Nelson Aggregate Company
Burlington Quarry Extension
Traffic Report

Paradigm Transportation Solutions Limited

February 2020

ptsl.com

Project Summary

Project Number
190428

February 2020

Client
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Burlington ON L7P 0G8

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Nelson Aggregate Company
Burlington Quarry Extension Traffic Report

Signatures and Seals

Signature

Engineer's Seal

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Executive Summary

Content

Paradigm Transportation Solutions Limited (Paradigm) was retained by the Nelson Aggregate Company (Nelson) to prepare a traffic report for a proposed extension of an existing quarry located in the City of Burlington.

The objectives of this report include the determine the amount of traffic generated by the quarry operations at present and in the future, an assessment of the impact of the quarry traffic on the area transportation network, and the determination of transportation improvements to accommodate traffic related to the proposed quarry extension project.

Conclusions

Nelson Aggregate Company is a prime supplier of aggregate for building and construction purposes in the west Greater Toronto Area (GTA) and Hamilton area.

Nelson is planning extensions of the area licensed for the mining and processing of aggregate material at the Company's Burlington Quarry. The Burlington Quarry has been producing aggregate since 1953. The extensions of the quarry will enable the quarry operations to continue.

With the proposed extension areas, Nelson plans to ship approximately 1.0 million tonnes of aggregate annually. The existing quarry is permitted to ship an unlimited amount of aggregate annually. Historically the quarry has shipped an average 1.5 to 2.0 million tonnes per year with lower levels over recent years. The proposed extension is applying for a maximum tonnage limit of 2.0 million tonnes per year.

The traffic impact assessment has been completed based on the proposed limit of 2.0 million tonnes per annum and considers asphalt production, aggregate recycling and clean fill imported for rehabilitation.

With production at a license limit of 2.0 million tonnes, the site's weekday AM peak hour truck generation is forecast to be approximately 111 truck trips (56 inbound + 55 outbound). The site's weekday PM peak hour truck generation is forecast to be 3 truck trips (0 inbound + 3 outbound).

Light vehicle traffic generated by the quarry does not have a measurable impact on the study area road network. The light vehicle traffic tends to be spread out beyond the typical weekday peak hours of the roadway traffic and it may also be spread out to a variety of routes as it is not restricted by the prohibition of truck movements on Cedar Springs Road.

The roadways used to haul the material are currently utilized by the existing operation as an established haul route. As there is no change proposed to the haul route, no new impacts to the road network are anticipated.

Some capacity deficiencies at the study area intersections are forecast under existing conditions. These deficiencies will occur with or without the proposed quarry extension. The impact of vehicle trips generated by the site with an annual production of 2.0 million tonnes per annum (aggregate/recycling/clean fill) is not anticipated to have a significant impact on the operations of the study area intersections.

The Halton Region Transportation Master Plan identifies a widening of Dundas Street to 6 lanes from east of Guelph Line to the City of Hamilton boundary. Additional improvements are indicated on Guelph Line south of Dundas Street. It is expected that these improvements will provide additional capacity to the Dundas Street corridor and to the intersections with Guelph Line and Cedar Springs Road/Brant Street.

The intersection of No. 2 Side Road with Guelph Line is designed to accommodate heavy vehicle traffic. The eastbound right-turn moment is a channelized free flow lane with a southbound acceleration lane on Guelph Line.

The capacity deficiencies forecast to occur on the eastbound approach of No. 2 Side Road to Guelph Line is related to the stop-controlled conditions for the shared through/left-turn movement. The forecast AM peak hour volume for this shared moment is approximately 55 vehicles (36 light vehicles + 19 heavy vehicles). The forecast PM peak hour volume for this shared moment is approximately 30 vehicles (18 light vehicles + 12 heavy vehicles). The low volume would not suggest the need for improvements to this approach. No changes the existing form of traffic control is recommended.

The mined aggregate from the South Extension lands is proposed to be transported by 70-tonne rock trucks across No. 2 Side Road at grade to the existing processing plant. Recommendations for this crossing have been developed to ensure appropriate sightlines are available and to ensure the structural integrity of the roadway.

Recommendations

Based on the findings of this study, it is recommended that:

- No improvements to the existing study area roadways are required or recommended to accommodate the proposed extension to the Nelson Burlington Quarry; and
- The South Extension of the Burlington Quarry will require a new roadway crossing No. 2 Sideroad at grade for trucks transporting rock material into the existing quarry for processing. The following provisions are recommended for this new roadway crossing:
  - The northbound and southbound approaches to No. 2 Sideroad shall be controlled by stop sign control.
  - The new roadway crossing should be located on the crest on No. 2 Sideroad with a clear sight distance of at least 215 metres in each direction along No. 2 Sideroad for both the northbound and southbound approaches.
  - The roadway geometry and road bed structure should be designed to accommodate the rock trucks that Nelson plans to operate.

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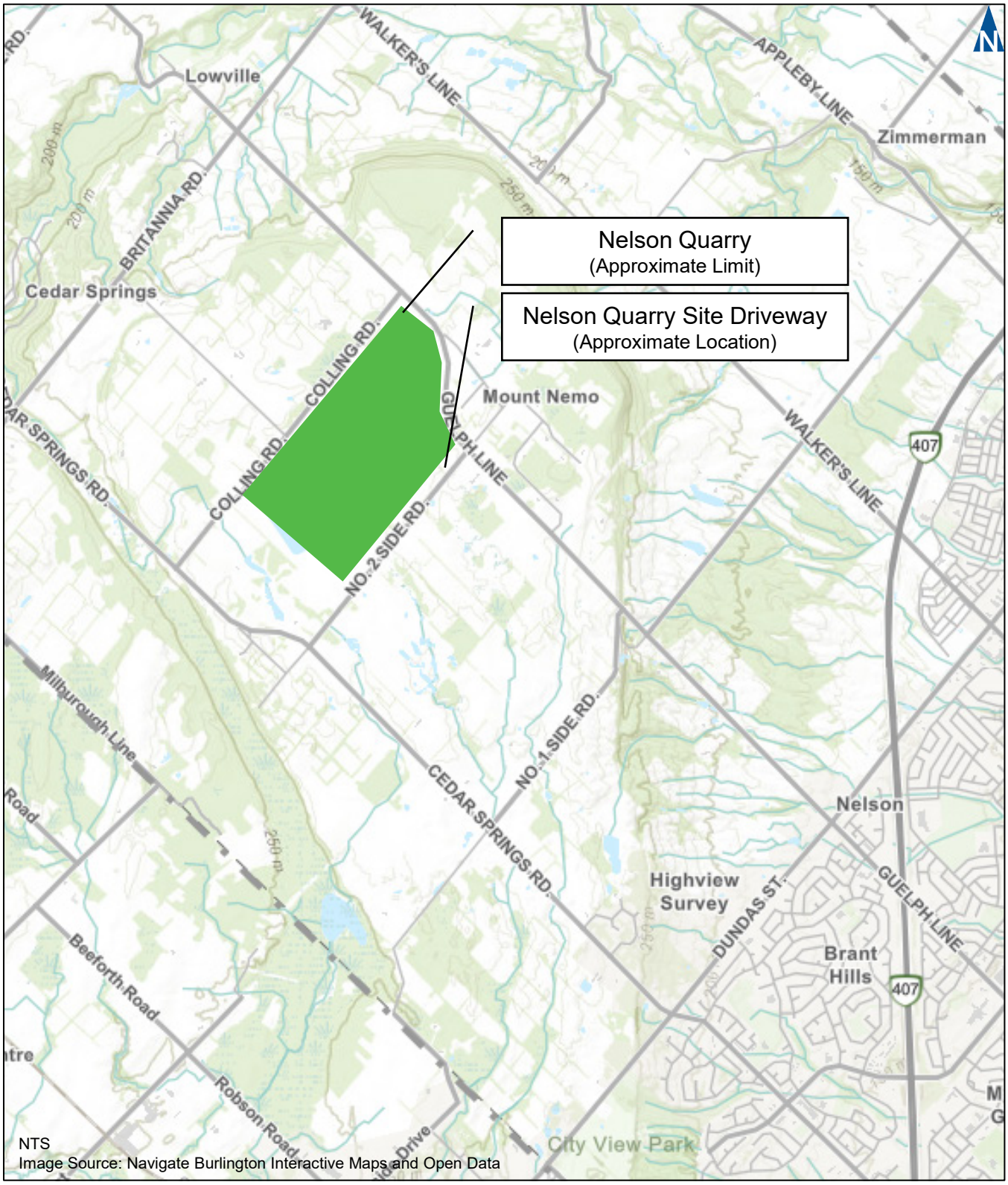
1 Introduction

1.1 Overview

Paradigm Transportation Solutions Limited (Paradigm) was retained by the Nelson Aggregate Company (Nelson) to prepare a traffic report for a proposed extension of an existing quarry located in the City of Burlington. The objectives of this report are as follows:

- To determine the amount of traffic generated by the quarry operations at present and in the future;
- To assess the impact of the quarry traffic on the area transportation network; and
- To determine the need for transportation improvements to accommodate traffic related to the proposed quarry extension project.

Nelson Aggregate Company is one of the prime suppliers of aggregate for building and construction purposes in the west Greater Toronto Area (GTA) and Hamilton area. The Burlington Quarry aggregate is produced at a quarry located on the north side of No. 2 Side Road, west of Guelph Line, in the City of Burlington, Halton Region. This quarry has been producing aggregate since 1953. **Figure 1.1** illustrates the location of the quarry.



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Location of Existing Quarry

Nelson Quarry Extension
190428

Figure 1.1

1.2 Proposed Quarry Extension

Nelson is proposing two extensions to the area currently licensed for aggregate production. Two quarry extension areas are proposed, as follows:

- **South Extension** - an area on the south side of No. 2 Side Road, directly south of the existing quarry, with a licensed boundary area of 18.3 hectares (ha) and extraction area of 14.5 ha; and
- **West Extension** - An area immediately west of the existing quarry, with a licensed boundary area of 60.0 ha and an extraction area of 35.9 ha.

Figure 1.2 illustrates the South and West Extension areas.

The proposed extension areas would be developed in phases. The proposed south extension will occur first (i.e., phase 1a, phase 1b and phase 2). The mined aggregate is proposed to be transported by 70-tonne rock trucks across No. 2 Side Road at grade to the existing processing plant. **Section 4** reviews the crossing location.

The proposed west extension will occur after the south extension. The west extension will occur in phases (i.e., phase 3, phase 4, phase 5 and phase 6). The extension lands are contiguous with the existing quarry and the material removed from this extraction will be transported by 70-tonne rock trucks to the existing processing plant.

With the proposed extension areas, Nelson plans to ship approximately 1.0 million tonnes of aggregate annually. The existing quarry is permitted to ship an unlimited amount of aggregate annually. Historically, the quarry has shipped an average 1.5 to 2.0 million tonnes per year with lower levels over recent years.

The traffic impact assessment has been completed based on the proposed limit of 2.0 million tonnes per annum and considers asphalt production, aggregate recycling and clean fill imported for rehabilitation.

With production at the license limit of 2.0 million tonnes, the site's weekday AM peak hour truck generation is forecast to be approximately 111 truck trips (56 inbound + 55 outbound). The site's weekday PM peak hour truck generation is forecast to be 3 truck trips (0 inbound + 3 outbound).

The quarry will continue to use existing haul routes. All material shipped to market, except local delivery, is transported to/from Guelph Line. No changes are proposed to haul route.

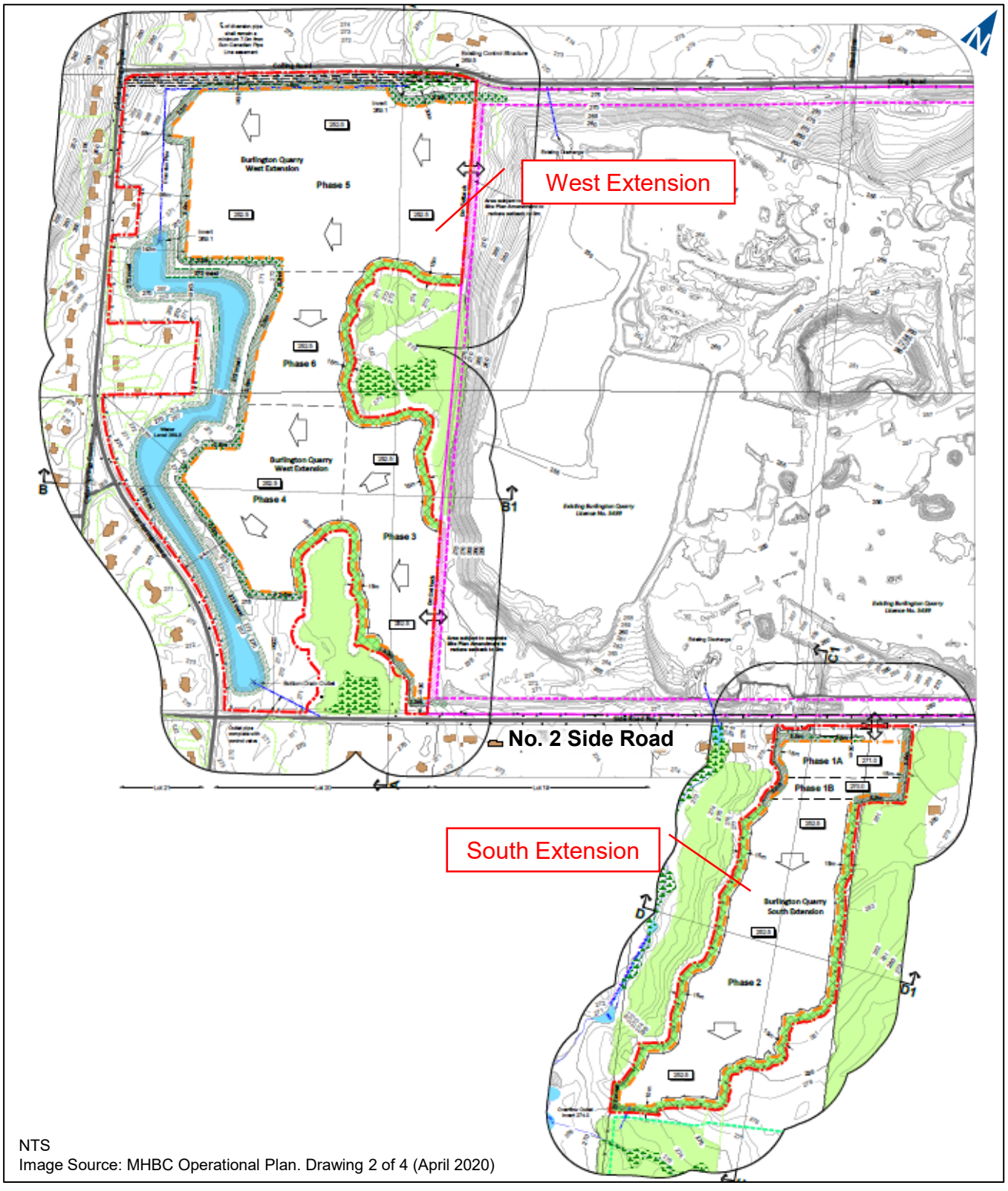

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Image Source: MHBC Operational Plan. Drawing 2 of 4 (April 2020)

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South and West Extension Area

Nelson Quarry Extension
190428

Figure 1.2

2 Existing Quarry Operations

2.1 Description of Site

2.1.1 Location

The existing quarry is located north of No. 2 Side Road and west of Guelph Line. **Figure 1.1** illustrates the location of the quarry. The quarry is bounded by No. 2 Side Road to the south, Guelph Line to the east, Colling Road to the north and a golf course on the west.

The quarry measures approximately 210 ha (519 acres) and includes peripheral buffering, the quarry mining area, the processing plant and a supportive office building. The Burlington Quarry is the current head office for Nelson.

2.1.2 Vehicle Access

Light vehicles travelling to and from the quarry are permitted to use all roadways including Cedar Springs Road to access the site.

Heavy vehicle (i.e., truck) access to the site is restricted west of the site driveway. Heavy vehicle trips generated by the quarry must travel on No. 2 Sideroad from Guelph Line. Local deliveries are exempt from this restriction. Nelson actively monitors trucks entering and exiting the quarry. Drivers observed travelling to or from the west are warned once and then barred from the quarry if they caught a second time travelling from or to Cedar Springs Road.

Guelph Line is the main truck route to and from the site. Guelph Line offers connections to the Burlington urban area and the wider provisional road network (Highway 401, Highway 403/QEW, Highway 407). The intersection with No. 2 Side Road is designed with auxiliary turn lanes and acceleration lanes to accommodate heavy vehicle trips generated by the quarry.

The quarry's truck entrance is located approximately 350 metres west of Guelph Line on the north side of No. 2 Side Road. A second driveway is located approximately 450 metres west of Guelph Line on the north side of No. 2 Side Road. The second driveway provides access for light vehicles to the supportive office building.

The quarry will continue to use existing haul routes. All material shipped to market, except local delivery, is transported to and from Guelph Line. No changes are proposed to this haul route.

2.1.3 Operation Times

From May to December, shipments generally occur from 6:00 AM to 5:00 PM on weekdays and from 7:00 AM to 12:00 PM on Saturdays. During the balance of the year (i.e., January to May), shipments generally occur on

weekdays from 7:00 AM to 5:00 PM. The quarry does not operate on Saturdays over the winter months.

2.1.4 Employees

The mining and processing operation requires about 30 to 35 persons during normal weekday operations. Saturday operations require about 6 to 12 persons. The office building functions with about 14 persons during normal weekday operations.

All staff travel by private light vehicles (e.g., cars, pick-up trucks). Office staff are typically on-site from 7:00 AM and 5:00 PM. Most office staff arrive between 8:00 AM and 8:30 AM and depart between 4:30 PM and 5:00PM. Most mining and processing staff arriving before 6:00 AM and depart around 5:00 PM.

2.2 Quarry Traffic

2.2.1 Time Periods

Turning Movement Count (TMC) data suggests that the AM peak hour for the adjacent roadway (Guelph Line) occurs between 7:30 AM and 8:30 AM. The PM peak hour occurs between 4:15 PM and 5:15 PM.

From May to December, shipments generally occur from 6:00 AM to 5:00 PM on weekdays. Most office staff arrive between 8:00 AM and 8:30 AM and depart between 4:30 PM and 5:00 PM on weekdays. Most mining and processing staff arriving before 6:00 AM and depart around 5:00 PM.

2.2.2 Light Vehicle Generation

During a typical weekday from May to December the quarry generates a number of light vehicle trips (e.g., cars, pick-up trucks). The light vehicle activity is related to employee, visitors and miscellaneous trips. The following trip types occur:

- Plant employees – generate approximately 35 inbound trips and approximately 35 inbound trips per day;
- Office employees – generate approximately 15 inbound trips and approximately 15 inbound trips per day; and
- Visitors and miscellaneous – generate approximately 5 inbound trips and approximately 5 inbound trips per day.

On a typical weekday from May to December the quarry generates about 45 to 55 light vehicle trips per direction (90-110 total vehicle trips).

Light vehicle traffic generated by the quarry does not have a measurable impact on the study area road network. The light vehicle traffic tends to be spread out beyond the typical weekday peak hours of the roadway traffic and

it may also be spread out to a variety of routes as it is not restricted by the prohibition of truck movements on Cedar Springs Road.

2.2.3 Heavy Vehicle Generation

Nelson does not own or operate any trucks for the shipping of material to market; rather, customers and their contractors transport the material from the quarry by truck.

Typically, trucks arrive on-site about 30-minutes before opening. Vehicles dwell on-site, queuing to be processed. Vehicles are weighed prior to entering the site and before exiting the site. Vehicle weight and other data (e.g. material type) is record for invoicing purposes. Trucking activity continues throughout the day.

Truck sizes range depending upon a customer's need. Typical truck sizes include:

- Tandem axle dump trucks – Net load of 12 to 15 tonnes;
- Tri-axle dump trucks – Net load of 20 to 25 tonnes; and
- Trailer end-dump trucks with 3 to 6 axles on the trailer and 3 axles on the tractor – Net loads of 30 to 42 tonnes.

There are also different truck/trailer configurations used for hauling aggregate products. Approximately 50% of the product is shipped on straight body dump trucks and 50% on tractor-trailer trucks. The overall average net load per truck trip of outgoing aggregate is approximately 30 tonnes.

The truck activity at the quarry has become more diverse in recent years with the following distinct types of trips:

- **Aggregate**, outgoing material that has been mined in the quarry and processed; and
- **Clean fill**, incoming material used for rehabilitation; and
- **Recycling material**, incoming material used for asphalt production.

Many of the incoming trucks with clean fill or recycling material leave with loads of aggregate material. Exact information is not available on the breakdown of trucks which enter with a load and also exit with a load. Nelson estimates that about 50% to 58% of the incoming trucks with clean fill and recycling material between 2014 and 2017 left with a load of aggregate. In 2018 there was an increase in the amount of incoming material for landscaping and it is estimated that about 23% of these incoming trucks left with a load of aggregate material.

The existing quarry is permitted to ship an unlimited amount of aggregate per annum. Historically, the quarry has shipped on average 1.5 to 2.0 million tonnes per annum. The proposed extensions is applying for a licence limit of

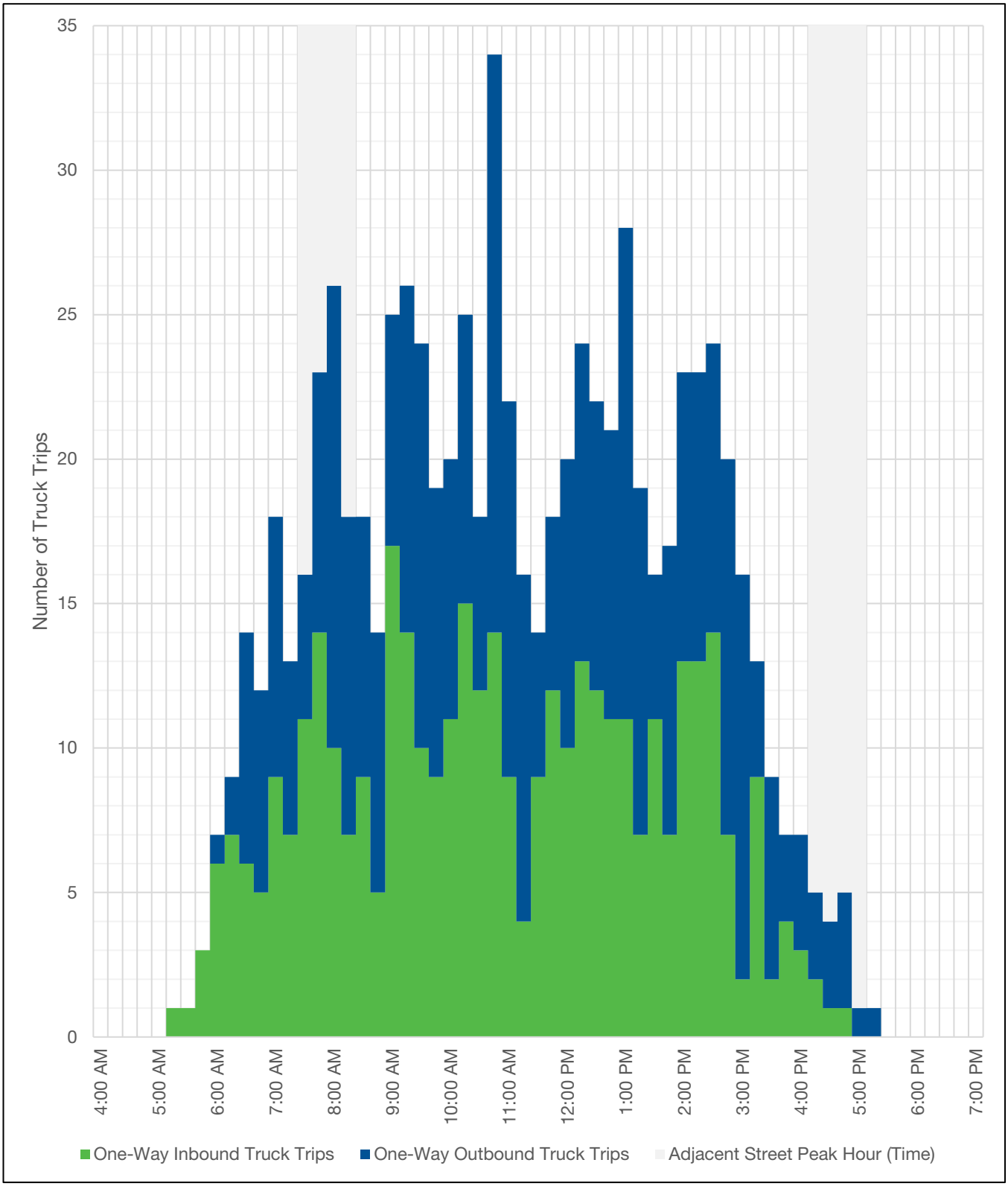
2.0 million tonnes per annum and considers asphalt production, aggregate recycling and clean fill imported for rehabilitation.

To determine estimated trucking levels for a 2.0 tonnes per annum scenario, Paradigm has reviewed detailed shipping records from Nelson for 2014 to 2018. **Appendix A** contains confidential data provided by Nelson. Data can be made available for technical review but following a non-disclosure agreement with Nelson Aggregate Co.

Additionally, a Turning Movement Count (TMC) at the site driveway to No. 2 Side Road was completed on 08 October 2019 to quantify truck trips during a normally busy month. **Appendix B** contains the existing turning movement count and signal timing data.

Figure 2.1 illustrates the temporal distribution of truck trips observed at the site driveway to No. 2 Side Road. Aspects of the TMC data include:

- The peak hour for the driveway (all vehicle types) occurs from approximately 7:30 AM to 8:30 AM. Site generated traffic includes:
  - 84 total vehicles (43 inbound + 41 outbound);
  - One (1) light vehicle (1 inbound);
  - 62 single unit trucks (32 inbound + 30 outbound); and
  - 21 articulated trucks (10 inbound + 11 outbound).
- The PM peak hour occurs from approximately 4:30 PM to 5:00 PM. Site generated traffic includes:
  - 15 total vehicles (zero inbound + 15 outbound).
  - 13 light vehicles (13 outbound);
  - One (1) single unit trucks (1 outbound);
  - One (1) articulated trucks (1 outbound);
  - Two (2) bicycle trips (1 inbound + 1 outbound).
- All truck trips originated from and were destined to east (Guelph Line);
- Shipping actively begins to taper off around 3:00 PM with a limited number of truck trips generated during the PM peak hour.



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Temporal Distribution of Truck Trips

Nelson Quarry Extension
190428

Figure 2.1

3 Existing Conditions

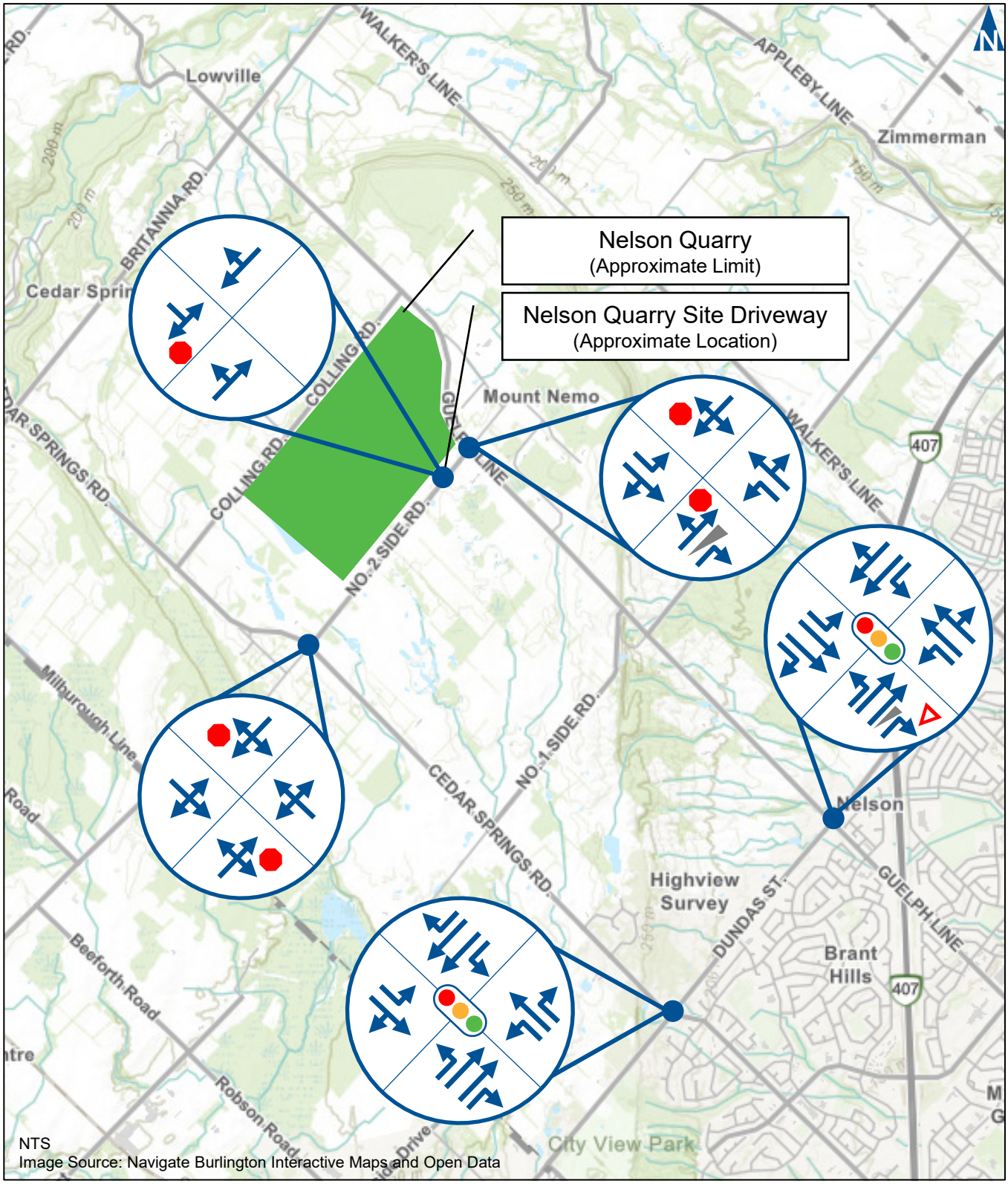
3.1 Study Area Roadways

The main roadways near the subject site considered in assessing the traffic impacts of the development include:

- **No. 2 Side Road**, a paved two-lane collector road[1] connecting to Guelph Line and Cedar Springs Road. It has a posted speed limit of 60 km/h. Heavy vehicles are restricted west of the site's truck entrance to No. 2 Side Road. The intersections with Guelph Line and Cedar Springs Road operate under stop control. The eastbound right-turn movement at Guelph Line is a channelized free flow lane with a southbound acceleration lane on Guelph Line to aid heavy vehicles.
- **Guelph Line (Halton Regional Road 1)**, a north-south major arterial roadway under the Region's jurisdiction. Between No. 2 Side Road and Dundas Street, it is a paved two-lane roadway with shoulders and a posted 80 km/h speed limit. There are no restrictions on truck traffic on this roadway. The intersection with No. 2 Side Road has northbound and southbound left turn lanes. The intersection with Dundas Street operates with traffic control signals.
- **Cedar Springs Road**, a north-south minor arterial roadway connecting to Brant Street (south of Dundas Street). The posted speed near the intersection of No. 2 Side Road is 70 km/h, changing to 60 km/h north of No. 2 Sideroad. A load restriction from February 15 to May 1 is in place along this roadway with through truck traffic prohibited at all times. The intersection with Dundas Street operates with traffic control signals.
- **Dundas Street (Halton Region Road 5)**, an east-west major arterial roadway under the Region's jurisdiction. The posted speed limit is 80 km/h. Within the study area the roadway has two travel lanes in each direction. The intersections with Guelph Line and Cedar Springs Road/Brant Street operate with traffic control signals.

Figure 3.1 illustrates the existing lane configuration and traffic control at the study area intersections.

[1] *Burlington Official Plan Schedule L Classification Of Transportation Facilities No. 1 Side Road to Derry Road*



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Existing Lane Configuration & Traffic Control

3.2 Traffic Volumes

Table 3.1 summarizes the location and date of the existing turning movement count (TMC) data used in the intersection capacity analysis. Peak hour traffic volumes were adjusted to a Year 2019 base year condition by applying a growth rate of 2.0% per annum. **Figure 3.2A and Figure 3.2B** illustrates the base year AM and PM peak hour traffic volumes.

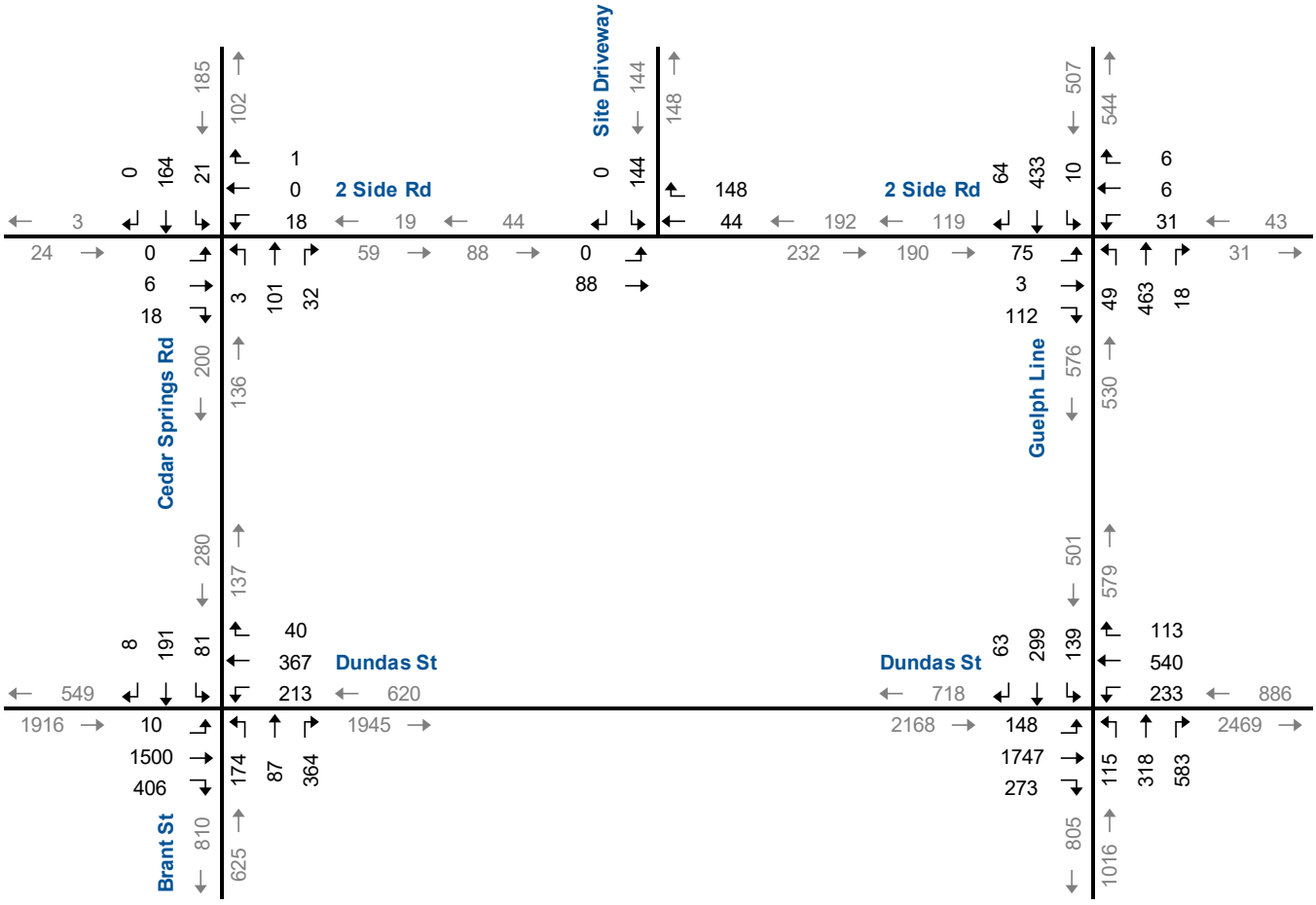
Appendix B contains the existing turning movement count and signal timing data.

TABLE 3.1: EXISTING COUNT DATA SUMMARY

Intersection	Date
Guelph Line at No. 2 Side Road	Thursday, 21 September, 2017
Guelph Line at Dundas Street	Wednesday, 5 April, 2017
Cedar Springs Road/Brant Street at Dundas Street	Thursday, 5 April, 2018
Cedar Springs Road at No. 2 Side Road	Tuesday, 2 April, 2013
2 Side Road at Site Driveway	Tuesday, 8 October, 2019

The heavy vehicles documented in the existing count data have been converted to passenger car units (PCE) using a factor of 3.5 PCE per vehicle[2]. The PCE factor assumes all heavy vehicles are multi-unit trucks, heavily loaded. A PCE is used for more conservative analyses, as it accounts for the relative performance of vehicles. Heavy vehicles take up more space and more importantly, heavy vehicles have lower performance from an acceleration/deceleration perspective.

