

Transportation Impact Study

5783 BLOOMINGTON ROAD SITE ALTERATION AND FILL PERMIT

5783 Bloomington Road, Town of Whitchurch-
Stouffville

April 16, 2024

Project No: NT-23-007

April 16, 2024

1398493 Ontario Inc.

Attention: Domenic Battistella

**Re: Transportaion Impact Study
5783 Bloomington Road Site Alteration and Fill Permit
Town of Whitchurch Stouffville
Our Project No. NT-23-219**

Nextrans Consulting Engineers (a Division of NextEng Consulting Group Inc.) is pleased to present the enclosed Transportation Impact Study in support of the Site Alteration and Fill Permit Application for the above noted property.

The subject site is located at the southeast quadrant of the intersection of Bloomington Road and Highway 48, addressed as 5783 Bloomington Road, in the Town of Whitchurch-Stouffville. Access to the site is provided through a single full movement access onto Bloomington Road.

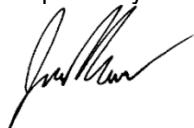
This study summarizes the traffic impacts of the fill operation and assesses the proposed full movement site access onto Bloomington Road, which will serve inbound and outbound traffic.

We trust the enclosed sufficiently addresses your needs. Should you have any questions, please do not hesitate to contact the undersigned.

Yours truly,

NEXTRANS CONSULTING ENGINEERS

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EXECUTIVE SUMMARY

Nexttrans Consulting Engineers (A Division of NextEng Consulting Group Inc.) was retained through 1398493 Ontario Inc. (the 'Client') to undertake a Transportation Impact Study in support of the Site Alteration and Fill Permit Application for a proposed fill operation located at 5783 Bloomington Road, in the Town of Whitchurch-Stouffville.

Development Proposal

The subject site is located on the south side Bloomington Road west of Ninth Line, addressed as 5783 Bloomington Road, in the town of Whitchurch-Stouffville. The subject site is currently occupied by an active farm with various structures, as well as associated access roads. There are man-made ponds on the property, which are remnants of the former aggregate production. The 1398493 Ontario Inc. is pursuing a Site Alteration and Fill Permit with the Town to restore the property to historic grades for future agricultural use. Access to the site is provided through a single full movement access onto Bloomington Road.

Capacity Analysis

The traffic analysis considered the AM and PM peak hours of the adjacent road network. Five (5)-year (2029) and 10-year horizons (2034) from the 2023 baseline year were assessed.

Based on information received from the Owner, the operation is expected to experience daily truck volumes of 180-300 trucks, which include inbound and outbound trips. The operating hours of the site are between 7:00 AM and 5:00 PM on weekdays, and 50% (150 trucks) of the total truck trips are expected to occur within the hours of 7:00 AM to 9:00 AM and 3:00 PM to 5:00 PM. The analysis was modeled such that 25% of the total truck trips (75 trucks) would occur during the adjacent road AM peak hour and 25% of the total truck trips (75 trucks) would occur during the adjacent road PM Peak hour.

Two truck routing options were considered for the operation. Under first option (Option 1), trucks would enter and leave the site from the west, approaching the site eastbound on Bloomington Road and make a right turn in to the site access and upon departure, would make a left turn onto Bloomington Road to travel westbound. Under the second option (Option 2), trucks would enter and leave the site from the west, approaching the site westbound on Bloomington Road and make a left turn in to the site access and upon departure, would make a right turn onto Bloomington Road to travel westbound.

The intersection capacity analysis results (based on the methodology and procedures outlined in the Highway Capacity Manual, HCM 2000, published by the Transportation Research Board) show that the study area intersections are expected to operate with acceptable Levels of Service with the introduction of site generated trips.

When considering the overall performance of the site access and nearby intersections, **Option 1** is the preferable truck routing option (trucks turning right in from Bloomington Road and left out onto Bloomington Road), as the impact on adjacent the adjacent intersections is more manageable.

Access Review

A functional design was prepared to show the recommended road improvements at the site access. The right turn taper and slip-around lane were designed in accordance with the York Region Standard Drawing DS-100 and the TAC manual.

The existing site access provides adequate stopping sight distance and departure sight distance.

Conclusions and Recommendations

Option 1 is the preferable truck routing option (trucks turning right in from Bloomington Road and left out onto Bloomington Road), as it produces a smaller impact on the adjacent intersections in the road network.

To facilitate operations and further improve safety, a right turn taper is recommended at the eastbound approach of Bloomington Road and the site access, on the south side of Bloomington Road, to facilitate inbound right turn movements. To minimize the interference of the site generated truck traffic with through traffic on Bloomington Road, a slip-around lane is recommended for the westbound approach, on the north side of Bloomington Road at the site access.

Based on the capacity analysis, which considered site operations for five (5)-year (2029) and 10-year horizons (2034), the existing road network intersections are expected to operate with overall acceptable LOS with the introduction of the truck trips entering and leaving the site. The analysis supports the proposed Site Alteration and Fill Permit, which is expected to have a manageable impact and can be adequately accommodated by surrounding road network.

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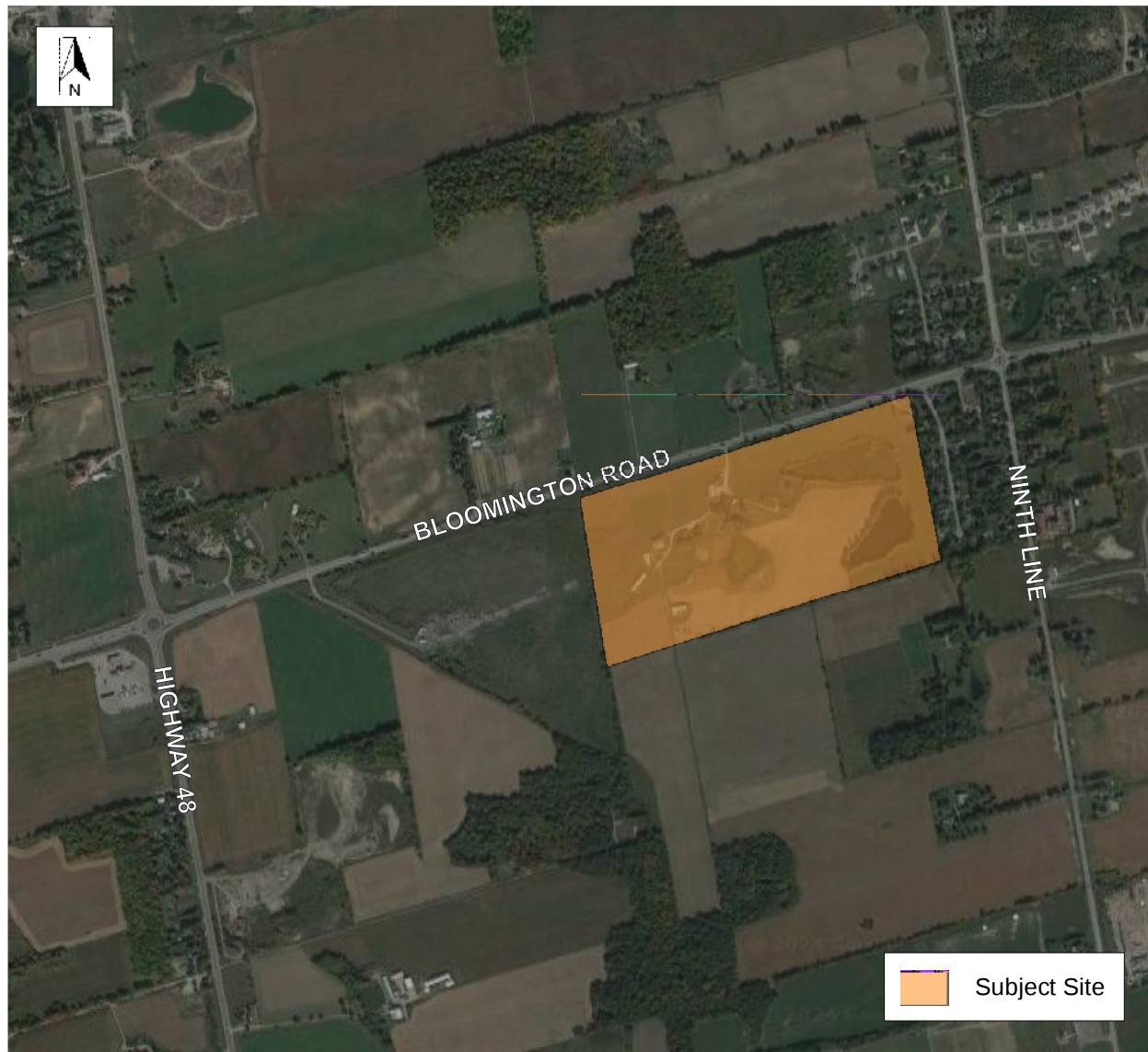
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1.0 INTRODUCTION

Nextrans Consulting Engineers (a Division of NextEng Consulting Group Inc.) is pleased to present the enclosed Transportation Impact Study in support of the Site Alteration and Fill Permit Application for the above noted property. The subject site is located at the southeast quadrant of the intersection of Bloomington Road and Highway 48, addressed as 5783 Bloomington Road, in the Town of Whitchurch -Stouffville. The location of the subject site is illustrated in **Figure 1-1**.

Figure 1-1 – Site Location



The subject site is located at the southeast quadrant of the intersection of Bloomington Road and Highway 48, addressed as 5783 Bloomington Road, in the Town of Whitchurch-Stouffville. Access to the site is provided through a single full movement access onto Bloomington Road.

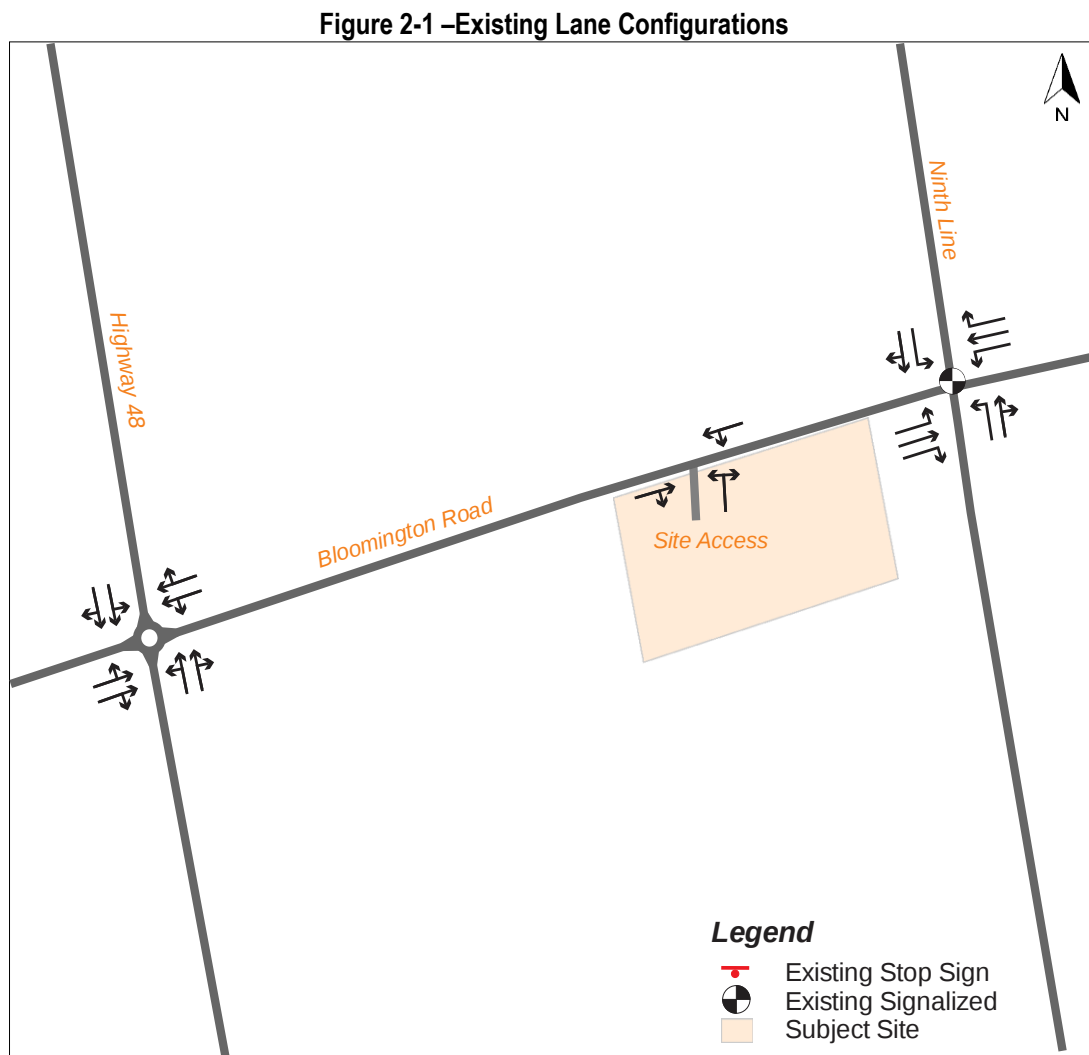
2.0 EXISTING TRAFFIC CONDITIONS

2.1. Existing Road Network

The existing road network in the study area is described below:

- **Bloomington Road:** An east-west Region of York (The “Region”) arterial road. Within the study area, Bloomington Road has a two (2)-lane cross-section (one (1) lane per travel direction). There is a posted speed limit of 70 km/h east of Highway 48.
- **Highway 48:** A north-south arterial road under the jurisdiction of the Ministry of Transportation of Ontario (MTO). Highway 48 has a two (2)-lane cross-section (one (1) lane per travel direction). The intersection of Highway 48 and Bloomington Road is controlled by a two (2)-lane roundabout. South of Bloomington Road is a posted speed limit of 80 km/h.
- **Ninth Line:** A north-south Regional arterial road. Ninth Line has a two (2)-lane cross-section (one (1) lane per travel direction). There is a posted speed limit of 80 km/h north of Aurora Road.

