIN QUARRY SIMPLIFIED OPERATION SCHEMATIC

Proposed Brechin Quarry

Part of Lots 11&12, Concession 1
Township of Ramara
County of Simcoe

LEGEND

- Subject Lands and Proposed Licence Boundary
- Proposed Limit of Extraction
- Phasing Area
- Proposed Entrance / Exit
- Parcel Fabric

DATE: December 2023

SOURCES: 2022 Ortho Photography County of Simcoe GIS

0 75 150 300
Meters

12135B - Planning Report Figures

MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE

Appendix C:
Turning Movement Counts

Spectrum

Turning Movement Count
Location Name: HIGHWAY 12 & CONCESSION RD 2
Date: Thu, Mar 30, 2023 Deployment Lead: Walter Fugaj

TYLin
200 8800 DUFFERIN STREET
VAUGHAN ONTARIO, L4K 0C5
CANADA

Turning Movement Count (1 . HIGHWAY 12 & CONCESSION RD 2)

Start Time	N Approach HWY 12						E Approach CONCESSION RD 2						S Approach HWY 12						W Approach CONCESSION RD 2						Int. Total (15 min)	Int. Total (1 hr)
	Right N:W	Thru N:S	Left N:E	UTurn N:N	Peds N:	Approach Total	Right E:N	Thru E:W	Left E:S	UTurn E:E	Peds E:	Approach Total	Right S:E	Thru S:N	Left S:W	UTurn S:S	Peds S:	Approach Total	Right W:S	Thru W:E	Left W:N	UTurn W:W	Peds W:	Approach Total		
06:00:00	0	33	2	0	0	35	0	0	4	0	0	4	3	41	0	0	0	44	0	0	1	0	0	1	84	
06:15:00	0	51	2	0	0	53	0	0	9	0	0	9	5	49	0	0	0	54	0	0	1	0	0	1	117	
06:30:00	0	48	1	0	0	49	0	0	8	0	0	8	4	53	0	0	0	57	0	0	0	0	0	0	114	
06:45:00	0	52	1	0	0	53	2	0	6	0	0	8	10	43	0	0	0	53	0	0	0	0	0	0	114	429
07:00:00	0	51	0	0	0	51	0	0	6	0	0	6	5	64	0	0	0	69	0	0	0	0	0	0	126	471
07:15:00	0	45	0	0	0	45	0	0	4	0	0	4	3	79	0	0	0	82	0	0	1	0	0	1	132	486
07:30:00	0	49	2	0	0	51	0	0	3	0	0	3	5	67	0	0	0	72	0	0	0	0	0	0	126	498
07:45:00	0	50	3	0	0	53	0	0	7	0	0	7	4	65	0	0	0	69	0	0	0	0	0	0	129	513
08:00:00	0	68	0	1	0	69	1	0	5	0	0	6	15	74	0	0	0	89	0	0	0	0	0	0	164	551
08:15:00	1	53	0	0	0	54	0	0	6	0	0	6	4	74	0	0	0	78	0	0	1	0	0	1	139	558
08:30:00	0	51	0	0	0	51	0	0	6	0	0	6	9	83	0	0	0	92	0	0	0	0	0	0	149	581
08:45:00	0	66	0	0	0	66	1	0	6	0	0	7	11	74	0	0	0	85	1	0	0	0	0	1	159	611
09:00:00	0	54	0	0	0	54	1	0	5	0	0	6	11	56	0	0	0	67	0	0	0	0	0	0	127	574
09:15:00	1	68	0	0	0	69	1	0	9	0	0	10	8	79	0	0	0	87	1	0	0	0	0	1	167	602
09:30:00	1	69	0	0	0	70	0	0	10	0	0	10	4	70	0	0	0	74	0	0	0	0	0	0	154	607
09:45:00	0	82	2	0	0	84	0	0	8	0	0	8	3	78	0	0	0	81	0	0	0	0	0	0	173	621
10:00:00	0	69	0	0	0	69	0	0	11	0	0	11	8	82	0	0	0	90	0	0	0	0	0	0	170	664
10:15:00	0	56	0	0	0	56	0	1	6	0	0	7	4	79	0	0	0	83	0	1	0	0	0	1	147	644
10:30:00	1	54	2	0	0	57	0	0	8	0	0	8	7	63	0	0	0	70	0	0	0	0	0	0	135	625
10:45:00	0	77	2	0	0	79	2	0	6	0	0	8	4	83	0	0	0	87	0	0	0	0	0	0	174	626
11:00:00	0	65	1	0	0	66	1	0	7	0	0	8	3	75	0	0	0	78	0	0	0	0	0	0	152	608
11:15:00	2	67	0	0	0	69	0	0	3	0	0	3	7	65	0	0	0	72	0	0	2	0	0	2	146	607
11:30:00	0	62	0	0	0	62	0	0	5	0	0	5	8	71	0	0	0	79	0	0	0	0	0	0	146	618
11:45:00	0	49	0	0	0	49	0	0	7	0	0	7	7	61	1	0	0	69	0	0	1	0	0	1	126	570
12:00:00	0	68	0	0	0	68	0	0	8	0	0	8	6	65	0	0	0	71	0	0	0	0	0	0	147	565
12:15:00	0	56	0	0	0	56	1	0	5	0	0	6	9	73	0	0	0	82	0	0	0	0	0	0	144	563
12:30:00	0	61	3	0	0	64	2	0	6	0	0	8	8	56	0	0	0	64	0	0	0	0	0	0	136	553
12:45:00	0	65	0	0	0	65	2	0	9	0	0	11	7	64	0	0	0	71	0	0	0	0	0	0	147	574
13:00:00	0	71	0	0	0	71	0	0	7	0	0	7	7	72	0	0	0	79	0	0	0	0	0	0	157	584
13:15:00	0	61	4	0	0	65	0	0	9	0	0	9	1	71	0	0	0	72	0	0	0	0	0	0	146	586
13:30:00	2	84	1	0	0	87	0	0	6	0	0	6	6	61	0	0	0	67	0	0	0	0	0	0	160	610
13:45:00	0	61	1	0	0	62	0	0	3	0	0	3	10	82	0	0	0	92	0	0	0	0	0	0	157	620
14:00:00	0	71	2	0	0	73	3	0	10	0	0	13	5	73	0	0	0	78	0	0	0	0	0	0	164	627
14:15:00	0	81	1	0	0	82	1	0	7	0	0	8	7	66	0	0	0	73	0	0	0	0	0	0	163	644
14:30:00	0	63	0	0	0	63	1	0	5	0	0	6	2	55	0	0	0	57	0	0	0	0	0	0	126	610
14:45:00	0	78	1	0	0	79	1	0	5	0	0	6	4	76	0	0	0	80	1	0	0	0	0	1	166	619
15:00:00	0	82	0	0	0	82	0	0	5	0	0	5	6	86	0	0	0	92	0	0	0	0	0	0	179	634
15:15:00	0	69	0	0	0	69	0	0	7	0	0	7	3	78	0	0	0	81	0	0	0	0	0	0	157	628
15:30:00	1	81	0	0	0	82	6	0	1	0	0	7	0	79	0	0	0	79	0	0	0	0	0	0	168	670
15:45:00	0	79	0	0	0	79	1	0	4	0	0	5	0	86	0	0	0	86	0	0	0	0	0	0	170	674
16:00:00	0	97	0	0	0	97	1	0	3	0	0	4	1	70	0	0	0	71	0	0	0	0	0	0	172	667
16:15:00	1	93	0	0	0	94	1	0	2	0	0	3	0	71	0	0	0	71	0	0	0	0	0	0	168	678
16:30:00	1	125	0	0	0	126	1	0	0	0	0	1	0	73	0	0	0	73	0	0	0	0	0	0	200	710
16:45:00	0	84	0	0	0	84	0	0	0	0	0	0	0	94	0	0	0	94	0	0	0	0	0	0	178	718
17:00:00	0	77	0	0	0	77	1	0	1	0	0	2	0	88	0	0	0	88	0	0	0	0	0	0	167	713

TYLin
200 8800 DUFFERIN STREET
VAUGHAN ONTARIO, L4K 0C5
CANADA

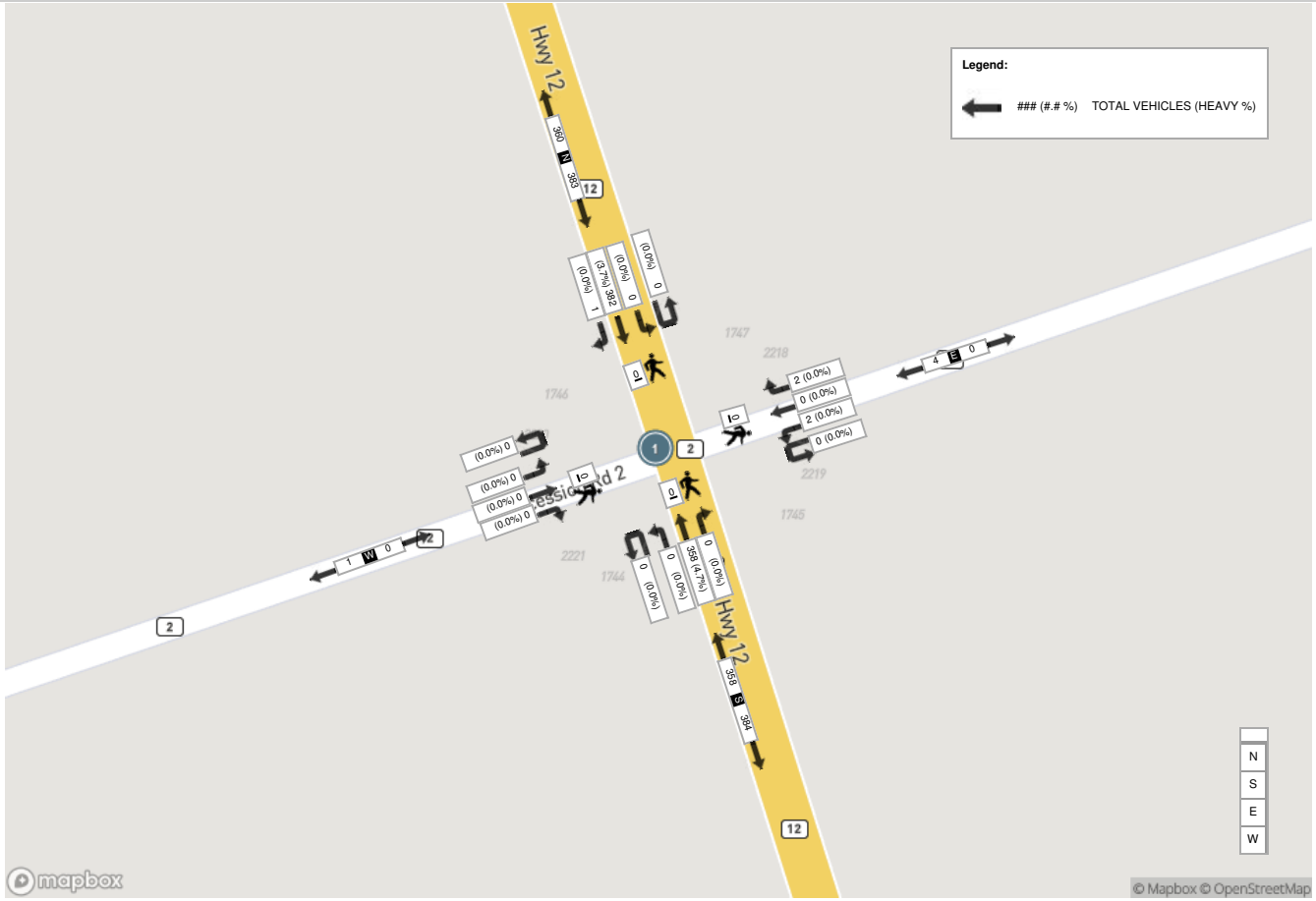
17:15:00	0	96	0	0	0	96	0	0	1	0	0	1	0	103	0	0	0	103	0	0	0	0	0	0	200	745
17:30:00	0	94	0	0	0	94	0	0	0	0	0	0	0	95	0	0	0	95	0	0	0	0	0	0	189	734
17:45:00	0	77	0	0	0	77	0	0	0	0	0	0	0	79	0	0	0	79	0	0	0	0	0	0	156	712
Grand Total	11	3263	31	1	0	3306	31	1	259	0	0	291	234	3444	1	0	0	3679	3	1	7	0	0	11	**7287**	-
Approach%	0.3%	98.7%	0.9%	0%		-	10.7%	0.3%	89%	0%		-	6.4%	93.6%	0%	0%		-	27.3%	9.1%	63.6%	0%		-	**-**	-
Totals %	0.2%	44.8%	0.4%	0%		45.4%	0.4%	0%	3.6%	0%		4%	3.2%	47.3%	0%	0%		50.5%	0%	0%	0.1%	0%		0.2%	**-**	-
Heavy	0	412	8	0		-	5	0	246	0		-	226	385	0	0		-	1	0	0	0		-	**-**	-
Heavy %	0%	12.6%	25.8%	0%		-	16.1%	0%	95%	0%		-	96.6%	11.2%	0%	0%		-	33.3%	0%	0%	0%		-	**-**	-
Bicycles	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	**-**	-
Bicycle %	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	**-**	-

Peak Hour: 04:30 PM - 05:30 PM Weather: Scattered Clouds (-7.01 °C)