[2] *Table 3.2 Passenger car unit equivalents1*



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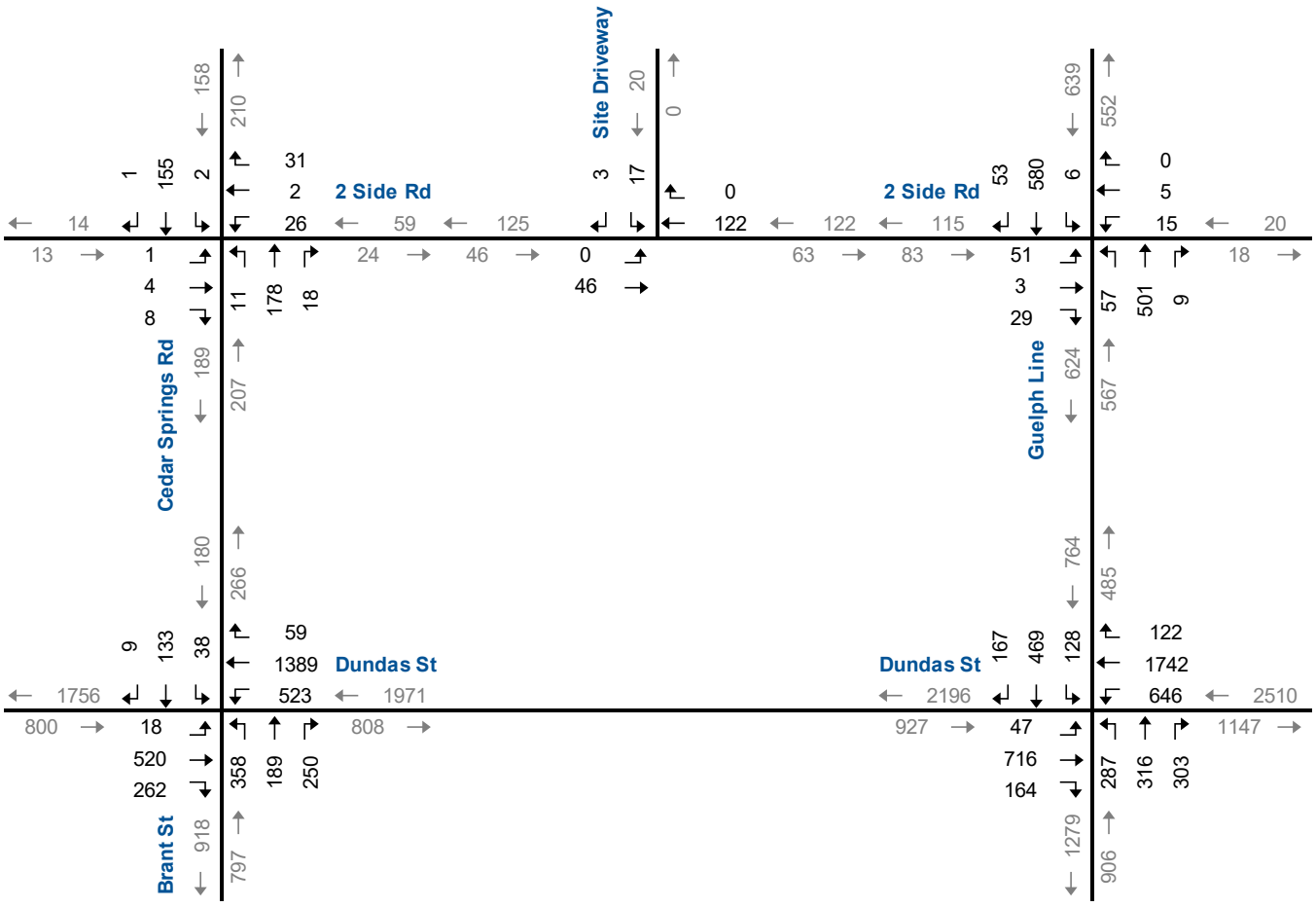
Base Year Traffic Volumes – AM Peak Hour (PCE)

Nelson Quarry Extension
190428

Figure 3.2A



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Base Year Traffic Volumes – PM Peak Hour (PCE)

Nelson Quarry Extension
190428

Figure 3.2B

3.3 Existing Traffic Operations

Intersection level of service (LOS) is a recognized method of quantifying the average delay experienced by drivers at intersections. It is based on the delay experienced by individual vehicles executing the various movements. The delay is related to the number of vehicles desiring to make a movement, compared to the estimated capacity for that movement. The capacity is based on several criteria related to the opposing traffic flows and intersection geometry.

The highest possible rating is LOS A, under which the average total delay is equal or less than 10.0 seconds per vehicle. When the average delay exceeds 80 seconds for signalized intersections, 50 seconds for unsignalized intersections or when the volume to capacity ratio is greater than 1.0, the movement is classed as LOS F and remedial measures are usually implemented, if they are feasible. LOS E is usually used as a guideline for the determination of road improvement needs on through lanes, while LOS F may be acceptable for left-turn movements at peak times, depending on delays.

The operations of the intersections in the study area were evaluated using the existing lane configuration and traffic control along with the base year traffic volumes and the existing signal timings Halton Region provided the signal timings. The intersection analysis considered three separate measures of performance:

- The LOS for each turning movement;
- The volume to capacity ratio (v/c) for each movement; and
- The 95th percentile queue lengths estimated using Synchro.

Synchro 9 with HCM 2000 procedures assessed the traffic conditions and performance. In accordance with the Halton Region TIS Guidelines[3], the following criteria were used in the determination of critical movements at signalized intersections:

- Volume/capacity (V/C) ratios for overall intersection operations, through movements, or shared through/turning movements increased to 0.85 or above:
- V/C ratios for exclusive movements increased to 0.95 or above; or
- Queues for an individual movement are projected to exceed available turning lane storage; and
- Level of service (LOS), based on average delay per vehicle, on individual movements exceeds LOS D for unsignalized intersections.

Table 3.2 details the base year level of service conditions and notes:

[3] *Halton Region Transportation Impact Study Guidelines. January 2015*

AM Peak Hour

- The westbound approaches of No. 2 Side Road to Guelph Line is operating with delays in the LOS E range with v/c ratios of less than 0.35;
- The Dundas Street intersection with Guelph Line is heavily utilized with several movements operating at capacity. The eastbound through and the shared northbound through/right-turn movements are forecast to operate with delays in the LOS E-F range with v/c ratios greater than 1.00. The westbound left-turn movement is forecast to operate with delays in the LOS F range with a v/c ratio approaching 0.95. Overall the intersection is operating with delays in the LOS E range with a v/c ratio approaching 1.00.
- The eastbound through movement at the Dundas Street intersection with Cedar Springs Road/Brant Street is operating with a v/c ratio approaching 0.95; and
- All other study area intersections are operating with acceptable levels of services.

PM Peak Hour

- The eastbound and westbound approaches of No. 2 Side Road to Guelph Line is operating with delays in the LOS E-F range with v/c ratios of less than 0.60;
- The Dundas Street intersection with Guelph Line is heavily utilized with several movements operating at capacity. The westbound and northbound left-turn movements are forecast to operate with delays in the LOS F range with v/c ratios greater than 1.00. The eastbound left-turn movement is forecast to operate with delays in the LOS F range with a v/c ratio greater than 0.90. Overall the intersection is operating with delays in the LOS D range with a v/c ratio approaching 1.00.
- The Dundas Street intersection with Brant Street/Cedar Springs Road is operating with reasonable traffic conditions except the estimated queue length for the westbound left-turn movement appears greater than the current available storage; and
- All other study area intersections are operating with acceptable levels of services.

Appendix C contains the detailed Synchro 9 output. The above noted capacity deficiencies are forecast under existing conditions and include the current level of quarry trucking traffic.

TABLE 3.2: BASE YEAR OPERATIONAL CONDITIONS

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				OVERALL
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Guelph Line & 2 Side Road	TWSC	LOS	<	D		D	<	E	>	E	A	A	>	A	A	A	>	A	
			Delay	<	29		29	<	37	>	37	9	0	>	1	9	0	>	0	
			V/C	<	0.53			<	0.30	>		0.05	0.31	>		0.01	0.32	>		
			95th	<	24			<	10	>		1	0	>		0	0	>		
			Storage	<	-			<	-	>		50	-	>		40	-	>		
			Avail.	<	-			<	-	>		49	-	>		40	-	>		
	Guelph Line & Dundas Street	TCS	LOS	C	E	C	E	F	B	>	C	D	F	>	F	D	D	D	D	E
			Delay	25	73	23	64	85	14	>	32	36	121	>	111	42	47	43	45	66
			V/C	0.44	1.05	0.27		0.93	0.31	>		0.33	1.17	>		0.61	0.39	0.04		0.99
			95th	51	345	45		106	58	>		39	174	>		46	56	6		
			Storage	100	-	70		115	-	>		50	-	>		70	-	70		
			Avail.	49	-	25		9	-	>		11	-	>		24	-	64		
	Cedar Springs Rd/Brant Street & Dundas Street	TCS	LOS	B	C	B	C	D	A	A	C	C	C	C	C	C	D	>	C	C
			Delay	13	33	15	29	43	8	8	20	26	22	26	25	32	36	>	35	27
			V/C	0.02	0.94	0.29		0.84	0.18	0.03		0.56	0.16	0.53		0.36	0.60	>		0.80
			95th	4	195	20		63	24	0		40	23	59		27	56	>		
			Storage	75	-	75		75	-	75		100	-	-		75	-	>		
			Avail.	71	-	55		12	-	75		60	-	-		48	-	>		
	Cedar Springs Rd & 2 Side Road	TWSC	LOS	<	B	>	B	<	B	>	B	<	A	>	A	<	A	>	A	
			Delay	<	10	>	10	<	12	>	12	<	0	>	0	<	1	>	1	
			V/C	<	0.04	>		<	0.04	>		<	0.00	>		<	0.02	>		
			95th	<	1	>		<	1	>		<	0	>		<	0	>		
	2 Side Road & Site Driveway	TWSC	LOS	<	A		A		A	>	A					B		>	A	
			Delay	<	0		0		0	>	0					11		>		
			V/C	<	0.00				0.12	>						0.20		>		
			95th	<	0				0	>						6		>		
PM Peak Hour	Guelph Line & 2 Side Road	TWSC	LOS	<	F		F	<	E	>	E	A	A	>	A	A	A	>	A	
			Delay	<	53		53	<	46	>	46	9	0	>	1	9	0	>	0	
			V/C	<	0.57			<	0.21	>		0.07	0.34	>		0.01	0.42	>		
			95th	<	24			<	6	>		2	0	>		0	0	>		
	Guelph Line & Dundas Street	TCS	LOS	F	D	C	D	F	C	>	D	F	E	>	E	D	E	D	D	D
			Delay	125	40	32	43	114	27	>	50	105	57	>	72	41	56	48	52	53
			V/C	0.89	0.63	0.12		1.14	0.88	>		1.04	0.77	>		0.56	0.72	0.32		0.98
			95th	41	119	19		268	289	>		126	96	>		43	89	43		
			Storage	100	-	70		115	-	>		50	-	>		70	-	70		
			Avail.	59	-	52		-153	-	>		-76	-	>		27	-	27		
	Cedar Springs Rd/Brant Street & Dundas Street	TCS	LOS	C	C	C	C	C	B	A	B	D	C	C	C	D	D	>	D	C
			Delay	23	25	23	24	32	16	9	20	45	26	25	34	40	43	>	42	25
			V/C	0.16	0.41	0.17		0.90	0.68	0.04		0.85	0.31	0.16		0.23	0.52	>		0.74
			95th	9	63	18		132	142	5		99	49	17		17	48	>		
			Storage	75	-	75		75	-	75		100	-	-		75	-	>		
			Avail.	66	-	57		-57	-	70		1	-	-		58	-	>		
	Cedar Springs Rd & 2 Side Road	TWSC	LOS	<	B	>	B	<	B	>	B	<	A	>	A	<	A	>	A	
			Delay	<	10	>	10	<	11	>	11	<	1	>	1	<	0	>	0	
			V/C	<	0.02	>		<	0.09	>		<	0.01	>		<	0.00	>		
			95th	<	1	>		<	3	>		<	0	>		<	0	>		
	2 Side Road & Site Driveway	TWSC	LOS	<	A		A		A	>	A					A		>	A	
			Delay	<	0		0		0	>	0					10		>		
			V/C	<	0.00				0.08	>						0.03		>		
			95th	<	0				0	>						1		>		

MOE - Measure of Effectiveness
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
V/C - Volume to Capacity Ratio
95th - 95th Percentile Queue Length
LOS - Level of Service
> - Shared Right-Turn Lane
< - Shared Left-Turn Lane

4 Future Conditions

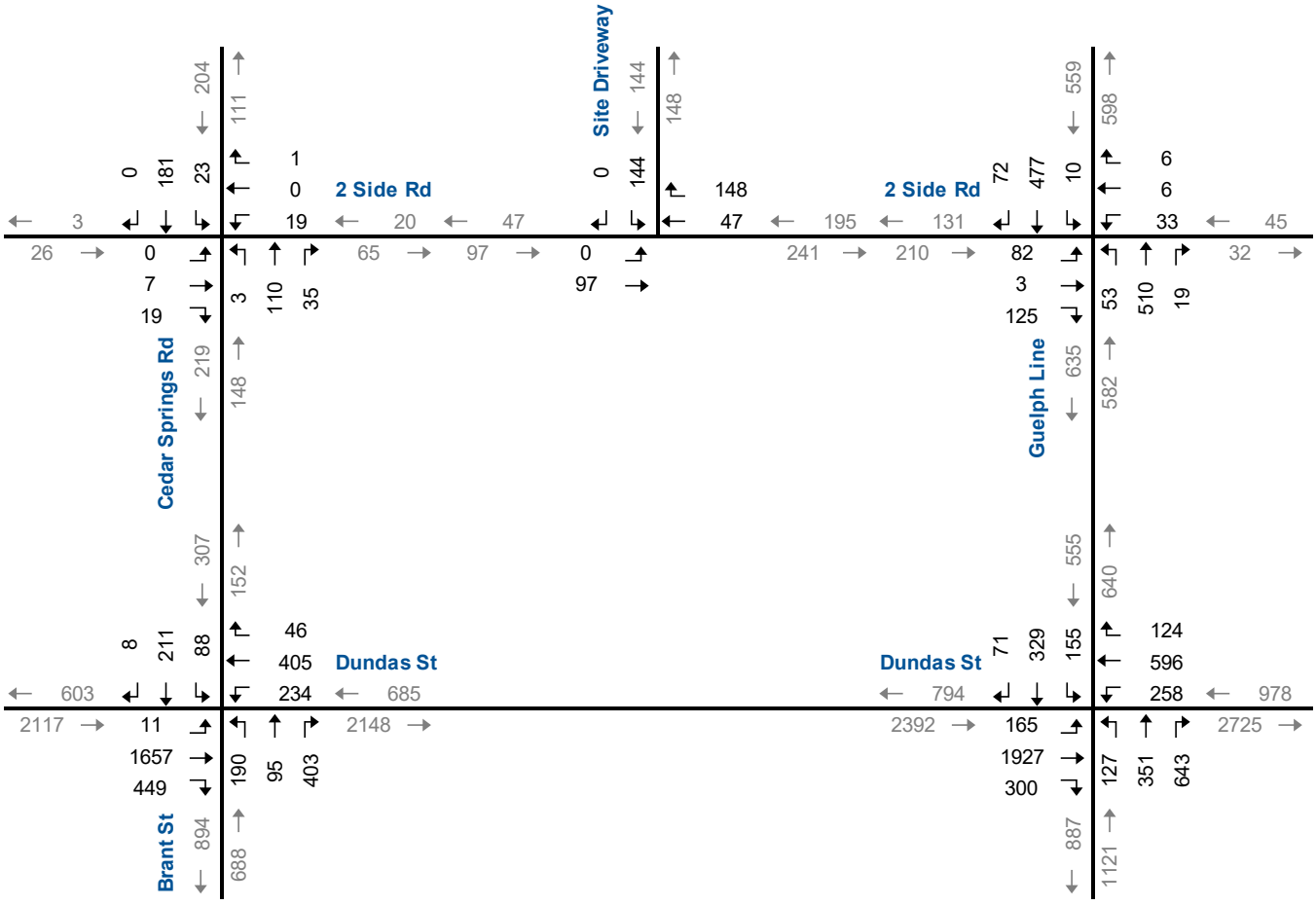
The assessment of the future traffic conditions contained in this section includes the traffic forecasts as well as the level of service analysis.

4.1 Traffic Forecasts

A five-year horizon (Year 2024) from the date of the study has been assessed following the Halton Region Transportation Impact Study Guidelines[4]. The likely future traffic volumes near the subject site are estimated to consist of increased non-site traffic (generalized background traffic growth). The generalized background traffic growth assumes an annual growth rate of 2% per annum. This growth rate is considered conservative (i.e., high) for the study area. In general terms, peak hour traffic growth is driven by urban development trends and in this area, the new urban development for the next few years is the Waterdown urban expansion, urban Burlington intensification and north Oakville urban expansion. These urban development trends would indicate that traffic growth is most likely to increase in the eastbound and westbound directions along Dundas Street with limited growth along the north/south arterial roadways of Guelph Line and Cedar Springs Road, south of Dundas Street.

Figure 4.1A and **Figure 4.1B** illustrates the forecast Five-Year Background Traffic volumes

[4] *Transportation Impact Study Guidelines, Region of Halton, January, 2015.*

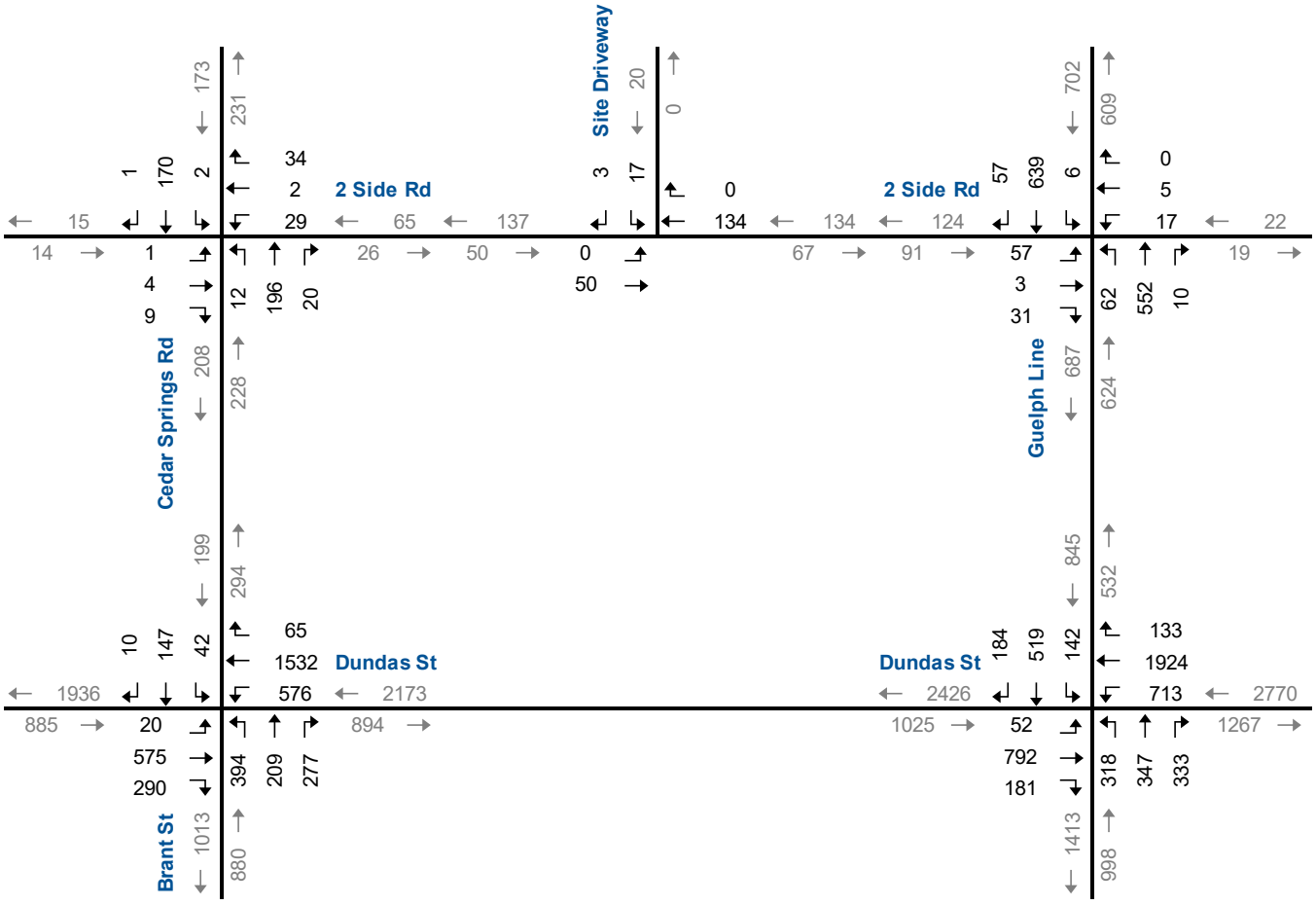


NTS

Forecast Background Traffic – AM Peak Hour (PCE)

Nelson Quarry Extension
190428

Figure 4.1A



Forecast Background Traffic – PM Peak Hour (PCE)

Nelson Quarry Extension
190428

Figure 4.1B

4.2 Future Quarry Activity

The current plans for the proposed quarry extension anticipate that the future levels of aggregate production and the related truck traffic will be about 1.0 million tonnes per annum. Historically, Nelson has shipped between 1.0 and 1.5 million tonnes per annum. However, the license application seeks a limit of 2.0 million tonnes per annum.

To assess the future traffic impact of the quarry extension, estimates of the truck traffic activity equivalent to the license application limit of 2.0 million tonnes per annum have been prepared, as shown in **Table 4.1**.

These estimates are developed using the October 2019 driveway counts factored to the maximum quarry production of 2.0 million tonnes per annum. With this level of production, the site's weekday peak hour traffic activity is estimated to be 112 AM trips and 16 PM trips. This would be equivalent to the maximum level of production in the busy month of October.

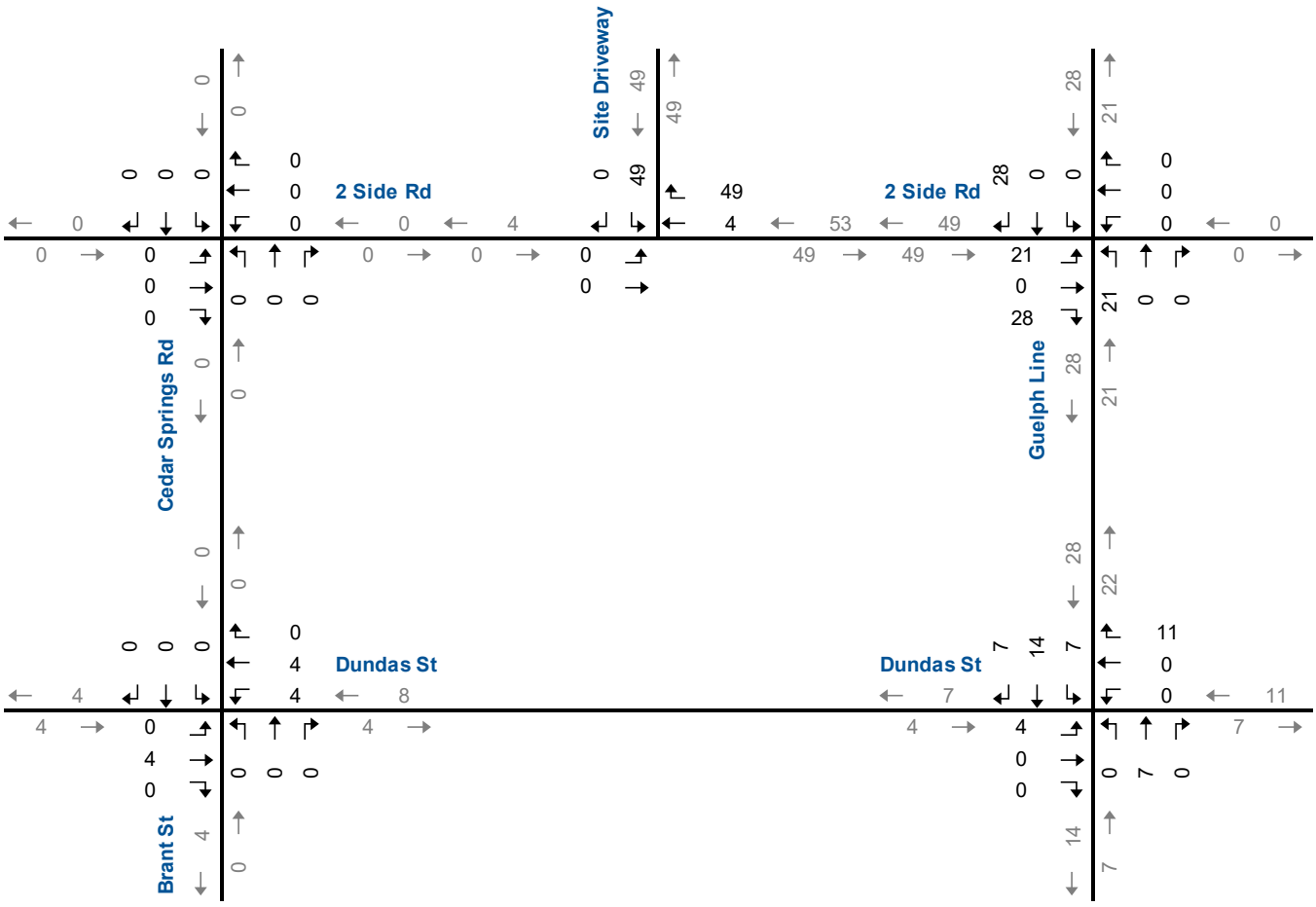
TABLE 4.1: SITE GENERATED TRAFFIC

Quarry Operations	AM Peak Hour			PM Peak Hour		
	In	Out	Sum	In	Out	Sum
TMC Data – Total Volume	43	41	**84**	0	15	**15**
License Limit – 2.0M tonnes/annum - Total Volume	14	14	**28**	0	1	**1**
Total Volume	**57**	**55**	**112**	**0**	**16**	**16**
TMC Data – Heavy Vehicles	42	41	**83**	0	2	**2**
License Limit – Heavy Vehicles	14	14	**28**	0	1	**1**
TMC Data – Light Vehicles	1	0	**1**	0	13	**13**
License Limit – Light Vehicles	0	0	**0**	0	0	**0**

Figure 4.2A and **Figure 4.2B** illustrates the forecast site generated traffic with a peak production limit of 2.0 million tonnes per annum.

Figure 4.3A and **Figure 4.3B** illustrates the forecast Five-Year Total Traffic volumes which include the subject site generated traffic with the peak annual production (i.e., 2.0 million tonnes annually).

Heavy vehicles at the critical intersection of Guelph Line and Dundas Street account for approximately 4% of the AM peak hour entering volume and 2% of the PM peak hour entering volume. This level of truck traffic is typical for an intersection of two major arterial roadways.

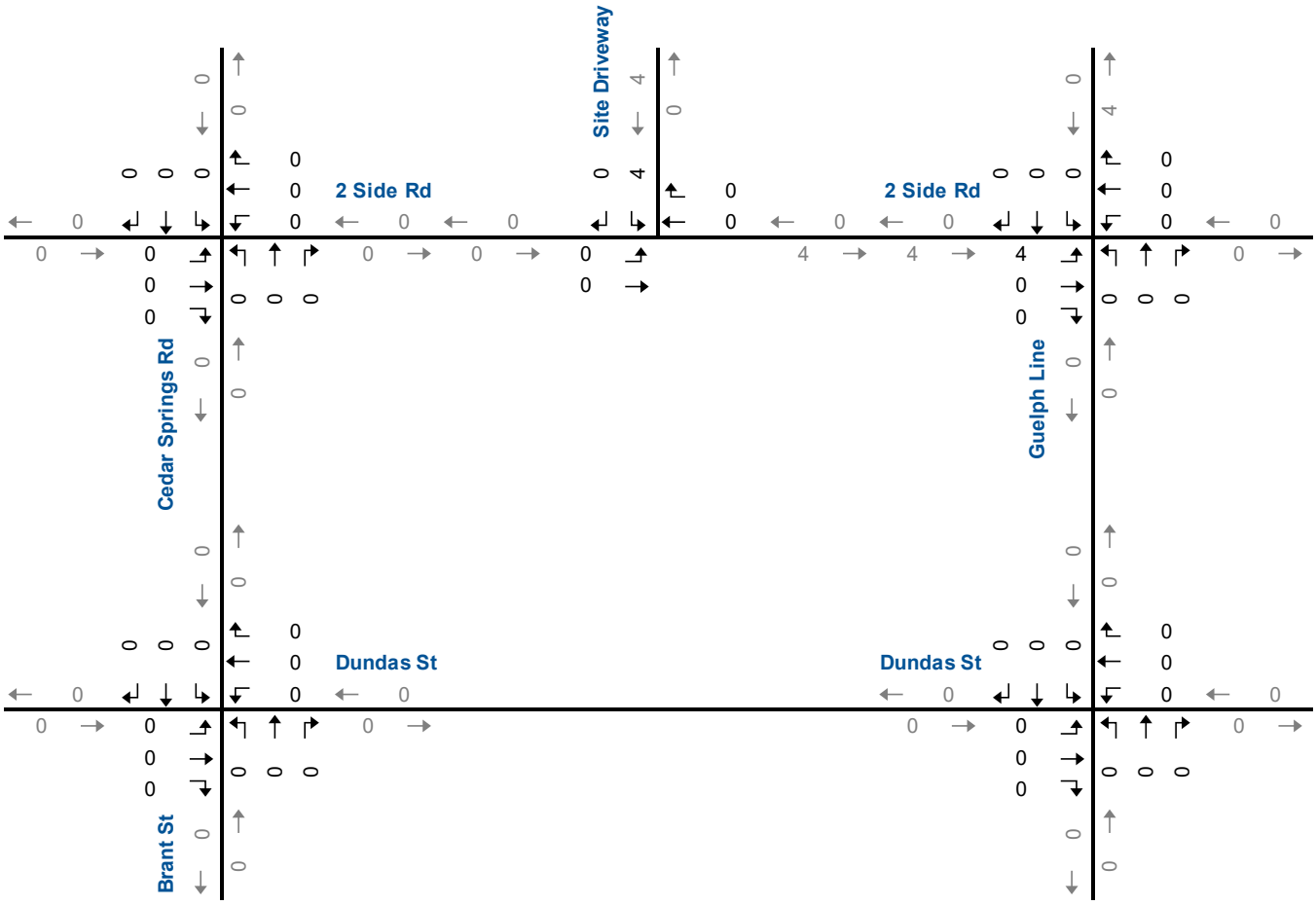


NTS

Forecast Site Generated Traffic – AM Peak Hour (PCE)

Nelson Quarry Extension
190428

Figure 4.2A

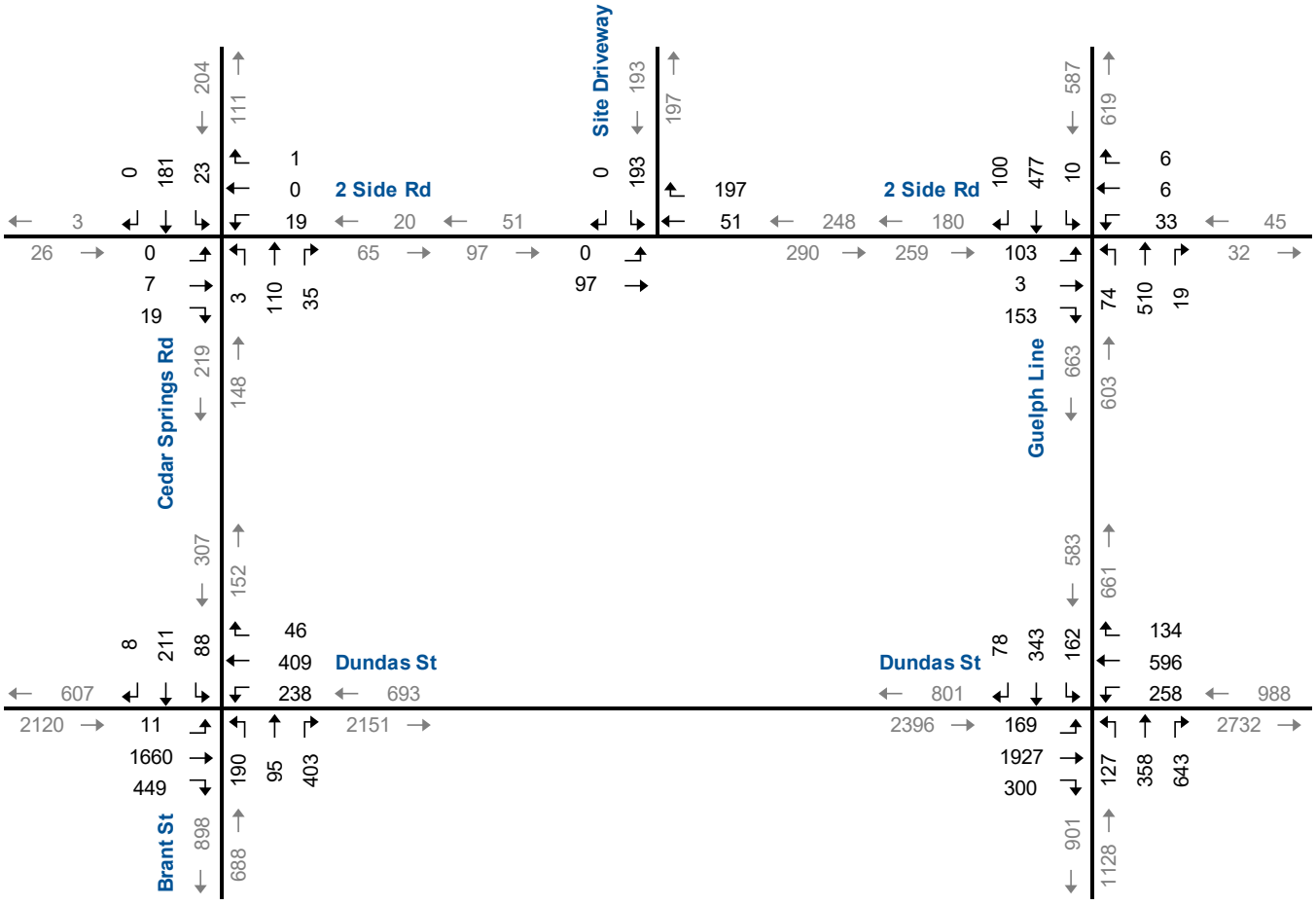


NTS

Forecast Site Generated Traffic – PM Peak Hour (PCE)

Nelson Quarry Extension
190428

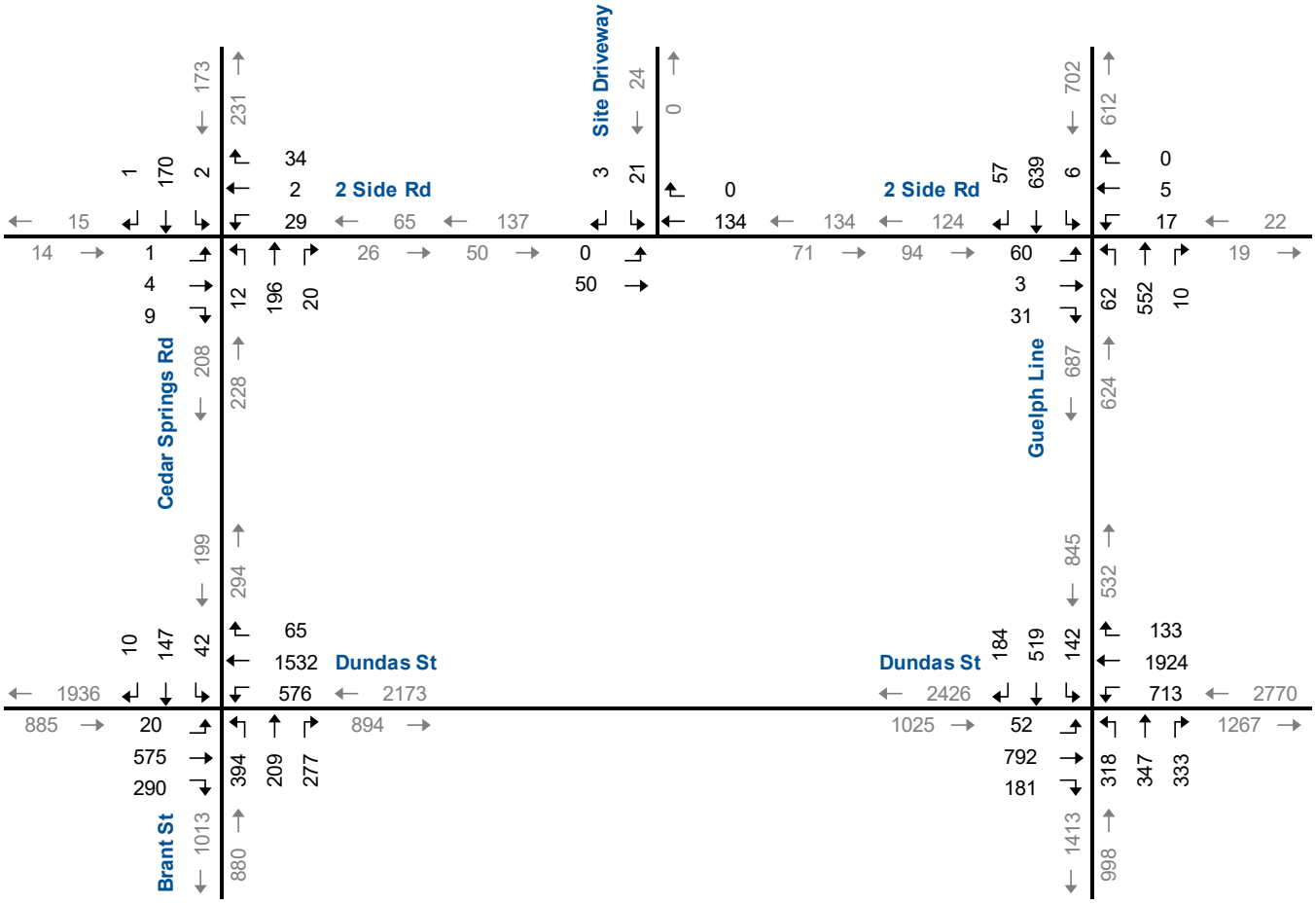
Figure 4.2B



Forecast Total Traffic – AM Peak Hour (PCE)

Nelson Quarry Extension
190428

Figure 4.3A



NTS

Forecast Total Traffic – PM Peak Hour (PCE)

Nelson Quarry Extension
190428

Figure 4.3B

4.3 Traffic Operations

4.3.1 Background Traffic Operations

The study area intersection operations analyses followed the same methodology used for existing conditions. Signal timings have been optimized to help ensure reasonable levels of service can be maintained. **Table 4.2** summarizes the level of service conditions with notes as follows:

AM Peak Hour

- The eastbound and westbound approaches of No. 2 Side Road to Guelph Line is forecast to operate with delays in the LOS E-F range with v/c ratios of less than 0.75;
- The Dundas Street intersection with Guelph Line is forecast to remain at capacity;
- The eastbound through movement at the Dundas Street intersection with Cedar Springs Road/Brant Street is forecast to operate with a v/c ratio greater than 1.00; and
- All other study area intersections are operating with acceptable levels of services.