Existing road network lane configurations are illustrated in **Figure 2-1**.



2.2. Baseline Traffic Conditions

2.2.1. Existing Traffic Volumes

Turning Movement counts at the study area intersections were conducted by Spectrum Traffic Inc. on Thursday, January 25, 2024, for weekday AM (7:00 AM to 10:00 AM) and PM (4:00 PM to 7:00 PM) peak periods. Turning movement counts are provided in **Appendix A**.

2.2.2. Traffic Volumes from Lafarge Stouffville Fill Operation

There is an existing site fill operation (the “Stouffville Pit”) located at 14204 Durham Road 30, in the Town of Whitchurch-Stouffville, which had been recently approved and commenced operations. However, it is Nexttrans’ understanding that the site is currently not operating at its maximum capacity, therefore the entirety of the truck traffic generated by the Stouffville Pit would not be represented in any existing TMCs collected in the current year. Thus, truck volumes from the Stouffville Pit were taken from the TIS prepared by TMIG for the fill permit titled “*Updated Transportation Impact Study, Lafarge Stouffville Pit – Site Alteration and Fill Permit*”, dated July 2022. Based on the TIS, the Stouffville Pit was forecast to generate 240 truck trips in the AM peak hour and 44 truck trips in the PM peak hour.

The peak hour truck trips from the Stouffville Pit fill operation were distributed through the study area road network, based on the TIS prepared by TMIG, under existing conditions and subsequent analysis scenarios. Based on the estimation in the TIS prepared by TMIG, 88 truck trips and 16 truck trips travel the eastbound and westbound directions on Bloomington Road during the AM and PM peak hours, respectively. For the purpose of this study, the 88 truck trips were incorporated into the traffic analysis model for all scenarios.

2.3. Existing Traffic Assessment

2.3.1. Capacity Analysis – Existing Traffic conditions

2024 existing traffic volumes are illustrated in **Figure 2-2**. Capacity analysis was conducted using model in Synchro 10, in accordance with the methodology outlined in the Highway Capacity Manual (HCM 2000) published by the Transportation Research Board. The intersection of Bloomington Road and Highway 48 was assessed in accordance with the HCM 2010 methodology. The detailed results are provided in **Appendix B** and summarized in **Table 2.1**.

Table 2.1 – Capacity Analysis Summary – Existing Traffic Conditions

Intersection	Movement	AM Peak Hour					PM Peak Hour				
		v/c ¹	Delay (s)	LOS ²	Queue (m) ³		v/c	Delay (s)	LOS	Queue (m)	
					50 th	95 th				50 th	95 th
Bloomington Road & Ninth Line (Signalized)	Overall	0.74	23.4	C	--	--	0.74	23.1	C	--	--
	EBL	0.39	10.7	B	6.2	16.1	0.17	9.1	A	4.3	10.3
	EBT	0.52	12.2	B	44.5	88.8	0.67	15.7	B	86.9	136.5
	EBR	0.03	6.9	A	0.0	4.9	0.05	7.6	A	1.2	6.7
	WBL	0.27	15.0	B	13.8	33.7	0.29	16.0	B	10.6	24.5
	WBT	0.76	26.6	C	88.1	187.7	0.60	20.1	C	69.5	112.5
	WBR	0.03	12.0	B	0.0	0.0	0.02	11.8	B	0.0	0.0
	NBL	0.30	33.3	C	10.3	23.3	0.22	31.0	C	10.6	21.2
	NBTR	0.21	32.1	C	10.4	26.0	0.78	44.8	D	57.2	84.6
	SBL	0.15	32.6	C	4.0	11.7	0.20	32.1	C	3.7	10.5
	SBTR	0.71	44.9	D	37.3	67.3	0.41	33.6	C	20.5	37.2

Intersection	Movement	v/c	Delay (s/veh)	LOS	95 th Queue (veh)	v/c	Delay (s/veh)	LOS	95 th Queue (veh)
Bloomington Road & Highway 48 (Roundabout)	EBLT	0.351	11.0	B	2	0.423	9.8	A	2
	EBTR	0.386	11.5	B	2	0.468	10.5	B	3
	WBLT	0.424	10.7	B	2	0.309	8.8	A	1
	WBTR	0.472	11.6	B	3	0.339	9.0	A	2
	NBLT	0.209	7.7	A	1	0.361	10.6	B	2
	NBTR	0.228	7.8	A	1	0.391	10.8	B	2
	SBLT	0.409	12.7	B	2	0.199	7.2	A	1
	SBTR	0.440	13.0	B	2	0.218	7.2	A	1

1. v/c: volume-capacity-ratio. Ratio of roadway demand (vehicle volumes) to roadway supply (storage capacity).

2. LOS: Level of Service.

3. Queue: 50th percentile and 90th percentile queueing lengths.

Under existing traffic conditions, the study area intersections operate with excellent overall Levels of Service (LOS) during the AM, PM and weekend midday (MD) peak hours. There were no identified capacity or delay issues.

3.0 FUTURE BACKGROUND CONDITIONS

3.1. Future Corridor Growth

Five (5)-year and 10-year horizons from the year 2024 was considered for future analyses. Annual Average Daily Traffic (AADT) data along Bloomington Road between Highway 48 and Thornbay Drive for the years 2013 were analyzed with linear regression to determine a growth rate between the years 2024 and 2029. Based on the AADT data, a growth rate of 2.4% per annum was established to forecast volumes on Bloomington Road for the five (5) and 10-year horizons. Regression Analysis is provided in **Appendix C**. Growth rates of 2.0% per annum were applied to Highway 48 and Ninth Line.

3.2. Capacity Analysis – Future Background 2029

The 2029 future background traffic volumes are illustrated in **Figure 3-1**. The capacity analysis results are provided in **Appendix D** and summarized in **Table 3.1**.

Table 3.1 – Capacity Analysis Summary – 2029 Future Background

Intersection	Movement	AM Peak Hour					PM Peak Hour				
		v/c	Delay (s)	LOS	Queue (m)		v/c	Delay (s)	LOS	Queue (m)	
					50 th	95 th				50 th	95 th
Bloomington Road & Ninth Line (Signalized)	Overall	0.80	26.1	C	--	--	0.82	25.2	C	--	--
	EBL	0.44	12.3	B	6.5	16.1	0.19	10.1	B	4.5	10.3
	EBT	0.58	13.5	B	53.3	102.9	0.76	19.1	B	111.7	166.9
	EBR	0.04	7.1	A	0.2	5.1	0.05	7.9	A	1.3	6.7
	WBL	0.28	15.6	B	14.2	34.1	0.37	18.9	B	11.6	27.0
	WBT	0.85	32.8	C	107.0	218.2	0.68	22.9	C	85.4	132.2
	WBR	0.03	12.3	B	0.0	0.0	0.02	12.1	B	0.0	0.0
	NBL	0.31	33.3	C	10.3	23.5	0.22	30.7	C	10.6	21.2
	NBTR	0.23	32.2	C	12.0	28.1	0.80	45.9	D	61.7	90.1
	SBL	0.15	32.4	C	4.0	11.7	0.21	32.0	C	3.7	10.6
	SBTR	0.74	46.2	D	40.7	72.2	0.42	33.6	C	22.6	40.0

Intersection	Movement	v/c	Delay (s/veh)	LOS	95 th Queue (veh)	v/c	Delay (s/veh)	LOS	95 th Queue (veh)
Bloomington Road & Highway 48 (Roundabout)	EBLT	0.390	12.1	B	2	0.469	10.8	B	3
	EBTR	0.427	12.7	B	2	0.520	11.7	B	3
	WBLT	0.467	11.8	B	2	0.346	9.6	A	2
	WBTR	0.520	12.9	B	3	0.381	10.0	A	2
	NBLT	0.227	8.2	A	1	0.408	12.0	B	2
	NBTR	0.249	8.3	A	1	0.442	12.3	B	2
	SBLT	0.462	14.6	B	2	0.220	7.7	A	1
	SBTR	0.498	15.1	C	3	0.241	7.8	A	1

Under future background conditions, the study area intersections are expected to continue to operate with acceptable overall LOS during the AM and PM peak hours. There were no identified capacity or delay issues.

3.3. Capacity Analysis – Future Background 2034

The 2034 future background traffic volumes are illustrated in **Figure 3-2**. The capacity analysis results are provided in **Appendix E** and summarized in **Table 3.2**.

Table 3.2 – Capacity Analysis Summary – 2034 Future Background

Intersection	Movement	AM Peak Hour					PM Peak Hour				
		v/c	Delay (s)	LOS	Queue (m)		v/c	Delay (s)	LOS	Queue (m)	
					50 th	95 th				50 th	95 th
Bloomington Road & Ninth Line (Signalized)	Overall	0.88	31.7	C	--	--	0.90	29.4	C	--	--
	EBL	0.51	15.1	B	6.8	16.1	0.22	11.6	B	4.9	10.3
	EBT	0.64	15.4	B	64.7	120.7	0.86	25.5	C	149.1	209.0
	EBR	0.04	7.3	A	0.2	5.1	0.05	8.2	A	1.4	6.7
	WBL	0.30	16.3	B	14.8	34.7	0.54	28.4	C	13.5	33.9
	WBT	0.95	45.8	D	132.8	252.6	0.77	27.3	C	107.5	157.4
	WBR	0.03	12.6	B	0.0	0.0	0.02	12.5	B	0.0	0.0
	NBL	0.32	33.4	C	10.4	23.7	0.21	30.4	C	10.6	21.2
	NBTR	0.25	32.3	C	14.1	31.1	0.82	48.1	D	67.2	96.7
	SBL	0.14	32.3	C	4.1	11.7	0.22	32.0	C	3.7	10.7
	SBTR	0.77	48.2	D	44.7	77.6	0.44	33.6	C	25.2	43.3
Intersection	Movement	v/c	Delay (s/veh)	LOS	95 th Queue (veh)		v/c	Delay (s/veh)	LOS	95 th Queue (veh)	
Bloomington Road & Highway 48 (Roundabout)	EBLT	0.432	13.4	B	2		0.534	12.2	B	3	
	EBTR	0.473	14.2	B	3		0.579	13.4	B	4	
	WBLT	0.517	13.1	B	3		0.391	10.6	B	2	
	WBTR	0.573	14.5	B	4		0.430	11.2	B	2	
	NBLT	0.249	8.8	A	1		0.465	14.0	B	2	
	NBTR	0.273	8.9	A	1		0.501	14.4	B	3	
	SBLT	0.527	17.4	C	3		0.246	8.3	A	1	
	SBTR	0.564	17.9	C	3		0.270	8.5	A	1	

Under future background conditions, the study area intersections are expected to continue to operate with acceptable overall LOS during the AM and PM peak hours. There were no identified capacity or delay issues.

4.0 SITE TRAFFIC

4.1. Trip Generation

The anticipated number of peak hour truck trips generated by the site during the peak hour was determined based on information provided by the Owner. Based on information received from the Owner, the operation is expected to experience daily truck volumes of 180-300 trucks, which include inbound and outbound trips. The operating hours of the site are between 7:00 AM and 5:00 PM on weekdays, and 50% (150 trucks) of the total truck trips are expected to occur within the hours of 7:00 AM to 9:00 AM and 3:00 PM to 5:00 PM. The analysis was modeled such that 25% of the total truck trips (75 trucks) would occur during the adjacent road AM peak hour and 25% of the total truck trips (75 trucks) would occur during the adjacent road PM Peak hour.