Start Time	N Approach HWY 12						E Approach CONCESSION RD 2						S Approach HWY 12						W Approach CONCESSION RD 2						Int. Total (15 min)
	Right	Thru	Left	UTurn	Peds	Approach Total	Right	Thru	Left	UTurn	Peds	Approach Total	Right	Thru	Left	UTurn	Peds	Approach Total	Right	Thru	Left	UTurn	Peds	Approach Total	
16:30:00	1	125	0	0	0	126	1	0	0	0	0	1	0	73	0	0	0	73	0	0	0	0	0	0	200
16:45:00	0	84	0	0	0	84	0	0	0	0	0	0	0	94	0	0	0	94	0	0	0	0	0	0	178
17:00:00	0	77	0	0	0	77	1	0	1	0	0	2	0	88	0	0	0	88	0	0	0	0	0	0	167
17:15:00	0	96	0	0	0	96	0	0	1	0	0	1	0	103	0	0	0	103	0	0	0	0	0	0	200
Grand Total	1	382	0	0	0	383	2	0	2	0	0	4	0	358	0	0	0	358	0	0	0	0	0	0	**745**
Approach%	0.3%	99.7%	0%	0%		-	50%	0%	50%	0%		-	0%	100%	0%	0%		-	0%	0%	0%	0%		-	**-**
Totals %	0.1%	51.3%	0%	0%		51.4%	0.3%	0%	0.3%	0%		0.5%	0%	48.1%	0%	0%		48.1%	0%	0%	0%	0%		0%	**-**
PHF	0.25	0.76	0	0		0.76	0.5	0	0.5	0		0.5	0	0.87	0	0		0.87	0	0	0	0		0	**-**
Heavy	0	14	0	0		14	0	0	0	0		0	0	17	0	0		17	0	0	0	0		0	**-**
Heavy %	0%	3.7%	0%	0%		3.7%	0%	0%	0%	0%		0%	0%	4.7%	0%	0%		4.7%	0%	0%	0%	0%		0%	**-**
Lights	1	368	0	0		369	2	0	2	0		4	0	341	0	0		341	0	0	0	0		0	**-**
Lights %	100%	96.3%	0%	0%		96.3%	100%	0%	100%	0%		100%	0%	95.3%	0%	0%		95.3%	0%	0%	0%	0%		0%	**-**
Single-Unit Trucks	0	8	0	0		8	0	0	0	0		0	0	2	0	0		2	0	0	0	0		0	**-**
Single-Unit Trucks %	0%	2.1%	0%	0%		2.1%	0%	0%	0%	0%		0%	0%	0.6%	0%	0%		0.6%	0%	0%	0%	0%		0%	**-**
Buses	0	2	0	0		2	0	0	0	0		0	0	3	0	0		3	0	0	0	0		0	**-**
Buses %	0%	0.5%	0%	0%		0.5%	0%	0%	0%	0%		0%	0%	0.8%	0%	0%		0.8%	0%	0%	0%	0%		0%	**-**
Articulated Trucks	0	3	0	0		3	0	0	0	0		0	0	10	0	0		10	0	0	0	0		0	**-**
Articulated Trucks %	0%	0.8%	0%	0%		0.8%	0%	0%	0%	0%		0%	0%	2.8%	0%	0%		2.8%	0%	0%	0%	0%		0%	**-**
Aggregate Trucks	0	1	0	0		1	0	0	0	0		0	0	2	0	0		2	0	0	0	0		0	**-**
Aggregate Trucks %	0%	0.3%	0%	0%		0.3%	0%	0%	0%	0%		0%	0%	0.6%	0%	0%		0.6%	0%	0%	0%	0%		0%	**-**

TYLin
200 8800 DUFFERIN STREET
VAUGHAN ONTARIO, L4K 0C5
CANADA

Peak Hour: 04:30 PM - 05:30 PM **Weather: Scattered Clouds (-7.01 °C)**



Spectrum

Turning Movement Count
Location Name: HIGHWAY 12 & CONCESSION RD 2
Date: Sat, Apr 01, 2023 Deployment Lead: Walter Fugaj

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VAUGHAN ONTARIO, L4K 0C5
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Turning Movement Count (1 . HIGHWAY 12 & CONCESSION RD 2)

Start Time	N Approach HWY 12						E Approach CONCESSION RD 2						S Approach HWY 12						W Approach CONCESSION RD 2						Int. Total (15 min)	Int. Total (1 hr)
	Right N:W	Thru N:S	Left N:E	UTurn N:N	Peds N:	Approach Total	Right E:N	Thru E:W	Left E:S	UTurn E:E	Peds E:	Approach Total	Right S:E	Thru S:N	Left S:W	UTurn S:S	Peds S:	Approach Total	Right W:S	Thru W:E	Left W:N	UTurn W:W	Peds W:	Approach Total		
10:00:00	0	61	2	0	0	63	0	0	0	0	0	0	1	82	0	0	0	83	0	0	0	0	0	0	146	
10:15:00	1	82	1	0	0	84	0	0	0	0	0	0	0	90	0	0	0	90	1	0	0	0	0	1	175	
10:30:00	0	74	0	0	0	74	0	0	0	0	0	0	0	90	0	0	0	90	0	1	0	0	0	1	165	
10:45:00	0	81	0	0	0	81	1	0	0	0	0	1	0	105	1	0	0	106	0	0	0	0	0	0	188	674
11:00:00	0	78	0	0	0	78	0	0	0	0	0	0	0	100	0	0	0	100	0	0	0	0	0	0	178	706
11:15:00	0	94	1	0	0	95	0	0	0	0	0	0	0	108	1	0	0	109	0	0	0	0	0	0	204	735
11:30:00	0	91	0	0	0	91	0	0	0	0	0	0	0	114	0	0	0	114	0	0	0	0	0	0	205	775
11:45:00	0	102	0	0	0	102	0	0	0	0	0	0	0	130	0	0	0	130	0	0	0	0	0	0	232	819
12:00:00	0	79	0	0	0	79	1	0	0	0	0	1	0	107	0	0	0	107	0	0	0	0	0	0	187	828
12:15:00	0	83	0	0	0	83	1	0	0	0	0	1	1	105	0	0	0	106	1	0	0	0	0	1	191	815
12:30:00	0	86	0	0	0	86	0	0	0	0	0	0	1	93	0	0	0	94	0	0	0	0	0	0	180	790
12:45:00	0	89	0	0	0	89	0	0	0	0	0	0	0	92	0	0	0	92	0	0	0	0	0	0	181	739
13:00:00	0	78	0	0	0	78	0	0	1	0	0	1	0	90	0	0	0	90	0	0	0	0	0	0	169	721
13:15:00	0	74	1	0	0	75	0	0	1	0	0	1	0	75	0	0	0	75	0	0	0	0	0	0	151	681
13:30:00	1	87	0	0	0	88	0	0	0	0	0	0	0	60	0	0	0	60	0	0	0	0	0	0	148	649
13:45:00	0	84	0	0	0	84	0	0	1	0	0	1	1	103	0	0	0	104	1	0	0	0	0	1	190	658
Grand Total	2	1323	5	0	0	1330	3	0	3	0	0	6	4	1544	2	0	0	1550	3	1	0	0	0	4	**2890**	-
Approach%	0.2%	99.5%	0.4%	0%		-	50%	0%	50%	0%		-	0.3%	99.6%	0.1%	0%		-	75%	25%	0%	0%		-	**-**	-
Totals %	0.1%	45.8%	0.2%	0%		46%	0.1%	0%	0.1%	0%		0.2%	0.1%	53.4%	0.1%	0%		53.6%	0.1%	0%	0%	0%		0.1%	**-**	-
Heavy	0	13	1	0		-	1	0	0	0		-	0	19	0	0		-	0	0	0	0		-	**-**	-
Heavy %	0%	1%	20%	0%		-	33.3%	0%	0%	0%		-	0%	1.2%	0%	0%		-	0%	0%	0%	0%		-	**-**	-
Bicycles	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	**-**	-
Bicycle %	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	**-**	-

TYLin
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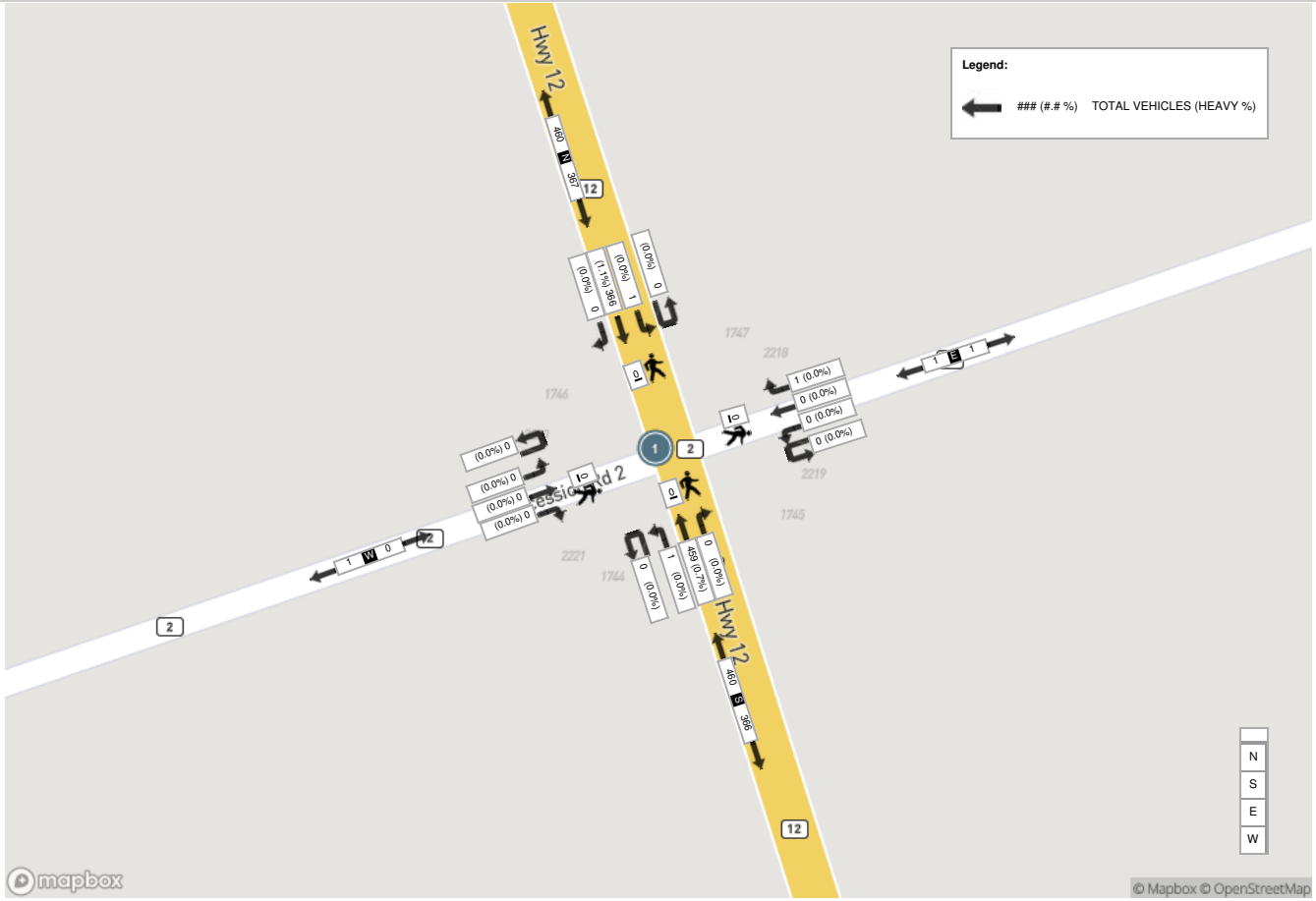
VAUGHAN ONTARIO, L4K 0C5
CANADA

Peak Hour: 11:15 AM - 12:15 PM Weather: Scattered Clouds (4.64 °C)

Start Time	N Approach HWY 12						E Approach CONCESSION RD 2						S Approach HWY 12						W Approach CONCESSION RD 2						Int. Total (15 min)
	Right	Thru	Left	UTurn	Peds	Approach Total	Right	Thru	Left	UTurn	Peds	Approach Total	Right	Thru	Left	UTurn	Peds	Approach Total	Right	Thru	Left	UTurn	Peds	Approach Total	
11:15:00	0	94	1	0	0	95	0	0	0	0	0	0	0	108	1	0	0	109	0	0	0	0	0	0	204
11:30:00	0	91	0	0	0	91	0	0	0	0	0	0	0	114	0	0	0	114	0	0	0	0	0	0	205
11:45:00	0	102	0	0	0	102	0	0	0	0	0	0	0	130	0	0	0	130	0	0	0	0	0	0	232
12:00:00	0	79	0	0	0	79	1	0	0	0	0	1	0	107	0	0	0	107	0	0	0	0	0	0	187
Grand Total	0	366	1	0	0	367	1	0	0	0	0	1	0	459	1	0	0	460	0	0	0	0	0	0	**828**
Approach%	0%	99.7%	0.3%	0%		-	100%	0%	0%	0%		-	0%	99.8%	0.2%	0%		-	0%	0%	0%	0%		-	**-**
Totals %	0%	44.2%	0.1%	0%		44.3%	0.1%	0%	0%	0%		0.1%	0%	55.4%	0.1%	0%		55.6%	0%	0%	0%	0%		0%	**-**
PHF	0	0.9	0.25	0		0.9	0.25	0	0	0		0.25	0	0.88	0.25	0		0.88	0	0	0	0		0	**-**
Heavy	0	4	0	0		4	0	0	0	0		0	0	3	0	0		3	0	0	0	0		0	**-**
Heavy %	0%	1.1%	0%	0%		1.1%	0%	0%	0%	0%		0%	0%	0.7%	0%	0%		0.7%	0%	0%	0%	0%		0%	**-**
Lights	0	362	1	0		363	1	0	0	0		1	0	456	1	0		457	0	0	0	0		0	**-**
Lights %	0%	98.9%	100%	0%		98.9%	100%	0%	0%	0%		100%	0%	99.3%	100%	0%		99.3%	0%	0%	0%	0%		0%	**-**
Single-Unit Trucks	0	0	0	0		0	0	0	0	0		0	0	2	0	0		2	0	0	0	0		0	**-**
Single-Unit Trucks %	0%	0%	0%	0%		0%	0%	0%	0%	0%		0%	0%	0.4%	0%	0%		0.4%	0%	0%	0%	0%		0%	**-**
Buses	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	**-**
Buses %	0%	0%	0%	0%		0%	0%	0%	0%	0%		0%	0%	0%	0%	0%		0%	0%	0%	0%	0%		0%	**-**
Articulated Trucks	0	4	0	0		4	0	0	0	0		0	0	1	0	0		1	0	0	0	0		0	**-**
Articulated Trucks %	0%	1.1%	0%	0%		1.1%	0%	0%	0%	0%		0%	0%	0.2%	0%	0%		0.2%	0%	0%	0%	0%		0%	**-**
Aggregate Trucks	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	**-**
Aggregate Trucks %	0%	0%	0%	0%		0%	0%	0%	0%	0%		0%	0%	0%	0%	0%		0%	0%	0%	0%	0%		0%	**-**

TYLin
200 8800 DUFFERIN STREET
VAUGHAN ONTARIO, L4K 0C5
CANADA

Peak Hour: 11:15 AM - 12:15 PM Weather: Scattered Clouds (4.64 °C)



Appendix D:
Growth Rate Calculations and Historical AADT Data

Background Growth Factor Calculation

Hwy 12 at Ramara Rd 51

Regression Analysis (1988-2019 AADT)