PM Peak Hour

- The eastbound and westbound approaches of No. 2 Side Road to Guelph Line is forecast to operate with delays in the LOS F range with v/c ratios of less than 0.85;
- The Dundas Street intersection with Guelph Line is forecast to remain at capacity;
- The queue length estimated for the westbound and southbound left-turn movements at the Dundas Street intersection with Cedar Springs Road/Brant Street are forecast to operate with queue lengths greater than the current available storage and with high v/c ratios; and
- All other study area intersections are operating with acceptable levels of services.

Appendix D contains the detailed Synchro 9 output.

The above noted capacity deficiencies are forecast to under existing and background conditions and are anticipated to continue to occur with or without the proposed quarry extension.

TABLE 4.2: BACKGROUND TRAFFIC OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				OVERALL
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Guelph Line & 2 Side Road	TWSC	LOS	<	E		**E**	<	F	>	**F**	A	A	>	**A**	A	A	>	**A**	
			Delay	<	41		**41**	<	51	>	**51**	9	0	>	**1**	9	0	>	**0**	
			V/C	<	0.70			<	0.40	>		0.06	0.34	>		0.01	0.35	>		
			95th	<	40			<	13	>		2	0	>		0	0	>		
			Storage	<	-			<	-	>		50	-	>		40	-	>		
			Avail.	<	-			<	-	>		49	-	>		40	-	>		
	Guelph Line & Dundas Street	TCS	LOS	C	F	C	**F**	F	B	>	**D**	D	F	>	**F**	D	D	D	**D**	**F**
			Delay	28	117	23	**99**	114	14	>	**40**	37	182	>	**165**	45	48	43	**46**	**97**
			V/C	0.53	1.16	0.31		1.04	0.34	>		0.38	1.31	>		0.66	0.43	0.05		**1.10**
			95th	60	402	53		123	66	>		43	208	>		52	62	8		
			Storage	100	-	70		115	-	>		50	-	>		70	-	70		
			Avail.	40	-	17		-8	-	>		7	-	>		18	-	62		
	Cedar Springs Rd/Brant Street & Dundas Street	TCS	LOS	B	E	B	**D**	E	A	A	**C**	C	C	C	**C**	C	D	>	**D**	**D**
			Delay	13	57	16	**48**	62	9	8	**27**	28	22	28	**27**	33	37	>	**36**	**40**
			V/C	0.03	1.04	0.35		0.93	0.20	0.03		0.63	0.17	0.61		0.39	0.65	>		**0.89**
			95th	4	228	29		74	26	1		44	25	71		29	62	>		
			Storage	75	-	75		75	-	75		100	-	-		75	-	>		
			Avail.	71	-	46		1	-	74		56	-	-		46	-	>		
	Cedar Springs Rd & 2 Side Road	TWSC	LOS	<	B	>	**B**	<	B	>	**B**	<	A	>	**A**	<	A	>	**A**	
			Delay	<	10	>	**10**	<	13	>	**13**	<	0	>	**0**	<	1	>	**1**	
			V/C	<	0.04	>		<	0.05	>		<	0.00	>		<	0.02	>		
			95th	<	1	>		<	1	>		<	0	>		<	1	>		
	2 Side Road & Site Driveway	TWSC	LOS	<	A		**A**		A	>	**A**					B		>	**A**	
			Delay	<	0		**0**		0	>	**0**					11		>		
			V/C	<	0.00				0.12	>						0.21		>		
			95th	<	0				0	>						6		>		
PM Peak Hour	Guelph Line & 2 Side Road	TWSC	LOS	<	F		**F**	<	F	>	**F**	A	A	>	**A**	A	A	>	**A**	
			Delay	<	93		**93**	<	63	>	**63**	10	0	>	**1**	9	0	>	**0**	
			V/C	<	0.80			<	0.29	>		0.08	0.38	>		0.01	0.47	>		
			95th	<	38			<	9	>		2	0	>		0	0	>		
	Guelph Line & Dundas Street	TCS	LOS	F	D	C	**D**	F	D	>	**F**	F	E	>	**F**	D	E	D	**D**	**E**
			Delay	176	42	33	**47**	198	42	>	**82**	168	62	>	**96**	44	58	49	**53**	**74**
			V/C	1.02	0.69	0.15		1.33	0.98	>		1.22	0.84	>		0.62	0.77	0.37		**1.10**
			95th	47	134	24		329	380	>		156	115	>		48	98	50		
			Storage	100	-	70		115	-	>		50	-	>		70	-	70		
			Avail.	53	-	46		-214	-	>		-106	-	>		23	-	21		
	Cedar Springs Rd/Brant Street & Dundas Street	TCS	LOS	C	C	C	**C**	E	B	A	**C**	E	C	C	**D**	D	D	>	**D**	**C**
			Delay	25	26	23	**25**	64	18	9	**30**	70	27	26	**46**	41	45	>	**44**	**33**
			V/C	0.24	0.44	0.19		1.04	0.74	0.04		0.98	0.34	0.18		0.25	0.57	>		**0.83**
			95th	10	70	17		177	165	6		163	61	19		21	58	>		
			Storage	75	-	75		75	-	75		100	-	-		75	-	>		
			Avail.	65	-	58		-102	-	70		-63	-	-		54	-	>		
	Cedar Springs Rd & 2 Side Road	TWSC	LOS	<	B	>	**B**	<	B	>	**B**	<	A	>	**A**	<	A	>	**A**	
			Delay	<	10	>	**10**	<	11	>	**11**	<	1	>	**1**	<	0	>	**0**	
			V/C	<	0.02	>		<	0.11	>		<	0.01	>		<	0.00	>		
			95th	<	1	>		<	3	>		<	0	>		<	0	>		
	2 Side Road & Site Driveway	TWSC	LOS	<	A		**A**		A	>	**A**					A		>	**A**	
			Delay	<	0		**0**		0	>	**0**					10		>		
			V/C	<	0.00				0.09	>						0.03		>		
			95th	<	0				0	>						1		>		

MOE - Measure of Effectiveness
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
V/C - Volume to Capacity Ratio
95th - 95th Percentile Queue Length
LOS - Level of Service
> - Shared Right-Turn Lane
< - Shared Left-Turn Lane

The Halton Region Transportation Master Plan[5] identifies the need for improvements to Dundas Street over the next five years to continue to accommodate the expected growth traffic along Dundas Street. The plan indicates that Dundas Street will be widened from 4 lanes to 6 lanes from east of Guelph Line to the City of Hamilton boundary.

The plan also indicates possible improvements to Guelph Line, south of Dundas Street. These improvements are expected to provide additional capacity to the Dundas Street corridor including the intersections with Guelph Line and Cedar Springs Road/Brant Street.

4.3.2 Total Traffic Operations

The "Total Traffic Operations" scenario is based on the five year growth in existing traffic, including the maximum level of production of 2.0 million tonnes annually in truck trips to and from the Nelson quarry. As noted earlier, this production increase is not planned but could occur based on the proposed limit of 2.0 million tonnes annually.

The study area intersection operations analyses followed the same methodology used for existing conditions. Signal timings have been optimized to help ensure reasonable levels of service can be maintained. **Table 4.3** summarizes the level of service conditions and notes:

AM Peak Hour

- The eastbound and westbound approaches of No. 2 Side Road to Guelph Line are forecast to operate with delays in the LOS F range. The v/c ratio for the eastbound approach is forecast to be greater than 1.00;
- The Dundas Street intersection with Guelph Line is forecast to remain at capacity;
- The eastbound through movement at the Dundas Street intersection with Cedar Springs Road/Brant Street is forecast to operate with a v/c ratio greater than 1.00. The westbound left-turn movement is forecast to operate with delays in the LOS E range with a v/c ratio of 0.95 and a queue length greater than the current available storage; and
- All other study area intersections are operating with acceptable levels of services.

PM Peak Hour

- The eastbound and westbound approaches of No. 2 Side Road to Guelph Line is forecast to operate with delays in the LOS F range with v/c ratios of less than 0.85;
- The Dundas Street intersection with Guelph Line is forecast to remain at capacity;

[5] *The Road to Change: Halton Region Transportation Master Plan 2031, September 2011.*

- The westbound and southbound left-turn movements at the Dundas Street intersection with Cedar Springs Road/Brant Street are forecast to operate with delays in the LOS F range with a v/c ratio near 1.00 and with queue lengths greater than the current available storage; and
- All other study area intersections are operating with acceptable levels of services.

Appendix E contains the detailed Synchro 9 output.

The above noted capacity deficiencies are generally expected to occur under background conditions and are anticipated to occur with or without the proposed quarry extension.

TABLE 4.3: TOTAL TRAFFIC OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																OVERALL
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Guelph Line & 2 Side Road	TWSC	LOS	<	F		F	<	F	>	F	A	A	>	A	A	A	>	A	
			Delay	<	121		121	<	66	>	66	9	0	>	1	9	0	>	0	
			V/C	<	1.08			<	0.47	>		0.08	0.34	>		0.01	0.37	>		
			95th	<	94			<	17	>		2	0	>		0	0	>		
			Storage	<	-			<	-	>		50	-	>		40	-	>		
			Avail.	<	-			<	-	>		48	-	>		40	-	>		
	Guelph Line & Dundas Street	TCS	LOS	C	F	C	F	F	B	>	D	D	F	>	F	D	D	D	D	F
			Delay	28	118	23	100	114	14	>	40	37	187	>	170	46	48	43	47	98
			V/C	0.54	1.16	0.31		1.04	0.35	>		0.39	1.32	>		0.69	0.45	0.05		1.11
			95th	62	402	53		123	67	>		43	210	>		54	64	11		
			Storage	100	-	70		115	-	>		50	-	>		70	-	70		
			Avail.	38	-	17		-8	-	>		7	-	>		16	-	59		
	Cedar Springs Rd/Brant Street & Dundas Street	TCS	LOS	B	E	B	D	E	A	A	C	C	C	C	C	C	D	>	D	D
			Delay	13	58	16	49	66	9	8	28	28	22	28	27	33	37	>	36	40
			V/C	0.03	1.04	0.35		0.95	0.20	0.03		0.63	0.17	0.61		0.39	0.65	>		0.90
			95th	4	229	29		76	26	1		44	25	71		29	62	>		
			Storage	75	-	75		75	-	75		100	-	-		75	-	>		
			Avail.	71	-	46		-1	-	74		56	-	-		46	-	>		
	Cedar Springs Rd & 2 Side Road	TWSC	LOS	<	B	>	B	<	B	>	B	<	A	>	A	<	A	>	A	
			Delay	<	10	>	10	<	13	>	13	<	0	>	0	<	1	>	1	
			V/C	<	0.04	>		<	0.05	>		<	0.00	>		<	0.02	>		
			95th	<	1	>		<	1	>		<	0	>		<	1	>		
	2 Side Road & Site Driveway	TWSC	LOS	<	A		A		A	>	A					B		>	A	
			Delay	<	0		0		0	>	0					12		>		
			V/C	<	0.00				0.16	>						0.29		>		
			95th	<	0				0	>						10		>		
PM Peak Hour	Guelph Line & 2 Side Road	TWSC	LOS	<	F		F	<	F	>	F	A	A	>	A	A	A	>	A	
			Delay	<	100		100	<	63	>	63	10	0	>	1	9	0	>	0	
			V/C	<	0.83			<	0.29	>		0.08	0.38	>		0.01	0.47	>		
			95th	<	41			<	9	>		2	0	>		0	0	>		
	Guelph Line & Dundas Street	TCS	LOS	F	D	C	D	F	D	>	F	F	E	>	F	D	E	D	D	E
			Delay	176	42	33	47	198	42	>	82	168	62	>	96	44	58	49	53	74
			V/C	1.02	0.69	0.15		1.33	0.98	>		1.22	0.84	>		0.62	0.77	0.37		1.10
			95th	47	134	24		329	380	>		156	115	>		48	98	50		
			Storage	100	-	70		115	-	>		50	-	>		70	-	70		
			Avail.	53	-	46		-214	-	>		-106	-	>		23	-	21		
	Cedar Springs Rd/Brant Street & Dundas Street	TCS	LOS	C	C	C	C	E	B	A	C	E	C	C	D	D	D	>	D	C
			Delay	25	26	23	25	64	18	9	30	70	27	26	46	41	45	>	44	33
			V/C	0.24	0.44	0.19		1.04	0.74	0.04		0.98	0.34	0.18		0.25	0.57	>		0.83
			95th	10	70	17		177	165	6		163	61	19		21	58	>		
			Storage	75	-	75		75	-	75		100	-	-		75	-	>		
			Avail.	65	-	58		-102	-	70		-63	-	-		54	-	>		
	Cedar Springs Rd & 2 Side Road	TWSC	LOS	<	B	>	B	<	B	>	B	<	A	>	A	<	A	>	A	
			Delay	<	10	>	10	<	11	>	11	<	1	>	1	<	0	>	0	
			V/C	<	0.02	>		<	0.11	>		<	0.01	>		<	0.00	>		
			95th	<	1	>		<	3	>		<	0	>		<	0	>		
	2 Side Road & Site Driveway	TWSC	LOS	<	A		A		A	>	A					A		>	A	
			Delay	<	0		0		0	>	0					10		>		
			V/C	<	0.00				0.09	>						0.03		>		
			95th	<	0				0	>						1		>		

MOE - Measure of Effectiveness
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
V/C - Volume to Capacity Ratio
95th - 95th Percentile Queue Length
LOS - Level of Service
> - Shared Right-Turn Lane
< - Shared Left-Turn Lane

5 Need for Improvements

The operational analyses outlined in **Section 3** and **Section 4** suggests several capacity deficiencies are occurring under existing conditions and will continue to occur in the future with or without the proposed quarry extension.

The Halton Region Transportation Master Plan identifies a widening of Dundas Street to 6 lanes from east of Guelph Line to the City of Hamilton boundary. Additional improvements are expected to occur on Guelph Line south of Dundas Street. It is expected that these improvements will provide additional capacity to the Dundas Street corridor and to the intersections with Guelph Line and Cedar Springs Road/Brant Street.

5.1 Traffic Control Improvements

The operational analysis suggests the Guelph Line intersection with No. 2 Side Road will experience higher levels of delay with the forecast traffic volumes.

To address the capacity related concerns, the intersections have been assessed using the Ontario Traffic Manual (OTM) Book 12[6] signal warrant guidelines to determine if the need for improvements to the existing form of two-way stop control is warranted under the traffic forecasts.

Appendix F contains the signal warrant analysis.

Based on the warrant analysis, the criteria necessary to warrant the installation of a traffic control signal is not satisfied. No change to the existing form of traffic control is needed or recommended.

[6] *Ontario Traffic Manual Book 12, Ministry of Transportation of Ontario, March 2012.*

5.2 South Extension Access Road

5.2.1 South Extension Shipping Traffic

Nelson has advised that the mined aggregate from the South Extension is proposed to be transported by CAT 775 70-tonne rock trucks across No. 2 Side Road at grade to the existing processing plant.

Traffic related to the shipping of material cross No. 2 Side Road is estimated using several assumptions related to the operation of the site. These include the following:

- The amount of material extracted and trucked across No. 2 Sideroad is expected to be 1.0 million tonnes annually but under the license provision could be 2.0 million tonnes annually.
- The trucking activity across No. 2 Sideroad will likely occur for 10 months of the year (e.g., February to November) and for 10 hours per day. This is equivalent to about 208 working days each year.
- Material is shipped across the road by 70-tonne rock trucks. The same empty truck returns to receive another load.

Using the information provided by Nelson, **Table 5.1** summarizes the estimated trip generation for truck trips crossing No. 2 Side Road. The hourly traffic across No. 2 Sideroad is estimated to be approximately 12 truck trips inbound to the processing plant (loaded) and 12 truck trips outbound returning to the extension lands (empty).

TABLE 5.1: ESTIMATED SOUTH QUARRY EXTENSION CROSSING TRAFFIC

Measure	Units	Input	Calculation
CAT 772 Trucks	Trucks	4	
One Way Trips per Hour	Trips/Hour	3	
Operating Hours per Day	Hours/Day	10	
One-way Truck Trips	Truck Trips/Day		120
Operating Days per Year	Days/Year	250	
One-way Truck Trips	Truck Trips/Year		30,000
Average Load per Truck	Tonnes/Truck	70	
Average Tonnes per Year	Tonnes/Year*		2,000,000
Loaded Inbound Trips	Trucks/Hour		12
Empty Outbound Trips	Trucks/Hour		12
Total Two-Way Truck Trips	**Trucks/Hour**		**24**

**Extraction limited by license amount.*

The volume of traffic crossing No. 2 Side Road is not expected to create capacity issues at the South Extension Access Road intersection with No. 2 Side Road. Forecast two-way traffic using No. 2 Side Road where the South Extension Access Road will be located is in the order of 85 PCE vehicles per hour (vph) during the AM peak hour and 90 PCE vph during the PM peak hour.

It is expected that the South Extension Access Road will be designed to accommodate the heavy truck design vehicle and that the northbound and southbound approaches will operate under stop control. Additional signage and/or gates to restrict the Access Road to authorized vehicles only should be considered.

5.2.2 Access Road Sight Distance

The required minimum departure sight distance along the major roadway is calculated using a series of assumptions related to quarry access road and the design vehicles used to ship material between the South Extension lands and the existing processing on the north side of No. 2 Side Road.

The assumptions include:

- Design speed on No. 2 Sideroad of 70 km/h;
- Perception and reaction time of crossing driver = 2.0 s
- Distance stopped from near edge of pavement = 3.0 m
- Width of pavement along the path of the crossing vehicle = 9.0 m
- Overall length of the design vehicle = 8.74 m
- Acceleration curves (Acceleration from stop control on minor road)

The required minimum departure sight distance along the major roadway is given by the expression[7]:

$$D = \frac{V(J + t)}{3.6}$$

- D = min crossing sight distance along the major roadway from intersection (m)
- V = design speed of major roadway (km/h) = 70 km/h
- J = perception and reaction time of crossing driver (s) = 2.0
- t = time to cross the major roadway pavement (s)

[7] TAC 1999 Section 2.3.3.3: No Control Sight Distance Requirements for Specific Traffic Control Devices

The crossing distance is computed using the formula:

$$s = d + w + L$$

- s = distance travelled during acceleration (m)
- d = distance from near edge of pavement to front of stopped vehicle (m), generally assumed to be 3.0 m
- w = width of pavement along the path of the crossing vehicle ~ 9.0 m
- l = overall length of the crossing vehicle (m) ~ 8.74 m (CAT 772 specs)

$$s = d + w + L = 3.00 + 9.00 + 8.74 = 20.74\,m \sim 21\,m$$

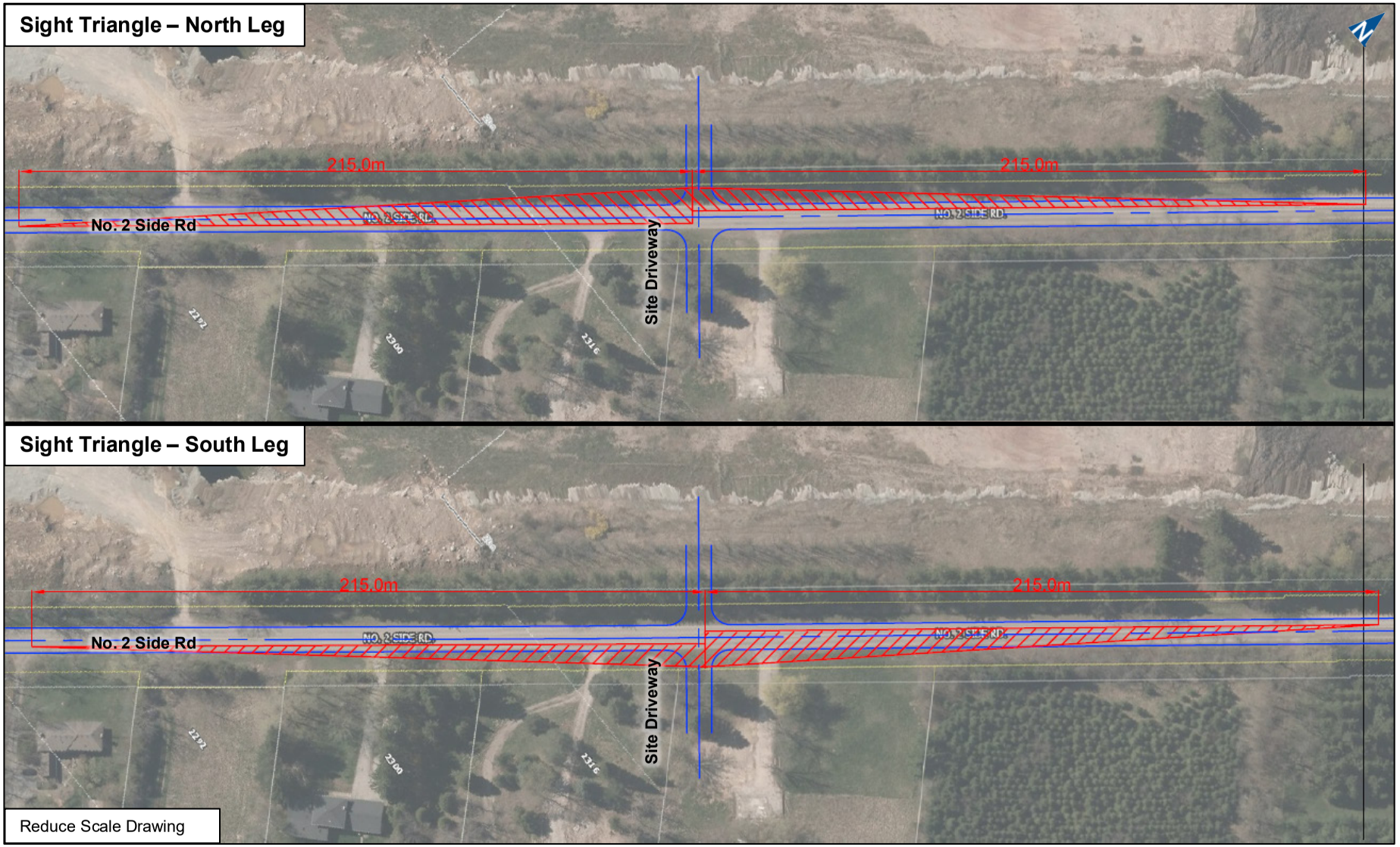
The crossing time for a tractor trailer to travel 21 metres is estimated to be approximately 9 seconds[8]. Using the formula to calculate the required minimum departure sight distance along the major roadway, the sight distance is estimated to be approximately 215 metres.

$$D = \frac{V(J+t)}{3.6} = \frac{70(2.0+9)}{3.6} = \frac{70(11)}{3.6} = \frac{770}{3.6} = 213\,m \sim 215m$$

To accommodate the proposed quarry access road intersection, its position should allow for at least 215 metres of sight distances in both directions. The suggested location for the quarry access road intersection is at the crest of No. 2 Side Road approximately 300 metres west of the existing office driveway. **Figure 5.1** illustrates the required sight triangles for the site driveway to No. 2 Side Road.

The design of the driveway should remove any trees or other vegetation encroaching into the line of sight triangles in each direction. Additional signage to restrict unauthorized vehicles should be considered by the site operator.

[8] TAC 1999 – Figure 2.3.3.3: Assumed Acceleration Curves (Acceleration From Stop Control on Minor Road).



Driveway Sight Triangle Requirements

5.3 Guelph Line at No. 2 Side Road

The intersection of No. 2 Side Road with Guelph Line is designed to accommodate heavy vehicle traffic. The eastbound right-turn moment is a channelized free flow lane with a southbound acceleration lane on Guelph Line.

The capacity deficiencies forecast to occur on the eastbound approach is related to the stop-controlled conditions for the shared through/left-turn movement. The forecast AM peak hour volume for this shared moment is approximately 55 vehicles (36 light vehicles + 19 heavy vehicles). The forecast PM peak hour volume for this shared moment is approximately 30 vehicles (18 light vehicles + 12 heavy vehicles). The low volume would not suggest the need for improvements to this approach. No changes the existing form of traffic control is recommended.

6 Conclusions and Recommendations

6.1 Conclusions

Nelson Aggregate Company is a prime supplier of aggregate for building and construction purposes in the west Greater Toronto Area (GTA) and Hamilton area.

Nelson is planning extensions of the area licensed for the mining and processing of aggregate material at the Company's Burlington Quarry. The Burlington Quarry has been producing aggregate since 1953. The extensions of the quarry will enable the quarry operations to continue.

With the proposed extension areas, Nelson plans to ship approximately 1.0 million tonnes of aggregate annually. The existing quarry is permitted to ship an unlimited amount of aggregate annually. Historically the quarry has shipped an average 1.5 to 2.0 million tonnes per year with lower levels over recent years. The proposed extension is applying for a maximum tonnage limit of 2.0 million tonnes per year.

The traffic impact assessment has been completed based on the proposed limit of 2.0 million tonnes per annum and considers asphalt production, aggregate recycling and clean fill imported for rehabilitation.

With production at a license limit of 2.0 million tonnes, the site's weekday AM peak hour truck generation is forecast to be approximately 111 truck trips (56 inbound + 55 outbound). The site's weekday PM peak hour truck generation is forecast to be 3 truck trips (0 inbound + 3 outbound).

Light vehicle traffic generated by the quarry does not have a measurable impact on the study area road network. The light vehicle traffic tends to be spread out beyond the typical weekday peak hours of the roadway traffic and it may also be spread out to a variety of routes as it is not restricted by the prohibition of truck movements on Cedar Springs Road.

The roadways used to haul the material are currently utilized by the existing operation as an established haul route. As there is no change proposed to the haul route, no new impacts to the road network are anticipated.

Some capacity deficiencies at the study area intersections are forecast under existing conditions. These deficiencies will occur with or without the proposed quarry extension. The impact of vehicle trips generated by the site with an annual production of 2.0 million tonnes per annum (aggregate/recycling/clean fill) is not anticipated to have a significant impact on the operations of the study area intersections.

The Halton Region Transportation Master Plan identifies a widening of Dundas Street to 6 lanes from east of Guelph Line to the City of Hamilton boundary. Additional improvements are indicated on Guelph Line south of Dundas Street. It is expected that these improvements will provide additional

capacity to the Dundas Street corridor and to the intersections with Guelph Line and Cedar Springs Road/Brant Street.

The intersection of No. 2 Side Road with Guelph Line is designed to accommodate heavy vehicle traffic. The eastbound right-turn moment is a channelized free flow lane with a southbound acceleration lane on Guelph Line.

The capacity deficiencies forecast to occur on the eastbound approach of No. 2 Side Road to Guelph Line is related to the stop-controlled conditions for the shared through/left-turn movement. The forecast AM peak hour volume for this shared moment is approximately 55 vehicles (36 light vehicles + 19 heavy vehicles). The forecast PM peak hour volume for this shared moment is approximately 30 vehicles (18 light vehicles + 12 heavy vehicles). The low volume would not suggest the need for improvements to this approach. No changes the existing form of traffic control is recommended.

The mined aggregate from the South Extension lands is proposed to be transported by 70-tonne rock trucks across No. 2 Side Road at grade to the existing processing plant. Recommendations for this crossing have been developed to ensure appropriate sightlines are available and to ensure the structural integrity of the roadway.

6.2 Recommendations

Based on the findings of this study, it is recommended that:

- No improvements to the existing study area roadways are required or recommended to accommodate the proposed extension to the Nelson Burlington Quarry; and
- The South Extension of the Burlington Quarry will require a new roadway crossing No. 2 Sideroad at grade for trucks transporting rock material into the existing quarry for processing. The following provisions are recommended for this new roadway crossing:
  - The northbound and southbound approaches to No. 2 Sideroad shall be controlled by stop sign control.
  - The new roadway crossing should be located on the crest on No. 2 Sideroad with a clear sight distance of at least 215 metres in each direction along No. 2 Sideroad for both the northbound and southbound approaches.
  - The roadway geometry and road bed structure should be designed to accommodate the rock trucks that Nelson plans to operate.

Appendix A

Confidential Nelson Trucking Data (Not Included in Public Report)

Appendix A contains Confidential Nelson Trucking Data. Data can be made available for technical review but following a non-disclosure agreement with Nelson Aggregate Co.

Appendix B

Traffic Data

Dundas St @ Guelph Line

Morning Peak Diagram

Specified Period
From: 6:00:00
To: 10:00:00

One Hour Peak
From: 7:30:00
To: 8:30:00

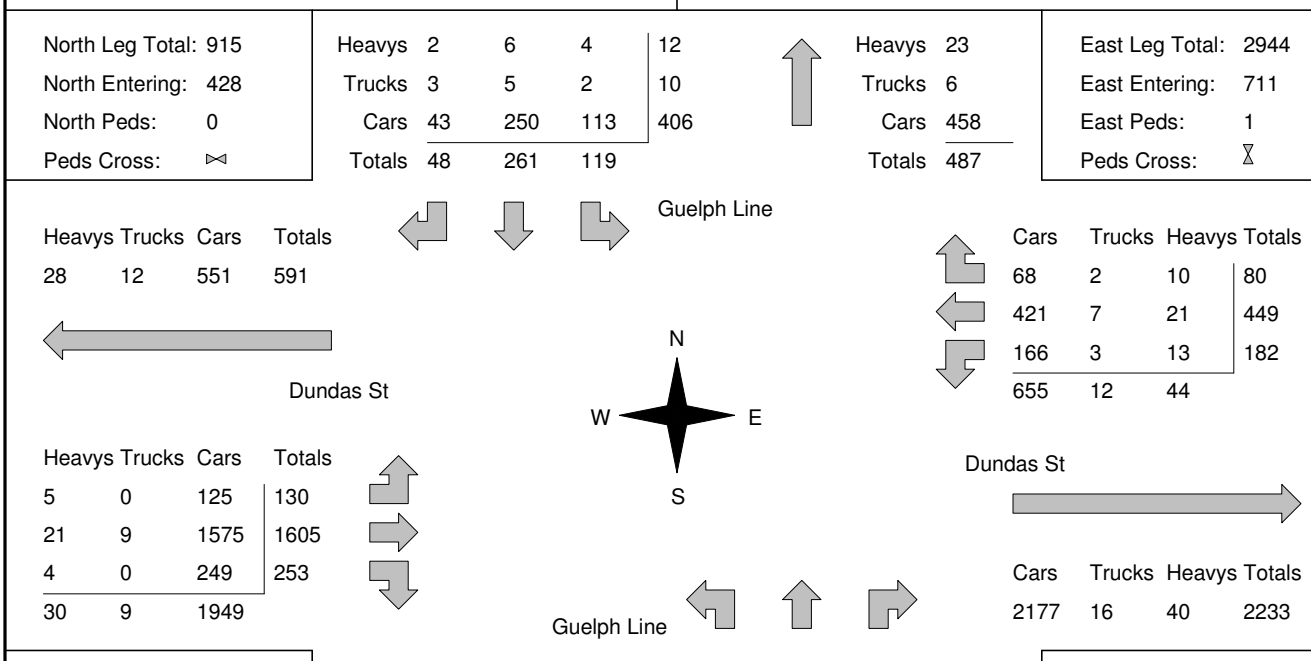
Municipality: Halton Region
Site #: 0000002733
Intersection: Dundas St & Guelph Line
TFR File #: 7
Count date: 5-Apr-2017

Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Dundas St runs W/E



Comments

Dundas St @ Guelph Line

Mid-day Peak Diagram

Specified Period
From: 12:00:00
To: 14:00:00

One Hour Peak
From: 13:00:00
To: 14:00:00

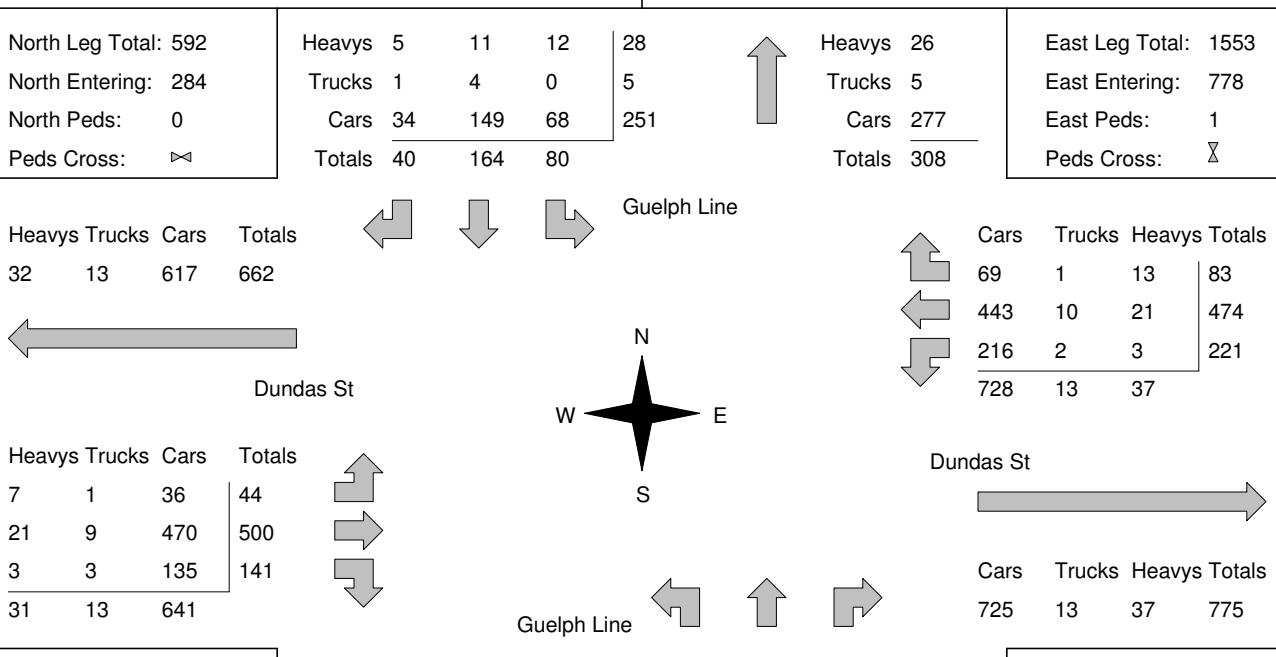
Municipality: Halton Region
Site #: 0000002733
Intersection: Dundas St & Guelph Line
TFR File #: 7
Count date: 5-Apr-2017

Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Dundas St runs W/E



Comments

Dundas St @ Guelph Line

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 22:00:00

One Hour Peak
From: 16:45:00
To: 17:45:00

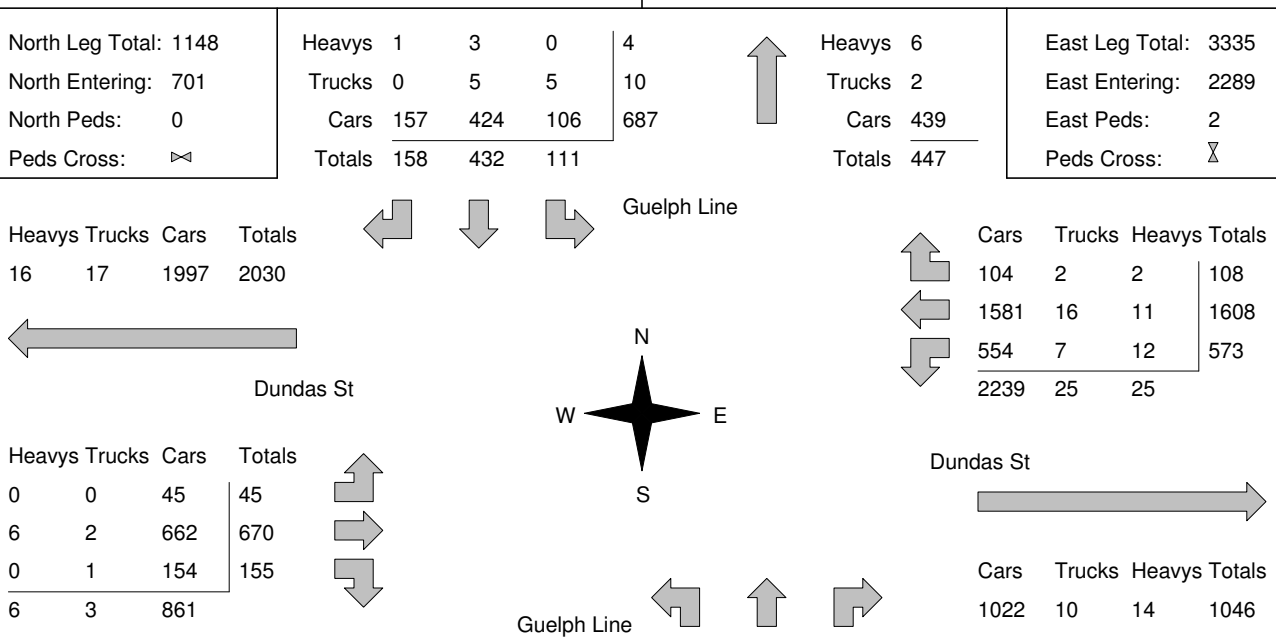
Municipality: Halton Region
Site #: 0000002733
Intersection: Dundas St & Guelph Line
TFR File #: 7
Count date: 5-Apr-2017

Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Dundas St runs W/E



Comments

Dundas St @ Guelph Line

Total Count Diagram

Municipality: Halton Region
Site #: 0000002733
Intersection: Dundas St & Guelph Line
TFR File #: 7
Count date: 5-Apr-2017

Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Dundas St runs W/E

North Leg Total:	8218			
North Entering:	4374			
North Peds:	0			
Peds Cross:	⋈			
Heavys	33	78	67	178
Trucks	7	28	18	53
Cars	770	2559	814	4143
Totals	810	2665	899	
Heavys	166			
Trucks	51			
Cars	3627			
Totals	3844			
East Leg Total:	25727			
East Entering:	12901			
East Peds:	6			
Peds Cross:	⧖			

Guelph Line

Heavys	Trucks	Cars	Totals
248	120	10899	11267

Cars	Trucks	Heavys	Totals
729	16	79	824
8435	100	182	8717
3237	39	84	3360
12401	155	345	

Dundas St

N
W E
S

Heavys	Trucks	Cars	Totals
35	8	590	633
152	80	8483	8715
18	15	1730	1763
205	103	10803	

Dundas St

Cars	Trucks	Heavys	Totals
12398	132	296	12826

Guelph Line

Peds Cross:	⧖			
West Peds:	0			
West Entering:	11111			
West Leg Total:	22378			
Cars	7526			
Trucks	82			
Heavys	180			
Totals	7788			
Cars	1694	2308	3101	7103
Trucks	13	27	34	74
Heavys	33	52	77	162
Totals	1740	2387	3212	
Peds Cross:	⋈			
South Peds:	2			
South Entering:	7339			
South Leg Total:	15127			

Comments

Intersection Name:	TS ID:	Line NO:	IP address:
Dundas St @ Guelph Line	703	5	172.22.233.2
Controller Make: Econolite	**Model:** ACS/3	**Firmware Rev. No:**	

Type of Operation 8 Phase Semi-Actuated

Revision

NO	Date Y	Date M	Date D	Description	Prepared by
1	2015	5	13	Implement timings in Centracs	MA

*- Start From Main Menu

PHASE DESCRIPTION

Ph1	WBLT - Dundas St.	Ph5	
Ph2	EB - Dundas St.	PH6	WB - Dundas St.
Ph3	SBL -Guelph Line	Ph7	NBL -Guelph Line
Ph4	NB - Guelph Line	Ph8	SB - Guelph Line

CONFIGURATION (PHASE SEQ): PHASE IN USE /EXCLUSIVE PED (MM) * - 1 - 2

Phase:	1	2	3	4	5	6	7	8
Phase in Use :	X	X	X	X		X	X	X
Bicycle Min Green								
Exclusive PED :								

CONTROLLER TIMING DATA - VEHICLE TIMINGS (4 available) * - 2 - 1

Timing Plan: 1

Phase:	1	2	3	4	5	6	7	8
Minimum Green :	7	8	7	8		8	7	8
Conditional Service Min. Green :								
Walk :		7		7		7		7
Ped. Clearance :		32		25		32		25
Pedestrians Carry Over :								
Vehicle Extension :	3	3	3	3		3	3	3
MAX 1 :	15	55	15	35		55	15	35
MAX 2 :	15	55	15	35		55	15	35
Yellow Change :	3	5	3	4		5	3	4
Red Clearance :	1	2	1	3		2	1	3

PHASE DATA - VEHICLE AND PEDESTRIAN RECALLS * - 2 - 8

Phase:	1	2	3	4	5	6	7	8
Lock Detector :								
Vehicle Recall :								
Pedestrian Recall :		X				X		
MAX Recall :								
Soft Recall :								

COORDINATION: COORDINATOR PATTERN, SPLIT PATTERN * - 3 - 2, - 3 - 3

Coordinator Pattern (CP)	Cycle Length	Offset (sec)	Timing Plan	Split Pattern	Phases (sec) 1	2	3	4	5	6	7	8
1	140	59	1	1	18	70	18	34		88	18	34
2	110	56	1	2	13	49	18	30		62	18	30
3	140	108	1	3	38	50	18	34		88	18	34

Intersection Name:	TS ID:	Line NO:	IP address:
Dundas St @ Guelph Line	703	5	172.22.233.2
Controller Make: Econolite	**Model:** ACS/3	**Firmware Rev. No:**	

10	0	0	1	10	0	0		0		0	0	0

CP # 1, 2, 10	Phase:	1	2	3	4	5	6	7	8
Coord Phase	:		X				X		
Vehicle Recall	:								
Pedestrian Recall *(3-3, 5-2)	:		X				X		
Recall to MAX Time	:								
Phase Omit	:								
Special Function Outputs	:								

Coordinator Pattern #	Prefer.	Phase							
		1	2	3	4	5	6	7	8
	1								
	2								

X - select "." deselect

TIME BASE: ACTION PLAN, DAY PLAN *** - 5 - 2, - 5 - 3, - 5 - 4**

Day Plan	Sched. #	Action Plan	Time Period	Pattern	Timing Plan
1	1	1	06:00	1	1
1	1	2	09:00	2	1
1	1	3	15:00	3	1
1	1	2	19:00	2	1
1	1	10	21:30	254	1
2	2	10	00:00	254	1
3	3	10	00:00	254	1

Schedule 1 = Day Plan 1
Schedule 2 = Day Plan 2
Schedule 3 = Day Plan 3

Day Plan 1 (Weekday)
Day Plan 2 (Saturday)
Day Plan 3 (Sunday, Holidays)

Action Plan 10 = free (254)

TIME BASE DATA - TIME OF YEAR EVENTS *** - 5 - 5**

Events	Exception Day		MON/ MON	DOW/ DOM	WOM/ Year	Day Plan
New Year's Day	1	Fixed	01	1	0	3
Family Day	2	Float	2	2	3	3
Good Friday	3	Float	04	6	1	3
Victoria Day	4	Float	05	2	3	3
Canada Day	5	Fixed	07	1	0	3
Civic Day	6	Float	08	2	1	3
Labour Day	7	Float	09	2	1	3
Thanksgiving	8	Float	10	2	2	3
Christmas Day	9	Fixed	12	25	0	3

Intersection Name:	TS ID:	Line NO:	IP address:
Dundas St @ Guelph Line	703	5	172.22.233.2

Controller Make:	Model:	Firmware Rev. No:	
Econolite	ACS/3		

Guelph Line @ 2 Side Rd

Morning Peak Diagram

Specified Period
From: 7:00:00
To: 9:00:00

One Hour Peak
From: 7:30:00
To: 8:30:00

Municipality: Halton Region
Site #: 0000001111
Intersection: Guelph Line & 2 Side Rd
TFR File #: 5
Count date: 21-Sep-2017

Weather conditions:
Sunny/Dry

Person(s) who counted:
Armando

**** Non-Signalized Intersection ****

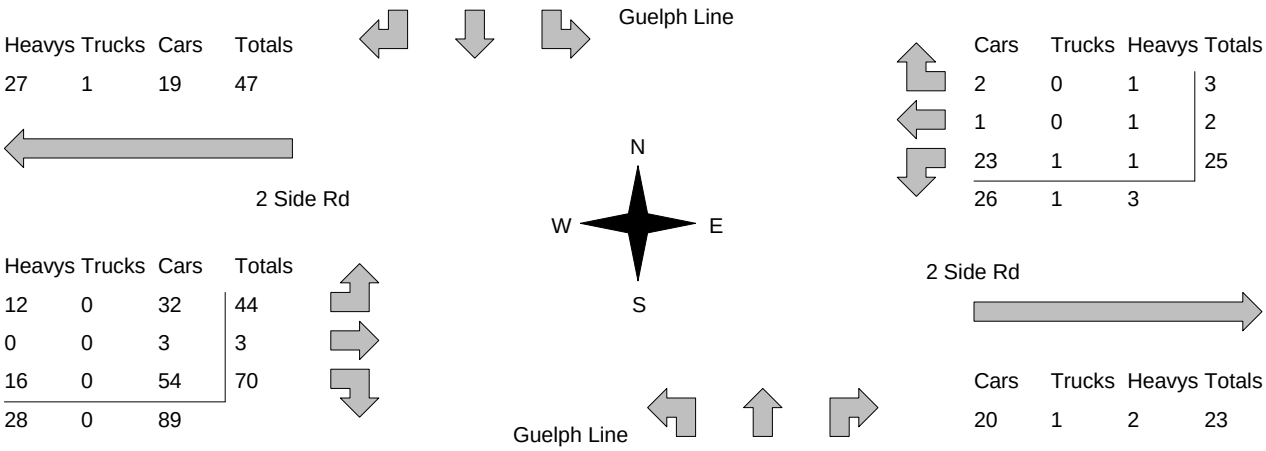
Major Road: Guelph Line runs N/S

North Leg Total: 861
North Entering: 416
North Peds: 0
Peds Cross: ⋈

Heavys	15	10	2	27
Trucks	1	4	0	5
Cars	8	373	3	384
Totals	24	387	5	

Heavys	25
Trucks	8
Cars	412
Totals	445

East Leg Total: 53
East Entering: 30
East Peds: 0
Peds Cross: ⧖



Heavys	Trucks	Cars	Totals
27	1	19	47

Cars	Trucks	Heavys	Totals
2	0	1	3
1	0	1	2
23	1	1	25
26	1	3	

Heavys	Trucks	Cars	Totals
12	0	32	44
0	0	3	3
16	0	54	70
28	0	89	

Cars	Trucks	Heavys	Totals
20	1	2	23

Peds Cross: ⧖
West Peds: 0
West Entering: 117
West Leg Total: 164

Cars	450			
Trucks	5			
Heavys	27			
Totals	482			

Cars	10	378	14	402
Trucks	0	8	1	9
Heavys	11	12	0	23
Totals	21	398	15	

Peds Cross: ⋈
South Peds: 0
South Entering: 434
South Leg Total: 916

Comments

Guelph Line @ 2 Side Rd

Mid-day Peak Diagram

Specified Period
From: 11:00:00
To: 14:00:00

One Hour Peak
From: 11:45:00
To: 12:45:00

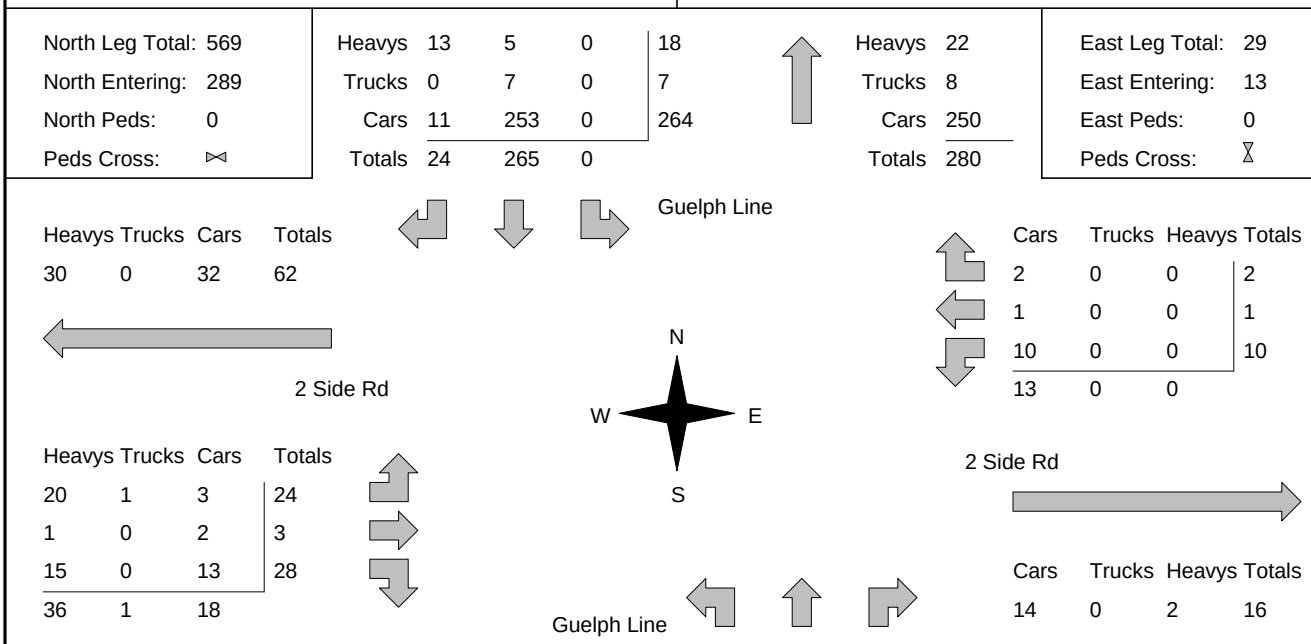
Municipality: Halton Region
Site #: 0000001111
Intersection: Guelph Line & 2 Side Rd
TFR File #: 5
Count date: 21-Sep-2017

Weather conditions:
Sunny/Dry

Person(s) who counted:
Armando

**** Non-Signalized Intersection ****

Major Road: Guelph Line runs N/S



Comments

Guelph Line @ 2 Side Rd

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 16:15:00
To: 17:15:00

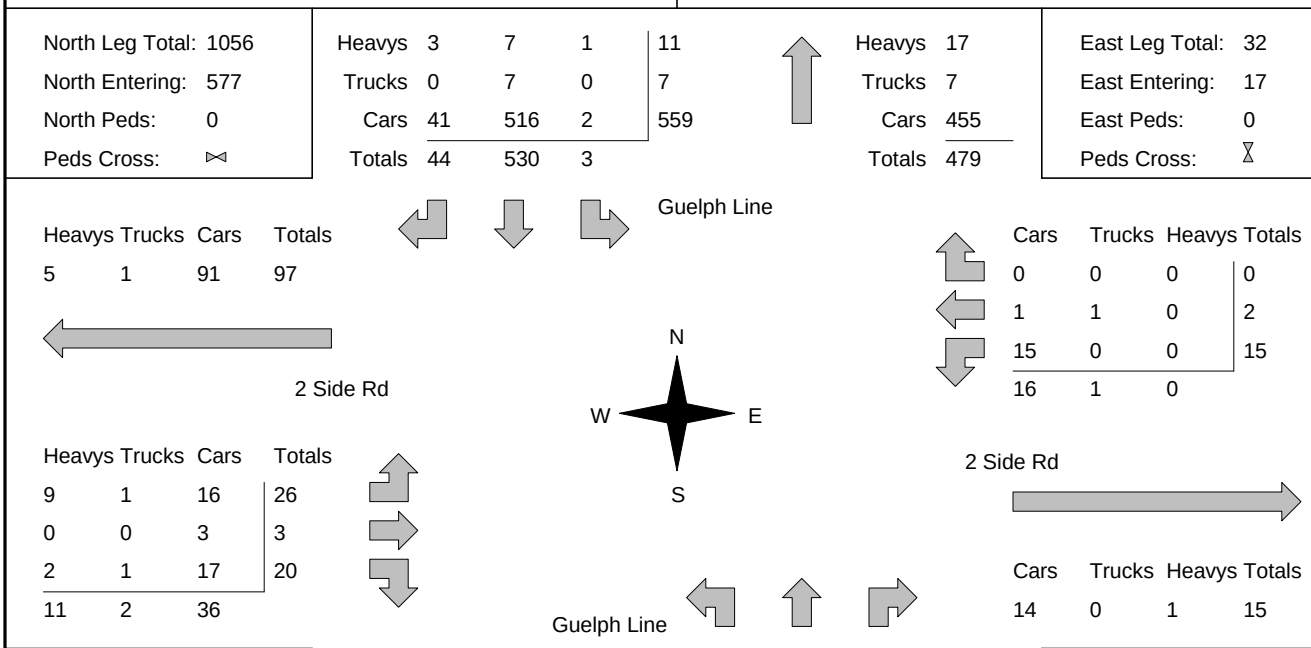
Municipality: Halton Region
Site #: 0000001111
Intersection: Guelph Line & 2 Side Rd
TFR File #: 5
Count date: 21-Sep-2017

Weather conditions:
Sunny/Dry

Person(s) who counted:
Armando

**** Non-Signalized Intersection ****

Major Road: Guelph Line runs N/S



Comments

Guelph Line @ 2 Side Rd

Total Count Diagram

Municipality: Halton Region
Site #: 0000001111
Intersection: Guelph Line & 2 Side Rd
TFR File #: 5
Count date: 21-Sep-2017

Weather conditions:
Sunny/Dry

Person(s) who counted:
Armando

**** Non-Signalized Intersection ****

Major Road: Guelph Line runs N/S

North Leg Total:	5762			
North Entering:	3031			
North Peds:	0			
Peds Cross:	⋈			
Heavys	78	56	3	137
Trucks	2	63	0	65
Cars	126	2690	13	2829
Totals	206	2809	16	
Heavys	165			
Trucks	50			
Cars	2516			
Totals	2731			
East Leg Total:	282			
East Entering:	138			
East Peds:	1			
Peds Cross:	⧖			

Guelph Line

Heavys	Trucks	Cars	Totals
184	9	372	565

2 Side Rd

Cars	Trucks	Heavys	Totals
15	0	2	17
16	2	2	20
94	4	3	101
125	6	7	

N
W E
S

Heavys	Trucks	Cars	Totals
107	3	121	231
3	1	22	26
89	3	190	282
199	7	333	

2 Side Rd

Cars	Trucks	Heavys	Totals
132	3	9	144

Guelph Line

Peds Cross:	⧖			
West Peds:	0			
West Entering:	539			
West Leg Total:	1104			
Cars	2974			
Trucks	70			
Heavys	148			
Totals	3192			
Cars	230	2380	97	2707
Trucks	5	47	2	54
Heavys	104	56	3	163
Totals	339	2483	102	
Peds Cross:	⋈			
South Peds:	0			
South Entering:	2924			
South Leg Total:	6116			

Comments

Cedar Springs Rd @ No. 2 Side Road

Morning Peak Diagram

Specified Period
From: 7:00:00
To: 9:00:00

One Hour Peak
From: 7:45:00
To: 8:45:00

Municipality: Burlington
Site #: 0000200455
Intersection: Cedar Springs Rd & No. 2 Side Roa
TFR File #: 2
Count date: 2-Apr-2013

Weather conditions:
Partly Cloudy/Dry

Person(s) who counted:
Rick W

**** Non-Signalized Intersection ****

Major Road: Cedar Springs Rd runs N/S

North Leg Total:	247			
North Entering:	163			
North Peds:	0			
Peds Cross:	⋈			
Cyclists	0	0	0	0
Trucks	0	1	0	1
Cars	0	143	19	162
Totals	0	144	19	
Cyclists	0			
Trucks	3			
Cars	81			
Totals	84			
East Leg Total:	61			
East Entering:	13			
East Peds:	0			
Peds Cross:	⧖			

Cedar Springs Rd

Cyclists	Trucks	Cars	Totals
0	0	3	3

No. 2 Side Road

Cars	Trucks	Cyclists	Totals
1	0	0	1
0	0	0	0
10	2	0	12
11	2	0	

N
W E
S

Cyclists	Trucks	Cars	Totals
0	0	0	0
0	0	5	5
0	2	10	12
0	2	15	

No. 2 Side Road

Cars	Trucks	Cyclists	Totals
46	2	0	48

Cedar Springs Rd

Peds Cross:	⧖			
West Peds:	0			
West Entering:	17			
West Leg Total:	20			
Cars	163			
Trucks	5			
Cyclists	0			
Totals	168			
Cars	3	80	22	105
Trucks	0	3	2	5
Cyclists	0	0	0	0
Totals	3	83	24	
Peds Cross:	⋈			
South Peds:	0			
South Entering:	110			
South Leg Total:	278			

Comments

Cedar Springs Rd @ No. 2 Side Road

Mid-day Peak Diagram

Specified Period
From: 11:00:00
To: 14:00:00

One Hour Peak
From: 13:00:00
To: 14:00:00

Municipality: Burlington
Site #: 0000200455
Intersection: Cedar Springs Rd & No. 2 Side Roa
TFR File #: 2
Count date: 2-Apr-2013

Weather conditions:
Partly Cloudy/Dry

Person(s) who counted:
Rick W

**** Non-Signalized Intersection ****

Major Road: Cedar Springs Rd runs N/S

North Leg Total: 185
North Entering: 85
North Peds: 0
Peds Cross: ⋈

Cyclists	0	0	0	0
Trucks	0	0	0	0
Cars	1	82	2	85
Totals	1	82	2	

Cyclists	0
Trucks	1
Cars	99
Totals	100

East Leg Total: 36
East Entering: 22
East Peds: 0
Peds Cross: ⧖

Cedar Springs Rd

Cyclists	Trucks	Cars	Totals
0	0	8	8

Cars	Trucks	Cyclists	Totals
9	0	0	9
4	0	0	4
9	0	0	9
22	0	0	

No. 2 Side Road

N
W E
S

Cyclists	Trucks	Cars	Totals
0	0	1	1
0	0	1	1
0	1	4	5
0	1	6	

No. 2 Side Road

Cars	Trucks	Cyclists	Totals
14	0	0	14

Cedar Springs Rd

Peds Cross: ⧖
West Peds: 0
West Entering: 7
West Leg Total: 15

Cars	95
Trucks	1
Cyclists	0
Totals	96

Cars	3	89	11	103
Trucks	0	1	0	1
Cyclists	0	0	0	0
Totals	3	90	11	

Peds Cross: ⋈
South Peds: 0
South Entering: 104
South Leg Total: 200

Comments

Cedar Springs Rd @ No. 2 Side Road

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 16:30:00
To: 17:30:00

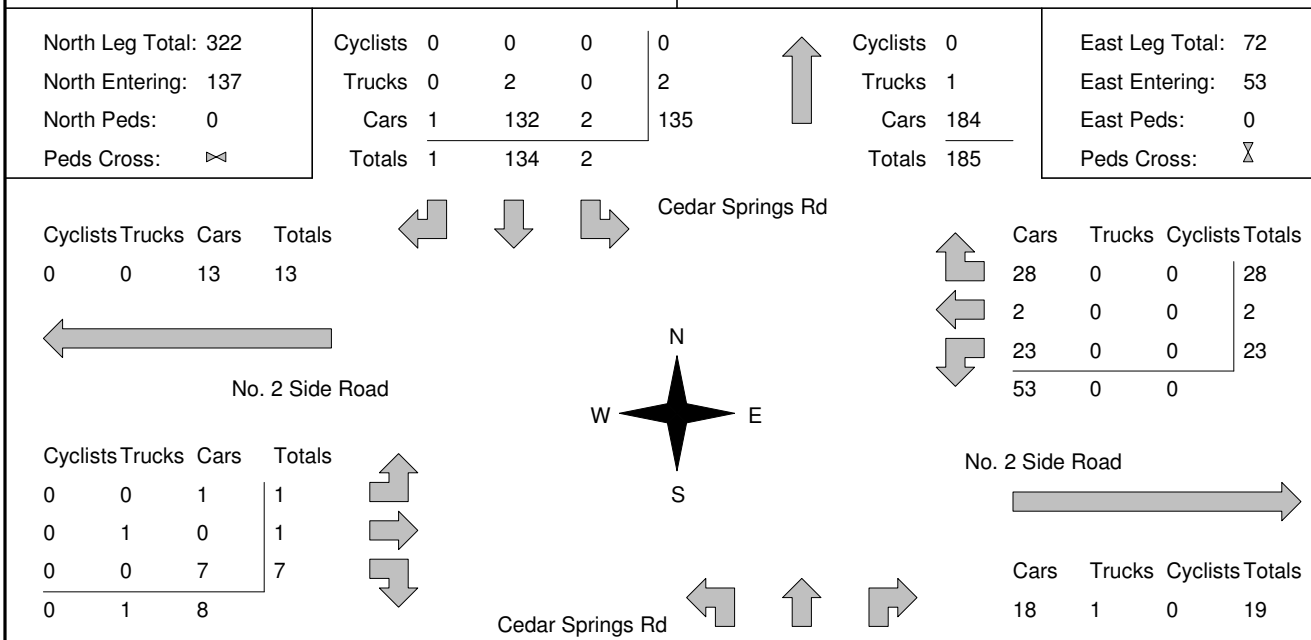
Municipality: Burlington
Site #: 0000200455
Intersection: Cedar Springs Rd & No. 2 Side Roa
TFR File #: 2
Count date: 2-Apr-2013

Weather conditions:
Partly Cloudy/Dry

Person(s) who counted:
Rick W

**** Non-Signalized Intersection ****

Major Road: Cedar Springs Rd runs N/S



Comments

Cedar Springs Rd @ No. 2 Side Road

Total Count Diagram

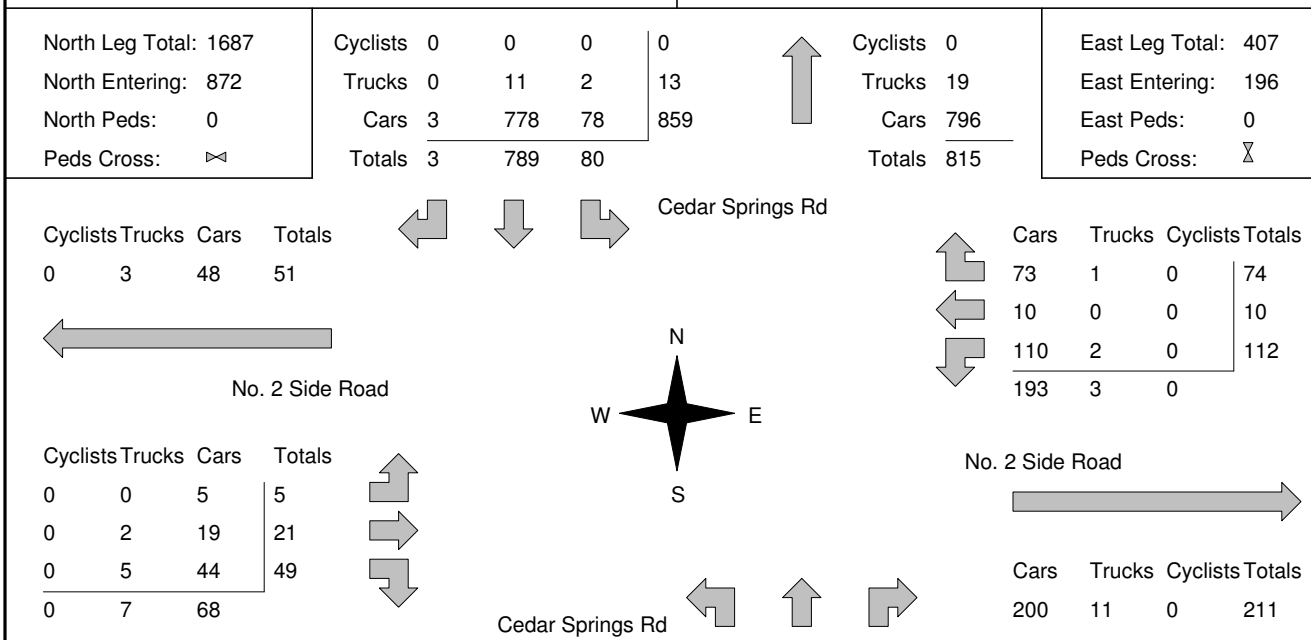
Municipality: Burlington
Site #: 0000200455
Intersection: Cedar Springs Rd & No. 2 Side Roa
TFR File #: 2
Count date: 2-Apr-2013

Weather conditions:
Partly Cloudy/Dry

Person(s) who counted:
Rick W

**** Non-Signalized Intersection ****

Major Road: Cedar Springs Rd runs N/S



Comments

Cedar Springs Rd @ No. 2 Side Road

Annual Average Daily Traffic Diagram

Total Factor = Monthly Factor(1.02) x Daily Factor(0.93) x 24 Hour Factor(1.85) = 1.754910

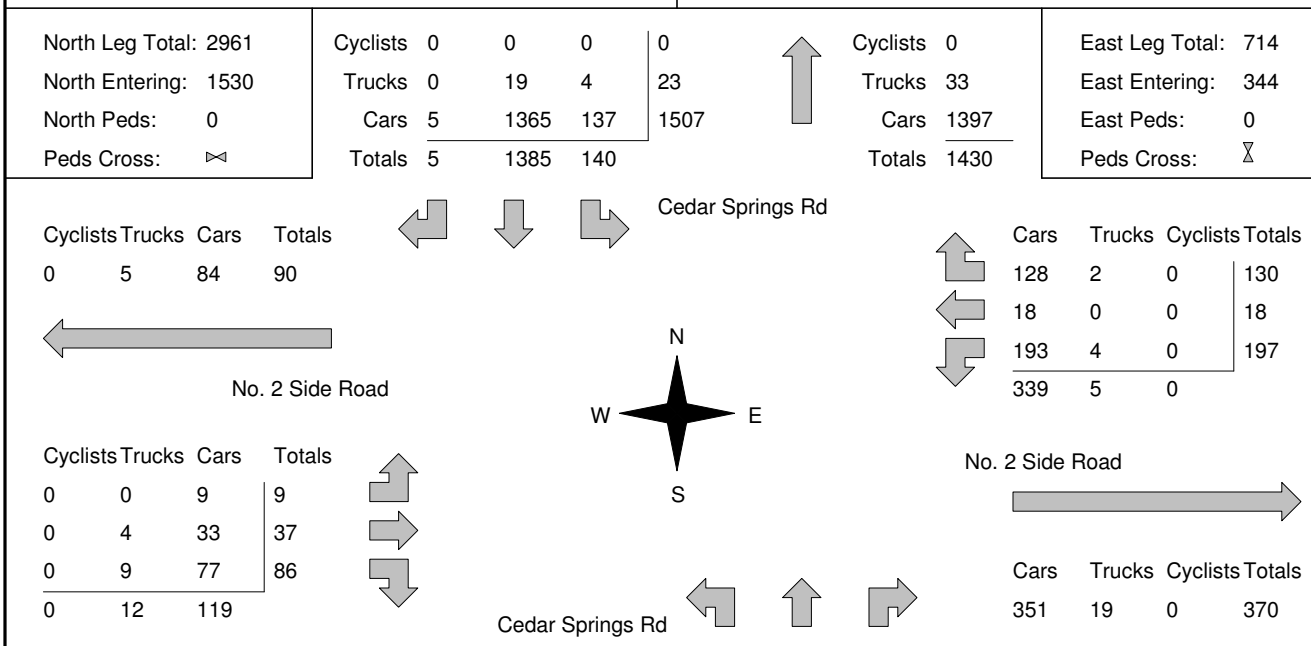
Municipality: Burlington
Site #: 0000200455
Intersection: Cedar Springs Rd & No. 2 Side Roa
TFR File #: 2
Count date: 2-Apr-2013

Weather conditions:
Partly Cloudy/Dry

Person(s) who counted:
Rick W

**** Non-Signalized Intersection ****

Major Road: Cedar Springs Rd runs N/S



Comments

Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@ptsl.com

Count Name: Gravel Pit - Number 2 Sideroad east of Guelph Line
Site Code:
Start Date: 10/08/2019

Turning Movement Data

Start Time	Number 2 Sideroad Eastbound					Number 2 Sideroad Westbound					Gravel Pit Southbound					
	Left	Thru	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
4:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:45 AM	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Hourly Total	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
5:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:15 AM	0	4	0	0	4	2	1	0	0	3	0	0	0	0	0	7
5:30 AM	2	3	0	0	5	1	1	0	0	2	0	0	0	0	0	7
5:45 AM	2	1	0	0	3	1	6	0	0	7	0	0	0	0	0	10
Hourly Total	4	8	0	0	12	4	8	0	0	12	0	0	0	0	0	24
6:00 AM	0	5	0	0	5	1	8	0	0	9	1	0	0	0	1	15
6:15 AM	1	2	0	0	3	1	9	0	0	10	2	0	0	0	2	15
6:30 AM	0	10	0	0	10	0	8	0	0	8	9	0	0	0	9	27
6:45 AM	0	11	0	0	11	4	8	0	0	12	7	0	0	0	7	30
Hourly Total	1	28	0	0	29	6	33	0	0	39	19	0	0	0	19	87
7:00 AM	1	8	0	0	9	6	8	0	0	14	9	0	0	0	9	32
7:15 AM	0	22	0	0	22	0	8	0	0	8	6	0	0	0	6	36
7:30 AM	0	22	0	0	22	11	11	0	0	22	5	0	0	0	5	49
7:45 AM	0	21	0	0	21	6	14	0	0	20	9	0	0	0	9	50
Hourly Total	1	73	0	0	74	23	41	0	0	64	29	0	0	0	29	167
8:00 AM	0	24	0	0	24	10	10	0	0	20	16	0	0	0	16	60
8:15 AM	0	18	0	0	18	7	8	0	0	15	11	0	0	0	11	44
8:30 AM	1	11	0	0	12	6	9	0	0	15	9	1	0	0	10	37
8:45 AM	0	11	0	0	11	7	5	0	0	12	8	2	0	0	10	33
Hourly Total	1	64	0	0	65	30	32	0	0	62	44	3	0	0	47	174
9:00 AM	0	6	0	0	6	4	19	0	0	23	10	0	0	0	10	39
9:15 AM	0	6	0	0	6	8	15	0	0	23	12	0	0	0	12	41
9:30 AM	0	6	0	0	6	6	12	0	0	18	16	0	0	0	16	40
9:45 AM	0	8	0	0	8	3	9	0	0	12	10	0	0	0	10	30
Hourly Total	0	26	0	0	26	21	55	0	0	76	48	0	0	0	48	150
10:00 AM	1	2	0	0	3	1	11	0	0	12	9	0	0	0	9	24
10:15 AM	0	6	0	0	6	8	15	0	0	23	9	1	0	0	10	39
10:30 AM	0	6	0	0	6	1	13	0	0	14	6	0	0	0	6	26
10:45 AM	0	3	0	0	3	3	15	0	0	18	20	1	0	0	21	42
Hourly Total	1	17	0	0	18	13	54	0	0	67	44	2	0	0	46	131
11:00 AM	0	9	0	0	9	3	9	0	0	12	14	1	0	0	15	36