A summary of the expected site generated trips is provided in **Table 4.1**.

Table 4.1 – Estimated Peak Hour Truck Volumes from Site

AM Peak Hour			PM Peak Hour		
In	Out	Total	In	Out	Total
38	37	75	38	37	75

4.2. Trip Distribution

Two truck routing options were considered for the operation. Under first option (Option 1), trucks would enter and leave the site from the west, approaching the site eastbound on Bloomington Road and make a right turn in to the site access and upon departure, would make a left turn onto Bloomington Road to travel westbound. Under the second option (Option 2), trucks would enter and leave the site from the west, approaching the site westbound on Bloomington Road and make a left turn in to the site access and upon departure, would make a right turn onto Bloomington Road to travel westbound.

The site-generated traffic volumes are illustrated in **Figure 4-1** and **Figure 4-2**.

5.0 FUTURE TOTAL ANALYSIS

The forecasted future total traffic volumes under proposed conditions were determined as the summation of the distributed site-generated traffic and future background traffic volumes. As previously stated, two (2) truck routing options were considered.

5.1. 2029 Capacity Analysis

2029 Option 1 future total traffic volumes are illustrated in **Figure 5-1**. Capacity analysis is summarized in **Table 5.1**. detailed results are provided in **Appendix F**.

Table 5.1 – Capacity Analysis Summary – 2029 Future Total – Option 1

Intersection	Movement	AM Peak Hour					PM Peak Hour				
		v/c	Delay (s)	LOS	Queue (m)		v/c	Delay (s)	LOS	Queue (m)	
					50 th	95 th				50 th	95 th
Bloomington Road & Ninth Line (Signalized)	Overall	0.80	26.1	C	--	--	0.82	25.2	C	--	--
	EBL	0.44	12.3	B	6.5	16.1	0.19	10.1	B	4.5	10.3
	EBT	0.58	13.5	B	53.3	102.9	0.76	19.1	B	111.7	166.9
	EBR	0.04	7.1	A	0.2	5.1	0.05	7.9	A	1.3	6.7
	WBL	0.28	15.6	B	14.2	34.1	0.37	18.9	B	11.6	27.0
	WBT	0.85	32.8	C	107.0	218.2	0.68	22.9	C	85.4	132.2
	WBR	0.03	12.3	B	0.0	0.0	0.02	12.1	B	0.0	0.0
	NBL	0.31	33.3	C	10.3	23.5	0.22	30.7	C	10.6	21.2
	NBTR	0.23	32.2	C	12.0	28.1	0.80	45.9	D	61.7	90.1
	SBL	0.15	32.4	C	4.0	11.7	0.21	32.0	C	3.7	10.6
	SBTR	0.74	46.2	D	40.7	72.2	0.42	33.6	C	22.6	40.0
Bloomington Road & Site Access (Unsignalized)	NBLR	0.40	63.5	F	--	13.2	0.49	84.6	F	--	16.4
Intersection	Movement	v/c	Delay (s/veh)	LOS	95 th Queue (veh)		v/c	Delay (s/veh)	LOS	95 th Queue (veh)	
Bloomington Road & Highway 48 (Roundabout)	EBLT	0.440	13.8	B	2		0.511	12.0	B	3	
	EBTR	0.483	14.6	B	3		0.566	13.2	B	4	
	WBLT	0.509	13.1	B	3		0.396	11.0	B	2	
	WBTR	0.565	14.5	B	4		0.434	11.5	B	2	
	NBLT	0.242	8.9	A	1		0.432	13.1	B	2	
	NBTR	0.264	8.9	A	1		0.466	13.5	B	2	
	SBLT	0.486	16.2	C	3		0.233	8.3	A	1	
	SBTR	0.526	16.7	C	3		0.255	8.3	A	1	

2029 Option 2 future total traffic volumes are illustrated in **Figure 5-2**. Capacity analysis is summarized in **Table 5.2**. detailed results are provided in **Appendix G**.

Table 5.2 – Capacity Analysis Summary – 2029 Future Total – Option 2

Intersection	Movement	AM Peak Hour					PM Peak Hour				
		v/c	Delay (s)	LOS	Queue (m)		v/c	Delay (s)	LOS	Queue (m)	
					50 th	95 th				50 th	95 th
Bloomington Road & Ninth Line (Signalized)	Overall	0.86	30.2	C	--	--	0.87	27.7	C	--	--
	EBL	0.48	13.5	B	6.5	16.1	0.21	10.7	B	4.5	10.3
	EBT	0.65	15.5	B	61.9	121.7	0.83	23.0	C	127.8	192.2
	EBR	0.04	7.1	A	0.2	5.1	0.05	7.9	A	1.3	6.7
	WBL	0.29	15.8	B	14.3	34.6	0.43	21.2	C	12.0	28.9
	WBT	0.93	43.1	D	122.9	243.7	0.78	27.2	C	99.7	156.2
	WBR	0.03	12.3	B	0.0	0.0	0.02	12.1	B	0.0	0.0
	NBL	0.31	33.3	C	10.3	23.5	0.22	30.7	C	10.6	21.2
	NBTR	0.23	32.2	C	12.0	28.1	0.80	45.9	D	61.7	90.1

	SBL	0.15	32.4	C	4.0	11.7	0.21	32.0	C	3.7	10.6
	SBTR	0.74	46.2	D	40.7	72.2	0.42	33.6	C	22.6	40.0
Bloomington Road & Site Access (Unsignalized)	WBLT	0.06	1.7	A	--	1.5	0.08	2.3	A	--	2.1
	NBLR	0.10	14.8	B	--	2.6	0.16	21.6	C	--	4.3
Intersection	Movement	v/c	Delay (s/veh)	LOS	95 th Queue (veh)		v/c	Delay (s/veh)	LOS	95 th Queue (veh)	
Bloomington Road & Highway 48 (Roundabout)	EBLT	0.390	12.1	B	2		0.469	10.8	B	3	
	EBTR	0.427	12.7	B	2		0.520	11.7	B	3	
	WBLT	0.467	11.8	B	2		0.346	9.6	A	2	
	WBTR	0.520	12.9	B	3		0.381	10.0	A	2	
	NBLT	0.227	8.2	A	1		0.408	12.0	B	2	
	NBTR	0.249	8.3	A	1		0.442	12.3	B	2	
	SBLT	0.462	14.6	B	2		0.220	7.7	A	1	
	SBTR	0.498	15.1	C	3		0.241	7.8	A	1	

5.2. 2034 Capacity Analysis

2034 Option 1 future total traffic volumes are illustrated in **Figure 5-3**. Capacity analysis is summarized in **Table 5.3**. detailed results are provided in **Appendix H**.

Table 5.3 – Capacity Analysis Summary – 2034 Future Total – Option 1

Intersection	Movement	AM Peak Hour					PM Peak Hour				
		v/c	Delay (s)	LOS	Queue (m)		v/c	Delay (s)	LOS	Queue (m)	
					50 th	95 th				50 th	95 th
Bloomington Road & Ninth Line (Signalized)	Overall	0.88	31.7	C	--	--	0.90	29.4	C	--	--
	EBL	0.51	15.1	B	6.8	16.1	0.22	11.6	B	4.9	10.3
	EBT	0.64	15.4	B	64.7	120.7	0.86	25.5	C	149.1	209.0
	EBR	0.04	7.3	A	0.2	5.1	0.05	8.2	A	1.4	6.7
	WBL	0.30	16.3	B	14.8	34.7	0.54	28.4	C	13.5	33.9
	WBT	0.95	45.8	D	132.8	252.6	0.77	27.3	C	107.5	157.4
	WBR	0.03	12.6	B	0.0	0.0	0.02	12.5	B	0.0	0.0
	NBL	0.32	33.4	C	10.4	23.7	0.21	30.4	C	10.6	21.2
	NBTR	0.25	32.3	C	14.1	31.1	0.82	48.1	D	67.2	96.7
	SBL	0.14	32.3	C	4.1	11.7	0.22	32.0	C	3.7	10.7
	SBTR	0.77	48.2	D	44.7	77.6	0.44	33.6	C	25.2	43.3
Bloomington Road & Site Access (Unsignalized)	NBLR	0.51	90.3	F	--	17.1	0.65	137.9	F	--	22.1
Intersection	Movement	v/c	Delay (s/veh)	LOS	95 th Queue (veh)		v/c	Delay (s/veh)	LOS	95 th Queue (veh)	
	EBLT	0.486	15.4	C	3		0.658	13.7	B	4	
	EBTR	0.534	16.5	C	3		0.626	15.4	C	4	

Bloomington Road & Highway 48 (Roundabout)	WBLT	0.561	14.7	B	4	0.444	12.3	B	2
	WBTR	0.622	16.6	C	4	0.487	13.0	B	3
	NBLT	0.265	9.5	A	1	0.493	15.5	C	3
	NBTR	0.290	9.6	A	1	0.529	15.9	C	3
	SBLT	0.561	19.6	C	3	0.262	9.0	A	1
	SBTR	0.597	20.2	C	4	0.286	9.1	A	1

2034 Option 2 future total traffic volumes are illustrated in **Figure 5-4**. Capacity analysis is summarized in **Table 5.4**. detailed results are provided in **Appendix I**.

Table 5.4 – Capacity Analysis Summary – 2034 Future Total – Option 2

Intersection	Movement	AM Peak Hour					PM Peak Hour				
		v/c	Delay (s)	LOS	Queue (m)		v/c	Delay (s)	LOS	Queue (m)	
					50 th	95 th				50 th	95 th
Bloomington Road & Ninth Line (Signalized)	Overall	0.94	40.4	D	--	--	0.96	35.1	D	--	--
	EBL	0.55	17.7	B	6.8	16.1	0.25	12.5	B	4.9	10.3
	EBT	0.71	17.9	B	75.2	142.7	0.93	34.3	C	172.4	260.9
	EBR	0.04	7.2	A	0.2	5.1	0.05	8.2	A	1.4	6.7
	WBL	0.31	16.7	B	14.8	36.3	0.66	39.6	D	14.7	42.8
	WBT	1.03	67.9	E	165.4	285.5	0.87	34.9	C	125.4	197.9
	WBR	0.03	12.7	B	0.0	0.0	0.02	12.5	B	0.0	0.0
	NBL	0.32	33.7	C	10.4	24.2	0.21	30.4	C	10.6	21.2
	NBTR	0.25	32.5	C	14.1	31.8	0.82	48.1	D	67.2	96.7
	SBL	0.14	32.5	C	4.1	12.0	0.22	32.0	C	3.7	10.7
Bloomington Road & Site Access (Unsignalized)	WBLT	0.06	1.9	A	--	1.6	0.09	2.8	A	--	2.4
	NBLR	0.11	15.6	C	--	2.8	0.18	24.9	C	--	5.2
Intersection	Movement	v/c	Delay (s/veh)	LOS	95 th Queue (veh)		v/c	Delay (s/veh)	LOS	95 th Queue (veh)	
Bloomington Road & Highway 48 (Roundabout)	EBLT	0.432	13.4	B	2		0.524	12.2	B	3	
	EBTR	0.473	14.2	B	3		0.579	13.4	B	4	
	WBLT	0.517	13.1	B	3		0.391	10.6	B	2	
	WBTR	0.573	14.5	B	4		0.430	11.2	B	2	
	NBLT	0.249	8.8	A	1		0.465	14.0	B	2	
	NBTR	0.273	8.9	A	1		0.501	14.4	B	3	
	SBLT	0.527	17.4	C	3		0.246	8.3	A	1	
	SBTR	0.564	17.9	C	3		0.270	8.5	A	1	

5.3. Future Total Summary

With both Option 1 and Option 2, the intersections of Bloomington Road and Highway 48 and Bloomington Road and Ninth Line are expected to continue operating at overall acceptable LOS. However, the eastbound through movement at the intersection of Bloomington Road and Ninth Line is anticipated to operate with a volume-to-capacity ratio (v/c) of 1.03 and 'E' LOS during the 2034 AM peak hour and the westbound through movement is anticipated to operate with a v/c of 0.93 during the PM peak hour. This is due to the increase of eastbound and westbound traffic, which the Site Alteration and Fill Permit would contribute to.

When considering the intersection of Bloomington Road and the site access, it was determined that under Option 1, the site access is anticipated to experience performance issues, performing at 'F' LOS. However, the approach is not at capacity, having a maximum v/c of 0.49 during the PM peak hour. The LOS is due to the delay resulting from the requirement for outbound truck trips to turn left onto Bloomington Road, which is a maneuver that requires a longer time to perform, especially for larger vehicles. Based on the capacity analysis, there would be insufficient gap opportunities for trucks to turn left out of the site without experiencing much delay. As reported in the capacity analysis, the maximum delay at the approach was 84.6 s. In Option 2, the site access is expected to operate with excellent LOS during both peak hours, operating at 'C' LOS or better. Delays and queueing at the approach are not expected to be problematic.