Year	AADT	(x)	AADT	Regression (y = mx + b)
1988	8100	1988	8,100	8,732
1989	8400	1989	8,400	8,816
1990	8750	1990	8,750	8,899
1991	8850	1991	8,850	8,982
1992	8700	1992	8,700	9,065
1993	8700	1993	8,700	9,148
1994	8950	1994	8,950	9,232
1995	9150	1995	9,150	9,315
1996	9000	1996	9,000	9,398
1997	9550	1997	9,550	9,481
1998	9750	1998	9,750	9,564
1999	10300	1999	10,300	9,648
2000	10600	2000	10,600	9,731
2001	11000	2001	11,000	9,814
2002	11600	2002	11,600	9,897
2003	10600	2003	10,600	9,980
2004	10300	2004	10,300	10,063
2005	10200	2005	10,200	10,147
2006	10100	2006	10,100	10,230
2007	9950	2007	9,950	10,313
2008	9850	2008	9,850	10,396
2009	10700	2009	10,700	10,479
2010	10800	2010	10,800	10,563
2011	9800	2011	9,800	10,646
2012	10700	2012	10,700	10,729
2013	10600	2013	10,600	10,812
2014	10800	2014	10,800	10,895
2015	10900	2015	10,900	10,979
2016	10900	2016	10,900	11,062
2017	11000	2017	11,000	11,145
2018	11000	2018	11,000	11,228
2019	11100	2019	11,100	11,311
		2023		11,644
		2028		12,060
		2033		12,476
2023 Regression-2019 Regression				333
(2023 Regression-2019 Regression)/2019 Regression				2.94%
2023 Annual Growth Rate:				0.728%
2023 Growth Factor:				1.029
Slope (m):		83	2016 Growth Result	11,644
y-intercept (b):		-156655	Check	OK

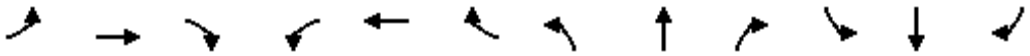
Hwy 12 at Simcoe Rd 169

Regression Analysis (1988-2019 AADT)

Year	AADT	(x)	AADT	Regression (y = mx + b)
1988	5500	1988	5,500	5,649
1989	5700	1989	5,700	5,858
1990	5850	1990	5,850	6,068
1991	5950	1991	5,950	6,278
1992	5800	1992	5,800	6,488
1993	6100	1993	6,100	6,698
1994	6700	1994	6,700	6,908
1995	6950	1995	6,950	7,118
1996	6800	1996	6,800	7,328
1997	7500	1997	7,500	7,537
1998	7750	1998	7,750	7,747
1999	8700	1999	8,700	7,957
2000	9200	2000	9,200	8,167
2001	9250	2001	9,250	8,377
2002	10100	2002	10,100	8,587
2003	9300	2003	9,300	8,797
2004	9350	2004	9,350	9,006
2005	9550	2005	9,550	9,216
2006	9600	2006	9,600	9,426
2007	9800	2007	9,800	9,636
2008	8950	2008	8,950	9,846
2009	10200	2009	10,200	10,056
2010	9750	2010	9,750	10,266
2011	10600	2011	10,600	10,476
2012	10800	2012	10,800	10,685
2013	11000	2013	11,000	10,895
2014	10100	2014	10,100	11,105
2015	11200	2015	11,200	11,315
2016	11400	2016	11,400	11,525
2017	11600	2017	11,600	11,735
2018	11800	2018	11,800	11,945
2019	12000	2019	12,000	12,155
		2023		12,994
		2028		14,043
		2033		15,093
2023 Regression-2019 Regression				839
(2023 Regression-2019 Regression)/2019 Regression				6.90%
2023 Annual Growth Rate:				1.683%
2023 Growth Factor:				1.069
Slope (m):		210	2016 Growth Result	12,994
y-intercept (b):		-411573	Check	OK

LHRS	Offset	Year	Hwy No	Hwy Letter	Hwy Type	Location Description	Station #	Region	Sec Len	Con Link Le	Secondary	PDCS #	Pattern	DHV %	Design Hr.	Design Hr.	AADT	SADT	SAWDT	WADT	Truck %	Truck AAD	Alpha Code	Count Code
19415	0.785	1988	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			32	IR	14	0	N/A	8,100	10,500	8,900	6,500	17	1,400	M	1
19415	0.785	1989	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			32	IR	14	0	N/A	8,400	10,800	9,300	6,900	17	1,450	M	1
19415	0.785	1990	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			35	IR	13	0	N/A	8,750	11,100	9,700	7,200	11	960	T	4
19415	0.785	1991	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			35	IR	13	0	N/A	8,850	11,200	9,800	7,350	11	970		1
19415	0.785	1992	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			35	IR	12	0	N/A	8,700	10,700	9,550	7,400	11	960		1
19415	0.785	1993	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			35	IR	12	0	N/A	8,700	10,700	9,000	7,100	9	780	T	6
19415	0.785	1994	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			35	IR	12	0	N/A	8,950	11,000	9,850	7,500	7	630	T	1
19415	0.785	1995	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			35	IR	12	0	N/A	9,150	11,300	10,100	7,800	7	640		1
19415	0.785	1996	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			91	IR	12	0	N/A	9,000	11,200	10,000	7,650	7	630		4
19415	0.785	1997	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			37	CR	10	0	N/A	9,550	11,800	11,300	8,100	10	960	T	1
19415	0.785	1998	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			37	CR	10	0	N/A	9,750	12,000	11,400	8,300	10	980		1
19415	0.785	1999	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			37	CR	10	0	N/A	10,300	12,700	12,100	8,750	6	620	T	6
19415	0.785	2000	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			37	CR	10	0	N/A	10,600	13,000	12,400	9,000	6	640		1
19415	0.785	2001	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			37	CR	10	0	N/A	11,000	13,500	12,900	9,300	6	660		1
19415	0.785	2002	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			37	CR	10	0	N/A	11,600	14,200	13,600	9,750	6	700		4
19415	0.785	2003	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			37	CR	10	0	N/A	10,600	12,900	12,400	8,950	22	2,350	T	1
19415	0.785	2004	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			37	CR	10	0	N/A	10,300	12,700	12,100	8,700	20	2,050	T	1
19415	0.785	2005	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			37	CR	10	0	N/A	10,200	12,400	11,900	8,600	20	2,050	C	6
19415	0.785	2006	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			37	CR	10	0	N/A	10,100	12,200	11,800	8,550	7	710	T	1
19415	0.785	2007	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			32	IR	12	0	N/A	9,950	12,100	12,000	8,450	7	700		4
19415	0.785	2008	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			32	IR	12	0	N/A	9,850	11,900	11,700	8,400	14	1,400	T	1
19415	0.785	2009	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			32	IR	12	0	N/A	10,700	12,800	11,700	9,100	14	1,500		1
19415	0.785	2010	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			32	IR	12	0	N/A	10,800	12,900	11,800	9,200	14	1,500		1
19415	0.785	2011	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			91	IR	11	0	N/A	9,800	11,700	11,400	8,350	14	1,350		4
19415	0.785	2012	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			91	IR	11	0	N/A	10,700	12,700	12,400	9,150	14	1,500		1
19415	0.785	2013	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			9	CTR	10	53	S	10,600	12,900	13,300	9,000	12	1,300		4
19415	0.785	2014	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			9	CTR	10	53	S	10,800	13,200	13,300	9,200	12	1,300		1
19415	0.785	2015	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			9	CTR	10	53	S	10,900	13,300	13,400	9,250	12	1,350		1
19415	0.785	2016	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			9	CTR	10	53	S	10,900	13,300	13,400	9,250	12	1,350		1
19415	0.785	2017	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			9	CTR	12	53	N/A	11,000	14,700	14,600	8,950	12	1,350	T	1
19415	0.785	2018	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381			9	CTR	12	53	N/A	11,000	14,700	14,600	8,950	12	1,350	T	1
19415	0.785	2019	12		KING	RAMARA RD 51 (E) CON RD A (W)	230	CENTRAL	8.381	0		9	CTR	12	53	N/A	11,100	14,800	14,700	9,050	26	2,900	MJ	6
19420	0	1988	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			91	IR	14	51	N/A	5,500	7,150	6,050	4,400	5	280		1
19420	0	1989	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			91	IR	14	51	N/A	5,700	7,350	6,350	4,650	5	280		1
19420	0	1990	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	13	51	N/A	5,850	7,450	6,500	4,800	5	290		4
19420	0	1991	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	13	51	N/A	5,950	7,500	6,600	4,950	6	360	T	1
19420	0	1992	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	12	51	N/A	5,800	7,150	6,400	4,950	6	350		1
19420	0	1993	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			47	LT	13	51	N/A	6,100	8,450	7,550	4,450	6	370		4
19420	0	1994	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			47	LT	13	51	N/A	6,700	9,850	9,450	4,850	6	400		1
19420	0	1995	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			47	LT	13	51	N/A	6,950	10,000	9,700	5,100	6	420		1
19420	0	1996	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	12	51	N/A	6,800	8,450	7,600	5,800	6	410		4
19420	0	1997	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			47	LT	13	51	N/A	7,500	10,600	10,400	5,550	6	450	T	4
19420	0	1998	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			47	LT	13	51	N/A	7,750	10,800	10,600	5,650	6	460		1
19420	0	1999	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	12	51	N/A	8,700	10,800	9,650	7,300	5	440	T	4
19420	0	2000	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	12	51	N/A	9,200	11,300	10,200	7,750	5	460		1
19420	0	2001	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	12	51	N/A	9,250	11,400	10,200	7,800	8	740	T	1
19420	0	2002	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	12	51	N/A	10,100	12,500	11,200	8,600	6	610	T	4
19420	0	2003	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	12	51	N/A	9,300	11,300	10,200	7,900	6	560	T	1
19420	0	2004	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	12	51	N/A	9,350	11,600	10,400	7,900	12	1,100	T	1
19420	0	2005	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	12	51	N/A	9,550	11,500	10,500	8,150	7	670	T	1
19420	0	2006	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	12	51	N/A	9,600	11,600	10,500	8,150	6	580	T	6
19420	0	2007	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	12	51	N/A	9,800	11,900	11,800	8,300	6	590		1
19420	0	2008	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	12	51	N/A	8,950	10,800	10,600	7,650	8	720	T	4
19420	0	2009	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	12	51	N/A	10,200	12,200	11,100	8,650	8	820		6
19420	0	2010	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	12	52	N/A	9,750	11,600	10,600	8,300	8	780		4
19420	0	2011	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	11	52	N/A	10,600	12,600	12,400	9,050	8	850		1
19420	0	2012	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	11	52	N/A	10,800	12,800	12,500	9,250	8	860		1
19420	0	2013	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	11	52	N/A	11,000	13,100	14,000	9,350	8	880		1
19420	0	2014	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	11	57	N	10,100	12,000	12,000	8,600	8	810		4
19420	0	2015	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	11	57	N	11,200	13,300	13,400	9,550	8	900		1
19420	0	2016	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	11	57	N	11,400	13,600	13,600	9,700	8	910		1
19420	0	2017	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	11	57	N/A	11,600	13,600	13,600	10,300	8	930	T	1
19420	0	2018	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916			4	IR	11	57	N/A	11,800	13,900	13,900	10,600	8	940	T	1
19420	0	2019	12		KING	RAMARA CON RD 6 (W) SIMCOE RD 169 (N)	235	CENTRAL	11.916	0		4	IR	11	57	N/A	12,000	14,100	14,100	10,800	8	960	T	1

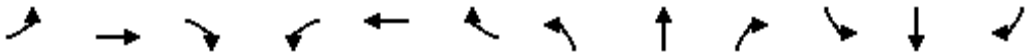
Appendix E:
Synchro Capacity Analysis Reports



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	1	38	0	1	0	309	23	2	288	2
Future Volume (Veh/h)	0	0	1	38	0	1	0	309	23	2	288	2
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	0	0	1	40	0	1	0	322	24	2	300	2
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	628	651	301	627	628	322	302			346		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	628	651	301	627	628	322	302			346		
tC, single (s)	7.1	6.5	6.2	8.1	6.5	6.2	4.1			4.6		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	4.4	4.0	3.3	2.2			2.7		
p0 queue free %	100	100	100	86	100	100	100			100		
cM capacity (veh/h)	397	390	743	285	401	724	1270			989		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	1	41	0	322	24	2	302
Volume Left	0	40	0	0	0	2	0
Volume Right	1	1	0	0	24	0	2
cSH	743	289	1700	1700	1700	989	1700
Volume to Capacity	0.00	0.14	0.00	0.19	0.01	0.00	0.18
Queue Length 95th (m)	0.0	3.7	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	9.8	19.5	0.0	0.0	0.0	8.6	0.0
Lane LOS	A	C				A	
Approach Delay (s)	9.8	19.5	0.0			0.1	
Approach LOS	A	C					

Intersection Summary				
Average Delay	1.2			
Intersection Capacity Utilization	31.8%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	2	0	2	0	358	0	0	382	1
Future Volume (Veh/h)	0	0	0	2	0	2	0	358	0	0	382	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	0	0	0	2	0	2	0	385	0	0	411	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	798	796	412	796	797	385	412			385		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	798	796	412	796	797	385	412			385		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	99	100	100	100			100		
cM capacity (veh/h)	305	322	645	307	322	667	1158			1185		

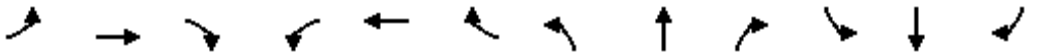
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	0	4	0	385	0	0	412
Volume Left	0	2	0	0	0	0	0
Volume Right	0	2	0	0	0	0	1
cSH	1700	421	1700	1700	1700	1700	1700
Volume to Capacity	0.00	0.01	0.00	0.23	0.00	0.00	0.24
Queue Length 95th (m)	0.0	0.2	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	0.0	13.6	0.0	0.0	0.0	0.0	0.0
Lane LOS	A	B					
Approach Delay (s)	0.0	13.6	0.0			0.0	
Approach LOS	A	B					