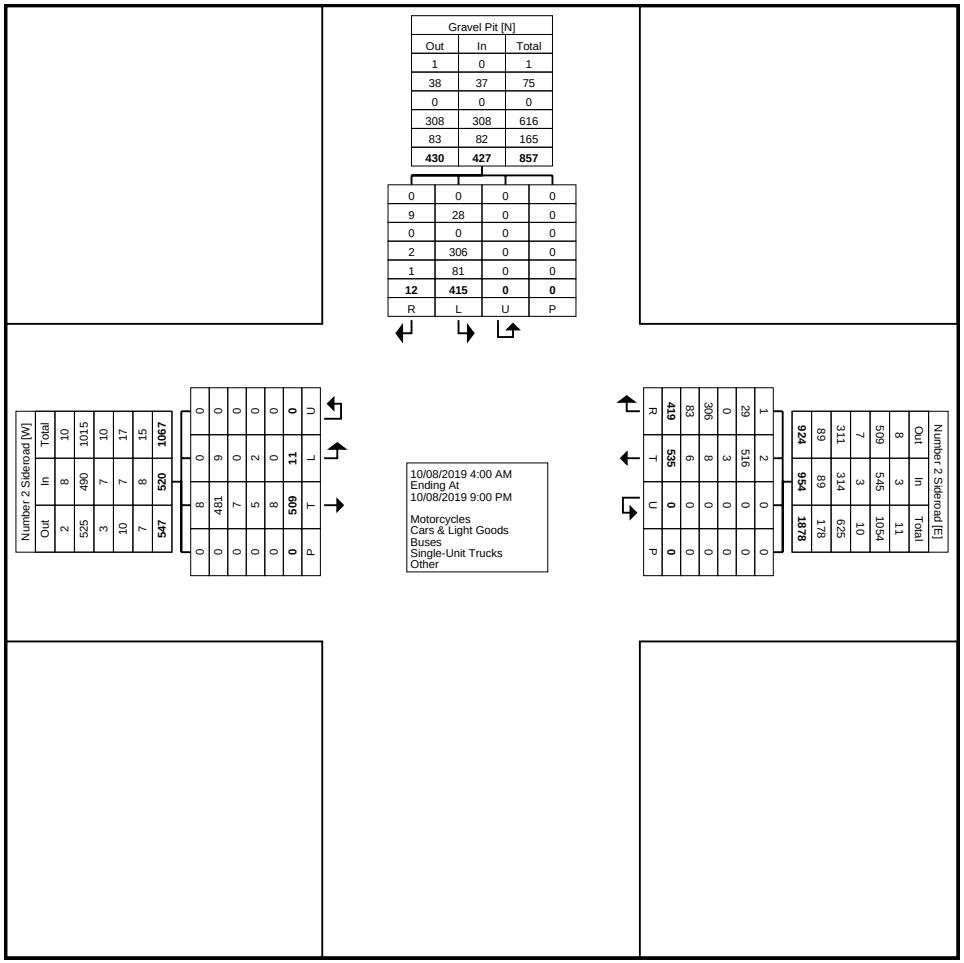
11:15 AM	0	8	0	0	8	6	4	0	0	10	15	0	0	0	15	33
11:30 AM	0	7	0	0	7	3	9	0	0	12	6	0	0	0	6	25
11:45 AM	0	7	0	0	7	7	12	0	0	19	6	0	0	0	6	32
Hourly Total	0	31	0	0	31	19	34	0	0	53	41	1	0	0	42	126
12:00 PM	0	8	0	0	8	5	10	0	0	15	10	0	0	0	10	33
12:15 PM	0	3	0	0	3	4	13	0	0	17	11	0	0	0	11	31
12:30 PM	0	2	0	0	2	6	12	0	0	18	10	0	0	0	10	30
12:45 PM	0	7	0	0	7	1	12	0	0	13	10	0	0	0	10	30
Hourly Total	0	20	0	0	20	16	47	0	0	63	41	0	0	0	41	124
1:00 PM	0	10	0	0	10	5	11	0	0	16	18	0	0	0	18	44
1:15 PM	0	11	0	0	11	6	7	0	0	13	12	0	0	0	12	36
1:30 PM	0	5	0	0	5	12	12	0	0	24	5	0	0	0	5	34
1:45 PM	0	7	0	0	7	4	7	0	0	11	10	0	0	0	10	28
Hourly Total	0	33	0	0	33	27	37	0	0	64	45	0	0	0	45	142
2:00 PM	0	9	0	0	9	5	14	0	0	19	10	0	0	0	10	38
2:15 PM	0	6	0	0	6	9	13	0	0	22	10	0	0	0	10	38
2:30 PM	0	11	0	0	11	9	14	0	0	23	10	0	0	0	10	44
2:45 PM	0	2	0	0	2	8	8	0	0	16	13	0	0	0	13	31
Hourly Total	0	28	0	0	28	31	49	0	0	80	43	0	0	0	43	151
3:00 PM	0	5	0	0	5	10	2	0	0	12	16	1	0	0	17	34
3:15 PM	1	4	0	0	5	10	10	0	0	20	4	0	0	0	4	29
3:30 PM	0	8	0	0	8	15	2	0	0	17	8	0	0	0	8	33
3:45 PM	0	9	0	0	9	15	5	0	0	20	3	0	0	0	3	32
Hourly Total	1	26	0	0	27	50	19	0	0	69	31	1	0	0	32	128
4:00 PM	0	15	0	0	15	21	4	0	0	25	4	0	0	0	4	44
4:15 PM	0	14	0	0	14	19	3	0	0	22	3	1	0	0	4	40
4:30 PM	1	12	0	0	13	28	1	0	0	29	3	0	0	0	3	45
4:45 PM	1	16	0	0	17	22	1	0	0	23	6	0	0	0	6	46
Hourly Total	2	57	0	0	59	90	9	0	0	99	16	1	0	0	17	175
5:00 PM	0	6	0	0	6	24	0	0	0	24	5	2	0	0	7	37
5:15 PM	0	16	0	0	16	32	0	0	0	32	2	1	0	0	3	51
5:30 PM	0	11	0	0	11	38	0	0	0	38	1	0	0	0	1	50
5:45 PM	0	12	0	0	12	26	1	0	0	27	4	1	0	0	5	44
Hourly Total	0	45	0	0	45	120	1	0	0	121	12	4	0	0	16	182
6:00 PM	0	13	0	0	13	13	0	0	0	13	0	0	0	0	0	26
6:15 PM	0	6	0	0	6	21	0	0	0	21	1	0	0	0	1	28
6:30 PM	0	4	0	0	4	12	0	0	0	12	0	0	0	0	0	16
6:45 PM	0	5	0	0	5	11	0	0	0	11	0	0	0	0	0	16
Hourly Total	0	28	0	0	28	57	0	0	0	57	1	0	0	0	1	86
7:00 PM	0	9	0	0	9	6	0	0	0	6	0	0	0	0	0	15
7:15 PM	0	3	0	0	3	2	0	0	0	2	0	0	0	0	0	5
7:30 PM	0	4	0	0	4	4	0	0	0	4	0	0	0	0	0	8
7:45 PM	0	1	0	0	1	6	0	0	0	6	0	0	0	0	0	7
Hourly Total	0	17	0	0	17	18	0	0	0	18	0	0	0	0	0	35
8:00 PM	0	1	0	0	1	2	0	0	0	2	1	0	0	0	1	4
8:15 PM	0	3	0	0	3	4	0	0	0	4	0	0	0	0	0	7
8:30 PM	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	2
8:45 PM	0	3	0	0	3	2	0	0	0	2	0	0	0	0	0	5
Hourly Total	0	7	0	0	7	10	0	0	0	10	1	0	0	0	1	18
Grand Total	11	509	0	0	520	535	419	0	0	954	415	12	0	0	427	1901
Approach %	2.1	97.9	0.0	-	-	56.1	43.9	0.0	-	-	97.2	2.8	0.0	-	-	-
Total %	0.6	26.8	0.0	-	27.4	28.1	22.0	0.0	-	50.2	21.8	0.6	0.0	-	22.5	-

Motorcycles	0	8	0	-	8	2	1	0	-	3	0	0	0	-	0	11
% Motorcycles	0.0	1.6	-	-	1.5	0.4	0.2	-	-	0.3	0.0	0.0	-	-	0.0	0.6
Cars & Light Goods	9	481	0	-	490	516	29	0	-	545	28	9	0	-	37	1072
% Cars & Light Goods	81.8	94.5	-	-	94.2	96.4	6.9	-	-	57.1	6.7	75.0	-	-	8.7	56.4
Buses	0	7	0	-	7	3	0	0	-	3	0	0	0	-	0	10
% Buses	0.0	1.4	-	-	1.3	0.6	0.0	-	-	0.3	0.0	0.0	-	-	0.0	0.5
Single-Unit Trucks	2	5	0	-	7	8	306	0	-	314	306	2	0	-	308	629
% Single-Unit Trucks	18.2	1.0	-	-	1.3	1.5	73.0	-	-	32.9	73.7	16.7	-	-	72.1	33.1
Articulated Trucks	0	3	0	-	3	5	82	0	-	87	81	0	0	-	81	171
% Articulated Trucks	0.0	0.6	-	-	0.6	0.9	19.6	-	-	9.1	19.5	0.0	-	-	19.0	9.0
Bicycles on Road	0	5	0	-	5	1	1	0	-	2	0	1	0	-	1	8
% Bicycles on Road	0.0	1.0	-	-	1.0	0.2	0.2	-	-	0.2	0.0	8.3	-	-	0.2	0.4
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@ptsl.com

Count Name: Gravel Pit - Number 2 Sideroad east of Guelph Line
Site Code:
Start Date: 10/08/2019



Turning Movement Data Plot

Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@ptsl.com

Count Name: Gravel Pit - Number 2 Sideroad east of Guelph Line
Site Code:
Start Date: 10/08/2019

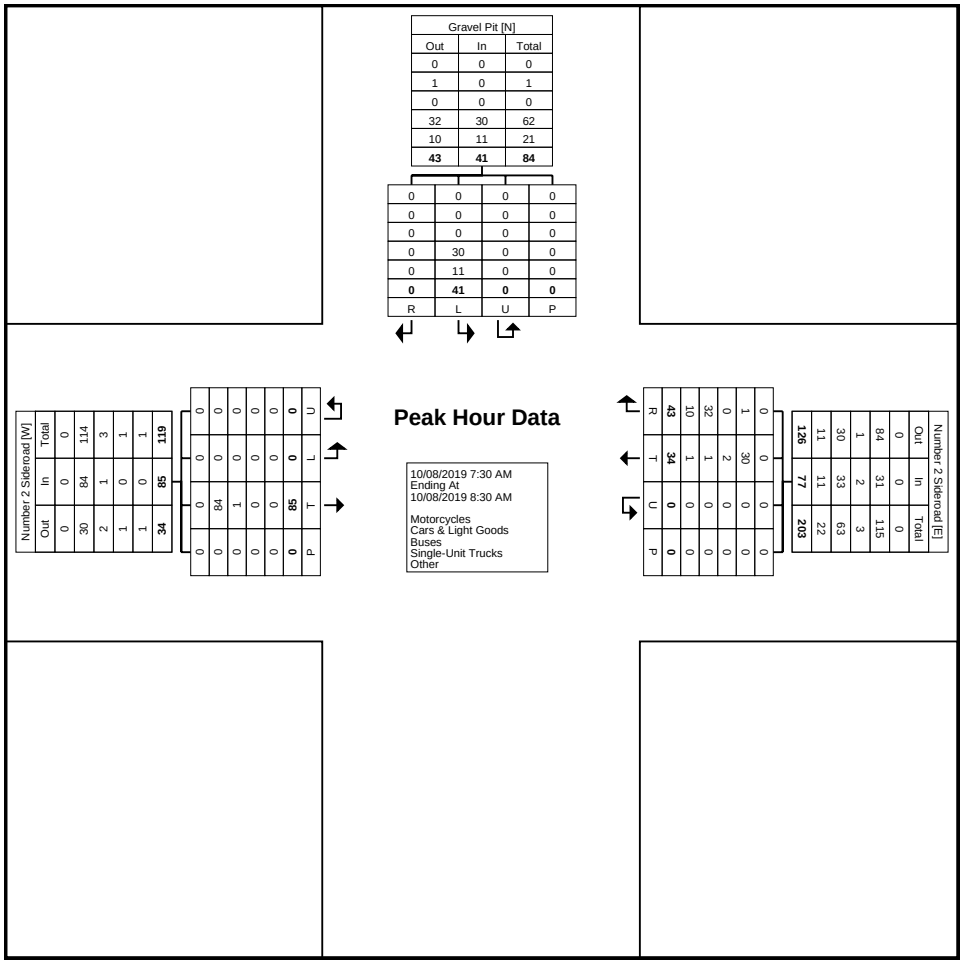
Turning Movement Peak Hour Data (7:30 AM)

Start Time	Number 2 Sideroad Eastbound					Number 2 Sideroad Westbound					Gravel Pit Southbound					
	Left	Thru	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
7:30 AM	0	22	0	0	22	11	11	0	0	22	5	0	0	0	5	49
7:45 AM	0	21	0	0	21	6	14	0	0	20	9	0	0	0	9	50
8:00 AM	0	24	0	0	24	10	10	0	0	20	16	0	0	0	16	60
8:15 AM	0	18	0	0	18	7	8	0	0	15	11	0	0	0	11	44
Total	0	85	0	0	85	34	43	0	0	77	41	0	0	0	41	203
Approach %	0.0	100.0	0.0	-	-	44.2	55.8	0.0	-	-	100.0	0.0	0.0	-	-	-
Total %	0.0	41.9	0.0	-	41.9	16.7	21.2	0.0	-	37.9	20.2	0.0	0.0	-	20.2	-
PHF	0.000	0.885	0.000	-	0.885	0.773	0.768	0.000	-	0.875	0.641	0.000	0.000	-	0.641	0.846
Motorcycles	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0
% Motorcycles	-	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0	-	-	-	0.0	0.0
Cars & Light Goods	0	84	0	-	84	30	1	0	-	31	0	0	0	-	0	115
% Cars & Light Goods	-	98.8	-	-	98.8	88.2	2.3	-	-	40.3	0.0	-	-	-	0.0	56.7
Buses	0	1	0	-	1	2	0	0	-	2	0	0	0	-	0	3
% Buses	-	1.2	-	-	1.2	5.9	0.0	-	-	2.6	0.0	-	-	-	0.0	1.5
Single-Unit Trucks	0	0	0	-	0	1	32	0	-	33	30	0	0	-	30	63
% Single-Unit Trucks	-	0.0	-	-	0.0	2.9	74.4	-	-	42.9	73.2	-	-	-	73.2	31.0
Articulated Trucks	0	0	0	-	0	1	10	0	-	11	11	0	0	-	11	22
% Articulated Trucks	-	0.0	-	-	0.0	2.9	23.3	-	-	14.3	26.8	-	-	-	26.8	10.8
Bicycles on Road	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0
% Bicycles on Road	-	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0	-	-	-	0.0	0.0
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@ptsl.com

Count Name: Gravel Pit - Number 2 Sideroad east of Guelph Line
Site Code:
Start Date: 10/08/2019



Turning Movement Peak Hour Data Plot (7:30 AM)

Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@ptsl.com

Count Name: Gravel Pit - Number 2 Sideroad east of Guelph Line
Site Code:
Start Date: 10/08/2019

Dundas St @ Brant St

Morning Peak Diagram

Specified Period
From: 7:00:00
To: 9:00:00

One Hour Peak
From: 7:30:00
To: 8:30:00

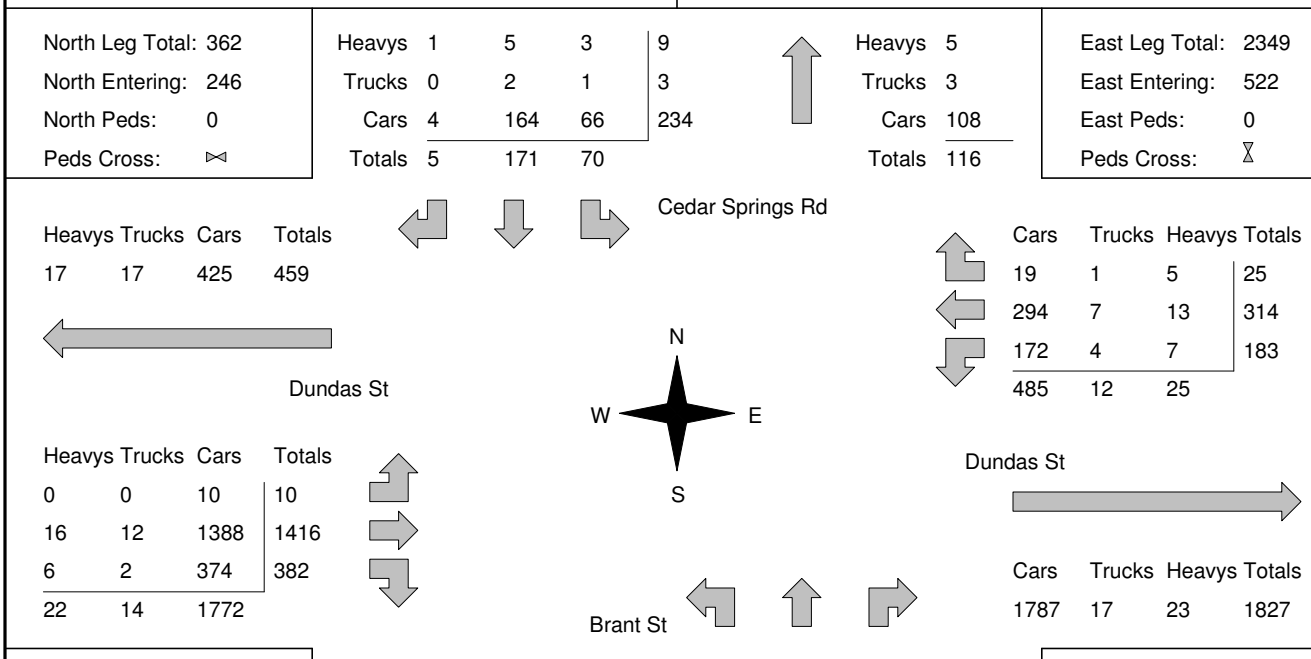
Municipality: Halton Region
Site #: 1000110100
Intersection: Dundas St & Brant St
TFR File #: 1
Count date: 5-Apr-2018

Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Dundas St runs W/E



Comments

Dundas St @ Brant St

Mid-day Peak Diagram

Specified Period
From: 11:00:00
To: 14:00:00

One Hour Peak
From: 11:30:00
To: 12:30:00

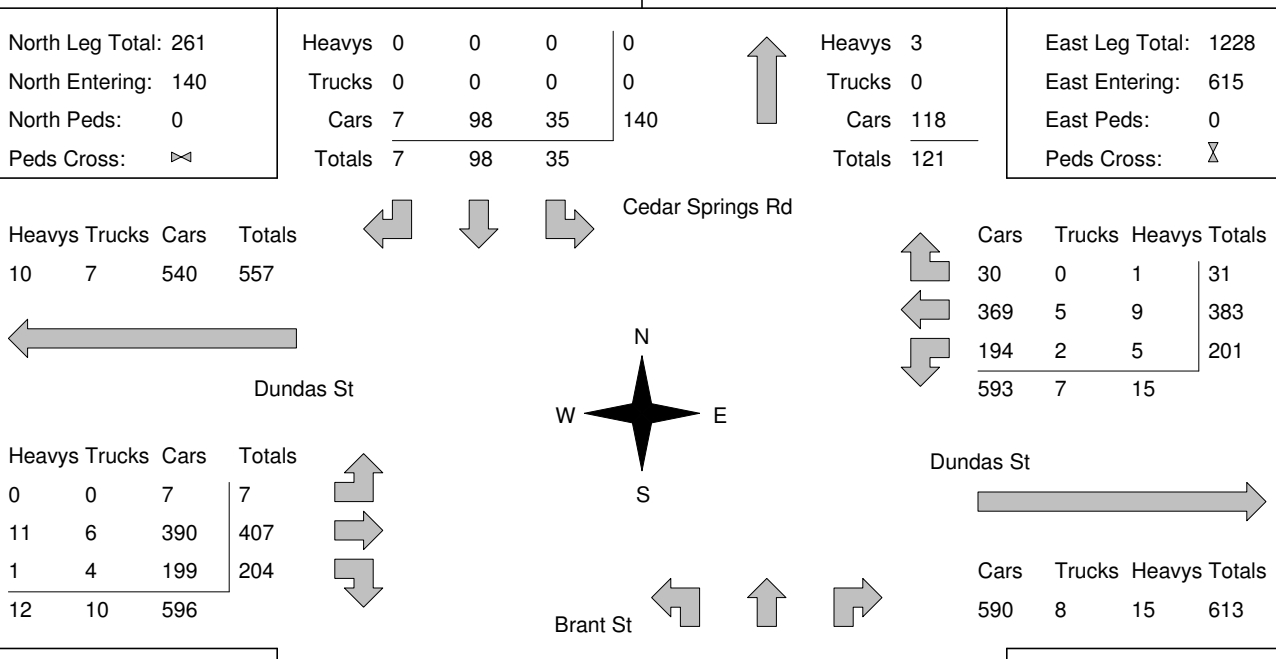
Municipality: Halton Region
Site #: 1000110100
Intersection: Dundas St & Brant St
TFR File #: 1
Count date: 5-Apr-2018

Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Dundas St runs W/E



Comments

Dundas St @ Brant St

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 16:45:00
To: 17:45:00

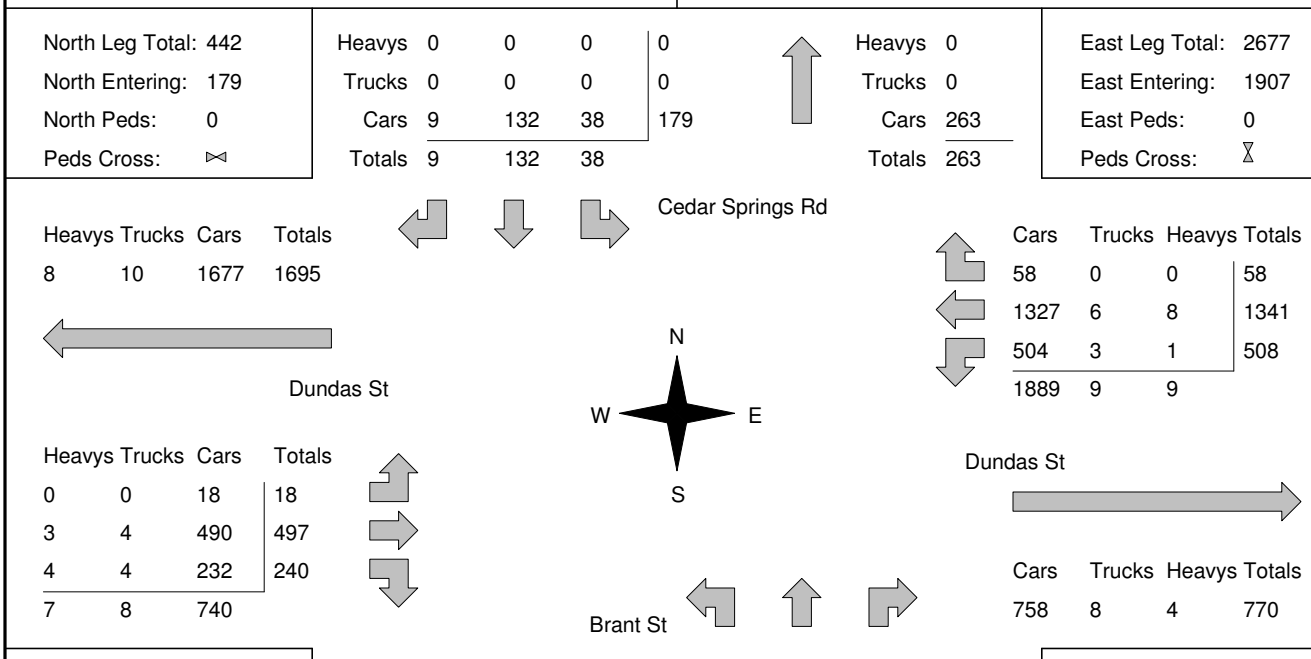
Municipality: Halton Region
Site #: 1000110100
Intersection: Dundas St & Brant St
TFR File #: 1
Count date: 5-Apr-2018

Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Dundas St runs W/E



Comments

Dundas St @ Brant St

Total Count Diagram

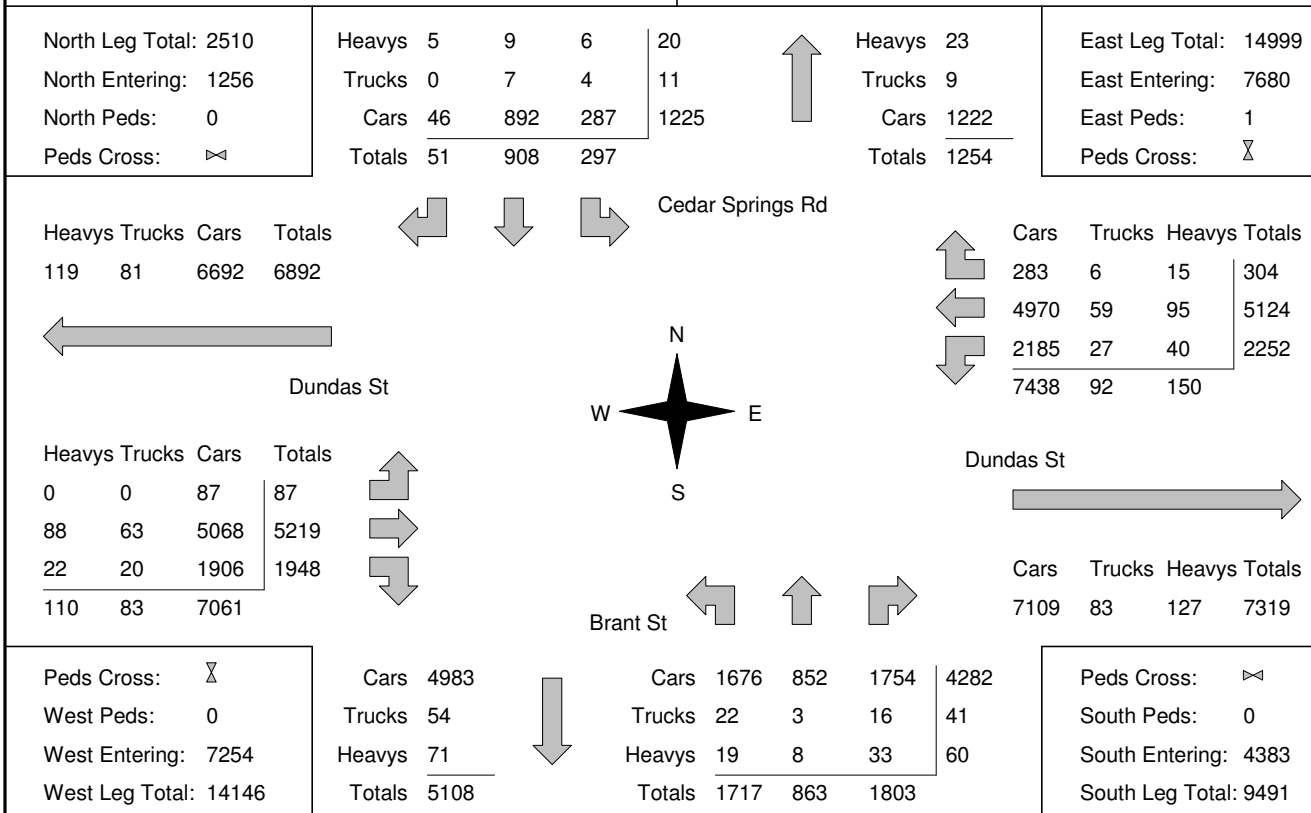
Municipality: Halton Region
Site #: 1000110100
Intersection: Dundas St & Brant St
TFR File #: 1
Count date: 5-Apr-2018

Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Dundas St runs W/E



Comments

Intersection Name:	TS ID:	Line No:	Model:	IP address:	Controller Make:
Dundas St @ Brant Street	187	1	ACS/3	172.22.230.2	Econolite

Type of Operation: 8 Phase Semi-Actuated

*-Start from Main Menu

No	Date			Description	Prepared by
	Y	M	D		BP
3	2018	2	28	Increased WBLT & NBLT in PM peak per Region's request	

PHASE DESCRIPTION

Ph1	WBLT - Dundas St.	Ph5	
Ph2	EB - Dundas St.	Ph6	WB - Dundas St.
Ph3		Ph7	NBL -Brant Street
Ph4	NB - Brant Street	Ph8	SB - Brant Street

PHASE IN USE/EXCLUSIVE PED (MM) *- 1 - 2

Phase:	1	2	3	4	5	6	7	8
Phase in Use	X	X		X		X	X	X
Exclusive PED								

CONTROLLER TIMING DATA - VEHICLE TIMING * - 2 - 1

Timing Plan: 1	Phase: 1	2	3	4	5	6	7	8
Minimum Green	7	15		15		15	7	15
Walk		7		7		7		7
Ped. Clearance		28		32		28		32
Pedestrian Carry Over								
Vehicle Extension	3	3		3		3	3	3
MAX 1	14	52		36		52	14	36
MAX 2	10	37		26		37	10	26
Yellow Change	3.0	4.6		3.7		4.6	3.0	3.7
Red Clearance	1.0	2.0		2.9		2.0	1.0	2.9
Phase Minimum:	12	42.6		46.6		42.6	12	46.6

PHASE DATA - VEHICLE AND PEDESTRIAN RECALLS

*** - 2 - 8**

Phase:	1	2	3	4	5	6	7	8
Lock Detector								
Vehicle Recall								
Pedestrian Recall		X				X		
MAX Recall								
Min Recall								

COORDINATION: COORDINATOR PATTERN, SPLIT PATTERN

*** - 3 - 2, - 3 - 3**

Coordinator Pattern (CP)	Cycle Length	Offset (sec)	Timing Plan	Split Pattern	Phases (sec)							
					1	2	3	4	5	6	7	8
1	120	0	1	1	16	69		35		85	11	24
2	90	0	1	2	11	45		34		56	11	23
3	120	0	1	3	23	53		44		76	19	25
10	0	0	1	10	0	0		0		0	0	0

TIME BASE: ACTION PLAN, DAY PLAN

*** - 5 - 2, - 5 - 3, -5 - 4**

Day Plan	Sched. #	Action Plan	Time Period	Pattern	Timing Plan
1	1	1	06:00	1	1
1	1	2	09:00	2	1
1	1	3	15:15	3	1
1	1	2	19:00	2	1
1	1	10	21:30	254	1
2	2	10	00:00	254	1
3	3	10	00:00	254	1

Schedule 1 = Day Plan 1
Schedule 2 = Day Plan 2
Schedule 3 = Day Plan 3

Day Plan 1 (Weekday)
Day Plan 2 (Saturday)
Day Plan 3 (Sunday, Holidays)

Action Plan 10 = free (254)

Special Programming:

TIME BASE DATA - TIME OF YEAR EVENTS *** - 5 - 5**

Events	Exception Day		MON/ MON	DOW/ DOW	WOM/ Year	Day Plan
New Year's Day	**1**	**Fixed**	**1**	**1**	**0**	**3**
Family Day	**2**	**Float**	**2**	**2**	**3**	**3**
Good Friday	**3**	**Float**	**4**	**6**	**1**	**3**
Victoria Day	**4**	**Float**	**5**	**2**	**3**	**3**
Canada Day	**5**	**Fixed**	**7**	**1**	**0**	**3**
Civic Day	**6**	**Float**	**8**	**2**	**1**	**3**
Labour Day	**7**	**Float**	**9**	**2**	**1**	**3**
Thanksgiving	**8**	**Float**	**10**	**2**	**2**	**3**
Christmas Day	**9**	**Fixed**	**12**	**25**	**0**	**3**

Appendix C

Existing Traffic Operations Reports

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	75	3	112	31	6	6	49	463	18	10	433	64
Future Volume (Veh/h)	75	3	112	31	6	6	49	463	18	10	433	64
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	82	3	123	34	7	7	54	509	20	11	476	70
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)			4									
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1160	1170	511	1126	1195	519	546			529		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1160	1170	511	1126	1195	519	546			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 %	48	98	78	75	96	99	95			99		
cM capacity (veh/h)	159	182	567	135	176	561	1033			1048		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	208	48	54	529	11	546
Volume Left	82	34	54	0	11	0
Volume Right	123	7	0	20	0	70
cSH	390	158	1033	1700	1048	1700
Volume to Capacity	0.53	0.30	0.05	0.31	0.01	0.32
Queue Length 95th (m)	24.2	9.6	1.3	0.0	0.3	0.0
Control Delay (s)	28.5	37.4	8.7	0.0	8.5	0.0
Lane LOS	D	E	A		A	
Approach Delay (s)	28.5	37.4	0.8		0.2	
Approach LOS	D	E				

Intersection Summary					
Average Delay	5.9				
Intersection Capacity Utilization	49.1%	ICU Level of Service	A		
Analysis Period (min)	15				

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Traffic Volume (vph)	148	1747	273	233	540	115	318	139	299	63
Future Volume (vph)	148	1747	273	233	540	115	318	139	299	63
Turn Type	Perm	NA	Perm	pm+pt	NA	pm+pt	NA	pm+pt	NA	Perm
Protected Phases		2		1	6	7	4	3	8	
Permitted Phases	2		2	6		4		8		8
Detector Phase	2	2	2	1	6	7	4	3	8	8
Switch Phase										
Minimum Initial (s)	8.0	8.0	8.0	5.0	8.0	5.0	8.0	5.0	8.0	8.0
Minimum Split (s)	46.0	46.0	46.0	11.0	46.0	11.0	39.0	11.0	39.0	39.0
Total Split (s)	70.0	70.0	70.0	18.0	88.0	18.0	34.0	18.0	34.0	34.0
Total Split (%)	50.0%	50.0%	50.0%	12.9%	62.9%	12.9%	24.3%	12.9%	24.3%	24.3%
Yellow Time (s)	5.0	5.0	5.0	3.0	5.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	1.0	2.0	1.0	3.0	1.0	3.0	3.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	5.0	5.0	5.0	2.0	5.0	2.0	5.0	2.0	5.0	5.0
Lead/Lag	Lag	Lag	Lag	Lead		Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	Ped	Ped	Ped	None	Ped	None	None	None	None	None
Act Effct Green (s)	65.0	65.0	65.0	86.0	83.0	45.5	29.0	47.2	29.8	29.8
Actuated g/C Ratio	0.47	0.47	0.47	0.62	0.60	0.33	0.21	0.34	0.22	0.22
v/c Ratio	0.44	1.05	0.34	0.93	0.31	0.32	1.17dr	0.59	0.39	0.15
Control Delay	30.0	72.6	12.5	78.0	13.6	33.9	93.8	42.6	48.6	3.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.0	72.6	12.5	78.0	13.6	33.9	93.8	42.6	48.6	3.9
LOS	C	E	B	E	B	C	F	D	D	A
Approach Delay		62.1			30.5		87.1		41.4	
Approach LOS		E			C		F		D	

Intersection Summary			
Cycle Length: 140			
Actuated Cycle Length: 138.4			
Natural Cycle: 120			
Control Type: Semi Act-Uncoord			
Maximum v/c Ratio: 1.08			
Intersection Signal Delay: 59.3		Intersection LOS: E	
Intersection Capacity Utilization 111.6%		ICU Level of Service H	
Analysis Period (min) 15			
dr Defacto Right Lane. Recode with 1 though lane as a right lane.			