The impact of the site generated truck traffic on the intersection of Bloomington Road and Highway 48 (Option 1) is lesser than the impact on Bloomington Road and Ninth Line (Option 2). However, as previously stated, both intersections are expected to continue operating at overall acceptable LOS with both options. When considering the overall performance of the site access and nearby intersections, **Option 1** is the preferable truck routing option (trucks turning right in from Bloomington Road and left out onto Bloomington Road), as the impacts on adjacent the adjacent intersections are more manageable. Although the site access operates with a somewhat worse LOS under Option 1, the impacts are significantly diminished by the fact that they are localized within the site and not on Bloomington Road. As previously mentioned, the 'F' LOS experienced under Option 1 is due to delay and there is ample capacity within the site. Operational issues at site access can be mitigated through road improvements, which are discussed in **Section 6**.

5.4. Sensitivity Analysis

A sensitivity analysis was undertaken for the purpose of determining the conditions in which either the eastbound or westbound approaches of Bloomington Road at the site access would experience capacity issues. This would indicate the maximum number of daily truck trips permissible for the proposed operation. The sensitivity analysis was conducted for the year 2034 in the PM peak hour, with trips coming to and from the west (Option 1). The peak hour truck trips were assumed to amount to 25% of the daily truck trips. The analysis was conducted assuming 80 trips in the peak hour. The capacity analysis results are summarized in **Table 5.5**. Synchro reports are provided in **Appendix J**.

Table 5.5 – Capacity Analysis Summary – 2034 Future Total – Sensitivity Analysis

Intersection	Movement	PM Peak Hour				
		v/c	Delay (s)	LOS	Queue (m)	
					50 th	95 th
Bloomington Road & Site Access (Unsignalized)	EBTR	1.02	--	--	--	1.6
	NBLR	25.21	Err	C	--	Err

As shown in the capacity analysis, for the eastbound on Bloomington Road to fail, there would need to be 750 eastbound right-turn volumes during the peak hour. Additionally, under this condition, the site access would experience catastrophic failure. Assuming that the peak hour volumes are 25% of the daily volume, maximum number of daily truck trips to and from the site would be approximately 3000. The proposed operation would not come close to producing 3000 daily truck trips.

6.0 SITE PLAN REVIEW

6.1. Site Access

Site access is provided via an existing full-movement driveway fronting Bloomington Road.

6.1.1. Queueing Analysis

A concern regarding the proposed fill operation is the queuing of trucks on Bloomington attempting to enter the site as well as internal queueing of trucks within the site. Queueing at the driveway was assessed using SimTraffic under 2034 future total PM peak hour conditions, the worst peak hour, with Option 1 (trucks turning right-in and left-out). Queueing analysis is summarized in **Table 6.1**. SimTraffic reports are provided in **Appendix K**.

Table 6.1 – Queueing Analysis

Intersection	Movement	Queue Length (m)	
		Average	95 th Percentile
Bloomington Road and Site Access	EBTR	0.1	1.3
	NBLR	18.0	42.0

The queuing analysis showed that the projected queue lengths are expected to be manageable and do not exceed the existing storage lengths provided. Based on the trip generation estimate, a conservative estimate of the maximum number of trucks entering the site during a peak hour would be about 38 trucks. The internal roadway is about 350 m in length, which is more than enough to accommodate the projects queues.

To facilitate effective circulation of trucks, auxiliary lanes are recommended on Bloomington Road. To minimize interference of right turning traffic off Bloomington Road, a right turn taper is recommended on the south side of Bloomington Road. As shown in **Table 6.1**, the projected 95th percentile queue length at the eastbound approach is only 1.3 m, which indicates that the queueing and interference is not expected to be severe. As such, a right turn taper would be preferable over a full right turn storage lane. To minimize the interference of truck traffic on westbound through traffic, it is recommended that a slip around lane be implemented on the north side of Bloomington Road. A functional design was prepared to show the recommended road improvements at the site access. The right turn taper and slip-around lane were designed in accordance with the York Region Standard Drawing DS-100 and the TAC manual.

Capacity analysis was conducted to demonstrate the effectiveness of providing a right-turn taper. The sensitivity analysis was conducted for the year 2034 in the PM peak hour, with trips coming to and from the west (Option 1). **Table 6.2** compares the site access operations with and without the right-turn taper. Synchro reports are provided in **Appendix L**.

Table 6.2 – Capacity Analysis Summary – 2034 Future Total – Right-Turn Taper

Intersection	Movement	Without Right-Turn Taper					With Right-Turn Taper				
		v/c	Delay (s)	LOS	Queue (m)		v/c	Delay (s)	LOS	Queue (m)	
					50 th	95 th				50 th	95 th
Bloomington Road & Site Access (Unsignalized)	EBT	0.57	--	--	--	--	0.54	--	--	--	--
	EBR	--	--	--	--	--	0.02	--	--	--	--
	NBLR	0.65	137.9	F	--	22.1	0.63	24.9	C	--	5.2

Intersection operations improve overall with the implementation of a right-turn taper. The northbound approach (exiting vehicles) improves marginally. It is important to note that the main purpose of the proposed right-turn taper is to minimize the disruption of through traffic on Bloomington Road by the turning volumes. This effect could not be clearly represented through the capacity analysis.

6.2. Road Maintenance

The site will employ a sweeper to manage the tracking of dust and gravel on the haul route internal to the site and on Bloomington Road. Thus, it is important to manage the potential impact the sweeper would have on Bloomington Road traffic during operations. The most effective way to prevent this interference would be to minimize the tracking of dust, gravel and mud out of the site onto Bloomington Road.

As the site expects a maximum 300 trucks per day, the dust will be managed and mitigated by the usage of a sweeper and the site access being paved 30 m into the site. To minimize interference with the Regional Road, the sweepers will operate mainly outside of the roadway peak hours.

6.3. Sight Distance Assessment

The sight distance requirements for the proposed access onto Bloomington Road were assessed in accordance with the Geometric Design Guide for Canadian Roads to determine if the site access location and configuration provides adequate sight distances for stopping and departure.

6.3.1. Stopping Sight Distance

For the distance assessment, a design speed of 80 km/hr (posted speed plus 10 km/hr) under stop control was utilized. Sight distance requirements were considered for passenger vehicles approaching the existing access on Bloomington Road. The criterion applied for vehicles approaching the intersection is stopping sight distance. Under the stopping sight distance assessment, the target height applied is 0.38 m for vehicle taillights, and for intersection movements a top of car height of 1.3 m is applied. A driver eye height of 1.05 m is applied for all scenarios.

Adjustments for road grade were not applied as the existing grading of Bloomington Road in the subject area is relatively flat and would have a negligible effect on the stopping sight distance.

In accordance with the Geometric Design Guide for Canadian Roads by the Transportation Association of Canada (TAC 2017) section 2.5.3, the required stopping distance, adjusted for effect of grade, is determined using the following equation:

$$d_b = 0.039 \times V^2 / a$$

Where:

d_b = Braking distance (m);

V = design speed (km/h);

a = Deceleration rate (m/s^2) (Assumed as $3.4 m/s^2$, as per TAC 2017 Section 2.5.2.2)

Then:

$$\text{Stopping Sight Distance} = 0.278tV + d_b$$

Where:

t = perception / reaction time = 2.5 s (TAC 2017, Section 2.2.5.5)

$$\begin{aligned} \text{Minimum stopping sight distance} &= 0.278 \times 2.5 \times 80 + 80^2 / 3.4 \\ &= 129.01 \text{ m say } \mathbf{130 \text{ m}} \end{aligned}$$

6.3.2. Departure Sight Distance

To assess scenarios where vehicles are departing from the location of the proposed driveway, the departure sight distance was assessed under Case B1 – Left Turn from the Minor Road, in accordance with Section 9.9.2.3 of the *Geometric Design Guide for Canadian Roads (TAC 2017)*. The departure sight distance was assumed to be under stop-controlled conditions.

As stipulated in the *Geometric Design Guide for Canadian Roads*, the intersection sight distance along the major road is determined using the following equation:

$$ISD = 0.278 V_{\text{major}} t_g$$

Where:

ISD = Intersection sight distance (length of the leg of sight triangle along the major road) (m);

V_{major} = design speed of the major road (km/h); and,

T_g = time gap for minor road vehicle to enter the major road (s)

Case B1 – Minimum intersection sight distance for vehicles turning left from the proposed access onto County Road 49:

$$\begin{aligned} ISD &= 0.278 \times 80 \times 7.5 \\ &= 166.8 \text{ m say } \mathbf{170 \text{ m}} \end{aligned}$$

The required stopping sight distance and departure sight distances are 130 m and 170 m, respectively. Bloomington Road has relatively flat grading and a straight horizontal alignment, which allows for very long sightlines along Bloomington Road from the location of the site access. The site access is an existing functional access and has not experienced any operation issues relating to sightlines. As shown below in **Figure 5-1**, the sight distances on Bloomington Road reach or exceed 200 m for the eastbound and westbound approaches. Therefore, the site distances provided by the site access onto Bloomington Road are sufficient for stopping and departure.

Figure 6-1 – Sightlines on Bloomington Road

6.4. Site Access Circulation

AutoTURN software was used to generate a vehicular turning template to confirm and demonstrate the accessibility of the proposed site access design. **Figure 6-2** demonstrates a fill truck (represented by HSU TAC-2017 design vehicle) performing right-in and left-out movements at the proposed site access.

7.0 MULTIMODAL TRANSPORTATION ASSESMENT

In accordance with the York Region Transportation Mobility Plan Guidelines, the level of service of the transit and active transportation facilities in the study area were assessed.

7.1. Transit Mode Assessment

York Region Transit (YRT) service currently does reach Bloomington Road, Highway 48, and Ninth Line within the study area. The transit level of service is summarized in **Table 7.1**.

Table 7.1 – Transit Level of Service

Intersection	Direction	Access to Transit Stops	Transit Headways	Intersection Approach
		LOS	LOS	LOS
Bloomington Road & Highway 48	EB	F	F	B
	WB	F	F	B
	NB	F	F	A
	SB	F	F	B
Bloomington Road & Ninth Line	EB	F	F	C
	WB	F	F	C
	NB	F	F	D
	SB	F	F	C
Bloomington Road & Site Access	EB	F	F	A
	WB	F	F	A
	NB	F	F	C

7.2. Pedestrian Mode Assessment

Currently, Bloomington Road and Ninth Line provide either gravel or paved shoulders and no dedicated pedestrian facilities. Multi-use paths are provided on both sides of Ninth Line in the area of Bloomington Road. Pedestrian level of service is summarized in **Table 7.2**.

Table 7.2 – Pedestrian Level of Service

Intersection	Direction	Segment	Intersection
		LOS	LOS
Bloomington Road & Highway 48	EB	F	F
	WB	F	F
	NB	F	F
	SB	F	F
Bloomington Road & Ninth Line	EB	F	D
	WB	F	D
	NB	F	D
	SB	F	D
Bloomington Road & Site Access	EB	F	F
	WB	F	F
	NB	F	F

7.3. Bicycle Mode Assessment

According to the York Region 2021 Cycling Map, off-road multi use trails are provided on Ninth Line in the area of Bloomington Road. Bloomington Road and Highway 48 do not currently provide cycling facilities. Bicycle level of service is summarized in **Table 7.3**.

Table 7.3 – Cycling Level of Service

Intersection	Direction	Segment	Intersection
		LOS	LOS
Bloomington Road & Highway 48	EB	F	F
	WB	F	F
	NB	F	F
	SB	F	F
Bloomington Road & Ninth Line	EB	F	C
	WB	F	C
	NB	C	C
	SB	C	C
Bloomington Road & Site Access	EB	F	F
	WB	F	F
	NB	F	F

7.4. Multimodal LOS Assessment Summary

Bloomington Road within the study area provides poor LOS for transit, pedestrian, and cycling. However, non-automobile transportation is not considered a critical factor when assessing the potential impacts of the proposed Site Alteration and Fill Permit. Due to the nature of the operation, the site is expected to generate no demand for non-automobile modes of transportation. Furthermore, due to the high truck volumes entering and leaving the site, it benefits from having little to no pedestrian or cycling traffic nearby.