Intersection Summary				
Average Delay	0.1			
Intersection Capacity Utilization	30.2%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	0	0	1	1	459	0	1	366	0
Future Volume (Veh/h)	0	0	0	0	0	1	1	459	0	1	366	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	0	0	0	0	0	1	1	516	0	1	411	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	932	931	411	931	931	516	411			516		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	932	931	411	931	931	516	411			516		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	100	100	100	100			100		
cM capacity (veh/h)	248	268	645	249	268	563	1159			1060		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	0	1	1	516	0	1	411
Volume Left	0	0	1	0	0	1	0
Volume Right	0	1	0	0	0	0	0
cSH	1700	563	1159	1700	1700	1060	1700
Volume to Capacity	0.00	0.00	0.00	0.30	0.00	0.00	0.24
Queue Length 95th (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	0.0	11.4	8.1	0.0	0.0	8.4	0.0
Lane LOS	A	B	A			A	
Approach Delay (s)	0.0	11.4	0.0			0.0	
Approach LOS	A	B					

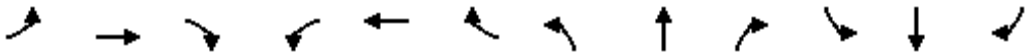
Intersection Summary				
Average Delay	0.0			
Intersection Capacity Utilization	34.2%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	2	39	0	2	0	317	24	3	295	3
Future Volume (Veh/h)	0	0	2	39	0	2	0	317	24	3	295	3
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	0	0	2	41	0	2	0	330	25	3	307	3
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	646	670	308	645	646	330	310			355		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	646	670	308	645	646	330	310			355		
tC, single (s)	7.1	6.5	6.2	8.1	6.5	6.2	4.1			4.6		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	4.4	4.0	3.3	2.2			2.7		
p0 queue free %	100	100	100	85	100	100	100			100		
cM capacity (veh/h)	385	380	736	276	392	716	1262			981		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	2	43	0	330	25	3	310
Volume Left	0	41	0	0	0	3	0
Volume Right	2	2	0	0	25	0	3
cSH	736	284	1700	1700	1700	981	1700
Volume to Capacity	0.00	0.15	0.00	0.19	0.01	0.00	0.18
Queue Length 95th (m)	0.1	4.0	0.0	0.0	0.0	0.1	0.0
Control Delay (s)	9.9	19.9	0.0	0.0	0.0	8.7	0.0
Lane LOS	A	C				A	
Approach Delay (s)	9.9	19.9	0.0			0.1	
Approach LOS	A	C					

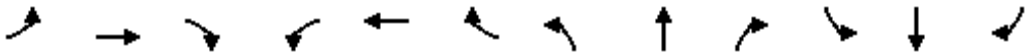
Intersection Summary				
Average Delay	1.3			
Intersection Capacity Utilization	32.3%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	3	0	3	0	367	0	0	392	2
Future Volume (Veh/h)	0	0	0	3	0	3	0	367	0	0	392	2
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	0	0	0	3	0	3	0	395	0	0	422	2
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	821	818	423	817	819	395	424			395		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	821	818	423	817	819	395	424			395		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	99	100	100	100			100		
cM capacity (veh/h)	294	313	635	298	312	659	1146			1175		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	0	6	0	395	0	0	424
Volume Left	0	3	0	0	0	0	0
Volume Right	0	3	0	0	0	0	2
cSH	1700	410	1700	1700	1700	1700	1700
Volume to Capacity	0.00	0.01	0.00	0.23	0.00	0.00	0.25
Queue Length 95th (m)	0.0	0.3	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	0.0	13.9	0.0	0.0	0.0	0.0	0.0
Lane LOS	A	B					
Approach Delay (s)	0.0	13.9	0.0			0.0	
Approach LOS	A	B					

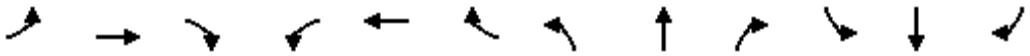
Intersection Summary				
Average Delay	0.1			
Intersection Capacity Utilization	30.8%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	0	0	2	2	471	0	2	375	0
Future Volume (Veh/h)	0	0	0	0	0	2	2	471	0	2	375	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	0	0	0	0	0	2	2	529	0	2	421	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	960	958	421	958	958	529	421			529		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	960	958	421	958	958	529	421			529		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	100	100	100	100			100		
cM capacity (veh/h)	237	258	637	238	258	554	1149			1048		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	0	2	2	529	0	2	421
Volume Left	0	0	2	0	0	2	0
Volume Right	0	2	0	0	0	0	0
cSH	1700	554	1149	1700	1700	1048	1700
Volume to Capacity	0.00	0.00	0.00	0.31	0.00	0.00	0.25
Queue Length 95th (m)	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	0.0	11.5	8.1	0.0	0.0	8.4	0.0
Lane LOS	A	B	A			A	
Approach Delay (s)	0.0	11.5	0.0			0.0	
Approach LOS	A	B					

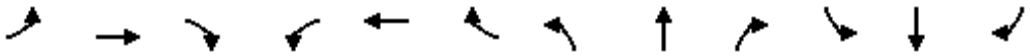
Intersection Summary				
Average Delay	0.1			
Intersection Capacity Utilization	34.8%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	2	42	0	2	0	336	26	3	314	3
Future Volume (Veh/h)	0	0	2	42	0	2	0	336	26	3	314	3
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	0	0	2	44	0	2	0	350	27	3	327	3
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	686	712	328	685	686	350	330			377		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	686	712	328	685	686	350	330			377		
tC, single (s)	7.1	6.5	6.2	8.1	6.5	6.2	4.1			4.6		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	4.4	4.0	3.3	2.2			2.7		
p0 queue free %	100	100	100	83	100	100	100			100		
cM capacity (veh/h)	362	359	718	257	372	698	1241			961		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	2	46	0	350	27	3	330
Volume Left	0	44	0	0	0	3	0
Volume Right	2	2	0	0	27	0	3
cSH	718	265	1700	1700	1700	961	1700
Volume to Capacity	0.00	0.17	0.00	0.21	0.02	0.00	0.19
Queue Length 95th (m)	0.1	4.7	0.0	0.0	0.0	0.1	0.0
Control Delay (s)	10.0	21.4	0.0	0.0	0.0	8.8	0.0
Lane LOS	B	C				A	
Approach Delay (s)	10.0	21.4	0.0			0.1	
Approach LOS	B	C					

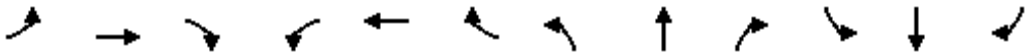
Intersection Summary				
Average Delay	1.4			
Intersection Capacity Utilization	33.5%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	3	0	3	0	390	0	0	416	2
Future Volume (Veh/h)	0	0	0	3	0	3	0	390	0	0	416	2
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	0	0	0	3	0	3	0	419	0	0	447	2
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	870	867	448	866	868	419	449			419		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	870	867	448	866	868	419	449			419		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	99	100	100	100			100		
cM capacity (veh/h)	273	293	615	276	293	638	1122			1151		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	0	6	0	419	0	0	449
Volume Left	0	3	0	0	0	0	0
Volume Right	0	3	0	0	0	0	2
cSH	1700	385	1700	1700	1700	1700	1700
Volume to Capacity	0.00	0.02	0.00	0.25	0.00	0.00	0.26
Queue Length 95th (m)	0.0	0.4	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	0.0	14.5	0.0	0.0	0.0	0.0	0.0
Lane LOS	A	B					
Approach Delay (s)	0.0	14.5	0.0			0.0	
Approach LOS	A	B					

Intersection Summary				
Average Delay	0.1			
Intersection Capacity Utilization	32.0%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	0	0	2	2	499	0	2	398	0
Future Volume (Veh/h)	0	0	0	0	0	2	2	499	0	2	398	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	0	0	0	0	0	2	2	561	0	2	447	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1018	1016	447	1016	1016	561	447			561		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1018	1016	447	1016	1016	561	447			561		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	100	100	100	100			100		
cM capacity (veh/h)	216	239	616	218	239	531	1124			1020		

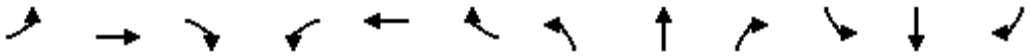
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	0	2	2	561	0	2	447
Volume Left	0	0	2	0	0	2	0
Volume Right	0	2	0	0	0	0	0
cSH	1700	531	1124	1700	1700	1020	1700
Volume to Capacity	0.00	0.00	0.00	0.33	0.00	0.00	0.26
Queue Length 95th (m)	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	0.0	11.8	8.2	0.0	0.0	8.5	0.0
Lane LOS	A	B	A			A	
Approach Delay (s)	0.0	11.8	0.0			0.0	
Approach LOS	A	B					

Intersection Summary				
Average Delay	0.1			
Intersection Capacity Utilization	36.3%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	2	44	0	2	0	357	27	3	333	3
Future Volume (Veh/h)	0	0	2	44	0	2	0	357	27	3	333	3
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	0	0	2	46	0	2	0	372	28	3	347	3
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	728	754	348	727	728	372	350			400		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	728	754	348	727	728	372	350			400		
tC, single (s)	7.1	6.5	6.2	8.1	6.5	6.2	4.1			4.6		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	4.4	4.0	3.3	2.2			2.7		
p0 queue free %	100	100	100	81	100	100	100			100		
cM capacity (veh/h)	339	339	699	239	351	678	1220			941		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	2	48	0	372	28	3	350
Volume Left	0	46	0	0	0	3	0
Volume Right	2	2	0	0	28	0	3
cSH	699	246	1700	1700	1700	941	1700
Volume to Capacity	0.00	0.20	0.00	0.22	0.02	0.00	0.21
Queue Length 95th (m)	0.1	5.4	0.0	0.0	0.0	0.1	0.0
Control Delay (s)	10.2	23.2	0.0	0.0	0.0	8.8	0.0
Lane LOS	B	C				A	
Approach Delay (s)	10.2	23.2	0.0			0.1	
Approach LOS	B	C					

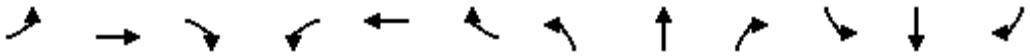
Intersection Summary				
Average Delay	1.4			
Intersection Capacity Utilization	34.7%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	3	0	3	0	414	0	0	441	2
Future Volume (Veh/h)	0	0	0	3	0	3	0	414	0	0	441	2
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	0	0	0	3	0	3	0	445	0	0	474	2
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	923	920	475	919	921	445	476			445		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	923	920	475	919	921	445	476			445		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	99	100	100	100			100		
cM capacity (veh/h)	251	273	594	254	273	617	1097			1126		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	0	6	0	445	0	0	476
Volume Left	0	3	0	0	0	0	0
Volume Right	0	3	0	0	0	0	2
cSH	1700	360	1700	1700	1700	1700	1700
Volume to Capacity	0.00	0.02	0.00	0.26	0.00	0.00	0.28
Queue Length 95th (m)	0.0	0.4	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	0.0	15.2	0.0	0.0	0.0	0.0	0.0
Lane LOS	A	C					
Approach Delay (s)	0.0	15.2	0.0			0.0	
Approach LOS	A	C					

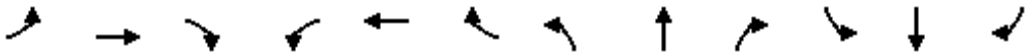
Intersection Summary				
Average Delay	0.1			
Intersection Capacity Utilization	33.3%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	0	0	2	2	530	0	2	423	0
Future Volume (Veh/h)	0	0	0	0	0	2	2	530	0	2	423	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	0	0	0	0	0	2	2	596	0	2	475	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1081	1079	475	1079	1079	596	475			596		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1081	1079	475	1079	1079	596	475			596		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	100	100	100	100			100		
cM capacity (veh/h)	196	219	594	197	219	507	1098			990		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	0	2	2	596	0	2	475
Volume Left	0	0	2	0	0	2	0
Volume Right	0	2	0	0	0	0	0
cSH	1700	507	1098	1700	1700	990	1700
Volume to Capacity	0.00	0.00	0.00	0.35	0.00	0.00	0.28
Queue Length 95th (m)	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	0.0	12.1	8.3	0.0	0.0	8.6	0.0
Lane LOS	A	B	A			A	
Approach Delay (s)	0.0	12.1	0.0			0.0	
Approach LOS	A	B					

Intersection Summary				
Average Delay	0.1			
Intersection Capacity Utilization	37.9%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	3	0	55	39	0	2	39	317	24	3	295	6
Future Volume (Veh/h)	3	0	55	39	0	2	39	317	24	3	295	6
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	3	0	57	41	0	2	41	330	25	3	307	6
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	730	753	310	782	731	330	313			355		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	730	753	310	782	731	330	313			355		
tC, single (s)	8.1	6.5	7.2	8.1	6.5	6.2	5.0			4.6		
tC, 2 stage (s)												
tF (s)	4.4	4.0	4.2	4.4	4.0	3.3	3.0			2.7		
p0 queue free %	99	100	90	78	100	100	95			100		
cM capacity (veh/h)	230	324	555	189	334	716	880			981		

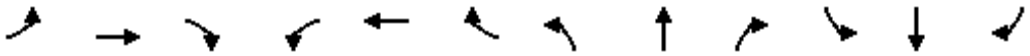
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	60	43	41	330	25	3	313
Volume Left	3	41	41	0	0	3	0
Volume Right	57	2	0	0	25	0	6
cSH	519	196	880	1700	1700	981	1700
Volume to Capacity	0.12	0.22	0.05	0.19	0.01	0.00	0.18
Queue Length 95th (m)	3.0	6.2	1.1	0.0	0.0	0.1	0.0
Control Delay (s)	12.8	28.5	9.3	0.0	0.0	8.7	0.0
Lane LOS	B	D	A			A	
Approach Delay (s)	12.8	28.5	1.0			0.1	
Approach LOS	B	D					

Intersection Summary				
Average Delay	3.0			
Intersection Capacity Utilization	39.0%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	2	0	42	3	0	56
Future Volume (Veh/h)	2	0	42	3	0	56
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	0	46	3	0	61
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			2		97	2
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			2		97	2
tC, single (s)			5.0		6.4	7.2
tC, 2 stage (s)						
tF (s)			3.0		3.5	4.2
p0 queue free %			96		100	93
cM capacity (veh/h)			1201		872	855

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	2	49	61
Volume Left	0	46	0
Volume Right	0	0	61
cSH	1700	1201	855
Volume to Capacity	0.00	0.04	0.07
Queue Length 95th (m)	0.0	0.9	1.7
Control Delay (s)	0.0	7.6	9.5
Lane LOS		A	A
Approach Delay (s)	0.0	7.6	9.5
Approach LOS			A