Splits and Phases: 2: Guelph Line & Dundas St

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	151	1783	279	238	666	117	919	142	305	64
v/c Ratio	0.44	1.05	0.34	0.93	0.31	0.32	1.17dr	0.59	0.39	0.15
Control Delay	30.0	72.6	12.5	78.0	13.6	33.9	93.8	42.6	48.6	3.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.0	72.6	12.5	78.0	13.6	33.9	93.8	42.6	48.6	3.9
Queue Length 50th (m)	29.0	~298.2	23.6	52.1	45.8	23.4	~129.2	28.9	40.1	0.0
Queue Length 95th (m)	51.1	#344.9	45.1	#106.2	58.4	38.9	#174.1	46.3	56.2	5.7
Internal Link Dist (m)		352.0			373.1		190.8		153.2	
Turn Bay Length (m)	100.0		70.0	115.0		50.0		70.0		70.0
Base Capacity (vph)	344	1696	823	257	2122	397	850	258	778	418
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.44	1.05	0.34	0.93	0.31	0.29	1.08	0.55	0.39	0.15

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
dr Defacto Right Lane. Recode with 1 though lane as a right lane.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	148	1747	273	233	540	113	115	318	583	139	299	63
Future Volume (vph)	148	1747	273	233	540	113	115	318	583	139	299	63
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	5.0	5.0	5.0	2.0	5.0		2.0	5.0		2.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	0.99		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.97		1.00	0.90		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1745	3610	1597	1745	3516		1745	3231		1745	3610	1597
Flt Permitted	0.40	1.00	1.00	0.06	1.00		0.47	1.00		0.13	1.00	1.00
Satd. Flow (perm)	732	3610	1597	110	3516		867	3231		247	3610	1597
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	151	1783	279	238	551	115	117	324	595	142	305	64
RTOR Reduction (vph)	0	0	74	0	12	0	0	173	0	0	0	50
Lane Group Flow (vph)	151	1783	205	238	654	0	117	746	0	142	305	14
Confl. Peds. (#/hr)									1	1		
Turn Type	Perm	NA	Perm	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases		2		1	6		7	4		3	8	
Permitted Phases	2		2	6			4			8		8
Actuated Green, G (s)	63.0	63.0	63.0	81.0	81.0		38.5	27.0		40.1	27.8	27.8
Effective Green, g (s)	65.0	65.0	65.0	83.0	83.0		42.5	29.0		44.1	29.8	29.8
Actuated g/C Ratio	0.47	0.47	0.47	0.60	0.60		0.31	0.21		0.32	0.22	0.22
Clearance Time (s)	7.0	7.0	7.0	4.0	7.0		4.0	7.0		4.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	344	1696	750	255	2110		352	677		233	777	344
v/s Ratio Prot		c0.49		c0.11	0.19		0.03	c0.23		c0.06	0.08	
v/s Ratio Perm	0.21		0.13	0.45			0.07			0.13		0.01
v/c Ratio	0.44	1.05	0.27	0.93	0.31		0.33	1.17dr		0.61	0.39	0.04
Uniform Delay, d1	24.5	36.7	22.3	46.1	13.6		35.7	54.7		37.5	46.5	42.9
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.9	36.7	0.2	38.5	0.1		0.6	65.8		4.5	0.3	0.0
Delay (s)	25.4	73.4	22.5	84.5	13.7		36.2	120.5		42.0	46.8	43.0
Level of Service	C	E	C	F	B		D	F		D	D	D
Approach Delay (s)		63.7			32.3			111.0			45.0	
Approach LOS		E			C			F			D	

Intersection Summary

HCM 2000 Control Delay	66.1	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	138.3	Sum of lost time (s)	14.0
Intersection Capacity Utilization	111.6%	ICU Level of Service	H
Analysis Period (min)	15		

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

Timings
3: Brant St/Cedar Springs Rd & Dundas St

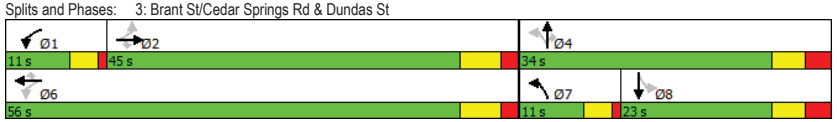
Base Year AM
190428

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations											
Traffic Volume (vph)	10	1500	406	213	367	40	174	87	364	81	191
Future Volume (vph)	10	1500	406	213	367	40	174	87	364	81	191
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA
Protected Phases		2		1	6		7	4			8
Permitted Phases	2		2	6		6	4		4	8	
Detector Phase	2	2	2	1	6	6	7	4	4	8	8
Switch Phase											
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	41.6	41.6	41.6	11.0	41.6	41.6	11.0	45.6	45.6	45.6	45.6
Total Split (s)	45.0	45.0	45.0	11.0	56.0	56.0	11.0	34.0	34.0	23.0	23.0
Total Split (%)	50.0%	50.0%	50.0%	12.2%	62.2%	62.2%	12.2%	37.8%	37.8%	25.6%	25.6%
Yellow Time (s)	4.6	4.6	4.6	3.0	4.6	4.6	3.0	3.7	3.7	3.7	3.7
All-Red Time (s)	2.0	2.0	2.0	1.0	2.0	2.0	1.0	2.9	2.9	2.9	2.9
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.6	4.6	4.6	2.0	4.6	4.6	2.0	4.6	4.6	4.6	4.6
Lead/Lag	Lag	Lag	Lag	Lead			Lead			Lag	Lag
Lead-Lag Optimize?											
Recall Mode	Ped	Ped	Ped	None	Ped	Ped	None	None	None	None	None
Act Effct Green (s)	40.4	40.4	40.4	54.0	51.4	51.4	29.4	26.8	26.8	15.7	15.7
Actuated g/C Ratio	0.46	0.46	0.46	0.62	0.59	0.59	0.34	0.31	0.31	0.18	0.18
v/c Ratio	0.02	0.94	0.45	0.83	0.18	0.04	0.52	0.16	0.62	0.36	0.61
Control Delay	14.0	35.1	4.1	43.0	8.9	0.2	27.3	22.6	18.3	36.0	40.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.0	35.1	4.1	43.0	8.9	0.2	27.3	22.6	18.3	36.0	40.6
LOS	B	D	A	D	A	A	C	C	B	D	D
Approach Delay		28.4			20.0			21.4			39.3
Approach LOS		C			C			C			D

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 87.4
Natural Cycle: 120
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.94
Intersection Signal Delay: 26.5 — Intersection LOS: C
Intersection Capacity Utilization 87.8% — ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 3: Brant St/Cedar Springs Rd & Dundas St



Queues
3: Brant St/Cedar Springs Rd & Dundas St

Base Year AM
190428

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	10	1563	423	222	382	42	181	91	379	84	207
v/c Ratio	0.02	0.94	0.45	0.83	0.18	0.04	0.52	0.16	0.62	0.36	0.61
Control Delay	14.0	35.1	4.1	43.0	8.9	0.2	27.3	22.6	18.3	36.0	40.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.0	35.1	4.1	43.0	8.9	0.2	27.3	22.6	18.3	36.0	40.6
Queue Length 50th (m)	0.9	135.2	3.4	21.6	15.4	0.0	23.4	11.6	29.2	13.1	33.6
Queue Length 95th (m)	4.0	#194.5	20.4	#63.1	23.5	0.4	40.1	22.8	59.4	26.8	56.0
Internal Link Dist (m)		503.2			1627.1			245.0			231.3
Turn Bay Length (m)	75.0		75.0	75.0		75.0	100.0			75.0	
Base Capacity (vph)	445	1669	946	269	2124	977	347	639	654	270	399
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.02	0.94	0.45	0.83	0.18	0.04	0.52	0.14	0.58	0.31	0.52

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	1500	406	213	367	40	174	87	364	81	191	8
Future Volume (vph)	10	1500	406	213	367	40	174	87	364	81	191	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	4.6	4.6	4.6	2.0	4.6	4.6	2.0	4.6	4.6	4.6	4.6	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1745	3610	1597	1745	3610	1597	1745	1900	1597	1745	1889	
Flt Permitted	0.53	1.00	1.00	0.09	1.00	1.00	0.39	1.00	1.00	0.70	1.00	
Satd. Flow (perm)	965	3610	1597	173	3610	1597	719	1900	1597	1282	1889	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	10	1562	423	222	382	42	181	91	379	84	199	8
RTOR Reduction (vph)	0	0	208	0	0	17	0	0	122	0	2	0
Lane Group Flow (vph)	10	1563	215	222	382	25	181	91	257	84	205	0
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2		2	6		6	4		4	8		
Actuated Green, G (s)	38.4	38.4	38.4	49.4	49.4	49.4	24.8	24.8	24.8	13.8	13.8	
Effective Green, g (s)	40.4	40.4	40.4	51.4	51.4	51.4	26.8	26.8	26.8	15.8	15.8	
Actuated g/C Ratio	0.46	0.46	0.46	0.59	0.59	0.59	0.31	0.31	0.31	0.18	0.18	
Clearance Time (s)	6.6	6.6	6.6	4.0	6.6	6.6	4.0	6.6	6.6	6.6	6.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	446	1668	738	263	2123	939	326	582	489	231	341	
v/s Ratio Prot		c0.43		c0.09	0.11		c0.06	0.05			0.11	
v/s Ratio Perm	0.01		0.13	0.41		0.02	0.11		c0.16	0.07		
v/c Ratio	0.02	0.94	0.29	0.84	0.18	0.03	0.56	0.16	0.53	0.36	0.60	
Uniform Delay, d1	12.8	22.3	14.6	22.2	8.3	7.5	23.7	22.1	25.0	31.4	32.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.0	10.4	0.2	21.2	0.0	0.0	2.0	0.1	1.0	1.0	3.0	
Delay (s)	12.8	32.7	14.8	43.4	8.3	7.5	25.8	22.2	26.1	32.4	35.9	
Level of Service	B	C	B	D	A	A	C	C	C	C	D	
Approach Delay (s)		28.8			20.3			25.4			34.9	
Approach LOS		C			C			C			C	

Intersection Summary				
HCM 2000 Control Delay	27.2	HCM 2000 Level of Service	C	
HCM 2000 Volume to Capacity ratio	0.80			
Actuated Cycle Length (s)	87.4	Sum of lost time (s)	13.2	
Intersection Capacity Utilization	87.8%	ICU Level of Service	E	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	6	18	18	0	1	3	101	32	21	164	0
Future Volume (Veh/h)	0	6	18	18	0	1	3	101	32	21	164	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	0	7	21	21	0	1	4	120	38	25	195	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	393	411	195	416	392	139	195			158		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	393	411	195	416	392	139	195			158		
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	99	98	96	100	100	100			98		
cM capacity (veh/h)	561	523	851	523	536	915	1390			1434		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	28	22	162	220
Volume Left	0	21	4	25
Volume Right	21	1	38	0
cSH	736	533	1390	1434
Volume to Capacity	0.04	0.04	0.00	0.02
Queue Length 95th (m)	0.9	1.0	0.1	0.4
Control Delay (s)	10.1	12.0	0.2	1.0
Lane LOS	B	B	A	A
Approach Delay (s)	10.1	12.0	0.2	1.0
Approach LOS	B	B		

Intersection Summary				
Average Delay	1.9			
Intersection Capacity Utilization	34.1%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	88	44	148	144	0
Future Volume (Veh/h)	0	88	44	148	144	0
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	96	48	161	157	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	209				224	128
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	209				224	128
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				80	100
cM capacity (veh/h)	1374				768	927

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	96	209	157
Volume Left	0	0	157
Volume Right	0	161	0
cSH	1374	1700	768
Volume to Capacity	0.00	0.12	0.20
Queue Length 95th (m)	0.0	0.0	6.1
Control Delay (s)	0.0	0.0	10.9
Lane LOS			B
Approach Delay (s)	0.0	0.0	10.9
Approach LOS			B

Intersection Summary				
Average Delay		3.7		
Intersection Capacity Utilization		26.1%	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)	51	3	29	15	5	0	57	501	9	6	580	53
Future Volume (Veh/h)	51	3	29	15	5	0	57	501	9	6	580	53
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	58	3	33	17	6	0	65	569	10	7	659	60
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)			4									
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1405	1412	689	1378	1437	574	719			579		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1405	1412	689	1378	1437	574	719			579		
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 %	46	98	93	84	95	100	93			99		
cM capacity (veh/h)	107	128	449	105	124	522	892			1005		

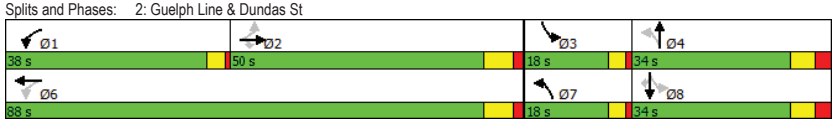
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	94	23	65	579	7	719
Volume Left	58	17	65	0	7	0
Volume Right	33	0	0	10	0	60
cSH	166	110	892	1700	1005	1700
Volume to Capacity	0.57	0.21	0.07	0.34	0.01	0.42
Queue Length 95th (m)	23.5	6.0	1.9	0.0	0.2	0.0
Control Delay (s)	53.4	46.4	9.4	0.0	8.6	0.0
Lane LOS	F	E	A		A	
Approach Delay (s)	53.4	46.4	0.9		0.1	
Approach LOS	F	E				

Intersection Summary				
Average Delay		4.5		
Intersection Capacity Utilization		54.8%	ICU Level of Service	A
Analysis Period (min)		15		

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Traffic Volume (vph)	47	716	164	646	1742	287	316	128	469	167
Future Volume (vph)	47	716	164	646	1742	287	316	128	469	167
Turn Type	Perm	NA	Perm	pm+pt	NA	pm+pt	NA	pm+pt	NA	Perm
Protected Phases		2		1	6	7	4	3	8	
Permitted Phases	2		2	6		4		8		8
Detector Phase	2	2	2	1	6	7	4	3	8	8
Switch Phase										
Minimum Initial (s)	8.0	8.0	8.0	5.0	8.0	5.0	8.0	5.0	8.0	8.0
Minimum Split (s)	46.0	46.0	46.0	11.0	46.0	11.0	39.0	11.0	39.0	39.0
Total Split (s)	50.0	50.0	50.0	38.0	88.0	18.0	34.0	18.0	34.0	34.0
Total Split (%)	35.7%	35.7%	35.7%	27.1%	62.9%	12.9%	24.3%	12.9%	24.3%	24.3%
Yellow Time (s)	5.0	5.0	5.0	3.0	5.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	1.0	2.0	1.0	3.0	1.0	3.0	3.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	5.0	5.0	5.0	2.0	5.0	2.0	5.0	2.0	5.0	5.0
Lead/Lag	Lag	Lag	Lag	Lead		Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	Ped	Ped	Ped	None	Ped	None	None	None	None	None
Act Effct Green (s)	44.2	44.2	44.2	85.3	82.3	45.4	27.3	42.2	25.3	25.3
Actuated g/C Ratio	0.33	0.33	0.33	0.63	0.61	0.33	0.20	0.31	0.19	0.19
v/c Ratio	0.91	0.63	0.27	1.12	0.88	1.02	0.80	0.55	0.72	0.46
Control Delay	144.3	41.9	6.9	105.4	29.3	96.1	47.6	40.9	58.5	26.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	144.3	41.9	6.9	105.4	29.3	96.1	47.6	40.9	58.5	26.4
LOS	F	D	A	F	C	F	D	D	E	C
Approach Delay		40.8			48.9		63.0		48.5	
Approach LOS		D			D		E		D	

Intersection Summary		
Cycle Length: 140		
Actuated Cycle Length: 135.6		
Natural Cycle: 120		
Control Type: Semi Act-Uncoord		
Maximum v/c Ratio: 1.13		
Intersection Signal Delay: 49.9	Intersection LOS: D	
Intersection Capacity Utilization 103.4%	ICU Level of Service G	
Analysis Period (min) 15		

Splits and Phases: 2: Guelph Line & Dundas St



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	48	738	169	666	1922	296	638	132	484	172
v/c Ratio	0.91	0.63	0.27	1.12	0.88	1.02	0.80	0.55	0.72	0.46
Control Delay	144.3	41.9	6.9	105.4	29.3	96.1	47.6	40.9	58.5	26.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	144.3	41.9	6.9	105.4	29.3	96.1	47.6	40.9	58.5	26.4
Queue Length 50th (m)	13.1	94.2	1.6	~183.8	236.2	~68.7	71.1	26.7	68.6	19.1
Queue Length 95th (m)	#41.4	119.1	18.5	#268.2	288.5	#125.7	95.5	43.4	88.5	42.6
Internal Link Dist (m)		352.0			373.1		190.8		153.2	
Turn Bay Length (m)	100.0		70.0	115.0		50.0		70.0		70.0
Base Capacity (vph)	54	1200	638	592	2195	290	834	266	773	416
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.89	0.61	0.26	1.13	0.88	1.02	0.76	0.50	0.63	0.41

Intersection Summary
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	47	716	164	646	1742	122	287	316	303	128	469	167
Future Volume (vph)	47	716	164	646	1742	122	287	316	303	128	469	167
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	5.0	5.0	5.0	2.0	5.0		2.0	5.0		2.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	0.99		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1745	3610	1597	1745	3575		1745	3321		1745	3610	1597
Flt Permitted	0.09	1.00	1.00	0.19	1.00		0.21	1.00		0.16	1.00	1.00
Satd. Flow (perm)	166	3610	1597	355	3575		388	3321		290	3610	1597
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	48	738	169	666	1796	126	296	326	312	132	484	172
RTOR Reduction (vph)	0	0	109	0	4	0	0	125	0	0	0	76
Lane Group Flow (vph)	48	738	60	666	1918	0	296	513	0	132	484	96
Confl. Peds. (#/hr)									2	2		
Turn Type	Perm	NA	Perm	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases		2		1	6		7	4		3	8	
Permitted Phases	2		2	6			4			8		8
Actuated Green, G (s)	42.2	42.2	42.2	80.3	80.3		39.3	25.3		35.3	23.3	23.3
Effective Green, g (s)	44.2	44.2	44.2	82.3	82.3		43.3	27.3		39.3	25.3	25.3
Actuated g/C Ratio	0.33	0.33	0.33	0.61	0.61		0.32	0.20		0.29	0.19	0.19
Clearance Time (s)	7.0	7.0	7.0	4.0	7.0		4.0	7.0		4.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	54	1176	520	585	2169		284	668		234	673	297
v/s Ratio Prot		0.20		c0.30	c0.54		c0.12	c0.15		0.06	0.13	
v/s Ratio Perm	0.29		0.04	0.39			0.21			0.10		0.06
v/c Ratio	0.89	0.63	0.12	1.14	0.88		1.04	0.77		0.56	0.72	0.32
Uniform Delay, d1	43.4	38.7	32.0	32.5	22.6		40.5	51.2		38.3	51.8	47.7
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	81.8	1.1	0.1	81.6	4.7		64.9	5.3		3.1	3.7	0.6
Delay (s)	125.1	39.8	32.1	114.1	27.3		105.4	56.5		41.4	55.5	48.4
Level of Service	F	D	C	F	C		F	E		D	E	D
Approach Delay (s)		42.7			49.7			72.0			51.6	
Approach LOS		D			D			E			D	

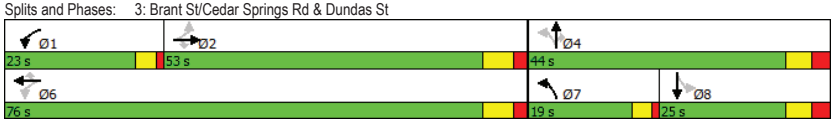
Intersection Summary				
HCM 2000 Control Delay	52.6	HCM 2000 Level of Service	D	
HCM 2000 Volume to Capacity ratio	0.98			
Actuated Cycle Length (s)	135.6	Sum of lost time (s)	14.0	
Intersection Capacity Utilization	103.4%	ICU Level of Service	G	
Analysis Period (min)	15			

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations											
Traffic Volume (vph)	18	520	262	523	1389	59	358	189	250	38	133
Future Volume (vph)	18	520	262	523	1389	59	358	189	250	38	133
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA
Protected Phases		2		1	6		7	4			8
Permitted Phases	2		2	6		6	4		4	8	
Detector Phase	2	2	2	1	6	6	7	4	4	8	8
Switch Phase											
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	41.6	41.6	41.6	11.0	41.6	41.6	11.0	45.6	45.6	45.6	45.6
Total Split (s)	53.0	53.0	53.0	23.0	76.0	76.0	19.0	44.0	44.0	25.0	25.0
Total Split (%)	44.2%	44.2%	44.2%	19.2%	63.3%	63.3%	15.8%	36.7%	36.7%	20.8%	20.8%
Yellow Time (s)	4.6	4.6	4.6	3.0	4.6	4.6	3.0	3.7	3.7	3.7	3.7
All-Red Time (s)	2.0	2.0	2.0	1.0	2.0	2.0	1.0	2.9	2.9	2.9	2.9
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.6	4.6	4.6	2.0	4.6	4.6	2.0	4.6	4.6	4.6	4.6
Lead/Lag	Lag	Lag	Lag	Lead			Lead			Lag	Lag
Lead-Lag Optimize?											
Recall Mode	Ped	Ped	Ped	None	Ped	Ped	None	None	None	None	None
Act Effct Green (s)	37.0	37.0	37.0	62.5	59.9	59.9	36.7	34.1	34.1	15.1	15.1
Actuated g/C Ratio	0.36	0.36	0.36	0.61	0.58	0.58	0.36	0.33	0.33	0.15	0.15
v/c Ratio	0.16	0.41	0.36	0.88	0.68	0.06	0.81	0.31	0.37	0.23	0.53
Control Delay	28.5	26.6	4.6	31.2	17.5	2.4	43.0	27.1	4.6	41.9	47.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.5	26.6	4.6	31.2	17.5	2.4	43.0	27.1	4.6	41.9	47.2
LOS	C	C	A	C	B	A	D	C	A	D	D
Approach Delay		19.4			20.7			27.2			46.1
Approach LOS		B			C			C			D

Intersection Summary			
Cycle Length: 120			
Actuated Cycle Length: 103.2			
Natural Cycle: 120			
Control Type: Semi Act-Uncoord			
Maximum v/c Ratio: 0.88			
Intersection Signal Delay: 23.0		Intersection LOS: C	
Intersection Capacity Utilization 85.1%		ICU Level of Service E	
Analysis Period (min) 15			

Splits and Phases: 3: Brant St/Cedar Springs Rd & Dundas St



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	18	531	267	534	1417	60	365	193	255	39	145
v/c Ratio	0.16	0.41	0.36	0.88	0.68	0.06	0.81	0.31	0.37	0.23	0.53
Control Delay	28.5	26.6	4.6	31.2	17.5	2.4	43.0	27.1	4.6	41.9	47.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.5	26.6	4.6	31.2	17.5	2.4	43.0	27.1	4.6	41.9	47.2
Queue Length 50th (m)	2.6	43.9	0.0	59.4	101.8	0.0	62.2	30.2	0.0	7.4	28.3
Queue Length 95th (m)	9.0	63.3	17.7	#131.9	142.0	5.0	#98.6	48.7	16.6	17.4	48.2
Internal Link Dist (m)		503.2			1627.1			245.0			231.3
Turn Bay Length (m)	75.0		75.0	75.0		75.0	100.0			75.0	
Base Capacity (vph)	149	1694	891	608	2499	1127	451	725	767	231	373
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.12	0.31	0.30	0.88	0.57	0.05	0.81	0.27	0.33	0.17	0.39

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	18	520	262	523	1389	59	358	189	250	38	133	9
Future Volume (vph)	18	520	262	523	1389	59	358	189	250	38	133	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	4.6	4.6	4.6	2.0	4.6	4.6	2.0	4.6	4.6	4.6	4.6	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1745	3610	1597	1745	3610	1597	1745	1900	1597	1745	1882	
Flt Permitted	0.17	1.00	1.00	0.34	1.00	1.00	0.47	1.00	1.00	0.64	1.00	
Satd. Flow (perm)	317	3610	1597	630	3610	1597	855	1900	1597	1169	1882	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	18	531	267	534	1417	60	365	193	255	39	136	9
RTOR Reduction (vph)	0	0	171	0	0	25	0	0	171	0	2	0
Lane Group Flow (vph)	18	531	96	534	1417	35	365	193	84	39	143	0
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2		2	6		6	4		4	8		
Actuated Green, G (s)	35.0	35.0	35.0	57.9	57.9	57.9	32.1	32.1	32.1	13.1	13.1	
Effective Green, g (s)	37.0	37.0	37.0	59.9	59.9	59.9	34.1	34.1	34.1	15.1	15.1	
Actuated g/C Ratio	0.36	0.36	0.36	0.58	0.58	0.58	0.33	0.33	0.33	0.15	0.15	
Clearance Time (s)	6.6	6.6	6.6	4.0	6.6	6.6	4.0	6.6	6.6	6.6	6.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	113	1294	572	591	2095	926	429	627	527	171	275	
v/s Ratio Prot		0.15		c0.18	c0.39		c0.14	0.10			c0.08	
v/s Ratio Perm	0.06		0.06	0.34		0.02	0.14		0.05	0.03		
v/c Ratio	0.16	0.41	0.17	0.90	0.68	0.04	0.85	0.31	0.16	0.23	0.52	
Uniform Delay, d1	22.5	24.9	22.6	14.3	15.0	9.3	29.8	25.8	24.4	38.9	40.7	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.7	0.2	0.1	17.2	0.9	0.0	14.9	0.3	0.1	0.7	1.8	
Delay (s)	23.2	25.1	22.7	31.5	15.8	9.3	44.7	26.0	24.6	39.6	42.5	
Level of Service	C	C	C	C	B	A	D	C	C	D	D	
Approach Delay (s)		24.3			19.8			33.9			41.9	
Approach LOS		C			B			C			D	

Intersection Summary

HCM 2000 Control Delay	24.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	103.2	Sum of lost time (s)	13.2
Intersection Capacity Utilization	85.1%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	1	4	8	26	2	31	11	178	18	2	155	1
Future Volume (Veh/h)	1	4	8	26	2	31	11	178	18	2	155	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)	1	4	9	28	2	33	12	191	19	2	167	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	430	406	168	407	396	200	168			210		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	430	406	168	407	396	200	168			210		
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	99	99	95	100	96	99			100		
cM capacity (veh/h)	513	532	882	545	538	846	1422			1373		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	14	63	222	170
Volume Left	1	28	12	2
Volume Right	9	33	19	1
cSH	712	669	1422	1373
Volume to Capacity	0.02	0.09	0.01	0.00
Queue Length 95th (m)	0.5	2.5	0.2	0.0
Control Delay (s)	10.2	10.9	0.5	0.1
Lane LOS	B	B	A	A
Approach Delay (s)	10.2	10.9	0.5	0.1
Approach LOS	B	B		

Intersection Summary				
Average Delay		2.0		
Intersection Capacity Utilization	33.9%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	46	122	0	17	3
Future Volume (Veh/h)	0	46	122	0	17	3
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	50	133	0	18	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	133				183	133
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	133				183	133
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				98	100
cM capacity (veh/h)	1464				811	922

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	50	133	21
Volume Left	0	0	18
Volume Right	0	0	3
cSH	1464	1700	825
Volume to Capacity	0.00	0.08	0.03
Queue Length 95th (m)	0.0	0.0	0.6
Control Delay (s)	0.0	0.0	9.5
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.5
Approach LOS			A

Intersection Summary				
Average Delay		1.0		
Intersection Capacity Utilization	16.4%	ICU Level of Service	A	
Analysis Period (min)	15			

Appendix D

Background Traffic Operations Reports

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	82	3	125	33	6	6	53	510	19	10	477	72
Future Volume (Veh/h)	82	3	125	33	6	6	53	510	19	10	477	72
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	90	3	137	36	7	7	58	560	21	11	524	79
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)			4									
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1272	1282	564	1234	1312	570	603			581		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1272	1282	564	1234	1312	570	603			581		
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 %	32	98	74	66	95	99	94			99		
cM capacity (veh/h)	131	155	529	107	149	524	984			1003		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	230	50	58	581	11	603
Volume Left	90	36	58	0	11	0
Volume Right	137	7	0	21	0	79
cSH	327	126	984	1700	1003	1700
Volume to Capacity	0.70	0.40	0.06	0.34	0.01	0.35
Queue Length 95th (m)	40.2	13.4	1.5	0.0	0.3	0.0
Control Delay (s)	40.7	51.1	8.9	0.0	8.6	0.0
Lane LOS	E	F	A		A	
Approach Delay (s)	40.7	51.1	0.8		0.2	
Approach LOS	E	F				

Intersection Summary					
Average Delay		8.2			
Intersection Capacity Utilization		52.0%	ICU Level of Service		A
Analysis Period (min)		15			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Traffic Volume (vph)	165	1927	300	258	596	127	351	155	329	71
Future Volume (vph)	165	1927	300	258	596	127	351	155	329	71
Turn Type	Perm	NA	Perm	pm+pt	NA	pm+pt	NA	pm+pt	NA	Perm
Protected Phases		2		1	6	7	4	3	8	
Permitted Phases	2		2	6		4		8		8
Detector Phase	2	2	2	1	6	7	4	3	8	8
Switch Phase										
Minimum Initial (s)	8.0	8.0	8.0	5.0	8.0	5.0	8.0	5.0	8.0	8.0
Minimum Split (s)	46.0	46.0	46.0	11.0	46.0	11.0	39.0	11.0	39.0	39.0
Total Split (s)	70.0	70.0	70.0	18.0	88.0	18.0	34.0	18.0	34.0	34.0
Total Split (%)	50.0%	50.0%	50.0%	12.9%	62.9%	12.9%	24.3%	12.9%	24.3%	24.3%
Yellow Time (s)	5.0	5.0	5.0	3.0	5.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	1.0	2.0	1.0	3.0	1.0	3.0	3.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	5.0	5.0	5.0	2.0	5.0	2.0	5.0	2.0	5.0	5.0
Lead/Lag	Lag	Lag	Lag	Lead		Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	Ped	Ped	Ped	None	Ped	None	None	None	None	None
Act Effct Green (s)	65.0	65.0	65.0	86.0	83.0	46.0	29.0	47.6	29.8	29.8
Actuated g/C Ratio	0.47	0.47	0.47	0.62	0.60	0.33	0.21	0.34	0.21	0.21
v/c Ratio	0.53	1.16	0.37	1.03	0.35	0.36	1.31dr	0.65	0.43	0.17
Control Delay	33.8	114.6	14.0	102.8	14.2	34.6	140.0	45.5	49.6	5.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	33.8	114.6	14.0	102.8	14.2	34.6	140.0	45.5	49.6	5.2
LOS	C	F	B	F	B	C	F	D	D	A
Approach Delay		96.4			37.5		128.0		42.8	
Approach LOS		F			D		F		D	

Intersection Summary			
Cycle Length: 140			
Actuated Cycle Length: 138.8			
Natural Cycle: 120			
Control Type: Semi Act-Uncoord			
Maximum v/c Ratio: 1.20			
Intersection Signal Delay: 86.1		Intersection LOS: F	
Intersection Capacity Utilization 121.6%		ICU Level of Service H	
Analysis Period (min) 15			
dr Defacto Right Lane. Recode with 1 though lane as a right lane.			

Splits and Phases: 2: Guelph Line & Dundas St

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	168	1966	306	263	735	130	1014	158	336	72
v/c Ratio	0.53	1.16	0.37	1.03	0.35	0.36	1.31dr	0.65	0.43	0.17
Control Delay	33.8	114.6	14.0	102.8	14.2	34.6	140.0	45.5	49.6	5.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	33.8	114.6	14.0	102.8	14.2	34.6	140.0	45.5	49.6	5.2
Queue Length 50th (m)	34.2	~358.9	29.6	~65.1	52.8	26.2	~163.0	32.4	44.9	0.0
Queue Length 95th (m)	59.7	#402.2	52.9	#123.4	65.7	42.9	#207.5	51.7	61.5	8.4
Internal Link Dist (m)		352.0			373.1		190.8		153.2	
Turn Bay Length (m)	100.0		70.0	115.0		50.0		70.0		70.0
Base Capacity (vph)	320	1691	821	256	2115	382	842	257	774	416
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.53	1.16	0.37	1.03	0.35	0.34	1.20	0.61	0.43	0.17

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
dr Defacto Right Lane. Recode with 1 though lane as a right lane.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	165	1927	300	258	596	124	127	351	643	155	329	71
Future Volume (vph)	165	1927	300	258	596	124	127	351	643	155	329	71
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	5.0	5.0	5.0	2.0	5.0		2.0	5.0		2.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	0.99		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.97		1.00	0.90		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1745	3610	1597	1745	3516		1745	3232		1745	3610	1597
Flt Permitted	0.37	1.00	1.00	0.06	1.00		0.43	1.00		0.13	1.00	1.00
Satd. Flow (perm)	684	3610	1597	110	3516		798	3232		247	3610	1597
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	168	1966	306	263	608	127	130	358	656	158	336	72
RTOR Reduction (vph)	0	0	73	0	12	0	0	167	0	0	0	57
Lane Group Flow (vph)	168	1966	233	263	723	0	130	847	0	158	336	15
Confl. Peds. (#/hr)									1	1		
Turn Type	Perm	NA	Perm	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases		2		1	6		7	4		3	8	
Permitted Phases	2		2	6			4			8		8
Actuated Green, G (s)	63.0	63.0	63.0	81.0	81.0		39.0	27.0		40.6	27.8	27.8
Effective Green, g (s)	65.0	65.0	65.0	83.0	83.0		43.0	29.0		44.6	29.8	29.8
Actuated g/C Ratio	0.47	0.47	0.47	0.60	0.60		0.31	0.21		0.32	0.21	0.21
Clearance Time (s)	7.0	7.0	7.0	4.0	7.0		4.0	7.0		4.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	320	1690	747	254	2102		342	675		239	775	342
v/s Ratio Prot		c0.54		c0.12	0.21		0.04	c0.26		c0.07	0.09	
v/s Ratio Perm	0.25		0.15	0.50			0.08			0.14		0.01
v/c Ratio	0.53	1.16	0.31	1.04	0.34		0.38	1.31dr		0.66	0.43	0.05
Uniform Delay, d1	26.0	36.9	23.0	47.7	14.1		35.9	54.9		37.8	47.2	43.2
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.6	80.4	0.2	66.0	0.1		0.7	126.6		6.7	0.4	0.1
Delay (s)	27.6	117.3	23.2	113.7	14.2		36.6	181.5		44.5	47.6	43.3
Level of Service	C	F	C	F	B		D	F		D	D	D
Approach Delay (s)		99.3			40.4			165.0			46.2	
Approach LOS		F			D			F			D	

Intersection Summary

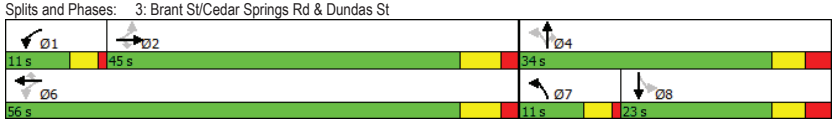
HCM 2000 Control Delay	96.7	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	138.8	Sum of lost time (s)	14.0
Intersection Capacity Utilization	121.6%	ICU Level of Service	H
Analysis Period (min)	15		

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations											
Traffic Volume (vph)	11	1657	449	234	405	46	190	95	403	88	211
Future Volume (vph)	11	1657	449	234	405	46	190	95	403	88	211
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA
Protected Phases		2		1	6		7	4			8
Permitted Phases	2		2	6		6	4		4	8	
Detector Phase	2	2	2	1	6	6	7	4	4	8	8
Switch Phase											
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	41.6	41.6	41.6	11.0	41.6	41.6	11.0	45.6	45.6	45.6	45.6
Total Split (s)	45.0	45.0	45.0	11.0	56.0	56.0	11.0	34.0	34.0	23.0	23.0
Total Split (%)	50.0%	50.0%	50.0%	12.2%	62.2%	62.2%	12.2%	37.8%	37.8%	25.6%	25.6%
Yellow Time (s)	4.6	4.6	4.6	3.0	4.6	4.6	3.0	3.7	3.7	3.7	3.7
All-Red Time (s)	2.0	2.0	2.0	1.0	2.0	2.0	1.0	2.9	2.9	2.9	2.9
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.6	4.6	4.6	2.0	4.6	4.6	2.0	4.6	4.6	4.6	4.6
Lead/Lag	Lag	Lag	Lag	Lead			Lead			Lag	Lag
Lead-Lag Optimize?											
Recall Mode	Ped	Ped	Ped	None	Ped	Ped	None	None	None	None	None
Act Effct Green (s)	40.5	40.5	40.5	54.1	51.5	51.5	29.9	27.3	27.3	16.3	16.3
Actuated g/C Ratio	0.46	0.46	0.46	0.61	0.59	0.59	0.34	0.31	0.31	0.19	0.19
v/c Ratio	0.03	1.04	0.50	0.91	0.20	0.05	0.59	0.17	0.68	0.39	0.65
Control Delay	14.2	58.7	5.3	57.9	9.2	0.5	29.8	22.7	21.5	36.6	42.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.2	58.7	5.3	57.9	9.2	0.5	29.8	22.7	21.5	36.6	42.1
LOS	B	E	A	E	A	A	C	C	C	D	D
Approach Delay		47.2			25.3			24.0			40.5
Approach LOS		D			C			C			D

Intersection Summary		
Cycle Length: 90		
Actuated Cycle Length: 88		
Natural Cycle: 120		
Control Type: Semi Act-Uncoord		
Maximum v/c Ratio: 1.04		
Intersection Signal Delay: 38.5	Intersection LOS: D	
Intersection Capacity Utilization 95.2%	ICU Level of Service F	
Analysis Period (min) 15		