8.0 CONCLUSION

The findings and conclusions of the analysis are as follows:

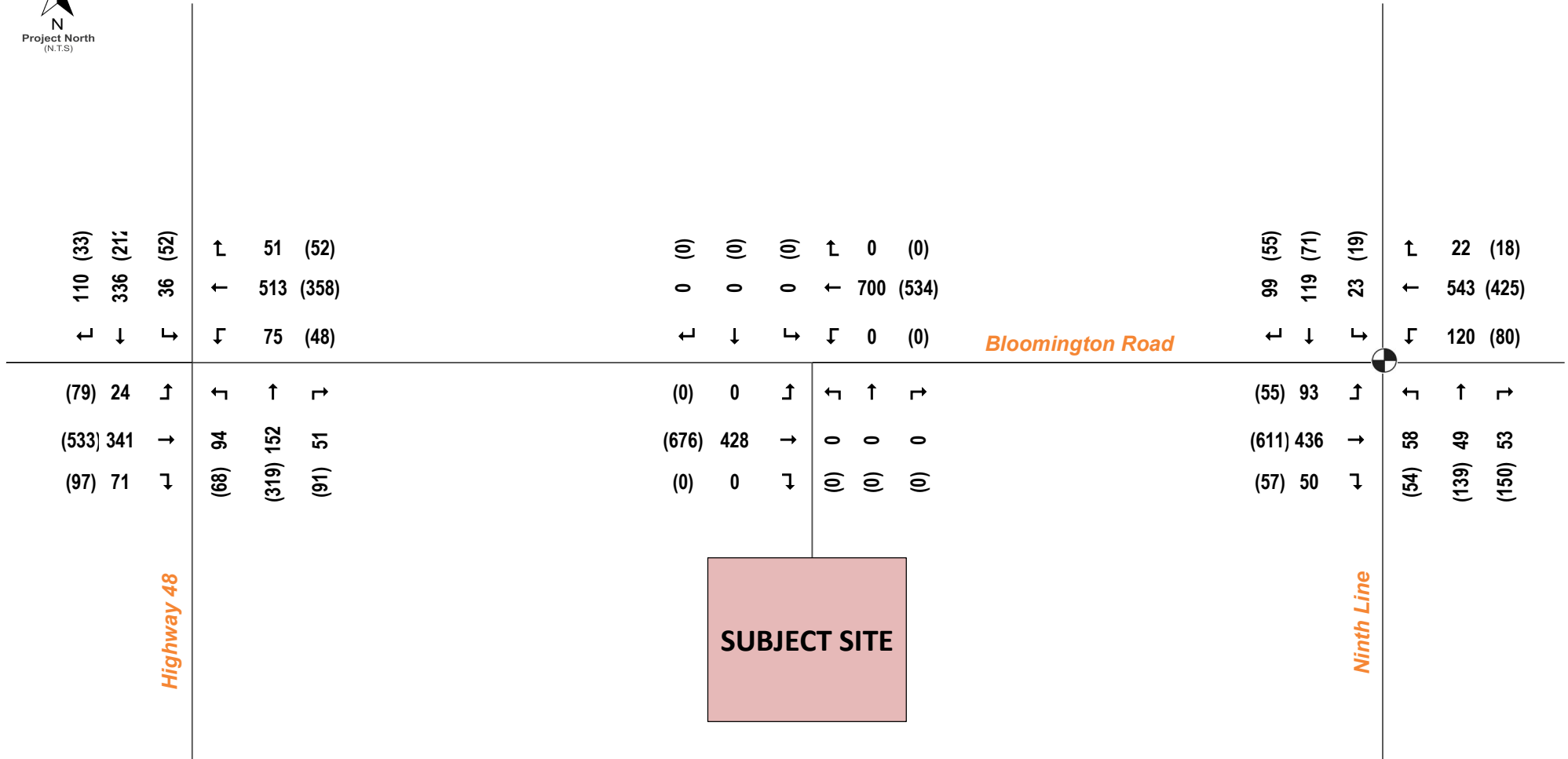
- The subject site is located at the southeast quadrant of the intersection of Bloomington Road and Highway 48, addressed as 5783 Bloomington Road, in the Town of Whitchurch-Stouffville. Access to the site is provided through a single full movement access onto Bloomington Road.
- Under existing traffic conditions, the study area intersections operate with excellent overall Levels of Service (LOS) during the AM, PM and weekend midday (MD) peak hours. There were no identified capacity or delay issues.
- Based on information received from the Owner, the operation is expected to experience daily truck volumes of 180-300 trucks, which include inbound and outbound trips. The operating hours of the site are between 7:00 AM and 5:00 PM on weekdays, and 50% (150 trucks) of the total truck trips are expected to occur within the hours of 7:00 AM to 9:00 AM and 3:00 PM to 5:00 PM.
- When considering the overall performance of the site access and nearby intersections, **Option 1** is the preferable truck routing option (trucks turning right in from Bloomington Road and left out onto Bloomington Road), as the impact on adjacent the adjacent intersections is more manageable.
- For the eastbound on Bloomington Road to fail, there would need to be 750 eastbound right-turn volumes during the peak hour. Additionally, under this condition, the site access would experience catastrophic failure. Assuming that the peak hour volumes are 25% of the daily volume, maximum number of daily truck trips to and from the site would be approximately 3000. The proposed operation would not come close to producing 3000 daily truck trips.
- To minimize interference with the Regional Road, the sweepers will operate mainly outside of the roadway peak hours. As the site expects about 300 trucks per day, the tracking of dust is not expected to be at a manageable level. To minimize tracking onto Bloomington Road, it is recommended that the site access be paved up to 30 m into the site.
- A right turn taper and slip-around lane were designed in accordance with the York Region Standard Drawing DS-100 and the TAC manual. Capacity analysis showed that Intersection operations improve overall with the implementation of a right-turn taper.
- The required stopping sight distance and departure sight distances are 130 m and 170 m, respectively. Bloomington Road has relatively flat grading and a straight horizontal alignment, which allows for very long sightlines along Bloomington Road from the location of the site access. The site access is an existing functional access and has not experienced any operation issues relating to sightlines.

8.1. Recommendation

Option 1 is the preferable truck routing option (trucks turning right in from Bloomington Road and left out onto Bloomington Road), as it produces a smaller impact on the adjacent intersections in the road network.

To facilitate operations and further improve safety, a right turn taper is recommended at the eastbound approach of Bloomington Road and the site access, on the south side of Bloomington Road, to facilitate inbound right turn movements. To minimize the interference of the site generated truck traffic with through traffic on Bloomington Road, a slip-around lane is recommended for the westbound approach, on the north side of Bloomington Road at the site access.

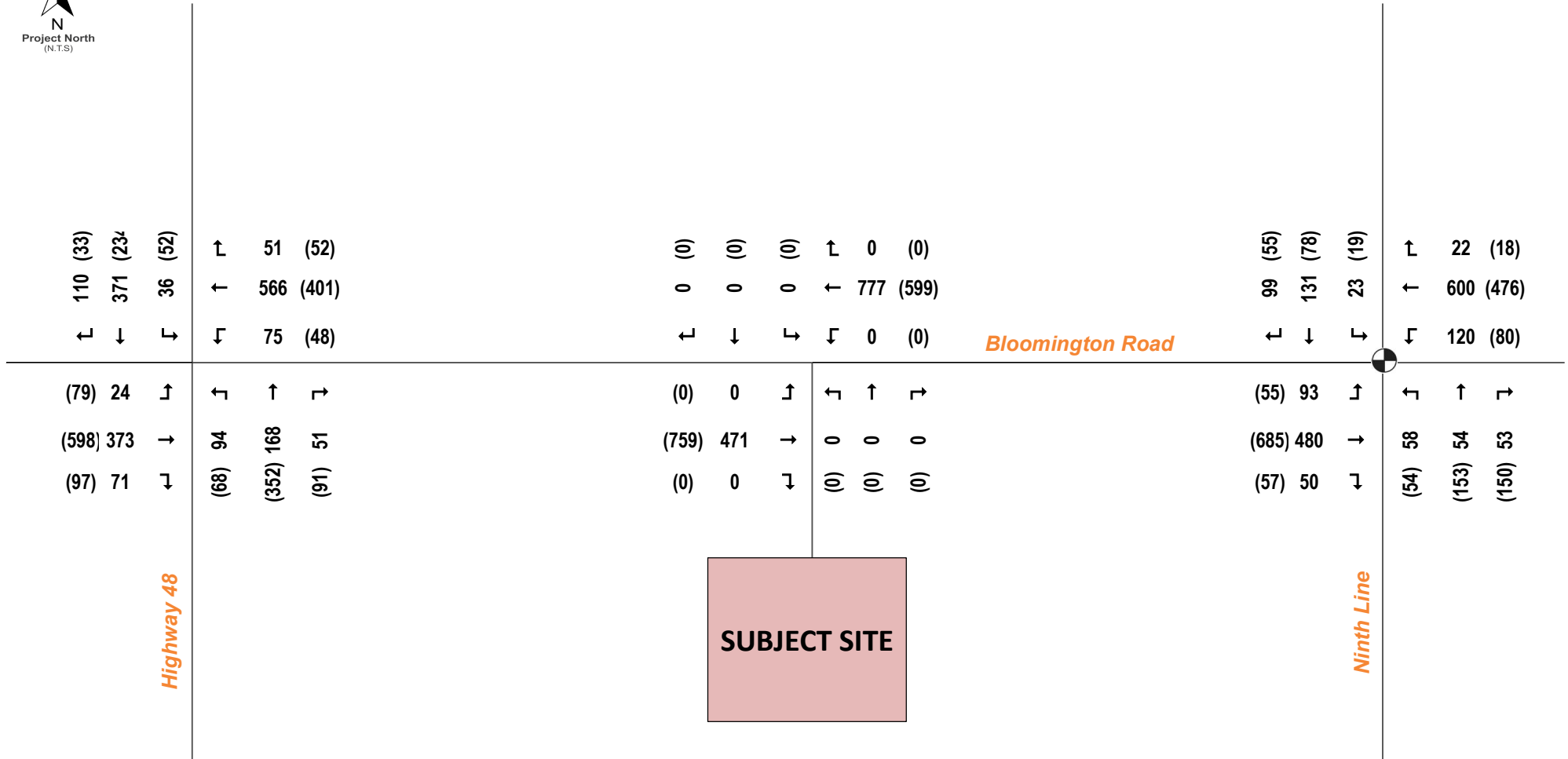
Based on the capacity analysis, which considered site operations for five (5)-year (2029) and 10-year horizons (2034), the existing road network intersections are expected to operate with overall acceptable LOS with the introduction of the truck trips entering and leaving the site. The analysis supports the proposed Site Alteration and Fill Permit, which is expected to have a manageable impact and can be adequately accommodated by surrounding road network.