Intersection Summary			
Average Delay	8.5		
Intersection Capacity Utilization	19.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	3	0	39	3	0	3	35	367	0	0	392	4
Future Volume (Veh/h)	3	0	39	3	0	3	35	367	0	0	392	4
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	3	0	42	3	0	3	38	395	0	0	422	4
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	898	895	424	935	897	395	426			395		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	898	895	424	935	897	395	426			395		
tC, single (s)	7.8	6.5	7.1	7.1	6.5	6.2	5.1			4.1		
tC, 2 stage (s)												
tF (s)	4.1	4.0	4.1	3.5	4.0	3.3	3.1			2.2		
p0 queue free %	98	100	91	99	100	100	95			100		
cM capacity (veh/h)	193	268	479	217	267	659	759			1175		

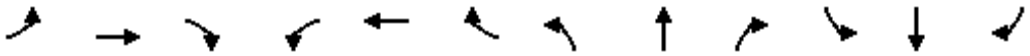
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	45	6	38	395	0	0	426
Volume Left	3	3	38	0	0	0	0
Volume Right	42	3	0	0	0	0	4
cSH	436	327	759	1700	1700	1700	1700
Volume to Capacity	0.10	0.02	0.05	0.23	0.00	0.00	0.25
Queue Length 95th (m)	2.6	0.4	1.2	0.0	0.0	0.0	0.0
Control Delay (s)	14.2	16.2	10.0	0.0	0.0	0.0	0.0
Lane LOS	B	C	A				
Approach Delay (s)	14.2	16.2	0.9			0.0	
Approach LOS	B	C					

Intersection Summary				
Average Delay	1.2			
Intersection Capacity Utilization	37.5%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	37	2	0	42
Future Volume (Veh/h)	0	0	37	2	0	42
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	40	2	0	46
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			0		82	0
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			0		82	0
tC, single (s)			5.1		6.4	7.1
tC, 2 stage (s)						
tF (s)			3.1		3.5	4.1
p0 queue free %			97		100	95
cM capacity (veh/h)			1161		893	880

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	0	42	46
Volume Left	0	40	0
Volume Right	0	0	46
cSH	1700	1161	880
Volume to Capacity	0.00	0.03	0.05
Queue Length 95th (m)	0.0	0.8	1.3
Control Delay (s)	0.0	7.8	9.3
Lane LOS		A	A
Approach Delay (s)	0.0	7.8	9.3
Approach LOS			A

Intersection Summary			
Average Delay	8.6		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	3	0	39	0	0	2	37	471	0	2	375	2
Future Volume (Veh/h)	3	0	39	0	0	2	37	471	0	2	375	2
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	3	0	44	0	0	2	42	529	0	2	421	2
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1041	1039	422	1082	1040	529	423			529		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1041	1039	422	1082	1040	529	423			529		
tC, single (s)	7.8	6.5	7.1	7.1	6.5	6.2	5.0			4.1		
tC, 2 stage (s)												
tF (s)	4.1	4.0	4.1	3.5	4.0	3.3	3.1			2.2		
p0 queue free %	98	100	91	100	100	100	95			100		
cM capacity (veh/h)	151	219	480	171	219	554	775			1048		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	47	2	42	529	0	2	423
Volume Left	3	0	42	0	0	2	0
Volume Right	44	2	0	0	0	0	2
cSH	422	554	775	1700	1700	1048	1700
Volume to Capacity	0.11	0.00	0.05	0.31	0.00	0.00	0.25
Queue Length 95th (m)	2.8	0.1	1.3	0.0	0.0	0.0	0.0
Control Delay (s)	14.6	11.5	9.9	0.0	0.0	8.4	0.0
Lane LOS	B	B	A			A	
Approach Delay (s)	14.6	11.5	0.7			0.0	
Approach LOS	B	B					

Intersection Summary				
Average Delay	1.1			
Intersection Capacity Utilization	42.7%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	37	2	0	42
Future Volume (Veh/h)	0	0	37	2	0	42
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	40	2	0	46
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			0		82	0
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			0		82	0
tC, single (s)			5.1		6.4	7.1
tC, 2 stage (s)						
tF (s)			3.1		3.5	4.1
p0 queue free %			97		100	95
cM capacity (veh/h)			1161		893	880

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	0	42	46
Volume Left	0	40	0
Volume Right	0	0	46
cSH	1700	1161	880
Volume to Capacity	0.00	0.03	0.05
Queue Length 95th (m)	0.0	0.8	1.3
Control Delay (s)	0.0	7.8	9.3
Lane LOS		A	A
Approach Delay (s)	0.0	7.8	9.3
Approach LOS			A

Intersection Summary			
Average Delay	8.6		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	3	0	55	42	0	2	39	336	26	3	314	6
Future Volume (Veh/h)	3	0	55	42	0	2	39	336	26	3	314	6
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	3	0	57	44	0	2	41	350	27	3	327	6
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	770	795	330	822	771	350	333			377		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	770	795	330	822	771	350	333			377		
tC, single (s)	8.1	6.5	7.2	8.1	6.5	6.2	5.0			4.6		
tC, 2 stage (s)												
tF (s)	4.4	4.0	4.2	4.4	4.0	3.3	3.0			2.7		
p0 queue free %	99	100	89	75	100	100	95			100		
cM capacity (veh/h)	214	306	540	175	316	698	863			961		

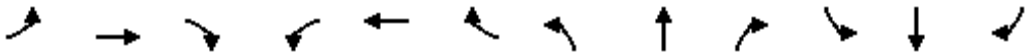
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	60	46	41	350	27	3	333
Volume Left	3	44	41	0	0	3	0
Volume Right	57	2	0	0	27	0	6
cSH	501	181	863	1700	1700	961	1700
Volume to Capacity	0.12	0.25	0.05	0.21	0.02	0.00	0.20
Queue Length 95th (m)	3.1	7.3	1.1	0.0	0.0	0.1	0.0
Control Delay (s)	13.2	31.5	9.4	0.0	0.0	8.8	0.0
Lane LOS	B	D	A			A	
Approach Delay (s)	13.2	31.5	0.9			0.1	
Approach LOS	B	D					

Intersection Summary				
Average Delay	3.1			
Intersection Capacity Utilization	40.1%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	2	0	42	3	0	56
Future Volume (Veh/h)	2	0	42	3	0	56
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	0	46	3	0	61
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			2		97	2
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			2		97	2
tC, single (s)			5.0		6.4	7.2
tC, 2 stage (s)						
tF (s)			3.0		3.5	4.2
p0 queue free %			96		100	93
cM capacity (veh/h)			1201		872	855

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	2	49	61
Volume Left	0	46	0
Volume Right	0	0	61
cSH	1700	1201	855
Volume to Capacity	0.00	0.04	0.07
Queue Length 95th (m)	0.0	0.9	1.7
Control Delay (s)	0.0	7.6	9.5
Lane LOS		A	A
Approach Delay (s)	0.0	7.6	9.5
Approach LOS			A

Intersection Summary			
Average Delay	8.5		
Intersection Capacity Utilization	19.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	3	0	39	3	0	3	35	390	0	0	416	4
Future Volume (Veh/h)	3	0	39	3	0	3	35	390	0	0	416	4
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	3	0	42	3	0	3	38	419	0	0	447	4
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	947	944	449	984	946	419	451			419		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	947	944	449	984	946	419	451			419		
tC, single (s)	7.8	6.5	7.1	7.1	6.5	6.2	5.1			4.1		
tC, 2 stage (s)												
tF (s)	4.1	4.0	4.1	3.5	4.0	3.3	3.1			2.2		
p0 queue free %	98	100	91	99	100	100	95			100		
cM capacity (veh/h)	178	251	462	200	250	638	740			1151		

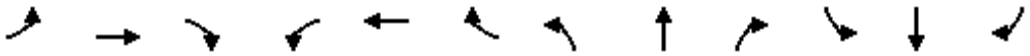
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	45	6	38	419	0	0	451
Volume Left	3	3	38	0	0	0	0
Volume Right	42	3	0	0	0	0	4
cSH	417	305	740	1700	1700	1700	1700
Volume to Capacity	0.11	0.02	0.05	0.25	0.00	0.00	0.27
Queue Length 95th (m)	2.7	0.5	1.2	0.0	0.0	0.0	0.0
Control Delay (s)	14.7	17.0	10.1	0.0	0.0	0.0	0.0
Lane LOS	B	C	B				
Approach Delay (s)	14.7	17.0	0.8			0.0	
Approach LOS	B	C					

Intersection Summary				
Average Delay	1.2			
Intersection Capacity Utilization	38.8%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	37	2	0	42
Future Volume (Veh/h)	0	0	37	2	0	42
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	40	2	0	46
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			0		82	0
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			0		82	0
tC, single (s)			5.1		6.4	7.1
tC, 2 stage (s)						
tF (s)			3.1		3.5	4.1
p0 queue free %			97		100	95
cM capacity (veh/h)			1161		893	880

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	0	42	46
Volume Left	0	40	0
Volume Right	0	0	46
cSH	1700	1161	880
Volume to Capacity	0.00	0.03	0.05
Queue Length 95th (m)	0.0	0.8	1.3
Control Delay (s)	0.0	7.8	9.3
Lane LOS		A	A
Approach Delay (s)	0.0	7.8	9.3
Approach LOS			A

Intersection Summary			
Average Delay	8.6		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	3	0	39	0	0	2	37	499	0	2	398	2
Future Volume (Veh/h)	3	0	39	0	0	2	37	499	0	2	398	2
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	3	0	44	0	0	2	42	561	0	2	447	2
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1099	1097	448	1140	1098	561	449			561		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1099	1097	448	1140	1098	561	449			561		
tC, single (s)	7.8	6.5	7.1	7.1	6.5	6.2	5.0			4.1		
tC, 2 stage (s)												
tF (s)	4.1	4.0	4.1	3.5	4.0	3.3	3.1			2.2		
p0 queue free %	98	100	90	100	100	100	94			100		
cM capacity (veh/h)	137	203	462	155	202	531	755			1020		

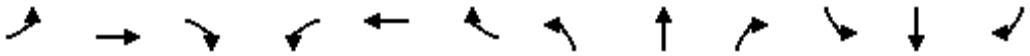
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	47	2	42	561	0	2	449
Volume Left	3	0	42	0	0	2	0
Volume Right	44	2	0	0	0	0	2
cSH	401	531	755	1700	1700	1020	1700
Volume to Capacity	0.12	0.00	0.06	0.33	0.00	0.00	0.26
Queue Length 95th (m)	3.0	0.1	1.3	0.0	0.0	0.0	0.0
Control Delay (s)	15.2	11.8	10.0	0.0	0.0	8.5	0.0
Lane LOS	C	B	B			A	
Approach Delay (s)	15.2	11.8	0.7			0.0	
Approach LOS	C	B					

Intersection Summary				
Average Delay	1.1			
Intersection Capacity Utilization	42.7%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	37	2	0	42
Future Volume (Veh/h)	0	0	37	2	0	42
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	40	2	0	46
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			0		82	0
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			0		82	0
tC, single (s)			5.1		6.4	7.1
tC, 2 stage (s)						
tF (s)			3.1		3.5	4.1
p0 queue free %			97		100	95
cM capacity (veh/h)			1161		893	880

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	0	42	46
Volume Left	0	40	0
Volume Right	0	0	46
cSH	1700	1161	880
Volume to Capacity	0.00	0.03	0.05
Queue Length 95th (m)	0.0	0.8	1.3
Control Delay (s)	0.0	7.8	9.3
Lane LOS		A	A
Approach Delay (s)	0.0	7.8	9.3
Approach LOS			A

Intersection Summary			
Average Delay	8.6		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	3	0	55	44	0	2	39	357	27	3	333	6
Future Volume (Veh/h)	3	0	55	44	0	2	39	357	27	3	333	6
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	3	0	57	46	0	2	41	372	28	3	347	6
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	812	838	350	864	813	372	353			400		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	812	838	350	864	813	372	353			400		
tC, single (s)	8.1	6.5	7.2	8.1	6.5	6.2	5.0			4.6		
tC, 2 stage (s)												
tF (s)	4.4	4.0	4.2	4.4	4.0	3.3	3.0			2.7		
p0 queue free %	98	100	89	72	100	100	95			100		
cM capacity (veh/h)	199	289	524	162	299	678	846			941		

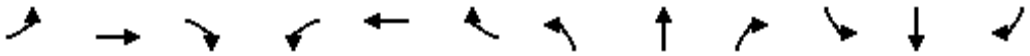
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	60	48	41	372	28	3	353
Volume Left	3	46	41	0	0	3	0
Volume Right	57	2	0	0	28	0	6
cSH	484	168	846	1700	1700	941	1700
Volume to Capacity	0.12	0.29	0.05	0.22	0.02	0.00	0.21
Queue Length 95th (m)	3.2	8.5	1.2	0.0	0.0	0.1	0.0
Control Delay (s)	13.5	34.9	9.5	0.0	0.0	8.8	0.0
Lane LOS	B	D	A			A	
Approach Delay (s)	13.5	34.9	0.9			0.1	
Approach LOS	B	D					

Intersection Summary				
Average Delay	3.2			
Intersection Capacity Utilization	41.3%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	2	0	42	3	0	56
Future Volume (Veh/h)	2	0	42	3	0	56
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	0	46	3	0	61
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			2		97	2
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			2		97	2
tC, single (s)			5.0		6.4	7.2
tC, 2 stage (s)						
tF (s)			3.0		3.5	4.2
p0 queue free %			96		100	93
cM capacity (veh/h)			1201		872	855

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	2	49	61
Volume Left	0	46	0
Volume Right	0	0	61
cSH	1700	1201	855
Volume to Capacity	0.00	0.04	0.07
Queue Length 95th (m)	0.0	0.9	1.7
Control Delay (s)	0.0	7.6	9.5
Lane LOS		A	A
Approach Delay (s)	0.0	7.6	9.5
Approach LOS			A

Intersection Summary			
Average Delay	8.5		
Intersection Capacity Utilization	19.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	3	0	39	3	0	3	35	414	0	0	441	4
Future Volume (Veh/h)	3	0	39	3	0	3	35	414	0	0	441	4
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	3	0	42	3	0	3	38	445	0	0	474	4
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1000	997	476	1037	999	445	478			445		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1000	997	476	1037	999	445	478			445		
tC, single (s)	7.8	6.5	7.1	7.1	6.5	6.2	5.1			4.1		
tC, 2 stage (s)												
tF (s)	4.1	4.0	4.1	3.5	4.0	3.3	3.1			2.2		
p0 queue free %	98	100	91	98	100	100	95			100		
cM capacity (veh/h)	162	233	444	184	232	617	720			1126		