Splits and Phases: 3: Brant St/Cedar Springs Rd & Dundas St



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	11	1726	468	244	422	48	198	99	420	92	228
v/c Ratio	0.03	1.04	0.50	0.91	0.20	0.05	0.59	0.17	0.68	0.39	0.65
Control Delay	14.2	58.7	5.3	57.9	9.2	0.5	29.8	22.7	21.5	36.6	42.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.2	58.7	5.3	57.9	9.2	0.5	29.8	22.7	21.5	36.6	42.1
Queue Length 50th (m)	1.1	~181.9	8.0	26.8	17.8	0.0	25.8	12.7	37.6	14.5	37.5
Queue Length 95th (m)	4.2	#227.7	29.1	#73.7	25.9	1.2	43.6	24.6	71.4	29.2	61.7
Internal Link Dist (m)		503.2			1627.1			245.0			231.3
Turn Bay Length (m)	75.0		75.0	75.0		75.0	100.0			75.0	
Base Capacity (vph)	427	1659	943	267	2111	972	333	635	649	266	397
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.03	1.04	0.50	0.91	0.20	0.05	0.59	0.16	0.65	0.35	0.57

Intersection Summary
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	11	1657	449	234	405	46	190	95	403	88	211	8
Future Volume (vph)	11	1657	449	234	405	46	190	95	403	88	211	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	4.6	4.6	4.6	2.0	4.6	4.6	2.0	4.6	4.6	4.6	4.6	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1745	3610	1597	1745	3610	1597	1745	1900	1597	1745	1890	
Flt Permitted	0.51	1.00	1.00	0.09	1.00	1.00	0.35	1.00	1.00	0.69	1.00	
Satd. Flow (perm)	928	3610	1597	173	3610	1597	650	1900	1597	1273	1890	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	11	1726	468	244	422	48	198	99	420	92	220	8
RTOR Reduction (vph)	0	0	210	0	0	20	0	0	119	0	2	0
Lane Group Flow (vph)	11	1726	258	244	422	28	198	99	301	92	226	0
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2		2	6		6	4		4	8		
Actuated Green, G (s)	38.4	38.4	38.4	49.4	49.4	49.4	25.3	25.3	25.3	14.3	14.3	
Effective Green, g (s)	40.4	40.4	40.4	51.4	51.4	51.4	27.3	27.3	27.3	16.3	16.3	
Actuated g/C Ratio	0.46	0.46	0.46	0.58	0.58	0.58	0.31	0.31	0.31	0.19	0.19	
Clearance Time (s)	6.6	6.6	6.6	4.0	6.6	6.6	4.0	6.6	6.6	6.6	6.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	426	1659	734	262	2110	933	313	590	495	236	350	
v/s Ratio Prot		c0.48		c0.10	0.12		c0.06	0.05			0.12	
v/s Ratio Perm	0.01		0.16	0.45		0.02	0.13		c0.19	0.07		
v/c Ratio	0.03	1.04	0.35	0.93	0.20	0.03	0.63	0.17	0.61	0.39	0.65	
Uniform Delay, d1	13.0	23.8	15.3	24.4	8.6	7.7	24.0	22.0	25.7	31.4	33.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.0	33.4	0.3	37.4	0.0	0.0	4.1	0.1	2.1	1.1	4.1	
Delay (s)	13.0	57.1	15.6	61.8	8.6	7.7	28.1	22.2	27.9	32.5	37.2	
Level of Service	B	E	B	E	A	A	C	C	C	C	D	
Approach Delay (s)		48.1			26.8			27.1			35.9	
Approach LOS		D			C			C			D	

Intersection Summary				
HCM 2000 Control Delay	39.5	HCM 2000 Level of Service	D	
HCM 2000 Volume to Capacity ratio	0.89			
Actuated Cycle Length (s)	87.9	Sum of lost time (s)	13.2	
Intersection Capacity Utilization	95.2%	ICU Level of Service	F	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	7	19	19	0	1	3	110	35	23	181	0
Future Volume (Veh/h)	0	7	19	19	0	1	3	110	35	23	181	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	0	8	23	23	0	1	4	131	42	27	215	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	430	450	215	456	429	152	215			173		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	430	450	215	456	429	152	215			173		
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	98	97	95	100	100	100			98		
cM capacity (veh/h)	529	496	830	489	510	900	1367			1416		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	31	24	177	242
Volume Left	0	23	4	27
Volume Right	23	1	42	0
cSH	707	499	1367	1416
Volume to Capacity	0.04	0.05	0.00	0.02
Queue Length 95th (m)	1.1	1.2	0.1	0.5
Control Delay (s)	10.3	12.6	0.2	1.0
Lane LOS	B	B	A	A
Approach Delay (s)	10.3	12.6	0.2	1.0
Approach LOS	B	B		

Intersection Summary				
Average Delay	1.9			
Intersection Capacity Utilization	36.5%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	97	47	148	144	0
Future Volume (Veh/h)	0	97	47	148	144	0
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	105	51	161	157	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	212				236	132
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	212				236	132
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				79	100
cM capacity (veh/h)	1370				756	923

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	105	212	157
Volume Left	0	0	157
Volume Right	0	161	0
cSH	1370	1700	756
Volume to Capacity	0.00	0.12	0.21
Queue Length 95th (m)	0.0	0.0	6.2
Control Delay (s)	0.0	0.0	11.0
Lane LOS			B
Approach Delay (s)	0.0	0.0	11.0
Approach LOS			B

Intersection Summary				
Average Delay		3.6		
Intersection Capacity Utilization		26.2%	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)	57	3	31	17	5	0	62	552	10	6	639	57
Future Volume (Veh/h)	57	3	31	17	5	0	62	552	10	6	639	57
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	65	3	35	19	6	0	70	627	11	7	726	65
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)			4									
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1542	1550	758	1514	1578	632	791			638		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1542	1550	758	1514	1578	632	791			638		
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 %	23	97	91	77	94	100	92			99		
cM capacity (veh/h)	84	104	410	83	101	484	838			956		

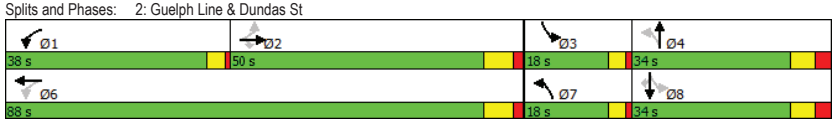
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	103	25	70	638	7	791
Volume Left	65	19	70	0	7	0
Volume Right	35	0	0	11	0	65
cSH	129	86	838	1700	956	1700
Volume to Capacity	0.80	0.29	0.08	0.38	0.01	0.47
Queue Length 95th (m)	38.4	8.6	2.2	0.0	0.2	0.0
Control Delay (s)	92.9	62.9	9.7	0.0	8.8	0.0
Lane LOS	F	F	A		A	
Approach Delay (s)	92.9	62.9	1.0		0.1	
Approach LOS	F	F				

Intersection Summary				
Average Delay		7.3		
Intersection Capacity Utilization		58.4%	ICU Level of Service	B
Analysis Period (min)		15		

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Traffic Volume (vph)	52	792	181	713	1924	318	347	142	519	184
Future Volume (vph)	52	792	181	713	1924	318	347	142	519	184
Turn Type	Perm	NA	Perm	pm+pt	NA	pm+pt	NA	pm+pt	NA	Perm
Protected Phases		2		1	6	7	4	3	8	
Permitted Phases	2		2	6		4		8		8
Detector Phase	2	2	2	1	6	7	4	3	8	8
Switch Phase										
Minimum Initial (s)	8.0	8.0	8.0	5.0	8.0	5.0	8.0	5.0	8.0	8.0
Minimum Split (s)	46.0	46.0	46.0	11.0	46.0	11.0	39.0	11.0	39.0	39.0
Total Split (s)	50.0	50.0	50.0	38.0	88.0	18.0	34.0	18.0	34.0	34.0
Total Split (%)	35.7%	35.7%	35.7%	27.1%	62.9%	12.9%	24.3%	12.9%	24.3%	24.3%
Yellow Time (s)	5.0	5.0	5.0	3.0	5.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	1.0	2.0	1.0	3.0	1.0	3.0	3.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	5.0	5.0	5.0	2.0	5.0	2.0	5.0	2.0	5.0	5.0
Lead/Lag	Lag	Lag	Lag	Lead		Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	Ped	Ped	Ped	None	Ped	None	None	None	None	None
Act Effct Green (s)	45.0	45.0	45.0	86.1	83.1	46.6	28.3	44.2	26.7	26.7
Actuated g/C Ratio	0.33	0.33	0.33	0.62	0.60	0.34	0.21	0.32	0.19	0.19
v/c Ratio	1.02	0.69	0.30	1.32	0.98	1.19	0.87	0.60	0.77	0.49
Control Delay	178.8	44.3	8.7	185.3	42.8	150.5	53.4	43.1	60.5	29.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	178.8	44.3	8.7	185.3	42.8	150.5	53.4	43.1	60.5	29.0
LOS	F	D	A	F	D	F	D	D	E	C
Approach Delay		44.9			79.5		84.4		50.7	
Approach LOS		D			E		F		D	

Intersection Summary		
Cycle Length: 140		
Actuated Cycle Length: 137.8		
Natural Cycle: 120		
Control Type: Semi Act-Uncoord		
Maximum v/c Ratio: 1.32		
Intersection Signal Delay: 69.7	Intersection LOS: E	
Intersection Capacity Utilization 111.9%	ICU Level of Service H	
Analysis Period (min) 15		

Splits and Phases: 2: Guelph Line & Dundas St



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	54	816	187	735	2121	328	701	146	535	190
v/c Ratio	1.02	0.69	0.30	1.32	0.98	1.19	0.87	0.60	0.77	0.49
Control Delay	178.8	44.3	8.7	185.3	42.8	150.5	53.4	43.1	60.5	29.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	178.8	44.3	8.7	185.3	42.8	150.5	53.4	43.1	60.5	29.0
Queue Length 50th (m)	~16.8	109.4	5.2	~247.9	308.1	~92.2	83.0	29.8	77.2	24.0
Queue Length 95th (m)	#47.1	134.0	23.6	#328.6	#379.8	#155.8	#114.5	47.5	98.3	49.5
Internal Link Dist (m)		352.0			373.1		190.8		153.2	
Turn Bay Length (m)	100.0		70.0	115.0		50.0		70.0		70.0
Base Capacity (vph)	53	1179	630	558	2158	275	823	262	760	410
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.02	0.69	0.30	1.32	0.98	1.19	0.85	0.56	0.70	0.46

Intersection Summary
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	52	792	181	713	1924	133	318	347	333	142	519	184
Future Volume (vph)	52	792	181	713	1924	133	318	347	333	142	519	184
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	5.0	5.0	5.0	2.0	5.0		2.0	5.0		2.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	0.99		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1745	3610	1597	1745	3575		1745	3321		1745	3610	1597
Flt Permitted	0.09	1.00	1.00	0.15	1.00		0.18	1.00		0.15	1.00	1.00
Satd. Flow (perm)	163	3610	1597	282	3575		327	3321		275	3610	1597
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	54	816	187	735	1984	137	328	358	343	146	535	190
RTOR Reduction (vph)	0	0	108	0	4	0	0	125	0	0	0	76
Lane Group Flow (vph)	54	816	79	735	2117	0	328	576	0	146	535	114
Confl. Peds. (#/hr)									2	2		
Turn Type	Perm	NA	Perm	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases		2		1	6		7	4		3	8	
Permitted Phases	2		2	6			4			8		8
Actuated Green, G (s)	43.0	43.0	43.0	81.0	81.0		40.3	26.3		37.1	24.7	24.7
Effective Green, g (s)	45.0	45.0	45.0	83.0	83.0		44.3	28.3		41.1	26.7	26.7
Actuated g/C Ratio	0.33	0.33	0.33	0.60	0.60		0.32	0.21		0.30	0.19	0.19
Clearance Time (s)	7.0	7.0	7.0	4.0	7.0		4.0	7.0		4.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	53	1179	521	552	2154		269	682		235	699	309
v/s Ratio Prot		0.23		c0.35	c0.59		c0.14	c0.17		0.06	0.15	
v/s Ratio Perm	0.33		0.05	0.45			0.25			0.12		0.07
v/c Ratio	1.02	0.69	0.15	1.33	0.98		1.22	0.84		0.62	0.77	0.37
Uniform Delay, d1	46.3	40.3	32.8	36.4	26.7		40.1	52.6		38.9	52.5	48.2
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	129.1	1.8	0.1	161.3	15.5		127.5	9.4		5.0	5.0	0.7
Delay (s)	175.5	42.1	33.0	197.7	42.1		167.6	62.0		43.9	57.5	48.9
Level of Service	F	D	C	F	D		F	E		D	E	D
Approach Delay (s)		47.3			82.2			95.7			53.4	
Approach LOS		D			F			F			D	

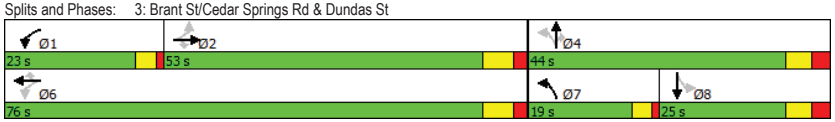
Intersection Summary				
HCM 2000 Control Delay	73.9	HCM 2000 Level of Service	E	
HCM 2000 Volume to Capacity ratio	1.10			
Actuated Cycle Length (s)	137.7	Sum of lost time (s)	14.0	
Intersection Capacity Utilization	111.9%	ICU Level of Service	H	
Analysis Period (min)	15			

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations											
Traffic Volume (vph)	20	575	290	576	1532	65	394	209	277	42	147
Future Volume (vph)	20	575	290	576	1532	65	394	209	277	42	147
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA
Protected Phases		2		1	6		7	4			8
Permitted Phases	2		2	6		6	4		4	8	
Detector Phase	2	2	2	1	6	6	7	4	4	8	8
Switch Phase											
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	41.6	41.6	41.6	11.0	41.6	41.6	11.0	45.6	45.6	45.6	45.6
Total Split (s)	53.0	53.0	53.0	23.0	76.0	76.0	19.0	44.0	44.0	25.0	25.0
Total Split (%)	44.2%	44.2%	44.2%	19.2%	63.3%	63.3%	15.8%	36.7%	36.7%	20.8%	20.8%
Yellow Time (s)	4.6	4.6	4.6	3.0	4.6	4.6	3.0	3.7	3.7	3.7	3.7
All-Red Time (s)	2.0	2.0	2.0	1.0	2.0	2.0	1.0	2.9	2.9	2.9	2.9
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.6	4.6	4.6	2.0	4.6	4.6	2.0	4.6	4.6	4.6	4.6
Lead/Lag	Lag	Lag	Lag	Lead			Lead			Lag	Lag
Lead-Lag Optimize?											
Recall Mode	Ped	Ped	Ped	None	Ped	Ped	None	None	None	None	None
Act Effct Green (s)	39.0	39.0	39.0	64.7	62.1	62.1	37.4	34.8	34.8	15.8	15.8
Actuated g/C Ratio	0.37	0.37	0.37	0.61	0.58	0.58	0.35	0.33	0.33	0.15	0.15
v/c Ratio	0.24	0.44	0.38	1.01	0.74	0.07	0.93	0.34	0.40	0.25	0.57
Control Delay	33.1	26.8	4.2	57.0	19.1	2.5	61.3	29.2	5.0	44.6	50.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	33.1	26.8	4.2	57.0	19.1	2.5	61.3	29.2	5.0	44.6	50.4
LOS	C	C	A	E	B	A	E	C	A	D	D
Approach Delay		19.6			28.7			35.9			49.2
Approach LOS		B			C			D			D

Intersection Summary			
Cycle Length: 120			
Actuated Cycle Length: 106.2			
Natural Cycle: 120			
Control Type: Semi Act-Uncoord			
Maximum v/c Ratio: 1.01			
Intersection Signal Delay: 29.3		Intersection LOS: C	
Intersection Capacity Utilization 92.3%		ICU Level of Service F	
Analysis Period (min) 15			

Splits and Phases: 3: Brant St/Cedar Springs Rd & Dundas St



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	20	587	296	588	1563	66	402	213	283	43	160
v/c Ratio	0.24	0.44	0.38	1.01	0.74	0.07	0.93	0.34	0.40	0.25	0.57
Control Delay	33.1	26.8	4.2	57.0	19.1	2.5	61.3	29.2	5.0	44.6	50.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	33.1	26.8	4.2	57.0	19.1	2.5	61.3	29.2	5.0	44.6	50.4
Queue Length 50th (m)	3.0	50.2	0.0	~75.1	123.3	0.0	70.4	33.7	0.0	8.2	31.5
Queue Length 95th (m)	10.3	69.5	17.2	#176.9	165.4	5.5	#163.3	61.1	19.2	20.7	58.2
Internal Link Dist (m)		503.2			1627.1			245.0			231.3
Turn Bay Length (m)	75.0		75.0	75.0		75.0	100.0			75.0	
Base Capacity (vph)	103	1651	891	581	2436	1100	430	707	772	221	364
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.19	0.36	0.33	1.01	0.64	0.06	0.93	0.30	0.37	0.19	0.44

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	575	290	576	1532	65	394	209	277	42	147	10
Future Volume (vph)	20	575	290	576	1532	65	394	209	277	42	147	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	4.6	4.6	4.6	2.0	4.6	4.6	2.0	4.6	4.6	4.6	4.6	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1745	3610	1597	1745	3610	1597	1745	1900	1597	1745	1882	
Flt Permitted	0.12	1.00	1.00	0.31	1.00	1.00	0.43	1.00	1.00	0.62	1.00	
Satd. Flow (perm)	227	3610	1597	572	3610	1597	783	1900	1597	1147	1882	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	20	587	296	588	1563	66	402	213	283	43	150	10
RTOR Reduction (vph)	0	0	187	0	0	27	0	0	190	0	2	0
Lane Group Flow (vph)	20	587	109	588	1563	39	402	213	93	43	158	0
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2		2	6		6	4		4	8		
Actuated Green, G (s)	37.0	37.0	37.0	60.1	60.1	60.1	32.9	32.9	32.9	13.8	13.8	
Effective Green, g (s)	39.0	39.0	39.0	62.1	62.1	62.1	34.9	34.9	34.9	15.8	15.8	
Actuated g/C Ratio	0.37	0.37	0.37	0.58	0.58	0.58	0.33	0.33	0.33	0.15	0.15	
Clearance Time (s)	6.6	6.6	6.6	4.0	6.6	6.6	4.0	6.6	6.6	6.6	6.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	83	1325	586	567	2110	933	412	624	524	170	279	
v/s Ratio Prot		0.16		c0.21	c0.43		c0.16	0.11			c0.08	
v/s Ratio Perm	0.09		0.07	0.40		0.02	0.16		0.06	0.04		
v/c Ratio	0.24	0.44	0.19	1.04	0.74	0.04	0.98	0.34	0.18	0.25	0.57	
Uniform Delay, d1	23.3	25.4	22.8	15.8	16.2	9.4	32.8	27.0	25.4	40.0	42.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.5	0.2	0.2	47.7	1.4	0.0	37.6	0.3	0.2	0.8	2.6	
Delay (s)	24.8	25.6	23.0	63.5	17.6	9.4	70.4	27.3	25.6	40.8	44.7	
Level of Service	C	C	C	E	B	A	E	C	C	D	D	
Approach Delay (s)		24.7			29.5			46.1			43.8	
Approach LOS		C			C			D			D	

Intersection Summary

HCM 2000 Control Delay	32.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	106.2	Sum of lost time (s)	13.2
Intersection Capacity Utilization	92.3%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	1	4	9	29	2	34	12	196	20	2	170	1
Future Volume (Veh/h)	1	4	9	29	2	34	12	196	20	2	170	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)	1	4	10	31	2	37	13	211	22	2	183	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	474	446	184	448	436	222	184			233		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	474	446	184	448	436	222	184			233		
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	99	99	94	100	96	99			100		
cM capacity (veh/h)	476	504	864	511	511	823	1403			1346		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	15	70	246	186
Volume Left	1	31	13	2
Volume Right	10	37	22	1
cSH	694	639	1403	1346
Volume to Capacity	0.02	0.11	0.01	0.00
Queue Length 95th (m)	0.5	2.9	0.2	0.0
Control Delay (s)	10.3	11.3	0.5	0.1
Lane LOS	B	B	A	A
Approach Delay (s)	10.3	11.3	0.5	0.1
Approach LOS	B	B		

Intersection Summary				
Average Delay	2.1			
Intersection Capacity Utilization	36.1%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	50	134	0	17	3
Future Volume (Veh/h)	0	50	134	0	17	3
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	54	146	0	18	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	146				200	146
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	146				200	146
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				98	100
cM capacity (veh/h)	1448				793	906

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	54	146	21
Volume Left	0	0	18
Volume Right	0	0	3
cSH	1448	1700	808
Volume to Capacity	0.00	0.09	0.03
Queue Length 95th (m)	0.0	0.0	0.6
Control Delay (s)	0.0	0.0	9.6
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.6
Approach LOS			A

Intersection Summary				
Average Delay	0.9			
Intersection Capacity Utilization	17.1%	ICU Level of Service	A	
Analysis Period (min)	15			

Appendix E

Total Traffic Operations Reports

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	103	3	153	33	6	6	74	510	19	10	477	100
Future Volume (Veh/h)	103	3	153	33	6	6	74	510	19	10	477	100
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	113	3	168	36	7	7	81	560	21	11	524	110
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)			4									
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1334	1344	579	1280	1388	570	634			581		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1334	1344	579	1280	1388	570	634			581		
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 %	3	98	68	59	95	99	92			99		
cM capacity (veh/h)	116	139	519	89	130	524	959			1003		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	284	50	81	581	11	634
Volume Left	113	36	81	0	11	0
Volume Right	168	7	0	21	0	110
cSH	262	106	959	1700	1003	1700
Volume to Capacity	1.08	0.47	0.08	0.34	0.01	0.37
Queue Length 95th (m)	94.0	16.6	2.2	0.0	0.3	0.0
Control Delay (s)	121.0	66.3	9.1	0.0	8.6	0.0
Lane LOS	F	F	A		A	
Approach Delay (s)	121.0	66.3	1.1		0.1	
Approach LOS	F	F				

Intersection Summary					
Average Delay	23.5				
Intersection Capacity Utilization	54.5%	ICU Level of Service		A	
Analysis Period (min)	15				

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Traffic Volume (vph)	169	1927	300	258	596	127	358	162	343	78
Future Volume (vph)	169	1927	300	258	596	127	358	162	343	78
Turn Type	Perm	NA	Perm	pm+pt	NA	pm+pt	NA	pm+pt	NA	Perm
Protected Phases		2		1	6	7	4	3	8	
Permitted Phases	2		2	6		4		8		8
Detector Phase	2	2	2	1	6	7	4	3	8	8
Switch Phase										
Minimum Initial (s)	8.0	8.0	8.0	5.0	8.0	5.0	8.0	5.0	8.0	8.0
Minimum Split (s)	46.0	46.0	46.0	11.0	46.0	11.0	39.0	11.0	39.0	39.0
Total Split (s)	70.0	70.0	70.0	18.0	88.0	18.0	34.0	18.0	34.0	34.0
Total Split (%)	50.0%	50.0%	50.0%	12.9%	62.9%	12.9%	24.3%	12.9%	24.3%	24.3%
Yellow Time (s)	5.0	5.0	5.0	3.0	5.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	1.0	2.0	1.0	3.0	1.0	3.0	3.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	5.0	5.0	5.0	2.0	5.0	2.0	5.0	2.0	5.0	5.0
Lead/Lag	Lag	Lag	Lag	Lead		Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	Ped	Ped	Ped	None	Ped	None	None	None	None	None
Act Effct Green (s)	65.0	65.0	65.0	86.0	83.0	46.0	29.0	47.8	29.9	29.9
Actuated g/C Ratio	0.47	0.47	0.47	0.62	0.60	0.33	0.21	0.34	0.22	0.22
v/c Ratio	0.54	1.16	0.37	1.03	0.35	0.37	1.32dr	0.67	0.45	0.19
Control Delay	34.6	115.2	14.0	103.1	14.2	34.8	144.6	47.1	49.9	7.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.6	115.2	14.0	103.1	14.2	34.8	144.6	47.1	49.9	7.1
LOS	C	F	B	F	B	C	F	D	D	A
Approach Delay		96.9			37.4		132.2		43.3	
Approach LOS		F			D		F		D	

Intersection Summary			
Cycle Length: 140			
Actuated Cycle Length: 138.9			
Natural Cycle: 120			
Control Type: Semi Act-Uncoord			
Maximum v/c Ratio: 1.22			
Intersection Signal Delay: 87.0		Intersection LOS: F	
Intersection Capacity Utilization 122.2%		ICU Level of Service H	
Analysis Period (min) 15			
dr Defacto Right Lane. Recode with 1 though lane as a right lane.			

Splits and Phases: 2: Guelph Line & Dundas St

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	172	1966	306	263	745	130	1021	165	350	80
v/c Ratio	0.54	1.16	0.37	1.03	0.35	0.37	1.32dr	0.67	0.45	0.19
Control Delay	34.6	115.2	14.0	103.1	14.2	34.8	144.6	47.1	49.9	7.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.6	115.2	14.0	103.1	14.2	34.8	144.6	47.1	49.9	7.1
Queue Length 50th (m)	35.4	~358.9	29.6	~65.1	53.5	26.2	~165.8	34.0	47.0	0.0
Queue Length 95th (m)	61.9	#402.2	52.9	#123.4	66.6	42.9	#210.4	54.3	63.9	11.1
Internal Link Dist (m)		352.0			373.1		190.8		153.2	
Turn Bay Length (m)	100.0		70.0	115.0		50.0		70.0		70.0
Base Capacity (vph)	317	1689	820	256	2110	375	840	257	777	417
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.54	1.16	0.37	1.03	0.35	0.35	1.22	0.64	0.45	0.19

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
dr Defacto Right Lane. Recode with 1 though lane as a right lane.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	169	1927	300	258	596	134	127	358	643	162	343	78
Future Volume (vph)	169	1927	300	258	596	134	127	358	643	162	343	78
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	5.0	5.0	5.0	2.0	5.0		2.0	5.0		2.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	0.99		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.97		1.00	0.90		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1745	3610	1597	1745	3510		1745	3234		1745	3610	1597
Flt Permitted	0.37	1.00	1.00	0.06	1.00		0.42	1.00		0.13	1.00	1.00
Satd. Flow (perm)	677	3610	1597	110	3510		771	3234		246	3610	1597
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	172	1966	306	263	608	137	130	365	656	165	350	80
RTOR Reduction (vph)	0	0	73	0	14	0	0	165	0	0	0	63
Lane Group Flow (vph)	172	1966	233	263	731	0	130	856	0	165	350	17
Confl. Peds. (#/hr)									1	1		
Turn Type	Perm	NA	Perm	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases		2		1	6		7	4		3	8	
Permitted Phases	2		2	6			4			8		8
Actuated Green, G (s)	63.0	63.0	63.0	81.0	81.0		39.0	27.0		40.8	27.9	27.9
Effective Green, g (s)	65.0	65.0	65.0	83.0	83.0		43.0	29.0		44.8	29.9	29.9
Actuated g/C Ratio	0.47	0.47	0.47	0.60	0.60		0.31	0.21		0.32	0.22	0.22
Clearance Time (s)	7.0	7.0	7.0	4.0	7.0		4.0	7.0		4.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	316	1689	747	254	2097		336	675		240	777	343
v/s Ratio Prot		c0.54		c0.12	0.21		0.04	c0.26		c0.07	0.10	
v/s Ratio Perm	0.25		0.15	0.50			0.08			0.15		0.01
v/c Ratio	0.54	1.16	0.31	1.04	0.35		0.39	1.32dr		0.69	0.45	0.05
Uniform Delay, d1	26.4	37.0	23.0	47.7	14.2		35.9	55.0		37.9	47.4	43.2
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.9	80.7	0.2	66.0	0.1		0.7	132.4		7.9	0.4	0.1
Delay (s)	28.3	117.7	23.3	113.7	14.3		36.7	187.4		45.8	47.8	43.3
Level of Service	C	F	C	F	B		D	F		D	D	D
Approach Delay (s)		99.6			40.2			170.4			46.6	
Approach LOS		F			D			F			D	

Intersection Summary

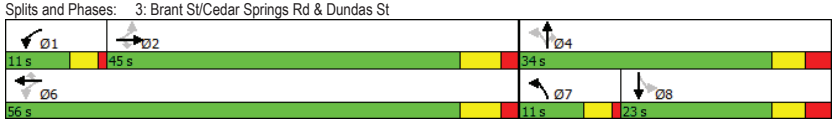
HCM 2000 Control Delay	97.7	HCM 2000 Level of Service		F	
HCM 2000 Volume to Capacity ratio	1.11				
Actuated Cycle Length (s)	138.9	Sum of lost time (s)		14.0	
Intersection Capacity Utilization	122.2%	ICU Level of Service		H	
Analysis Period (min)	15				

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations											
Traffic Volume (vph)	11	1660	449	238	409	46	190	95	403	88	211
Future Volume (vph)	11	1660	449	238	409	46	190	95	403	88	211
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA
Protected Phases		2		1	6		7	4			8
Permitted Phases	2		2	6		6	4		4	8	
Detector Phase	2	2	2	1	6	6	7	4	4	8	8
Switch Phase											
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	41.6	41.6	41.6	11.0	41.6	41.6	11.0	45.6	45.6	45.6	45.6
Total Split (s)	45.0	45.0	45.0	11.0	56.0	56.0	11.0	34.0	34.0	23.0	23.0
Total Split (%)	50.0%	50.0%	50.0%	12.2%	62.2%	62.2%	12.2%	37.8%	37.8%	25.6%	25.6%
Yellow Time (s)	4.6	4.6	4.6	3.0	4.6	4.6	3.0	3.7	3.7	3.7	3.7
All-Red Time (s)	2.0	2.0	2.0	1.0	2.0	2.0	1.0	2.9	2.9	2.9	2.9
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.6	4.6	4.6	2.0	4.6	4.6	2.0	4.6	4.6	4.6	4.6
Lead/Lag	Lag	Lag	Lag	Lead			Lead			Lag	Lag
Lead-Lag Optimize?											
Recall Mode	Ped	Ped	Ped	None	Ped	Ped	None	None	None	None	None
Act Effct Green (s)	40.5	40.5	40.5	54.1	51.5	51.5	29.9	27.3	27.3	16.3	16.3
Actuated g/C Ratio	0.46	0.46	0.46	0.61	0.59	0.59	0.34	0.31	0.31	0.19	0.19
v/c Ratio	0.03	1.04	0.50	0.93	0.20	0.05	0.59	0.17	0.68	0.39	0.65
Control Delay	14.2	59.3	5.3	61.0	9.2	0.5	29.8	22.7	21.5	36.6	42.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.2	59.3	5.3	61.0	9.2	0.5	29.8	22.7	21.5	36.6	42.1
LOS	B	E	A	E	A	A	C	C	C	D	D
Approach Delay		47.6			26.4			24.0			40.5
Approach LOS		D			C			C			D

Intersection Summary		
Cycle Length: 90		
Actuated Cycle Length: 88		
Natural Cycle: 120		
Control Type: Semi Act-Uncoord		
Maximum v/c Ratio: 1.04		
Intersection Signal Delay: 38.9	Intersection LOS: D	
Intersection Capacity Utilization 95.5%	ICU Level of Service F	
Analysis Period (min) 15		

Splits and Phases: 3: Brant St/Cedar Springs Rd & Dundas St



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	11	1729	468	248	426	48	198	99	420	92	228
v/c Ratio	0.03	1.04	0.50	0.93	0.20	0.05	0.59	0.17	0.68	0.39	0.65
Control Delay	14.2	59.3	5.3	61.0	9.2	0.5	29.8	22.7	21.5	36.6	42.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.2	59.3	5.3	61.0	9.2	0.5	29.8	22.7	21.5	36.6	42.1
Queue Length 50th (m)	1.1	~182.5	8.2	27.6	18.0	0.0	25.8	12.7	37.6	14.5	37.5
Queue Length 95th (m)	4.2	#228.6	29.3	#75.7	26.2	1.2	43.6	24.6	71.4	29.2	61.7
Internal Link Dist (m)		503.2			1627.1			245.0			231.3
Turn Bay Length (m)	75.0		75.0	75.0		75.0	100.0			75.0	
Base Capacity (vph)	425	1659	943	267	2111	972	333	635	649	266	397
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.03	1.04	0.50	0.93	0.20	0.05	0.59	0.16	0.65	0.35	0.57

Intersection Summary
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	11	1660	449	238	409	46	190	95	403	88	211	8
Future Volume (vph)	11	1660	449	238	409	46	190	95	403	88	211	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	4.6	4.6	4.6	2.0	4.6	4.6	2.0	4.6	4.6	4.6	4.6	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1745	3610	1597	1745	3610	1597	1745	1900	1597	1745	1890	
Flt Permitted	0.50	1.00	1.00	0.09	1.00	1.00	0.35	1.00	1.00	0.69	1.00	
Satd. Flow (perm)	925	3610	1597	173	3610	1597	650	1900	1597	1273	1890	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	11	1729	468	248	426	48	198	99	420	92	220	8
RTOR Reduction (vph)	0	0	209	0	0	20	0	0	119	0	2	0
Lane Group Flow (vph)	11	1729	259	248	426	28	198	99	301	92	226	0
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2		2	6		6	4		4	8		
Actuated Green, G (s)	38.4	38.4	38.4	49.4	49.4	49.4	25.3	25.3	25.3	14.3	14.3	
Effective Green, g (s)	40.4	40.4	40.4	51.4	51.4	51.4	27.3	27.3	27.3	16.3	16.3	
Actuated g/C Ratio	0.46	0.46	0.46	0.58	0.58	0.58	0.31	0.31	0.31	0.19	0.19	
Clearance Time (s)	6.6	6.6	6.6	4.0	6.6	6.6	4.0	6.6	6.6	6.6	6.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	425	1659	734	262	2110	933	313	590	495	236	350	
v/s Ratio Prot		c0.48		c0.10	0.12		c0.06	0.05			0.12	
v/s Ratio Perm	0.01		0.16	0.46		0.02	0.13		c0.19	0.07		
v/c Ratio	0.03	1.04	0.35	0.95	0.20	0.03	0.63	0.17	0.61	0.39	0.65	
Uniform Delay, d1	13.0	23.8	15.3	24.7	8.6	7.7	24.0	22.0	25.7	31.4	33.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.0	34.0	0.3	40.8	0.0	0.0	4.1	0.1	2.1	1.1	4.1	
Delay (s)	13.0	57.7	15.6	65.5	8.6	7.7	28.1	22.2	27.9	32.5	37.2	
Level of Service	B	E	B	E	A	A	C	C	C	C	D	
Approach Delay (s)		48.6			28.1			27.1			35.9	
Approach LOS		D			C			C			D	

Intersection Summary				
HCM 2000 Control Delay	40.0	HCM 2000 Level of Service	D	
HCM 2000 Volume to Capacity ratio	0.90			
Actuated Cycle Length (s)	87.9	Sum of lost time (s)	13.2	
Intersection Capacity Utilization	95.5%	ICU Level of Service	F	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	7	19	19	0	1	3	110	35	23	181	0
Future Volume (Veh/h)	0	7	19	19	0	1	3	110	35	23	181	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	0	8	23	23	0	1	4	131	42	27	215	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	430	450	215	456	429	152	215			173		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	430	450	215	456	429	152	215			173		
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	98	97	95	100	100	100			98		
cM capacity (veh/h)	529	496	830	489	510	900	1367			1416		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	31	24	177	242
Volume Left	0	23	4	27
Volume Right	23	1	42	0
cSH	707	499	1367	1416
Volume to Capacity	0.04	0.05	0.00	0.02
Queue Length 95th (m)	1.1	1.2	0.1	0.5
Control Delay (s)	10.3	12.6	0.2	1.0
Lane LOS	B	B	A	A
Approach Delay (s)	10.3	12.6	0.2	1.0
Approach LOS	B	B		

Intersection Summary				
Average Delay	1.9			
Intersection Capacity Utilization	36.5%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	97	51	197	193	0
Future Volume (Veh/h)	0	97	51	197	193	0
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	105	55	214	210	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	269				267	162
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	269				267	162
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				71	100
cM capacity (veh/h)	1306				727	888

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	105	269	210
Volume Left	0	0	210
Volume Right	0	214	0
cSH	1306	1700	727
Volume to Capacity	0.00	0.16	0.29
Queue Length 95th (m)	0.0	0.0	9.6
Control Delay (s)	0.0	0.0	12.0
Lane LOS			B
Approach Delay (s)	0.0	0.0	12.0
Approach LOS			B

Intersection Summary				
Average Delay		4.3		
Intersection Capacity Utilization		32.2%	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)	60	3	31	17	5	0	62	552	10	6	639	57
Future Volume (Veh/h)	60	3	31	17	5	0	62	552	10	6	639	57
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	68	3	35	19	6	0	70	627	11	7	726	65
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)			4									
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1542	1550	758	1514	1578	632	791			638		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1542	1550	758	1514	1578	632	791			638		
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 %	19	97	91	77	94	100	92			99		
cM capacity (veh/h)	84	104	410	83	101	484	838			956		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	106	25	70	638	7	791
Volume Left	68	19	70	0	7	0
Volume Right	35	0	0	11	0	65
cSH	127	86	838	1700	956	1700
Volume to Capacity	0.83	0.29	0.08	0.38	0.01	0.47
Queue Length 95th (m)	41.0	8.6	2.2	0.0	0.2	0.0
Control Delay (s)	99.5	62.9	9.7	0.0	8.8	0.0
Lane LOS	F	F	A		A	
Approach Delay (s)	99.5	62.9	1.0		0.1	
Approach LOS	F	F				