LEGEND

XX Weekday AM Peak Hour Volumes
(XX) Weekday PM Peak Hour Volumes

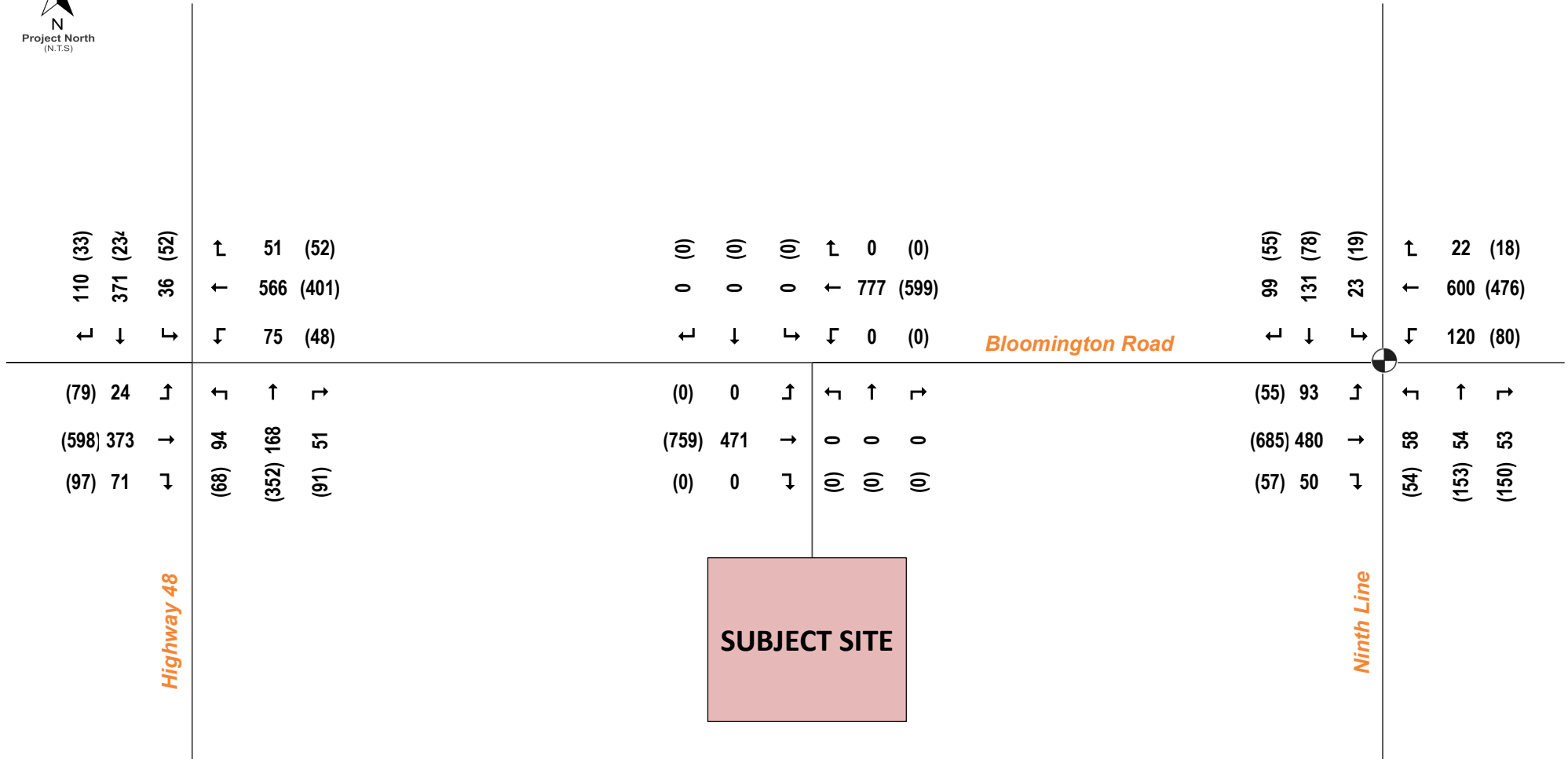
Figure 2-2 - Existing Traffic Volumes



LEGEND

XX Weekday AM Peak Hour Volumes
(XX) Weekday PM Peak Hour Volumes

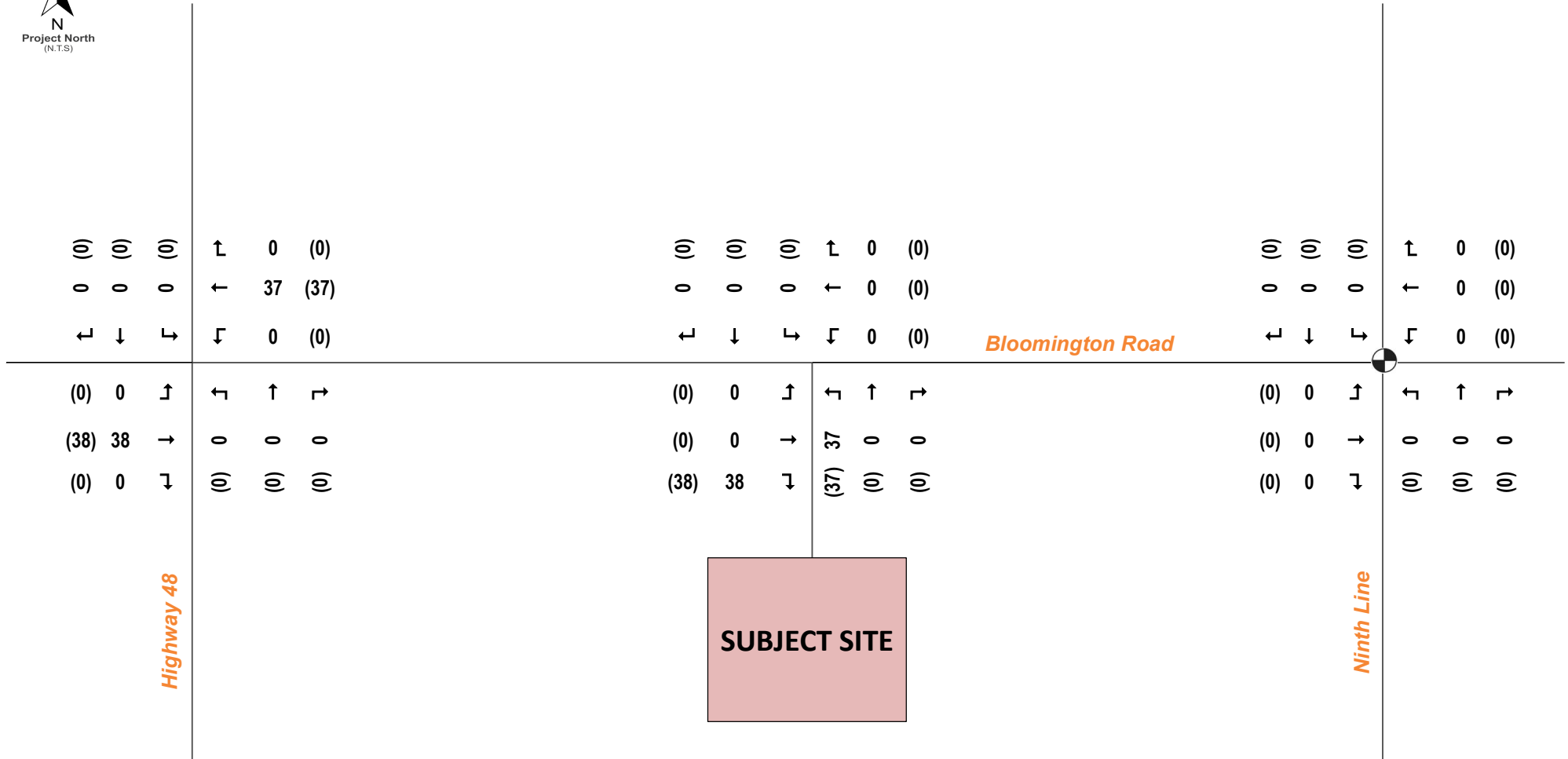
Figure 3-1 - 2029 Future Background Traffic Volumes



LEGEND

XX Weekday AM Peak Hour Volumes
(XX) Weekday PM Peak Hour Volumes

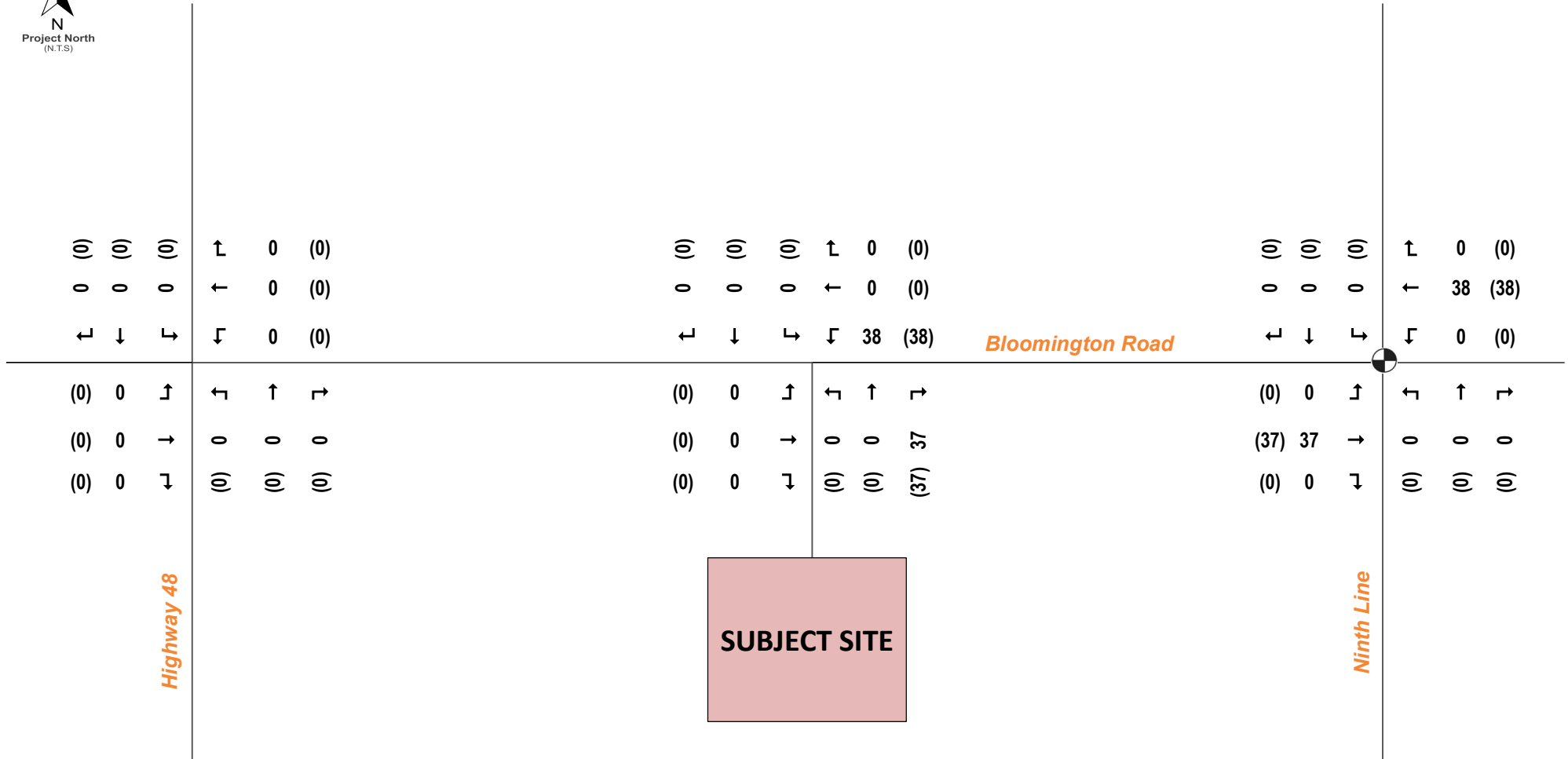
Figure 3-1 - 2029 Future Background Traffic Volumes



LEGEND

XX Weekday AM Peak Hour Volumes
(XX) Weekday PM Peak Hour Volumes

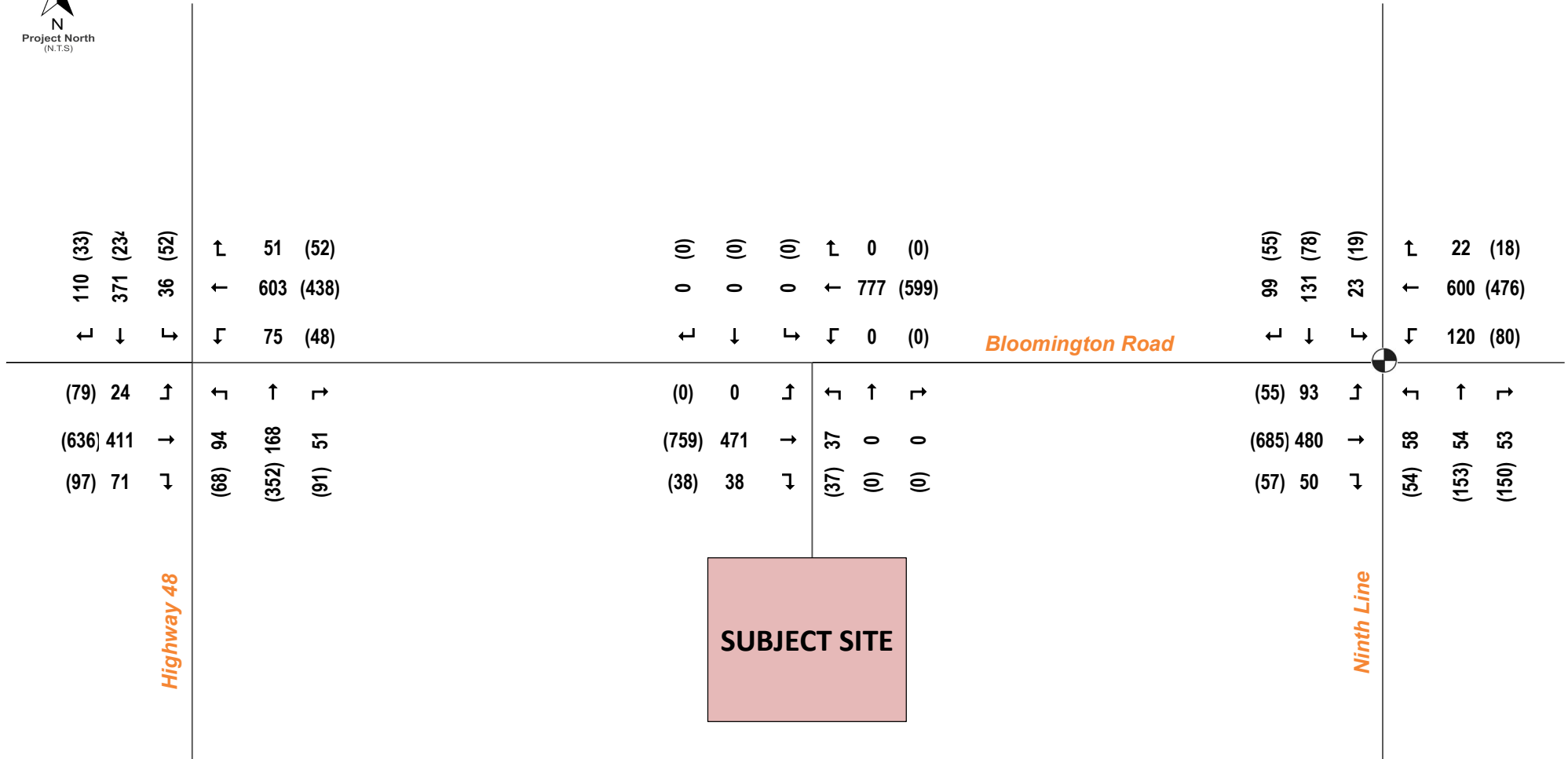
Figure 4-1 - Site Generated Traffic Volumes (Option 1)