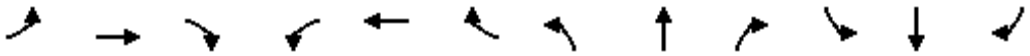
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	45	6	38	445	0	0	478
Volume Left	3	3	38	0	0	0	0
Volume Right	42	3	0	0	0	0	4
cSH	398	283	720	1700	1700	1700	1700
Volume to Capacity	0.11	0.02	0.05	0.26	0.00	0.00	0.28
Queue Length 95th (m)	2.9	0.5	1.3	0.0	0.0	0.0	0.0
Control Delay (s)	15.2	18.0	10.3	0.0	0.0	0.0	0.0
Lane LOS	C	C	B				
Approach Delay (s)	15.2	18.0	0.8			0.0	
Approach LOS	C	C					

Intersection Summary				
Average Delay	1.2			
Intersection Capacity Utilization	39.1%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	37	2	0	42
Future Volume (Veh/h)	0	0	37	2	0	42
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	40	2	0	46
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			0		82	0
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			0		82	0
tC, single (s)			5.1		6.4	7.1
tC, 2 stage (s)						
tF (s)			3.1		3.5	4.1
p0 queue free %			97		100	95
cM capacity (veh/h)			1161		893	880

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	0	42	46
Volume Left	0	40	0
Volume Right	0	0	46
cSH	1700	1161	880
Volume to Capacity	0.00	0.03	0.05
Queue Length 95th (m)	0.0	0.8	1.3
Control Delay (s)	0.0	7.8	9.3
Lane LOS		A	A
Approach Delay (s)	0.0	7.8	9.3
Approach LOS			A

Intersection Summary			
Average Delay	8.6		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	3	0	39	0	0	2	37	530	0	2	423	2
Future Volume (Veh/h)	3	0	39	0	0	2	37	530	0	2	423	2
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	3	0	44	0	0	2	42	596	0	2	475	2
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1162	1160	476	1203	1161	596	477			596		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1162	1160	476	1203	1161	596	477			596		
tC, single (s)	7.8	6.5	7.1	7.1	6.5	6.2	5.0			4.1		
tC, 2 stage (s)												
tF (s)	4.1	4.0	4.1	3.5	4.0	3.3	3.1			2.2		
p0 queue free %	98	100	90	100	100	100	94			100		
cM capacity (veh/h)	123	186	444	140	185	507	734			990		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	47	2	42	596	0	2	477
Volume Left	3	0	42	0	0	2	0
Volume Right	44	2	0	0	0	0	2
cSH	380	507	734	1700	1700	990	1700
Volume to Capacity	0.12	0.00	0.06	0.35	0.00	0.00	0.28
Queue Length 95th (m)	3.2	0.1	1.4	0.0	0.0	0.0	0.0
Control Delay (s)	15.8	12.1	10.2	0.0	0.0	8.6	0.0
Lane LOS	C	B	B			A	
Approach Delay (s)	15.8	12.1	0.7			0.0	
Approach LOS	C	B					

Intersection Summary				
Average Delay	1.0			
Intersection Capacity Utilization	42.7%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	37	2	0	42
Future Volume (Veh/h)	0	0	37	2	0	42
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	40	2	0	46
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			0		82	0
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			0		82	0
tC, single (s)			5.1		6.4	7.1
tC, 2 stage (s)						
tF (s)			3.1		3.5	4.1
p0 queue free %			97		100	95
cM capacity (veh/h)			1161		893	880

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	0	42	46
Volume Left	0	40	0
Volume Right	0	0	46
cSH	1700	1161	880
Volume to Capacity	0.00	0.03	0.05
Queue Length 95th (m)	0.0	0.8	1.3
Control Delay (s)	0.0	7.8	9.3
Lane LOS		A	A
Approach Delay (s)	0.0	7.8	9.3
Approach LOS			A

Intersection Summary			
Average Delay	8.6		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix F:
SimTraffic Queueing Analysis Reports

Intersection: 1: Highway 12 & Concession Rd 2

Movement	EB	WB	SB
Directions Served	LTR	LTR	L
Maximum Queue (m)	8.1	29.0	6.4
Average Queue (m)	0.5	11.6	0.3
95th Queue (m)	3.8	24.5	3.7
Link Distance (m)	1079.4	1059.9	
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)			125.0
Storage Blk Time (%)			
Queuing Penalty (veh)			

Network Summary

Network wide Queuing Penalty: 0

Intersection: 1: Highway 12 & Concession Rd 2

Movement	WB
Directions Served	LTR
Maximum Queue (m)	6.0
Average Queue (m)	1.0
95th Queue (m)	4.6
Link Distance (m)	1059.9
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 0

Intersection: 1: Highway 12 & Concession Rd 2

Movement	WB	NB	SB
Directions Served	LTR	L	L
Maximum Queue (m)	4.4	2.8	3.1
Average Queue (m)	0.2	0.1	0.1
95th Queue (m)	2.1	1.4	1.5
Link Distance (m)	1059.9		
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)		100.0	125.0
Storage Blk Time (%)			
Queuing Penalty (veh)			

Network Summary

Network wide Queuing Penalty: 0

Intersection: 1: Highway 12 & Concession Rd 2

Movement	EB	WB	SB
Directions Served	LTR	LTR	L
Maximum Queue (m)	6.6	35.7	13.3
Average Queue (m)	0.5	12.4	0.6
95th Queue (m)	3.6	28.6	5.1
Link Distance (m)	1079.4	1059.9	
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)			125.0
Storage Blk Time (%)			
Queuing Penalty (veh)			

Network Summary

Network wide Queuing Penalty: 0

Intersection: 1: Highway 12 & Concession Rd 2

Movement	WB
Directions Served	LTR
Maximum Queue (m)	6.0
Average Queue (m)	0.9
95th Queue (m)	4.3
Link Distance (m)	1059.9
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 0

Intersection: 1: Highway 12 & Concession Rd 2

Movement	WB	NB	SB
Directions Served	LTR	L	L
Maximum Queue (m)	4.3	5.8	3.1
Average Queue (m)	0.2	0.3	0.2
95th Queue (m)	1.9	2.6	2.2
Link Distance (m)	1059.9		
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)		100.0	125.0
Storage Blk Time (%)			
Queuing Penalty (veh)			

Network Summary

Network wide Queuing Penalty: 0

Intersection: 1: Highway 12 & Concession Rd 2

Movement	EB	WB	SB
Directions Served	LTR	LTR	L
Maximum Queue (m)	5.0	33.3	13.3
Average Queue (m)	0.5	13.7	0.8
95th Queue (m)	3.7	27.9	6.2
Link Distance (m)	1079.4	1059.9	
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)			125.0
Storage Blk Time (%)			
Queuing Penalty (veh)			

Network Summary

Network wide Queuing Penalty: 0

Intersection: 1: Highway 12 & Concession Rd 2

Movement	WB
Directions Served	LTR
Maximum Queue (m)	5.8
Average Queue (m)	0.9
95th Queue (m)	4.2
Link Distance (m)	1059.9
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 0

Intersection: 1: Highway 12 & Concession Rd 2

Movement	WB	NB	SB
Directions Served	LTR	L	L
Maximum Queue (m)	4.3	5.8	4.5
Average Queue (m)	0.2	0.3	0.2
95th Queue (m)	2.1	2.9	1.9
Link Distance (m)	1059.9		
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)		100.0	125.0
Storage Blk Time (%)			
Queuing Penalty (veh)			

Network Summary

Network wide Queuing Penalty: 0

Intersection: 1: Highway 12 & Concession Rd 2

Movement	EB	WB	NB	SB	SB
Directions Served	LTR	LTR	L	L	TR
Maximum Queue (m)	33.5	36.2	28.5	7.4	3.6
Average Queue (m)	15.5	11.9	6.1	0.2	0.1
95th Queue (m)	29.1	27.4	20.6	3.8	1.5
Link Distance (m)	225.5	1059.9			551.4
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (m)			100.0	125.0	
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 2: Site Access & Concession Rd 2

Movement	NB
Directions Served	LR
Maximum Queue (m)	31.3
Average Queue (m)	15.7
95th Queue (m)	28.5
Link Distance (m)	96.5
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 0

Intersection: 1: Highway 12 & Concession Rd 2

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	L	TR
Maximum Queue (m)	27.6	6.4	24.5	5.0
Average Queue (m)	11.5	1.3	6.7	0.2
95th Queue (m)	25.3	5.2	20.5	2.1
Link Distance (m)	247.5	1059.9		551.4
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (m)			100.0	
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 2: Site Access & Concession Rd 2

Movement	NB
Directions Served	LR
Maximum Queue (m)	23.9
Average Queue (m)	11.8
95th Queue (m)	24.9
Link Distance (m)	158.6
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 0

Intersection: 1: Highway 12 & Concession Rd 2

Movement	EB	WB	NB	SB	SB
Directions Served	LTR	LTR	L	L	TR
Maximum Queue (m)	26.4	7.0	22.7	4.5	1.3
Average Queue (m)	10.6	0.6	5.9	0.2	0.0
95th Queue (m)	24.0	3.8	19.0	2.4	0.9
Link Distance (m)	206.5	1059.9			551.4
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (m)			100.0	125.0	
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 2: Site Access & Concession Rd 2

Movement	NB
Directions Served	LR
Maximum Queue (m)	22.4
Average Queue (m)	11.2
95th Queue (m)	24.1
Link Distance (m)	143.3
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 0

Intersection: 1: Highway 12 & Concession Rd 2

Movement	EB	WB	NB	NB	SB	SB
Directions Served	LTR	LTR	L	T	L	TR
Maximum Queue (m)	34.8	44.2	30.8	1.2	2.9	3.7
Average Queue (m)	15.5	12.4	7.1	0.0	0.1	0.2
95th Queue (m)	28.4	29.6	22.5	0.9	2.1	1.8
Link Distance (m)	225.5	1059.9		435.6		551.4
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (m)			100.0		125.0	
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 2: Site Acess & Concession Rd 2

Movement	NB
Directions Served	LR
Maximum Queue (m)	30.2
Average Queue (m)	16.4
95th Queue (m)	27.7
Link Distance (m)	96.5
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 0

Intersection: 1: Highway 12 & Concession Rd 2

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	L	TR
Maximum Queue (m)	27.6	8.9	25.2	5.1
Average Queue (m)	11.7	1.4	7.6	0.2
95th Queue (m)	25.5	5.8	22.2	1.9
Link Distance (m)	247.5	1059.9		551.4
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (m)			100.0	
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 2: Site Acess & Concession Rd 2

Movement	NB
Directions Served	LR
Maximum Queue (m)	26.8
Average Queue (m)	12.1
95th Queue (m)	25.8
Link Distance (m)	158.6
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 0

Intersection: 1: Highway 12 & Concession Rd 2

Movement	EB	WB	NB	SB	SB
Directions Served	LTR	LTR	L	L	TR
Maximum Queue (m)	28.2	5.9	23.9	6.0	1.3
Average Queue (m)	11.3	0.5	6.4	0.3	0.0
95th Queue (m)	24.9	3.4	20.0	2.9	0.9
Link Distance (m)	206.5	1059.9			551.4
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (m)			100.0	125.0	
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 2: Site Acess & Concession Rd 2

Movement	NB
Directions Served	LR
Maximum Queue (m)	26.7
Average Queue (m)	11.6
95th Queue (m)	24.9
Link Distance (m)	143.3
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 0

Intersection: 1: Highway 12 & Concession Rd 2

Movement	EB	WB	NB	NB	SB	SB
Directions Served	LTR	LTR	L	T	L	TR
Maximum Queue (m)	35.1	45.4	30.3	1.2	3.0	2.5
Average Queue (m)	15.0	14.0	7.6	0.0	0.1	0.1
95th Queue (m)	28.0	32.1	22.4	0.9	1.9	1.3
Link Distance (m)	225.5	1059.9		435.6		551.4
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (m)			100.0		125.0	
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 2: Site Acess & Concession Rd 2

Movement	NB
Directions Served	LR
Maximum Queue (m)	28.9
Average Queue (m)	15.3
95th Queue (m)	27.4
Link Distance (m)	96.5
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 0

Intersection: 1: Highway 12 & Concession Rd 2

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	L	TR
Maximum Queue (m)	24.5	7.5	27.5	3.7
Average Queue (m)	10.6	1.4	6.8	0.1
95th Queue (m)	24.1	5.5	21.2	2.0
Link Distance (m)	247.5	1059.9		551.4
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (m)			100.0	
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 2: Site Acess & Concession Rd 2

Movement	NB
Directions Served	LR
Maximum Queue (m)	24.4
Average Queue (m)	11.1
95th Queue (m)	24.7
Link Distance (m)	158.6
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 0

Intersection: 1: Highway 12 & Concession Rd 2

Movement	EB	WB	NB	SB	SB
Directions Served	LTR	LTR	L	L	TR
Maximum Queue (m)	27.6	4.5	26.7	6.0	3.7
Average Queue (m)	12.2	0.3	7.1	0.3	0.2
95th Queue (m)	25.4	2.4	21.0	2.7	2.0
Link Distance (m)	206.5	1059.9			551.4
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (m)			100.0	125.0	
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 2: Site Acess & Concession Rd 2

Movement	NB
Directions Served	LR
Maximum Queue (m)	26.0
Average Queue (m)	12.4
95th Queue (m)	25.4
Link Distance (m)	143.3
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 0

Appendix G:
Poisson Distribution Calculation of Aggregate Truck Arrivals

Aggregate Truck Poisson Distribution Calculation

180 Second Cycle Length

Parameter	IN
	1.85
180s Cycle Arrival (Veh/Cycle)	1.85
Arrivals (Veh/Hr)	37
average	1.85
Remaining Volume	1.85

Analyst: Gaurav Chauhan

Date: Saturday, December 16, 2023

Cycle Length= 180 sec

		X equal or less	More than X
# of vehicles	Probability	Cum Probability	
0	15.7%	16%	84.3%
1	29.1%	45%	55.2%
2	26.9%	72%	28.3%
3	16.6%	88%	11.7%
4	7.7%	96%	4.0%
5	2.8%	99%	1.2%
6	0.9%	100%	0.3%
7	0.2%	100%	0.1%
8	0.1%	100%	0.0%
9	0.0%	100%	0.0%
10	0.0%	100%	0.0%
11	0.0%	100%	0.0%
12	0.0%	100%	0.0%
13	0.0%	100%	0.0%
14	0.000%	100%	0.000%
15	0.000%	100%	0.000%

Appendix H:
Signal Warrants

Traffic Signal Warrant - Input Sheet
Justification 7 - Projected Volumes

Based Ontario Traffic Manual Book 12 - Traffic Signals (March 2012)

Project and Scenario Summary

Project:	Brechin Quarry TIS			**Project No.:**	2453
				Date:	2023-12-01
Horizon:	Future Background	**Horizon Year:**	2025	**Analyst:**	GC

Study Intersection Summary

Major Street:	Highway 12	**Direction:**	North/South
Minor Street:	Concession Road 2	**Direction:**	East/West

Intersection Details for Warrant Parameters

Flow Conditions:	Free Flow (Rural)	**Number of Lanes:**	1
Number of Legs:	Four	**Intersection Type:**	Existing

Notes: "Free Flow" is used when the operating speed is greater than or equal to 70km/h, "Restricted Flow" otherwise.
The Number of Lanes greater than 1 only needs to be for one direction along the major road.
An intersection is considered "New" if at least 1-leg is added to an existing intersection.