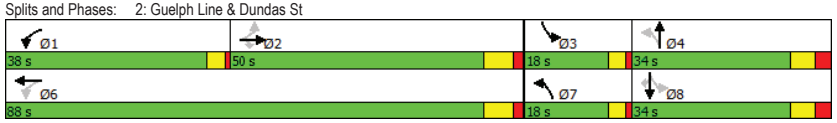
Intersection Summary				
Average Delay		7.9		
Intersection Capacity Utilization		58.4%	ICU Level of Service	B
Analysis Period (min)		15		

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Traffic Volume (vph)	52	792	181	713	1924	318	347	142	519	184
Future Volume (vph)	52	792	181	713	1924	318	347	142	519	184
Turn Type	Perm	NA	Perm	pm+pt	NA	pm+pt	NA	pm+pt	NA	Perm
Protected Phases		2		1	6	7	4	3	8	
Permitted Phases	2		2	6		4		8		8
Detector Phase	2	2	2	1	6	7	4	3	8	8
Switch Phase										
Minimum Initial (s)	8.0	8.0	8.0	5.0	8.0	5.0	8.0	5.0	8.0	8.0
Minimum Split (s)	46.0	46.0	46.0	11.0	46.0	11.0	39.0	11.0	39.0	39.0
Total Split (s)	50.0	50.0	50.0	38.0	88.0	18.0	34.0	18.0	34.0	34.0
Total Split (%)	35.7%	35.7%	35.7%	27.1%	62.9%	12.9%	24.3%	12.9%	24.3%	24.3%
Yellow Time (s)	5.0	5.0	5.0	3.0	5.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	1.0	2.0	1.0	3.0	1.0	3.0	3.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	5.0	5.0	5.0	2.0	5.0	2.0	5.0	2.0	5.0	5.0
Lead/Lag	Lag	Lag	Lag	Lead		Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	Ped	Ped	Ped	None	Ped	None	None	None	None	None
Act Effct Green (s)	45.0	45.0	45.0	86.1	83.1	46.6	28.3	44.2	26.7	26.7
Actuated g/C Ratio	0.33	0.33	0.33	0.62	0.60	0.34	0.21	0.32	0.19	0.19
v/c Ratio	1.02	0.69	0.30	1.32	0.98	1.19	0.87	0.60	0.77	0.49
Control Delay	178.8	44.3	8.7	185.3	42.8	150.5	53.4	43.1	60.5	29.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	178.8	44.3	8.7	185.3	42.8	150.5	53.4	43.1	60.5	29.0
LOS	F	D	A	F	D	F	D	D	E	C
Approach Delay		44.9			79.5		84.4		50.7	
Approach LOS		D			E		F		D	

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 137.8
Natural Cycle: 120
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.32
Intersection Signal Delay: 69.7 — Intersection LOS: E
Intersection Capacity Utilization 111.9% — ICU Level of Service H
Analysis Period (min) 15

Splits and Phases: 2: Guelph Line & Dundas St



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	54	816	187	735	2121	328	701	146	535	190
v/c Ratio	1.02	0.69	0.30	1.32	0.98	1.19	0.87	0.60	0.77	0.49
Control Delay	178.8	44.3	8.7	185.3	42.8	150.5	53.4	43.1	60.5	29.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	178.8	44.3	8.7	185.3	42.8	150.5	53.4	43.1	60.5	29.0
Queue Length 50th (m)	~16.8	109.4	5.2	~247.9	308.1	~92.2	83.0	29.8	77.2	24.0
Queue Length 95th (m)	#47.1	134.0	23.6	#328.6	#379.8	#155.8	#114.5	47.5	98.3	49.5
Internal Link Dist (m)		352.0			373.1		190.8		153.2	
Turn Bay Length (m)	100.0		70.0	115.0		50.0		70.0		70.0
Base Capacity (vph)	53	1179	630	558	2158	275	823	262	760	410
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.02	0.69	0.30	1.32	0.98	1.19	0.85	0.56	0.70	0.46

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	52	792	181	713	1924	133	318	347	333	142	519	184
Future Volume (vph)	52	792	181	713	1924	133	318	347	333	142	519	184
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	5.0	5.0	5.0	2.0	5.0		2.0	5.0		2.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	0.99		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1745	3610	1597	1745	3575		1745	3321		1745	3610	1597
Flt Permitted	0.09	1.00	1.00	0.15	1.00		0.18	1.00		0.15	1.00	1.00
Satd. Flow (perm)	163	3610	1597	282	3575		327	3321		275	3610	1597
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	54	816	187	735	1984	137	328	358	343	146	535	190
RTOR Reduction (vph)	0	0	108	0	4	0	0	125	0	0	0	76
Lane Group Flow (vph)	54	816	79	735	2117	0	328	576	0	146	535	114
Confl. Peds. (#/hr)									2	2		
Turn Type	Perm	NA	Perm	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases		2		1	6		7	4		3	8	
Permitted Phases	2		2	6			4			8		8
Actuated Green, G (s)	43.0	43.0	43.0	81.0	81.0		40.3	26.3		37.1	24.7	24.7
Effective Green, g (s)	45.0	45.0	45.0	83.0	83.0		44.3	28.3		41.1	26.7	26.7
Actuated g/C Ratio	0.33	0.33	0.33	0.60	0.60		0.32	0.21		0.30	0.19	0.19
Clearance Time (s)	7.0	7.0	7.0	4.0	7.0		4.0	7.0		4.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	53	1179	521	552	2154		269	682		235	699	309
v/s Ratio Prot		0.23		c0.35	c0.59		c0.14	c0.17		0.06	0.15	
v/s Ratio Perm	0.33		0.05	0.45			0.25			0.12		0.07
v/c Ratio	1.02	0.69	0.15	1.33	0.98		1.22	0.84		0.62	0.77	0.37
Uniform Delay, d1	46.3	40.3	32.8	36.4	26.7		40.1	52.6		38.9	52.5	48.2
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	129.1	1.8	0.1	161.3	15.5		127.5	9.4		5.0	5.0	0.7
Delay (s)	175.5	42.1	33.0	197.7	42.1		167.6	62.0		43.9	57.5	48.9
Level of Service	F	D	C	F	D		F	E		D	E	D
Approach Delay (s)		47.3			82.2			95.7			53.4	
Approach LOS		D			F			F			D	

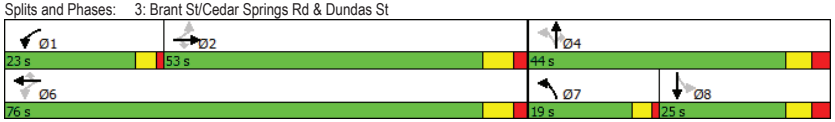
Intersection Summary				
HCM 2000 Control Delay	73.9	HCM 2000 Level of Service	E	
HCM 2000 Volume to Capacity ratio	1.10			
Actuated Cycle Length (s)	137.7	Sum of lost time (s)	14.0	
Intersection Capacity Utilization	111.9%	ICU Level of Service	H	
Analysis Period (min)	15			

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations											
Traffic Volume (vph)	20	575	290	576	1532	65	394	209	277	42	147
Future Volume (vph)	20	575	290	576	1532	65	394	209	277	42	147
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA
Protected Phases		2		1	6		7	4			8
Permitted Phases	2		2	6		6	4		4	8	
Detector Phase	2	2	2	1	6	6	7	4	4	8	8
Switch Phase											
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	41.6	41.6	41.6	11.0	41.6	41.6	11.0	45.6	45.6	45.6	45.6
Total Split (s)	53.0	53.0	53.0	23.0	76.0	76.0	19.0	44.0	44.0	25.0	25.0
Total Split (%)	44.2%	44.2%	44.2%	19.2%	63.3%	63.3%	15.8%	36.7%	36.7%	20.8%	20.8%
Yellow Time (s)	4.6	4.6	4.6	3.0	4.6	4.6	3.0	3.7	3.7	3.7	3.7
All-Red Time (s)	2.0	2.0	2.0	1.0	2.0	2.0	1.0	2.9	2.9	2.9	2.9
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.6	4.6	4.6	2.0	4.6	4.6	2.0	4.6	4.6	4.6	4.6
Lead/Lag	Lag	Lag	Lag	Lead			Lead			Lag	Lag
Lead-Lag Optimize?											
Recall Mode	Ped	Ped	Ped	None	Ped	Ped	None	None	None	None	None
Act Effct Green (s)	39.0	39.0	39.0	64.7	62.1	62.1	37.4	34.8	34.8	15.8	15.8
Actuated g/C Ratio	0.37	0.37	0.37	0.61	0.58	0.58	0.35	0.33	0.33	0.15	0.15
v/c Ratio	0.24	0.44	0.38	1.01	0.74	0.07	0.93	0.34	0.40	0.25	0.57
Control Delay	33.1	26.8	4.2	57.0	19.1	2.5	61.3	29.2	5.0	44.6	50.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	33.1	26.8	4.2	57.0	19.1	2.5	61.3	29.2	5.0	44.6	50.4
LOS	C	C	A	E	B	A	E	C	A	D	D
Approach Delay		19.6			28.7			35.9			49.2
Approach LOS		B			C			D			D

Intersection Summary			
Cycle Length: 120			
Actuated Cycle Length: 106.2			
Natural Cycle: 120			
Control Type: Semi Act-Uncoord			
Maximum v/c Ratio: 1.01			
Intersection Signal Delay: 29.3		Intersection LOS: C	
Intersection Capacity Utilization 92.3%		ICU Level of Service F	
Analysis Period (min) 15			

Splits and Phases: 3: Brant St/Cedar Springs Rd & Dundas St



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	20	587	296	588	1563	66	402	213	283	43	160
v/c Ratio	0.24	0.44	0.38	1.01	0.74	0.07	0.93	0.34	0.40	0.25	0.57
Control Delay	33.1	26.8	4.2	57.0	19.1	2.5	61.3	29.2	5.0	44.6	50.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	33.1	26.8	4.2	57.0	19.1	2.5	61.3	29.2	5.0	44.6	50.4
Queue Length 50th (m)	3.0	50.2	0.0	~75.1	123.3	0.0	70.4	33.7	0.0	8.2	31.5
Queue Length 95th (m)	10.3	69.5	17.2	#176.9	165.4	5.5	#163.3	61.1	19.2	20.7	58.2
Internal Link Dist (m)		503.2			1627.1			245.0			231.3
Turn Bay Length (m)	75.0		75.0	75.0		75.0	100.0			75.0	
Base Capacity (vph)	103	1651	891	581	2436	1100	430	707	772	221	364
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.19	0.36	0.33	1.01	0.64	0.06	0.93	0.30	0.37	0.19	0.44

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	575	290	576	1532	65	394	209	277	42	147	10
Future Volume (vph)	20	575	290	576	1532	65	394	209	277	42	147	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	4.6	4.6	4.6	2.0	4.6	4.6	2.0	4.6	4.6	4.6	4.6	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1745	3610	1597	1745	3610	1597	1745	1900	1597	1745	1882	
Flt Permitted	0.12	1.00	1.00	0.31	1.00	1.00	0.43	1.00	1.00	0.62	1.00	
Satd. Flow (perm)	227	3610	1597	572	3610	1597	783	1900	1597	1147	1882	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	20	587	296	588	1563	66	402	213	283	43	150	10
RTOR Reduction (vph)	0	0	187	0	0	27	0	0	190	0	2	0
Lane Group Flow (vph)	20	587	109	588	1563	39	402	213	93	43	158	0
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2		2	6		6	4		4	8		
Actuated Green, G (s)	37.0	37.0	37.0	60.1	60.1	60.1	32.9	32.9	32.9	13.8	13.8	
Effective Green, g (s)	39.0	39.0	39.0	62.1	62.1	62.1	34.9	34.9	34.9	15.8	15.8	
Actuated g/C Ratio	0.37	0.37	0.37	0.58	0.58	0.58	0.33	0.33	0.33	0.15	0.15	
Clearance Time (s)	6.6	6.6	6.6	4.0	6.6	6.6	4.0	6.6	6.6	6.6	6.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	83	1325	586	567	2110	933	412	624	524	170	279	
v/s Ratio Prot		0.16		c0.21	c0.43		c0.16	0.11			c0.08	
v/s Ratio Perm	0.09		0.07	0.40		0.02	0.16		0.06	0.04		
v/c Ratio	0.24	0.44	0.19	1.04	0.74	0.04	0.98	0.34	0.18	0.25	0.57	
Uniform Delay, d1	23.3	25.4	22.8	15.8	16.2	9.4	32.8	27.0	25.4	40.0	42.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.5	0.2	0.2	47.7	1.4	0.0	37.6	0.3	0.2	0.8	2.6	
Delay (s)	24.8	25.6	23.0	63.5	17.6	9.4	70.4	27.3	25.6	40.8	44.7	
Level of Service	C	C	C	E	B	A	E	C	C	D	D	
Approach Delay (s)		24.7			29.5			46.1			43.8	
Approach LOS		C			C			D			D	

Intersection Summary

HCM 2000 Control Delay	32.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	106.2	Sum of lost time (s)	13.2
Intersection Capacity Utilization	92.3%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	1	4	9	29	2	34	12	196	20	2	170	1
Future Volume (Veh/h)	1	4	9	29	2	34	12	196	20	2	170	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)	1	4	10	31	2	37	13	211	22	2	183	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	474	446	184	448	436	222	184			233		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	474	446	184	448	436	222	184			233		
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	99	99	94	100	96	99			100		
cM capacity (veh/h)	476	504	864	511	511	823	1403			1346		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	15	70	246	186
Volume Left	1	31	13	2
Volume Right	10	37	22	1
cSH	694	639	1403	1346
Volume to Capacity	0.02	0.11	0.01	0.00
Queue Length 95th (m)	0.5	2.9	0.2	0.0
Control Delay (s)	10.3	11.3	0.5	0.1
Lane LOS	B	B	A	A
Approach Delay (s)	10.3	11.3	0.5	0.1
Approach LOS	B	B		

Intersection Summary				
Average Delay	2.1			
Intersection Capacity Utilization	36.1%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	50	134	0	21	3
Future Volume (Veh/h)	0	50	134	0	21	3
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	54	146	0	23	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	146				200	146
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	146				200	146
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				97	100
cM capacity (veh/h)	1448				793	906

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	54	146	26
Volume Left	0	0	23
Volume Right	0	0	3
cSH	1448	1700	805
Volume to Capacity	0.00	0.09	0.03
Queue Length 95th (m)	0.0	0.0	0.8
Control Delay (s)	0.0	0.0	9.6
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.6
Approach LOS			A

Intersection Summary				
Average Delay	1.1			
Intersection Capacity Utilization	17.1%	ICU Level of Service	A	
Analysis Period (min)	15			

Appendix F

OTM Book 12 Traffic Control Signal Warrants

Signal Justification Calculation for Forecasted Volumes (OTM Book 12 - Justification 7)

Horizon Year: Total Traffic
Region/City/Township: City of Burlington

Major Street: Guelph Line
Minor Street: No. 2 Side Road
North/South: Y

Number of Approach Lanes: 1
Tee Intersection? N
Flow Conditions: Free

PM Forecast Only? N

Warrant Results		
150% Satisfied	**No**	Justification for new intersections with forecast traffic
120% Satisfied	**No**	Justification for existing intersections with forecast traffic

Time Period	Major Street: Guelph Line						Minor Street: No. 2 Side Road						Peds Crossing Main Road
	Northbound			Southbound			Eastbound			Westbound			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
AM Peak Hour	29	452	16	5	439	35	55	3	Free Flow	28	3	3	0
PM Peak Hour	57	514	10	3	601	49	30	3	Free Flow	17	2	0	0
Average Hourly Volume	**22**	**242**	**7**	**2**	**260**	**21**	**21**	**2**	**0**	**11**	**1**	**1**	**0**

Warrant 1 - Minimum Vehicular Volume

Warrant	AHV
1A - All	589
1B - Minor	36
2A - Major	553
2B - Cross	34

	Approach Lanes	1		2 or more		Average Hourly Volume
1A	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	All Approaches	480	720	600	900	589
					% Fulfilled	**122.6%**

	Approach Lanes	1		2 or more		Average Hourly Volume
1B	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	Minor Street Approaches	120	170	120	170	36
					% Fulfilled	**30.0%**

Warrant 2 - Delay To Cross Traffic

	Approach Lanes	1		2 or more		Average Hourly Volume
2A	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	Major Street Approaches	480	720	600	900	553
					% Fulfilled	**115.1%**

	Approach Lanes	1		2 or more		Average Hourly Volume
2B	Flow Conditions	Free	Restricted	Free	Restricted	
		X				
	Traffic Crossing Major Street	50	75	50	75	34
					% Fulfilled	**68.0%**

Appendix G

Curriculum Vitae

W. B. O'BRIEN SERVICES

William B O'Brien, M. A. Sc., P. Eng.

Senior Transportation Consultant

EMPLOYMENT HISTORY

2010 – Present
Principal of W B O'Brien Services, Burlington, ON

1999 – 2010
Paradigm Transportation Solutions Limited, Burlington, ON
Vice-President

1990–1999
Region of Hamilton-Wentworth, Hamilton, ON
Director of Transportation Services

1983–1990
Delcan Corporation, Toronto, ON
Associate;
Senior Project Manager

1980–1983
Capital Regional District, Victoria, BC
Chief Transit Planner

1974–1980
City of Edmonton, Edmonton, AB
Director of Functional Planning;
Senior Transit Engineer

1973–1974
Dr. B. G. Hutchinson, Waterloo, ON
Project Engineer

Business Office:
2109 Kerns Road
Burlington, ON L7P 1P7

✉ billobrien@cogeco.ca
☎ 905 336 8998

William (Bill) O'Brien has practiced transportation planning and engineering since entering the profession in 1973. He brings a balance of municipal and private consulting experience to client projects, including 18 years working for municipalities in Hamilton, Victoria and Edmonton where he held management and technical positions that involved a broad range of transportation services. Mr. O'Brien has also worked extensively in professional transportation consulting practices where he has managed or played a major technical role in a wide variety of transportation projects.

As a Principal Consultant with Paradigm, Bill was responsible for the company's practice in the Halton-Hamilton-Niagara geographic areas as well as public transit projects across Canada. As a consultant, Mr. O'Brien has worked on transportation planning studies for London, Guelph, Peterborough, Caledon and numerous other communities in Canada. He has also managed and conducted a wide variety of traffic planning and parking studies related to new development, downtown areas and special activity centre land uses. Since retiring in 2010, he has continued to work with Paradigm on a part-time retainer basis.

During the 1990 to 1999 period, Mr. O'Brien was the Director of Transportation Services for Hamilton-Wentworth Region where he was responsible for the preparation of a Regional transportation plan as well as planning of both public transit services for the Region. This included managing a travel forecasting model for the Region, maintenance of Regional travel data, planning of new and expanded public transit services as well as transit marketing and specialized transit services.

EDUCATION

- Master of Applied Science, Civil Engineering (Transportation)
  University of Waterloo, 1974.
- Bachelor of Applied Science, Civil Engineering
  University of Waterloo, 1972.
- Diploma, Civil Technology
  Ryerson Polytechnical Institute, 1968.
- Graduate level course in traffic engineering and business administration at University of Alberta and McMaster University

PROFESSIONAL AFFILIATIONS

- Association of Professional Engineers of Ontario
- Institute of Transportation Engineers (Fellow)

COMMUNITY INVOLVEMENT

- St Stephens United Church Finance Committee
- Canadian Hearing Society (Hamilton Region) Board Member
- VOICE for Hearing Impaired Children Hamilton-Halton-Niagara
- Burlington Probus Club
- Bruce Trail Conservancy, Trail Monitor Volunteer

SELECT PROJECT EXPERIENCE

Transportation Planning

City of London 2030 Transportation Master Plan	On behalf of Paradigm, Mr. O'Brien was a team leader with the consulting consortium that prepared the City of London Transportation Master Plan. Mr. O'Brien was responsible for helping to develop the public transit component of the plan and specifically the plan for transit priority measures to implement a bus rapid transit service in the main corridors. The transit priority plan included field investigations, assessment of different measures within each corridor, the development of a recommended plan for short term implementation as well as longer term improvements. Cost estimates were also provided for plan implementation.
GO Transit Niagara Region Rail Expansion Study	As part of the overall environmental assessment and preliminary design study team for the expansion of GO Transit rail services to Niagara Region, Mr. O'Brien was team leader for the development of commuter travel forecasts and transit ridership estimates for the Niagara – GTA corridor. Several rail expansion alternatives were considered along with specific rail station options. Detailed ridership estimates were developed for each rail station along with estimates of the commuter parking demand.
Peterborough Transportation Plan Update	Mr. O'Brien was a member of the consulting team that prepared the Peterborough Transportation Plan update with team leader responsibility for the public transit component of the plan. He carried out a review of the current services and developed estimates of the future transit ridership based on growth forecasts. A strategic transit plan was developed in consultation with the City staff.
Caledon Transportation Needs Study & Caledon Transportation Needs Study Update	On behalf of Paradigm, Mr. O'Brien managed and was the principal consultant for the Town of Caledon Transportation Needs Study conducted in 2003 and the Study Update conducted in 2008. The initial study involved a detailed assessment of the current transportation system and traffic patterns, forecasts of the future traffic on the road network in Caledon and an assessment of the improvement requirements for a 25 year horizon. Supporting strategies for public transit were also developed as part of the study. The 2008 Study Update was required to investigate the impact of changing Provincial highway plans and followed a similar format as the initial study.
Hamilton Wentworth Regional Transportation Review	On behalf of Hamilton-Wentworth Region, Mr. O'Brien managed the preparation of a Regional transportation plan for Hamilton-Wentworth. The project involved extensive public and stakeholder consultation, travel forecasts, investigation of alternative improvement strategies and the development of a recommended overall plan.

Traffic Engineering

Traffic Impact Studies

St Catharines Downtown Two Way Street Study	On behalf of Paradigm, Mr. O'Brien was the technical leader of a detailed study of traffic operations in downtown St Catharines and the development of a plan for conversion of one-way streets to two-way operation. This project included origin-destination surveys, development of a downtown traffic model, public consultation, cost estimates of street changes and a final report to City Council.
McMaster Innovation Park	Mr. O'Brien provided traffic planning services for the development of the McMaster Innovation Park (MIP) Master Plan. He also conducted subsequent traffic planning studies in support of the 175 Longwood Rd building renovation and the new Can-Met building development.

Port Colborne Downtown Business District Community Improvement Plan	This project involved a comprehensive traffic study for the central business area of Port Colborne. The existing traffic conditions were assessed and alternative traffic plans were developed to accommodate the downtown community improvement plan goals.
Primary author of over 200 traffic impact studies	Mr. O'Brien has managed and carried out well over 200 traffic impact studies for a wide variety of different land use plans, including commercial, residential, industrial and institutional uses. These studies typically include an assessment of current conditions, development of future traffic estimates, detailed assessment of future operating conditions and provision of recommendations on traffic improvements to accommodate the future traffic safely and efficiently.

Parking Studies

Burlington Décor Centre Parking Study	This study was carried out on behalf of the owner to determine the parking requirements for a new 85,000 sq ft home décor centre in Burlington. The study included parking utilization surveys of similar land uses in Burlington. Also industry parking data was used to estimate the potential demand. The study provided an estimate of the expected peak parking demand and recommended a parking plan for the development.
Malton Community Centre Parking Study	Mr. O'Brien was project manager and principal investigator for this study of parking for a major expansion of the Malton Community Centre in the City of Mississauga. The facility included a library, community recreational programs and an Islamic Mosque area. Surveys of the existing parking activity were conducted and estimates of the future parking requirements were developed based on these surveys. A recommended parking plan was provided in support of the expansion project.
Players Paradise Soccer Facility Parking Study	The Players Paradise indoor soccer facility was a 100,000 ft^2 facility in the east end of Hamilton. A detailed estimate of the parking requirements was developed based on the observed soccer game attendance at a number of other soccer events. This was used to estimate the total parking requirements for the new development and supported City approval of the site plan.
Aberdeen & Dundurn Residential Development Parking Study	Mr. O'Brien managed this study for a new residential apartment building in an inner city area of Hamilton. Surveys of the local area parking conditions were conducted and estimates of the development parking needs were prepared using industry data on residential parking demand. A plan was prepared for the development to reduce the potential parking demand through transit supportive measures, bicycle facilities and a car share program.
Lincoln Mall (St. Catharines) Parking Study	This study was carried out for a major expansion of the Lincoln Mall in St. Catharines. Surveys of the current parking demand at the 400,000 ft^2 mall were carried out to determine the existing demand. Estimates of the additional demand that should be expected with a major expansion of the mall were prepared and a parking plan was developed to accommodate this major expansion as well as the existing parking activities.
Crystal Beach (Fort Erie) Neighbourhood Parking Study	This study for the Town of Fort Erie included detailed parking surveys conducted on weekends and weekdays over two summers. The detailed nature of the available parking and the peak demand characteristics were used to recommend actions to the Town to support the overall neighbourhood plan. This study report was subsequently presented to the Ontario Municipal Board as evidence in a case.
Ahmadiyya Muslim Mosque Campus Parking Study	This study was conducted for the Ahmadiyya Islamic Group for a major new Mosque and Campus plan in the City of Vaughan. As part of the study, traffic and parking surveys were conducted for several Islamic Mosques in the Greater Toronto Area. The survey data together with traffic industry data on parking demand was utilized to estimate the parking demand for the overall development. A recommended parking plan was provided.

Stewart K. Elkins BES, MITE

Vice-President | Principal and Project Manager

Education

- Bachelor of Environmental Studies (Hons), University of Waterloo, 1993.

Professional Affiliations

- Institute of Transportation Engineers (Member)

Representative Projects

Transportation Master Plans

Role: Project Manager; Transportation Planner

Services Provided: Research, Demographic Forecasting, Travel Demand Forecasting, Network Analysis, Evaluation of Alternatives, Program Development, Policy Formulation, Conceptual Design, Public and Stakeholder Consultation, Council Presentations, Project Management

- City of Owen Sound Transportation Master Plan, City of Owen Sound
- Westshore Settlement Area Transportation Master Plan, Township of Severn
- County of Oxford Transportation Master Plan, County of Oxford
- Guelph-Wellington Transportation Master Plan, City of Guelph

Community and Secondary Plans

Role: Project Manager; Transportation Planner

Services Provided: Travel Demand Forecasting, Traffic Operations Analysis, Program Development, Policy Formulation, Public and Stakeholder Consultation, Council Presentations, Project Management

- Saugeen Shores Official Plan and Zoning Update, Saugeen Shores
- Rural East Lands Study, City of Waterloo
- South Ingersoll Secondary Plan Traffic Study, County of Oxford
- Doon South Community Road Network Review, City of Kitchener
- Hurontario Street and Eglinton Street Node Study, City of Mississauga
- Highway 401 Corridor Integrated Planning Study, Town of Halton Hills
- Glen Williams Secondary Plan, Town of Halton Hills

Environmental Assessments and Facility Planning

Role: Traffic Engineering, Transportation Planning and Public Consultation

Services Provided: Travel Demand Forecasting, Traffic Operations Analysis, Need and Justification, Evaluation of Alternatives, Conceptual and Preliminary Design, Public and Stakeholder Consultation, Council Presentations, Project Management

- Main Street West / McMaster University Entrance Class EA, City of Hamilton
- King Street (Pottruff Road to Nash Road) Class EA, City of Hamilton
- Mountain Road (Regional Road 70) Class EA, Region of Niagara
- Fixed Link to the Toronto City Centre Airport Class EA, Toronto Harbour Commissioners
- McNeilly Road (Barton Street to South Service Road) Class EA, City of Hamilton
- Weber Street (Northfield Drive to Benjamin Road, Region of Waterloo
- County Road 51 (Vienna Road to Mall Road) Class EA, County of Oxford
- Norwich Street (Montclair Road to Parkinson Road) Class EA, County of Oxford
- County Road 17, 30, 59 (Pittock Park Drive to County Road 2) Class EA, County of Oxford
- Willow Street Realignment and Curtis Avenue Class EA, County of Brant

- Fisher-Hallman Road (Erb Street to Columbia Street) Class EA, Region of Waterloo
- Kennedy Road (Derry Road to Steeles Avenue) Class EA, City of Brampton
- Road (Ottawa Street to Activa Avenue) Class EA, Region of Waterloo

Transportation Impact Studies
Role: Project Manager

Services Provided: Traffic Forecasting, Traffic Operations Analysis, Safety Analysis, Technical Review, Conceptual Design, Stakeholder Consultation, Council Presentations, Project Management

- Over 100 studies, including residential, commercial, industrial, institutional, recreation and aggregates (pits and quarries) land uses

Transportation Policy Planning
Role: Project Manager; Transportation Planner

Services Provided: Research, Evaluation of Alternatives, Policy Formulation, Guideline Development, Public and Stakeholder Consultation, Council Presentations, Project Management

- Sidewalk Policy Study, Municipality of Chatham-Kent
- Cycling and End-of-Trip Facilities Policy and Action Plan, Town of LaSalle
- York Boulevard Cycling Lanes Class EA, City of Hamilton
- Parade and Special Events Policy, Municipality of Chatham-Kent
- Alternative Local Road Standards Study, City of Surrey
- Development Charges Update, County of Wellington
- Tandem Parking Guidelines, City of Surrey
- Corridor Management and Access Control Policy and Action Plan – Town of LaSalle

Neighbourhood Traffic Calming
Role: Project Manager; Transportation Planner

Services Provided: Traffic Forecasting, Traffic Operations Analysis, Safety Analysis, Evaluation of Alternatives, Policy Formulation, Conceptual Design, Preliminary and Detailed Design, Public and Stakeholder Consultation, Council Presentations, Project Management

- Chatham-Kent Traffic Calming Policy, Municipality of Chatham-Kent
- Lakeside Subdivision Traffic Calming Plan – Town of Ajax, Runnymede Development Corporation
- Traffic Calming Policy and Action Plan, Town of LaSalle
- Traffic Calming Projects (Various), City of Surrey, British Columbia
- Ambleside Area Traffic Calming Study, City of London
- Westmount Area Traffic Calming Study, City of London
- Norwich Street Bridge Crossing Class EA, City of Guelph
- Lake Louise Boulevard Traffic Calming Class EA, City of Waterloo

Municipal, Institutional and Development Parking
Role: Project Manager; Transportation Planner

Services Provided: Survey Design and Administration, Parking Demand Forecasting, Traffic Operations Analysis, Safety Analysis, Evaluation of Alternatives, Technical Review, Conceptual Design, Public and Stakeholder Consultation, Council Presentations, Project Management

- World Youth Day Public Parking Operations Review and Plan Development - Downsview Lands, City of Toronto
- Celestica World Headquarters – Don Mills Road at Eglinton Avenue, City of Toronto
- Wendy's Restaurants of Canada Inc. – Yonge Street and Doncaster Avenue, Town of Richmond Hill
- Cadillac-Fairview Development Corporation (Various Mall Locations – Hamilton, Barrie, Toronto)
- Port Dover Parking Study, Norfolk County

Scott Catton Dipl.T, C.E.T, MITE

Senior Project Manager

Education

- Diploma, Transportation Engineering Technology (Co-Op)
  Mohawk College of Applied Arts and Technology, 2005

Professional Affiliations

- Ontario Association of Certified Engineering Technicians and Technologists (C.E.T. since 2005)
- Member, Institute of Transportation Engineers

Specialized Training

- AutoTURN Training, 2008
- Ontario Traffic Council OTM Book 18: Cycling Facilities Training, 2015
- School and Municipal Design Workshop to Support Active and Sustainable School Transportation (ASST), 2016
- OTC Transportation Planning Workshop, 2016 and 2017
- Synchro Studio Advanced Training, Trafficware, 2016
- CITE Bike Facilities Design Workshop, 2018
- Project Management Fundamentals, University of Waterloo, 2018

Community Transportation Planning

Role: Transportation Technologist, Technical Staff, Traffic Engineer, Transportation Planner

Responsibilities: Travel Demand Forecasting, Network Analysis, Traffic Operations Analysis, Need and Justification, Evaluation of Alternatives, Program Development, Public and Stakeholder Consultation, Project Management, Report Writing.

- East Fonthill Secondary Plan Review (2006 to 2018)
- University of Guelph Precincts 3, 5 and 6 (2016)
- Wade Secondary Plan Area Transportation Review (2013)
- Milton Education Village Secondary Plan (2012)
- Vaughan Mills Secondary Plan (2011)

Active and Sustainable Transportation

Role: Transportation Technologist, Technical Staff, Traffic Engineer, Transportation Planner

Responsibilities: Traffic Operations Analysis, Conceptual Design, Preliminary and Detailed Design, Tender Document Preparation.

- Town of Tillsonburg - PXO Design Broadway at Trans Canada Trail (2019)
- Town of Caledon - Kennedy Road and Queensgate Boulevard On-Street Cycling Facilities (2019)
- Town of Tillsonburg - PXO Design Broadway at Glendale Drive (2016)
- Town of Oakview – On-Street Cycling Facilities (2015)

Traffic Operations and Safety Analysis

Role: Transportation Technologist, Technical Staff, CAD Technologist

Responsibilities: Technical Review, Research, Conceptual Design, , Evaluation of Alternatives, Preliminary and Detailed Design, Report Writing.

- McMaster University Pedestrian Access and Circulation Review (2019)
- District Municipality of Muskoka, Detailed Engineering Analysis on Muskoka Road 118 (2018)
- Waterloo Landfill Expansion, TES (2017)
- McMaster University Main Campus Sterling Street Design (2016)

- Northumberland County, Elgin Street and Ontario Street Operational and Safety Review (2016)
- Putnam Bridge Rehabilitation Traffic Management Plan (2016)
- Various Signage and Pavement Marking Plans

Transportation Impact Assessment

Role: Transportation Technologist, Technical Staff, Traffic Engineer, Transportation Planner

Responsibilities: Traffic Forecasting, Travel Demand Forecasting, Traffic Operations Analysis, Safety Analysis, Parking Demand Forecasting, Safety Analysis, Need and Justification, Evaluation of Alternatives, Technical Review, Conceptual Design, Preliminary and Detailed Design, Public and Stakeholder Consultation, Council Presentations, Project Management, Evidence Preparation, Liaison with Counsel and Participants, Staff Supervision, and Report Writing

- 4880 Valera Road TIS, Parking Study and TDM Options Report (2017)
- 493-507 Line 2 Road, NOTL TIS (2017)
- Halton Islamic Association - 4721 Palladium Way TIS, Parking Study and TDM Options Report (2016)
- Over 100 other Transportation Impact Assessments and Investigations

Parking Planning

Role: Survey Design and Administration, Survey Manager, Survey Supervisor, Surveyor, and Parking Demand Forecasting

Responsibilities: Survey Design and Administration, Parking Demand Forecasting, Traffic Operations Analysis, Safety Analysis, Need and Justification, Evaluation of Alternatives, Technical Review, Program Development, Policy Formulation, Conceptual Design, Project Management, Evidence Preparation, Liaison with Counsel and Participant, Staff Supervision, Report Writing.

- University of Guelph Parking Master Plan (2018)
- McMaster Innovation Park Parking Study (2017)
- McMaster Residences Traymore Avenue Hamilton TCS (2017)
- Global Kingdom Ministries TIS and Parking Study Update (2017)
- 210-214 Locke Street South, Hamilton Parking Study (2017)
- McMaster Living and Learning Centre/Main Campus, Hamilton TDM (2016)
- 372 Queen Street, Acton Parking Justification (2016)

Environmental Assessments

Role: Transportation Technologist, Technical Staff

Responsibilities: Travel Demand Forecasting, Traffic Forecasting, Data Analysis, Network Analysis, Traffic Operations Analysis, Evaluation of Alternatives, Technical Review, Conceptual Design, Preliminary and Detailed Design, Public and Stakeholder Consultation, Council Presentations, Project Management, Report Writing.

- Conlin Road East EA and Preliminary Design (2013)
- Emmett/Howland Class EA Traffic Study (2011)
- Martindale Road EA Niagara (2011)
- Clair Road Class EA Traffic Study (2010)

Transportation Data Management

Role: Project Staff, Survey Supervisor, Surveyor

Responsibilities: Survey planning and training, Supervision of Survey Crews, and Conducting Surveys.

- Halton Region 2017 Travel Time and Delay Studies (2017)
- Town of Halton Hills Travel Time and Delay (2017)

- Ontario-New York Border Crossing Survey (Niagara) (Summer 2013)
- Niagara Escarpment Crossing Origin-Destination Survey (Niagara Region) (2012)
- Simcoe County O-D Survey (Simcoe County) (Summer 2011)
- Simcoe County O-D Survey (Simcoe County) (Fall 2010)