LEGEND

XX Weekday AM Peak Hour Volumes
(XX) Weekday PM Peak Hour Volumes

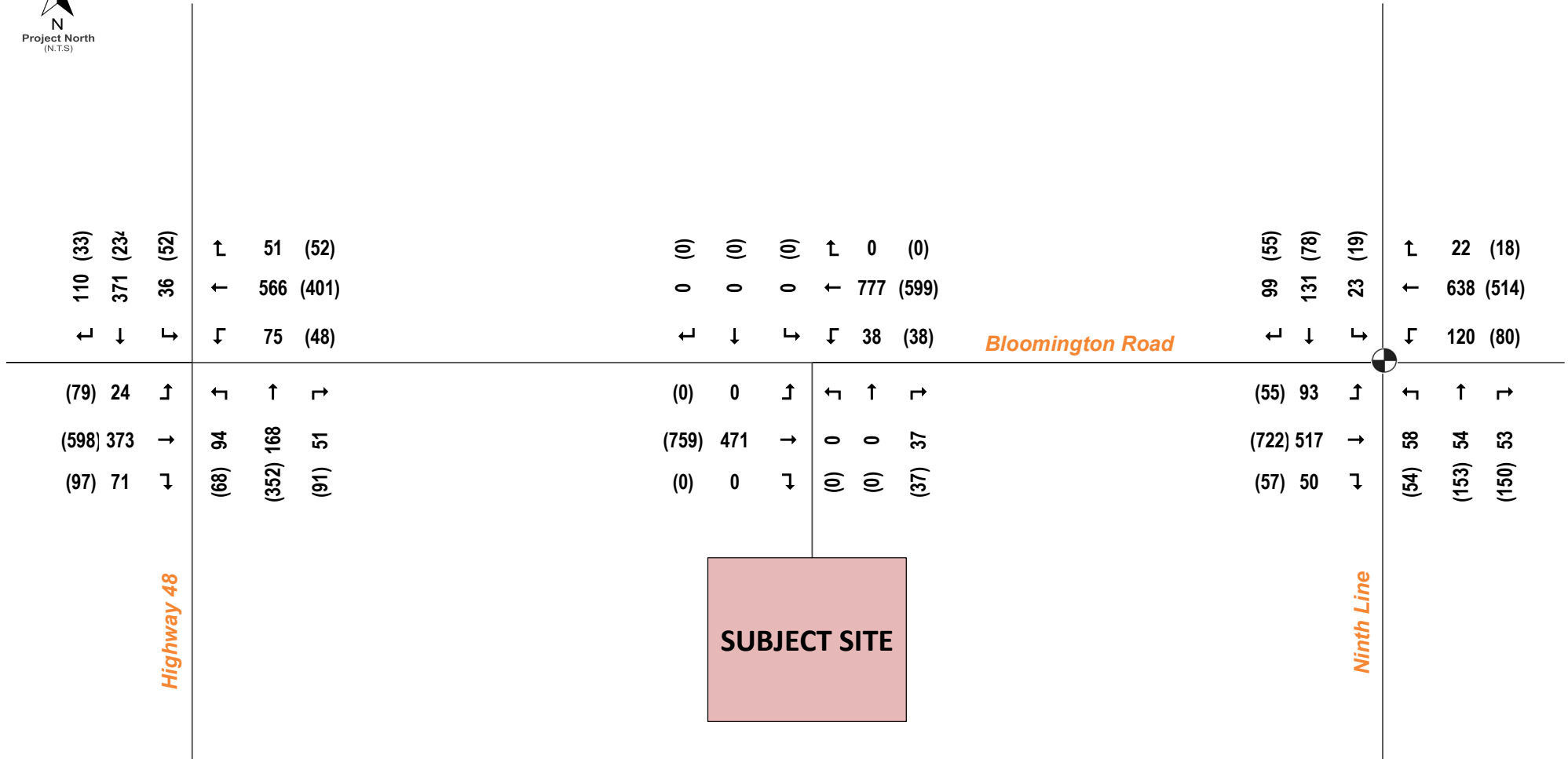
Figure 4-2 - Site Generated Traffic Volumes (Option 2)



LEGEND

XX Weekday AM Peak Hour Volumes
(XX) Weekday PM Peak Hour Volumes

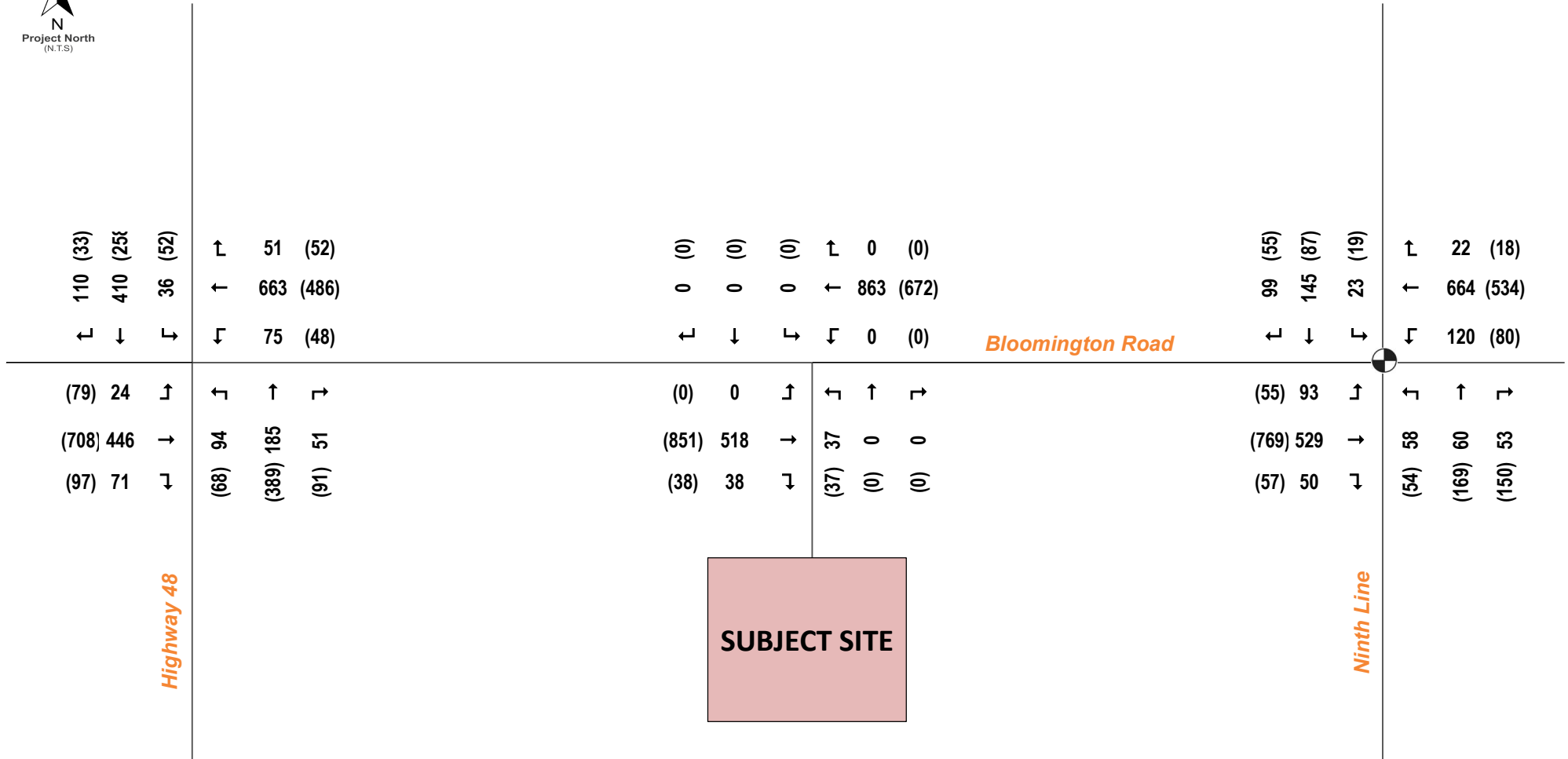
Figure 5-1 - 2029 Future Total Traffic Volumes (Option 1)



LEGEND

XX Weekday AM Peak Hour Volumes
(XX) Weekday PM Peak Hour Volumes

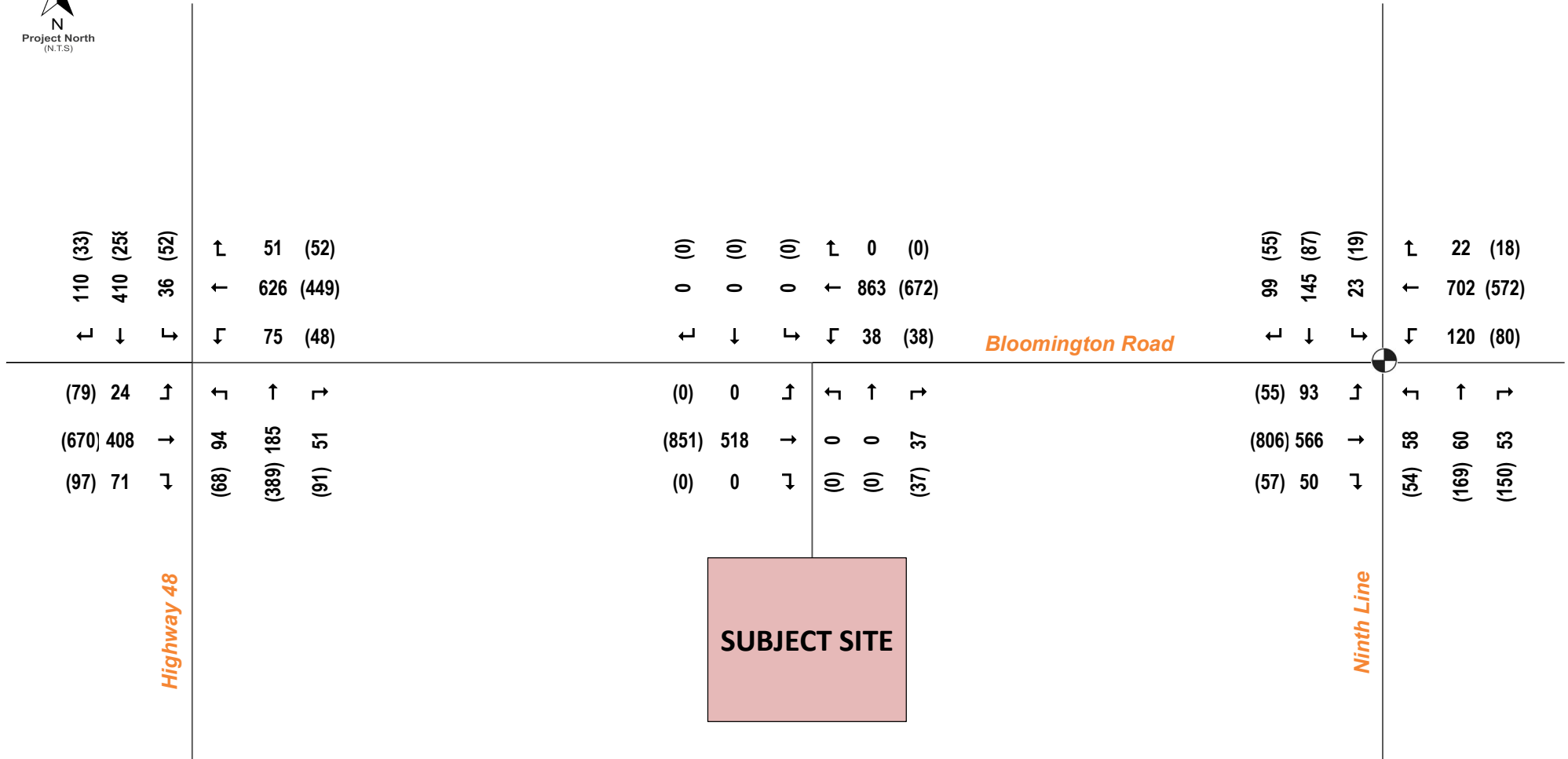
Figure 5-2 - 2029 Future Total Traffic Volumes (Option 2)