Input Volumes and Average Hourly Volume Determination

Peak Hour	Major: Highway 12						Minor: Concession Road 2						Pedestrians Crossing Major
	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	
AM	0	317	24	3	295	3	0	0	2	39	0	2	0
PM	0	367	0	0	392	2	0	0	0	3	0	3	0
AHV[1]	**0**	**171**	**6**	**1**	**172**	**1**	**0**	**0**	**1**	**11**	**0**	**1**	**0**

1. The AHV is determined by the availability of the peak hour estimates. If both the AM and PM Peak Hour Volume estimate is available then AHV = $(AM_{PHV} + PM_{PHV}) / 4$. In the case that only one estimate is available then AHV = $AM_{PHV} / 2$ **or** AHV = $PM_{PHV} / 2$.

Determination of Justification Volumes (Based on AHV)

Justification 1A: All Approach Lanes	364	Justification 2A: Major Street Both Approaches	351
Justification 1B: Minor Street Both Approaches	13	Justification 2B: Traffic Crossing Major Street	11

Note: The crossing volume is defined as the sum of:

(1) Left turns from both minor street approaches:			11
(2) The heaviest through volume from the minor street:			0
(3) 50% of the heavier left turn movement from major street when both of the following criteria are met:			0
(a) The left turn volume > 120 vph	1	FALSE	
(b) The left turn volume plus the opposing volume > 720 vph	172	FALSE	
(4) Pedestrians crossing the major street:			0
		Total	**11**

Traffic Signal Warrant - Output Sheet
Justification 7 - Projected Volumes

Based Ontario Traffic Manual Book 12 - Traffic Signals (March 2012)

Project and Scenario Summary

Project:	Brechin Quarry TIS			**Project No.:**	2453
				Date:	2023-12-01
Horizon:	Future Background	**Horizon Year:**	2025	**Analyst:**	GC

Study Intersection Summary

Major Street:	Highway 12	**Direction:**	North/South
Minor Street:	Concession Road 2	**Direction:**	East/West

Summary of Base Justification Thresholds

Justification	1 Approach Lane		2 or More Approach Lanes	
	Free Flow	Restricted Flow	Free Flow	Restricted Flow
1A: All Approach Lanes	**480**	720	600	900
1B: Minor Street Both Approaches	**120**	170	120	170
2A: Major Street Both Approaches	**480**	720	600	900
2B: Traffic Crossing Major Street	**50**	75	50	75

The above values are taken from Table 12 and Table 13 from OTM Book 12 (March 2012).
The grey shaded values are provided for reference only, and are not applicable to the study intersection.

Adjusted Justification Thresholds for Study Intersection Conditions

Justification	Base Threshold	Existing Intersection	"T" Intersection	Final Threshold
1A: All Approach Lanes	480	120%	-	**576**
1B: Minor Street Both Approaches	120	120%	100%	**144**
2A: Major Street Both Approaches	480	120%	-	**576**
2B: Traffic Crossing Major Street	50	120%	-	**60**

The above adjustments are taken from OTM Book 12 (March 2012) the "T" Intersection adjustment only applies to Justification 1B, and is a 50% increase on the threshold when the study intersection is a "T' intersection. Otherwise a value of 100% is used.

Warrant Calculation

Justification	Study Intersection Justification Volume	Justification Threshold	Percentage Warrant	Warrant Met?
1A: All Approach Lanes	364	**576**	63%	**No**
1B: Minor Street Both Approaches	13	**144**	9%	
2A: Major Street Both Approaches	351	**576**	61%	**No**
2B: Traffic Crossing Major Street	11	**60**	18%	

Notes: In the case of Justification 7 based on AHV both Warrant 1 and 2 must be met 100%, which requires both the A and B part of each warrant being equal to 100%.
When calculating the percentage, any value greater than 100% is expressed as 100%.

Based on OTM Book 12's Signal Warrant Justification 7 and the estimated AHV for the subject study intersection a signal is:

Not Warranted

Traffic Signal Warrant - Input Sheet
Justification 7 - Projected Volumes

Based Ontario Traffic Manual Book 12 - Traffic Signals (March 2012)

Project and Scenario Summary

Project:	Brechin Quarry TIS			**Project No.:**	2453
				Date:	2023-12-01
Horizon:	Future Background	**Horizon Year:**	2030	**Analyst:**	GC

Study Intersection Summary

Major Street:	Highway 12	**Direction:**	North/South
Minor Street:	Concession Road 2	**Direction:**	East/West

Intersection Details for Warrant Parameters

Flow Conditions:	Free Flow (Rural)	**Number of Lanes:**	1
Number of Legs:	Four	**Intersection Type:**	Existing

Notes: "Free Flow" is used when the operating speed is greater than or equal to 70km/h, "Restricted Flow" otherwise.
The Number of Lanes greater than 1 only needs to be for one direction along the major road.
An intersection is considered "New" if at least 1-leg is added to an existing intersection.

Input Volumes and Average Hourly Volume Determination

Peak Hour	Major: Highway 12						Minor: Concession Road 2						Pedestrians Crossing Major
	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	
AM	0	336	26	3	314	3	0	0	2	42	0	2	0
PM	0	390	0	0	416	2	0	0	0	3	0	3	0
AHV[1]	**0**	**182**	**7**	**1**	**183**	**1**	**0**	**0**	**1**	**11**	**0**	**1**	**0**

1. The AHV is determined by the availability of the peak hour estimates. If both the AM and PM Peak Hour Volume estimate is available then AHV = (AM_{PHV} + PM_{PHV}) / 4. In the case that only one estimate is available then AHV = AM_{PHV} / 2 **or** AHV = PM_{PHV} / 2.

Determination of Justification Volumes (Based on AHV)

Justification 1A: All Approach Lanes	387	Justification 2A: Major Street Both Approaches	374
Justification 1B: Minor Street Both Approaches	13	Justification 2B: Traffic Crossing Major Street	11

Note: The crossing volume is defined as the sum of:			
(1) Left turns from both minor street approaches:			11
(2) The heaviest through volume from the minor street:			0
(3) 50% of the heavier left turn movement from major street when both of the following criteria are met:			0
(a) The left turn volume > 120 vph	1	FALSE	
(b) The left turn volume plus the opposing volume > 720 vph	183	FALSE	
(4) Pedestrians crossing the major street:			0
		Total	**11**

TYLin

Traffic Signal Warrant - Output Sheet
Justification 7 - Projected Volumes

Based Ontario Traffic Manual Book 12 - Traffic Signals (March 2012)

Project and Scenario Summary

Project:	Brechin Quarry TIS			**Project No.:**	2453
				Date:	2023-12-01
Horizon:	Future Background	**Horizon Year:**	2030	**Analyst:**	GC

Study Intersection Summary

Major Street:	Highway 12	**Direction:**	North/South
Minor Street:	Concession Road 2	**Direction:**	East/West

Summary of Base Justification Thresholds

Justification	1 Approach Lane		2 or More Approach Lanes	
	Free Flow	Restricted Flow	Free Flow	Restricted Flow
1A: All Approach Lanes	**480**	720	600	900
1B: Minor Street Both Approaches	**120**	170	120	170
2A: Major Street Both Approaches	**480**	720	600	900
2B: Traffic Crossing Major Street	**50**	75	50	75

The above values are taken from Table 12 and Table 13 from OTM Book 12 (March 2012).
The grey shaded values are provided for reference only, and are not applicable to the study intersection.

Adjusted Justification Thresholds for Study Intersection Conditions

Justification	Base Threshold	Existing Intersection	"T" Intersection	Final Threshold
1A: All Approach Lanes	480	120%	-	**576**
1B: Minor Street Both Approaches	120	120%	100%	**144**
2A: Major Street Both Approaches	480	120%	-	**576**
2B: Traffic Crossing Major Street	50	120%	-	**60**

The above adjustments are taken from OTM Book 12 (March 2012) the "T" Intersection adjustment only applies to Justification 1B, and is a 50% increase on the threshold when the study intersection is a "T' intersection. Otherwise a value of 100% is used.

Warrant Calculation

Justification	Study Intersection Justification Volume	Justification Threshold	Percentage Warrant	Warrant Met?
1A: All Approach Lanes	387	**576**	67%	**No**
1B: Minor Street Both Approaches	13	**144**	9%	
2A: Major Street Both Approaches	374	**576**	65%	**No**
2B: Traffic Crossing Major Street	11	**60**	18%	

Notes: In the case of Justification 7 based on AHV both Warrant 1 and 2 must be met 100%, which requires both the A and B part of each warrant being equal to 100%.
When calculating the percentage, any value greater than 100% is expressed as 100%.

Based on OTM Book 12's Signal Warrant Justification 7 and the estimated AHV for the subject study intersection a signal is:

Not Warranted

Traffic Signal Warrant - Input Sheet
Justification 7 - Projected Volumes

Based Ontario Traffic Manual Book 12 - Traffic Signals (March 2012)

Project and Scenario Summary

Project:	Brechin Quarry TIS			**Project No.:**	2453
				Date:	2023-12-01
Horizon:	Future Background	**Horizon Year:**	2035	**Analyst:**	GC

Study Intersection Summary

Major Street:	Highway 12	**Direction:**	North/South
Minor Street:	Concession Road 2	**Direction:**	East/West

Intersection Details for Warrant Parameters

Flow Conditions:	Free Flow (Rural)	**Number of Lanes:**	1
Number of Legs:	Four	**Intersection Type:**	Existing

Notes: "Free Flow" is used when the operating speed is greater than or equal to 70km/h, "Restricted Flow" otherwise.
The Number of Lanes greater than 1 only needs to be for one direction along the major road.
An intersection is considered "New" if at least 1-leg is added to an existing intersection.

Input Volumes and Average Hourly Volume Determination

Peak Hour	Major: Highway 12						Minor: Concession Road 2						Pedestrians Crossing Major
	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	
AM	0	357	27	3	333	3	0	0	2	44	0	2	0
PM	0	414	0	0	441	2	0	0	0	3	0	3	0
AHV[1]	**0**	**193**	**7**	**1**	**194**	**1**	**0**	**0**	**1**	**12**	**0**	**1**	**0**

1. The AHV is determined by the availability of the peak hour estimates. If both the AM and PM Peak Hour Volume estimate is available then AHV = $(AM_{PHV} + PM_{PHV}) / 4$. In the case that only one estimate is available then AHV = $AM_{PHV} / 2$ **or** AHV = $PM_{PHV} / 2$.

Determination of Justification Volumes (Based on AHV)

Justification 1A: All Approach Lanes	410	Justification 2A: Major Street Both Approaches	396
Justification 1B: Minor Street Both Approaches	14	Justification 2B: Traffic Crossing Major Street	12

Note: The crossing volume is defined as the sum of:

(1) Left turns from both minor street approaches:			12
(2) The heaviest through volume from the minor street:			0
(3) 50% of the heavier left turn movement from major street when both of the following criteria are met:			0
(a) The left turn volume > 120 vph	1	FALSE	
(b) The left turn volume plus the opposing volume > 720 vph	194	FALSE	
(4) Pedestrians crossing the major street:			0
		Total	**12**

Traffic Signal Warrant - Output Sheet
Justification 7 - Projected Volumes

Based Ontario Traffic Manual Book 12 - Traffic Signals (March 2012)

Project and Scenario Summary

Project:	Brechin Quarry TIS			**Project No.:**	2453
				Date:	2023-12-01
Horizon:	Future Background	**Horizon Year:**	2035	**Analyst:**	GC

Study Intersection Summary

Major Street:	Highway 12	**Direction:**	North/South
Minor Street:	Concession Road 2	**Direction:**	East/West

Summary of Base Justification Thresholds

Justification	1 Approach Lane		2 or More Approach Lanes	
	Free Flow	Restricted Flow	Free Flow	Restricted Flow
1A: All Approach Lanes	**480**	720	600	900
1B: Minor Street Both Approaches	**120**	170	120	170
2A: Major Street Both Approaches	**480**	720	600	900
2B: Traffic Crossing Major Street	**50**	75	50	75

The above values are taken from Table 12 and Table 13 from OTM Book 12 (March 2012).
The grey shaded values are provided for reference only, and are not applicable to the study intersection.

Adjusted Justification Thresholds for Study Intersection Conditions

Justification	Base Threshold	Existing Intersection	"T" Intersection	Final Threshold
1A: All Approach Lanes	480	120%	-	**576**
1B: Minor Street Both Approaches	120	120%	100%	**144**
2A: Major Street Both Approaches	480	120%	-	**576**
2B: Traffic Crossing Major Street	50	120%	-	**60**

The above adjustments are taken from OTM Book 12 (March 2012) the "T" Intersection adjustment only applies to Justification 1B, and is a 50% increase on the threshold when the study intersection is a "T' intersection. Otherwise a value of 100% is used.

Warrant Calculation

Justification	Study Intersection Justification Volume	Justification Threshold	Percentage Warrant	Warrant Met?
1A: All Approach Lanes	410	**576**	71%	**No**
1B: Minor Street Both Approaches	14	**144**	10%	
2A: Major Street Both Approaches	396	**576**	69%	**No**
2B: Traffic Crossing Major Street	12	**60**	20%	

Notes: In the case of Justification 7 based on AHV both Warrant 1 and 2 must be met 100%, which requires both the A and B part of each warrant being equal to 100%.
When calculating the percentage, any value greater than 100% is expressed as 100%.

Based on OTM Book 12's Signal Warrant Justification 7 and the estimated AHV for the subject study intersection a signal is:

Not Warranted

TYLin

Traffic Signal Warrant - Input Sheet
Justification 7 - Projected Volumes

Based Ontario Traffic Manual Book 12 - Traffic Signals (March 2012)

Project and Scenario Summary

Project:	Brechin Quarry TIS			**Project No.:**	2453
				Date:	2023-12-01
Horizon:	Future Total	**Horizon Year:**	2025	**Analyst:**	GC

Study Intersection Summary

Major Street:	Highway 12	**Direction:**	North/South
Minor Street:	Concession Road 2	**Direction:**	East/West

Intersection Details for Warrant Parameters

Flow Conditions:	Free Flow (Rural)	**Number of Lanes:**	1
Number of Legs:	Four	**Intersection Type:**	Existing

Notes: "Free Flow" is used when the operating speed is greater than or equal to 70km/h, "Restricted Flow" otherwise.
The Number of Lanes greater than 1 only needs to be for one direction along the major road.
An intersection is considered "New" if at least 1-leg is added to an existing intersection.

Input Volumes and Average Hourly Volume Determination

Peak Hour	Major: Highway 12						Minor: Concession Road 2						Pedestrians Crossing Major
	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	
AM	39	317	24	3	295	6	3	0	55	39	0	2	0
PM	35	367	0	0	392	4	3	0	39	3	0	3	0
AHV[1]	**19**	**171**	**6**	**1**	**172**	**3**	**2**	**0**	**24**	**11**	**0**	**1**	**0**

1. The AHV is determined by the availability of the peak hour estimates. If both the AM and PM Peak Hour Volume estimate is available then AHV = (AM_{PHV} + PM_{PHV}) / 4. In the case that only one estimate is available then AHV = AM_{PHV} / 2 **or** AHV = PM_{PHV} / 2.

Determination of Justification Volumes (Based on AHV)

Justification 1A: All Approach Lanes	410	Justification 2A: Major Street Both Approaches	372
Justification 1B: Minor Street Both Approaches	38	Justification 2B: Traffic Crossing Major Street	13

Note: The crossing volume is defined as the sum of:			
(1) Left turns from both minor street approaches:			13
(2) The heaviest through volume from the minor street:			0
(3) 50% of the heavier left turn movement from major street when both of the following criteria are met:			0
(a) The left turn volume > 120 vph	19	FALSE	
(b) The left turn volume plus the opposing volume > 720 vph	191	FALSE	
(4) Pedestrians crossing the major street:			0
		Total	**13**

Traffic Signal Warrant - Output Sheet
Justification 7 - Projected Volumes

Based Ontario Traffic Manual Book 12 - Traffic Signals (March 2012)

Project and Scenario Summary

Project:	Brechin Quarry TIS			**Project No.:**	2453
				Date:	2023-12-01
Horizon:	Future Total	**Horizon Year:**	2025	**Analyst:**	GC

Study Intersection Summary

Major Street:	Highway 12	**Direction:**	North/South
Minor Street:	Concession Road 2	**Direction:**	East/West

Summary of Base Justification Thresholds

Justification	1 Approach Lane		2 or More Approach Lanes	
	Free Flow	Restricted Flow	Free Flow	Restricted Flow
1A: All Approach Lanes	**480**	720	600	900
1B: Minor Street Both Approaches	**120**	170	120	170
2A: Major Street Both Approaches	**480**	720	600	900
2B: Traffic Crossing Major Street	**50**	75	50	75

The above values are taken from Table 12 and Table 13 from OTM Book 12 (March 2012).
The grey shaded values are provided for reference only, and are not applicable to the study intersection.

Adjusted Justification Thresholds for Study Intersection Conditions

Justification	Base Threshold	Existing Intersection	"T" Intersection	Final Threshold
1A: All Approach Lanes	480	120%	-	**576**
1B: Minor Street Both Approaches	120	120%	100%	**144**
2A: Major Street Both Approaches	480	120%	-	**576**
2B: Traffic Crossing Major Street	50	120%	-	**60**

The above adjustments are taken from OTM Book 12 (March 2012) the "T" Intersection adjustment only applies to Justification 1B, and is a 50% increase on the threshold when the study intersection is a "T' intersection. Otherwise a value of 100% is used.

Warrant Calculation

Justification	Study Intersection Justification Volume	Justification Threshold	Percentage Warrant	Warrant Met?
1A: All Approach Lanes	410	**576**	71%	**No**
1B: Minor Street Both Approaches	38	**144**	26%	
2A: Major Street Both Approaches	372	**576**	65%	**No**
2B: Traffic Crossing Major Street	13	**60**	22%	

Notes: In the case of Justification 7 based on AHV both Warrant 1 and 2 must be met 100%, which requires both the A and B part of each warrant being equal to 100%.
When calculating the percentage, any value greater than 100% is expressed as 100%.

Based on OTM Book 12's Signal Warrant Justification 7 and the estimated AHV for the subject study intersection a signal is:

Not Warranted

TYLin

Traffic Signal Warrant - Input Sheet
Justification 7 - Projected Volumes

Based Ontario Traffic Manual Book 12 - Traffic Signals (March 2012)

Project and Scenario Summary

Project:	Brechin Quarry TIS			**Project No.:**	2453
				Date:	2023-12-01
Horizon:	Future Total	**Horizon Year:**	2030	**Analyst:**	GC

Study Intersection Summary

Major Street:	Highway 12	**Direction:**	North/South
Minor Street:	Concession Road 2	**Direction:**	East/West

Intersection Details for Warrant Parameters

Flow Conditions:	Free Flow (Rural)	**Number of Lanes:**	1
Number of Legs:	Four	**Intersection Type:**	Existing

Notes: "Free Flow" is used when the operating speed is greater than or equal to 70km/h, "Restricted Flow" otherwise.
The Number of Lanes greater than 1 only needs to be for one direction along the major road.
An intersection is considered "New" if at least 1-leg is added to an existing intersection.

Input Volumes and Average Hourly Volume Determination

Peak Hour	Major: Highway 12						Minor: Concession Road 2						Pedestrians Crossing Major
	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	
AM	39	336	26	3	314	6	3	0	55	42	0	2	0
PM	35	390	0	0	416	4	3	0	39	3	0	3	0
AHV[1]	**19**	**182**	**7**	**1**	**183**	**3**	**2**	**0**	**24**	**11**	**0**	**1**	**0**

1. The AHV is determined by the availability of the peak hour estimates. If both the AM and PM Peak Hour Volume estimate is available then AHV = $(AM_{PHV} + PM_{PHV}) / 4$. In the case that only one estimate is available then AHV = $AM_{PHV} / 2$ **or** AHV = $PM_{PHV} / 2$.

Determination of Justification Volumes (Based on AHV)

Justification 1A: All Approach Lanes	433	Justification 2A: Major Street Both Approaches	395
Justification 1B: Minor Street Both Approaches	38	Justification 2B: Traffic Crossing Major Street	13

Note: The crossing volume is defined as the sum of:

(1) Left turns from both minor street approaches:			13
(2) The heaviest through volume from the minor street:			0
(3) 50% of the heavier left turn movement from major street when both of the following criteria are met:			0
(a) The left turn volume > 120 vph	19	FALSE	
(b) The left turn volume plus the opposing volume > 720 vph	202	FALSE	
(4) Pedestrians crossing the major street:			0
		Total	**13**

Traffic Signal Warrant - Output Sheet
Justification 7 - Projected Volumes

Based Ontario Traffic Manual Book 12 - Traffic Signals (March 2012)

Project and Scenario Summary

Project:	Brechin Quarry TIS			**Project No.:**	2453
				Date:	2023-12-01
Horizon:	Future Total	**Horizon Year:**	2030	**Analyst:**	GC

Study Intersection Summary

Major Street:	Highway 12	**Direction:**	North/South
Minor Street:	Concession Road 2	**Direction:**	East/West

Summary of Base Justification Thresholds

Justification	1 Approach Lane		2 or More Approach Lanes	
	Free Flow	Restricted Flow	Free Flow	Restricted Flow
1A: All Approach Lanes	**480**	720	600	900
1B: Minor Street Both Approaches	**120**	170	120	170
2A: Major Street Both Approaches	**480**	720	600	900
2B: Traffic Crossing Major Street	**50**	75	50	75

The above values are taken from Table 12 and Table 13 from OTM Book 12 (March 2012).
The grey shaded values are provided for reference only, and are not applicable to the study intersection.

Adjusted Justification Thresholds for Study Intersection Conditions

Justification	Base Threshold	Existing Intersection	"T" Intersection	Final Threshold
1A: All Approach Lanes	480	120%	-	**576**
1B: Minor Street Both Approaches	120	120%	100%	**144**
2A: Major Street Both Approaches	480	120%	-	**576**
2B: Traffic Crossing Major Street	50	120%	-	**60**

The above adjustments are taken from OTM Book 12 (March 2012) the "T" Intersection adjustment only applies to Justification 1B, and is a 50% increase on the threshold when the study intersection is a "T' intersection. Otherwise a value of 100% is used.

Warrant Calculation

Justification	Study Intersection Justification Volume	Justification Threshold	Percentage Warrant	Warrant Met?
1A: All Approach Lanes	433	**576**	75%	**No**
1B: Minor Street Both Approaches	38	**144**	26%	
2A: Major Street Both Approaches	395	**576**	69%	**No**
2B: Traffic Crossing Major Street	13	**60**	22%	

Notes: In the case of Justification 7 based on AHV both Warrant 1 and 2 must be met 100%, which requires both the A and B part of each warrant being equal to 100%.
When calculating the percentage, any value greater than 100% is expressed as 100%.

Based on OTM Book 12's Signal Warrant Justification 7 and the estimated AHV for the subject study intersection a signal is:

Not Warranted

TYLin

Traffic Signal Warrant - Input Sheet
Justification 7 - Projected Volumes

Based Ontario Traffic Manual Book 12 - Traffic Signals (March 2012)

Project and Scenario Summary

Project:	Brechin Quarry TIS			**Project No.:**	2453
				Date:	2023-12-01
Horizon:	Future Total	**Horizon Year:**	2035	**Analyst:**	GC

Study Intersection Summary

Major Street:	Highway 12	**Direction:**	North/South
Minor Street:	Concession Road 2	**Direction:**	East/West

Intersection Details for Warrant Parameters

Flow Conditions:	Free Flow (Rural)	**Number of Lanes:**	1
Number of Legs:	Four	**Intersection Type:**	Existing

Notes: "Free Flow" is used when the operating speed is greater than or equal to 70km/h, "Restricted Flow" otherwise.
The Number of Lanes greater than 1 only needs to be for one direction along the major road.
An intersection is considered "New" if at least 1-leg is added to an existing intersection.

Input Volumes and Average Hourly Volume Determination

Peak Hour	Major: Highway 12						Minor: Concession Road 2						Pedestrians Crossing Major
	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	
AM	39	357	27	3	333	6	3	0	55	44	0	2	0
PM	35	414	0	0	441	4	3	0	39	3	0	3	0
AHV[1]	**19**	**193**	**7**	**1**	**194**	**3**	**2**	**0**	**24**	**12**	**0**	**1**	**0**

1. The AHV is determined by the availability of the peak hour estimates. If both the AM and PM Peak Hour Volume estimate is available then AHV = $(AM_{PHV} + PM_{PHV}) / 4$. In the case that only one estimate is available then AHV = $AM_{PHV} / 2$ **or** AHV = $PM_{PHV} / 2$.

Determination of Justification Volumes (Based on AHV)

Justification 1A: All Approach Lanes	456	Justification 2A: Major Street Both Approaches	417
Justification 1B: Minor Street Both Approaches	39	Justification 2B: Traffic Crossing Major Street	14

Note: The crossing volume is defined as the sum of:

(1) Left turns from both minor street approaches:			14
(2) The heaviest through volume from the minor street:			0
(3) 50% of the heavier left turn movement from major street when both of the following criteria are met:			0
(a) The left turn volume > 120 vph	19	FALSE	
(b) The left turn volume plus the opposing volume > 720 vph	213	FALSE	
(4) Pedestrians crossing the major street:			0
		Total	**14**

Traffic Signal Warrant - Output Sheet
Justification 7 - Projected Volumes

Based Ontario Traffic Manual Book 12 - Traffic Signals (March 2012)

Project and Scenario Summary

Project:	Brechin Quarry TIS			**Project No.:**	2453
				Date:	2023-12-01
Horizon:	Future Total	**Horizon Year:**	2035	**Analyst:**	GC

Study Intersection Summary

Major Street:	Highway 12	**Direction:**	North/South
Minor Street:	Concession Road 2	**Direction:**	East/West

Summary of Base Justification Thresholds

Justification	1 Approach Lane		2 or More Approach Lanes	
	Free Flow	Restricted Flow	Free Flow	Restricted Flow
1A: All Approach Lanes	**480**	720	600	900
1B: Minor Street Both Approaches	**120**	170	120	170
2A: Major Street Both Approaches	**480**	720	600	900
2B: Traffic Crossing Major Street	**50**	75	50	75

The above values are taken from Table 12 and Table 13 from OTM Book 12 (March 2012).
The grey shaded values are provided for reference only, and are not applicable to the study intersection.

Adjusted Justification Thresholds for Study Intersection Conditions

Justification	Base Threshold	Existing Intersection	"T" Intersection	Final Threshold
1A: All Approach Lanes	480	120%	-	**576**
1B: Minor Street Both Approaches	120	120%	100%	**144**
2A: Major Street Both Approaches	480	120%	-	**576**
2B: Traffic Crossing Major Street	50	120%	-	**60**

The above adjustments are taken from OTM Book 12 (March 2012) the "T" Intersection adjustment only applies to Justification 1B, and is a 50% increase on the threshold when the study intersection is a "T' intersection. Otherwise a value of 100% is used.

Warrant Calculation

Justification	Study Intersection Justification Volume	Justification Threshold	Percentage Warrant	Warrant Met?
1A: All Approach Lanes	456	**576**	79%	**No**
1B: Minor Street Both Approaches	39	**144**	27%	
2A: Major Street Both Approaches	417	**576**	72%	**No**
2B: Traffic Crossing Major Street	14	**60**	23%	

Notes: In the case of Justification 7 based on AHV both Warrant 1 and 2 must be met 100%, which requires both the A and B part of each warrant being equal to 100%.
When calculating the percentage, any value greater than 100% is expressed as 100%.

Based on OTM Book 12's Signal Warrant Justification 7 and the estimated AHV for the subject study intersection a signal is:

Not Warranted