LEGEND

XX Weekday AM Peak Hour Volumes
(XX) Weekday PM Peak Hour Volumes

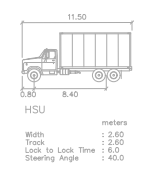
Figure 5-3 - 2034 Future Total Traffic Volumes (Option 1)



LEGEND

XX Weekday AM Peak Hour Volumes
(XX) Weekday PM Peak Hour Volumes

Figure 5-4 - 2034 Future Total Traffic Volumes (Option 2)



REVISIONS

NO	REVISION	DATE	BY

STAMP



DRAWING TITLE:

AutoTURN Analysis
HSU TAC-2017

DESIGN BY: K.A.	DATE: March 8, 2023
CHECKED BY: R.P.	PROJECT NO. NT-23-219
DRAWN BY: K.A.	
SCALE: N.T.S.	DRAWING NO. Figure 6-2

Appendix A – Traffic Data



Turning Movement Count (1 . BLOOMINGTON RD & HWY 48)

Start Time	Southbound HWY 48						Westbound BLOOMINGTON RD						Northbound HWY 48						Eastbound BLOOMINGTON RD						Int. Total (15 min)	Int. Total (1 hr)
	Right N:W	Thru N:S	Left N:E	UTurn N:N	Peds N:	Approach Total	Right E:N	Thru E:W	Left E:S	UTurn E:E	Peds E:	Approach Total	Right S:E	Thru S:N	Left S:W	UTurn S:S	Peds S:	Approach Total	Right W:S	Thru W:E	Left W:N	UTurn W:W	Peds W:	Approach Total		
07:00:00	21	55	5	0	0	81	9	106	3	0	0	118	9	16	6	0	0	31	6	60	2	0	0	68	298	
07:15:00	33	60	4	0	0	97	12	120	18	0	0	150	12	27	10	1	0	50	12	67	6	0	0	85	382	
07:30:00	25	76	5	0	0	106	10	124	24	0	0	158	16	38	26	0	0	80	15	57	5	0	0	77	421	
07:45:00	29	82	7	0	0	118	16	113	23	0	0	152	12	34	26	1	0	73	18	62	4	0	0	84	427	1528
08:00:00	31	78	13	0	0	122	12	95	17	0	0	124	14	42	23	0	0	79	13	64	6	0	0	83	408	1638
08:15:00	25	100	11	0	0	136	13	93	11	0	0	117	9	38	19	0	0	66	25	70	9	0	0	104	423	1679
08:30:00	16	89	11	0	0	116	8	91	8	0	0	107	14	40	21	0	0	75	26	81	7	0	0	114	412	1670
08:45:00	17	80	8	0	0	105	9	90	16	0	0	115	6	39	17	1	0	63	14	73	7	0	0	94	377	1620
09:00:00	16	75	4	0	0	95	8	67	17	0	0	92	10	41	17	0	0	68	17	61	6	0	0	84	339	1551
09:15:00	10	61	10	0	0	81	11	74	10	0	0	95	15	39	16	0	0	70	12	61	7	0	0	80	326	1454
09:30:00	10	62	9	0	0	81	8	72	13	0	0	93	10	29	12	1	0	52	7	57	3	0	0	67	293	1335
09:45:00	12	60	12	0	0	84	6	68	15	0	0	89	6	41	14	0	0	61	15	55	8	0	0	78	312	1270
BREAK																										
16:00:00	10	31	11	0	0	52	12	74	17	0	0	103	30	106	13	0	0	149	14	101	20	0	0	135	439	
16:15:00	9	60	12	0	0	81	14	71	10	0	0	95	25	95	20	0	0	140	14	120	17	0	0	151	467	
16:30:00	12	52	12	0	0	76	19	83	13	0	0	115	21	69	18	0	0	108	21	141	19	0	0	181	480	
16:45:00	6	46	9	0	0	61	8	89	13	0	0	110	21	76	15	0	0	112	26	141	21	0	0	188	471	1857
17:00:00	6	54	19	0	0	79	11	99	12	0	0	122	24	79	15	0	0	118	36	115	22	0	0	173	492	1910
17:15:00	7	52	15	0	0	74	7	76	10	0	0	93	21	67	20	0	0	108	38	98	20	0	0	156	431	1874
17:30:00	8	52	11	0	0	71	14	68	10	0	0	92	15	88	21	0	0	124	28	141	17	0	0	186	473	1867
17:45:00	7	53	10	0	0	70	6	60	11	0	0	77	21	47	14	0	0	82	32	87	20	0	0	139	368	1764
18:00:00	7	38	5	0	0	50	13	62	10	0	0	85	18	63	11	0	0	92	12	68	13	0	0	93	320	1592
18:15:00	8	41	4	0	0	53	2	55	8	0	0	65	12	50	11	0	0	73	13	77	8	0	0	98	289	1450
18:30:00	7	42	5	0	0	54	5	43	12	0	0	60	16	39	12	0	0	67	15	66	10	0	0	91	272	1249
18:45:00	9	27	4	0	0	40	6	42	13	0	0	61	14	51	7	0	0	72	7	60	13	0	0	80	253	1134
Grand Total	341	1426	216	0	0	1983	239	1935	314	0	0	2488	371	1254	384	4	0	2013	436	1983	270	0	0	2689	9173	-
Approach%	17.2%	71.9%	10.9%	0%		-	9.6%	77.8%	12.6%	0%		-	18.4%	62.3%	19.1%	0.2%		-	16.2%	73.7%	10%	0%		-	-	-
Totals %	3.7%	15.5%	2.4%	0%		21.6%	2.6%	21.1%	3.4%	0%		27.1%	4%	13.7%	4.2%	0%		21.9%	4.8%	21.6%	2.9%	0%		29.3%	-	-
Heavy	14	51	23	0		-	22	188	23	0		-	20	48	12	0		-	27	181	17	0		-	-	-
Heavy %	4.1%	3.6%	10.6%	0%		-	9.2%	9.7%	7.3%	0%		-	5.4%	3.8%	3.1%	0%		-	6.2%	9.1%	6.3%	0%		-	-	-
Bicycles	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	-	-
Bicycle %	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	-	-



Peak Hour: 07:30 AM - 08:30 AM Weather:

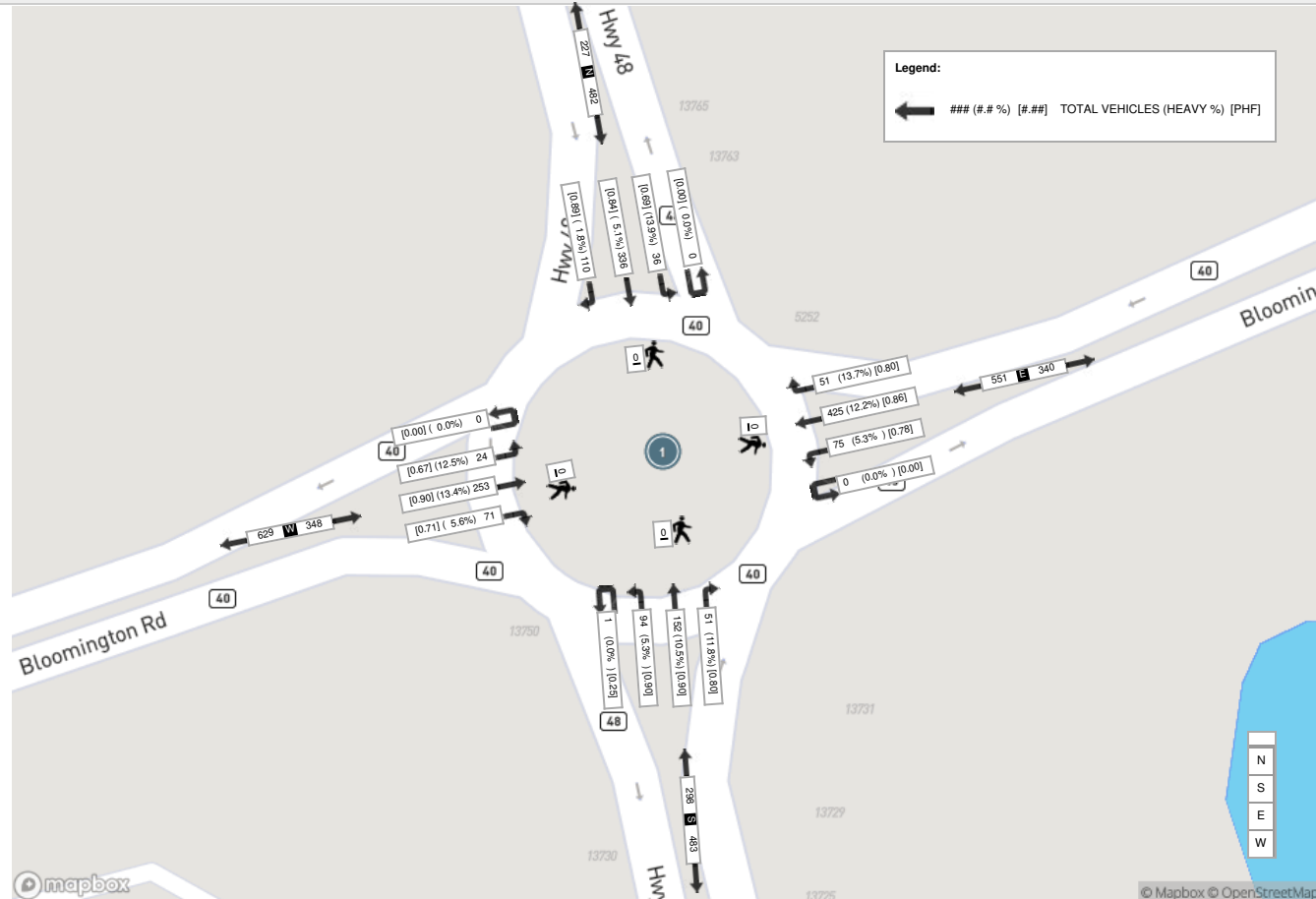
Start Time	Southbound HWY 48						Westbound BLOOMINGTON RD						Northbound HWY 48						Eastbound BLOOMINGTON RD						Int. Total (15 min)
	Right	Thru	Left	UTurn	Peds	Approach Total	Right	Thru	Left	UTurn	Peds	Approach Total	Right	Thru	Left	UTurn	Peds	Approach Total	Right	Thru	Left	UTurn	Peds	Approach Total	
07:30:00	25	76	5	0	0	106	10	124	24	0	0	158	16	38	26	0	0	80	15	57	5	0	0	77	421
07:45:00	29	82	7	0	0	118	16	113	23	0	0	152	12	34	26	1	0	73	18	62	4	0	0	84	427
08:00:00	31	78	13	0	0	122	12	95	17	0	0	124	14	42	23	0	0	79	13	64	6	0	0	83	408
08:15:00	25	100	11	0	0	136	13	93	11	0	0	117	9	38	19	0	0	66	25	70	9	0	0	104	423
Grand Total	110	336	36	0	0	482	51	425	75	0	0	551	51	152	94	1	0	298	71	253	24	0	0	348	1679
Approach%	22.8%	69.7%	7.5%	0%		-	9.3%	77.1%	13.6%	0%		-	17.1%	51%	31.5%	0.3%		-	20.4%	72.7%	6.9%	0%		-	-
Totals %	6.6%	20%	2.1%	0%		28.7%	3%	25.3%	4.5%	0%		32.8%	3%	9.1%	5.6%	0.1%		17.7%	4.2%	15.1%	1.4%	0%		20.7%	-
PHF	0.89	0.84	0.69	0		0.89	0.8	0.86	0.78	0		0.87	0.8	0.9	0.9	0.25		0.93	0.71	0.9	0.67	0		0.84	-
Heavy	2	17	5	0		24	7	52	4	0		63	6	16	5	0		27	4	34	3	0		41	-
Heavy %	1.8%	5.1%	13.9%	0%		5%	13.7%	12.2%	5.3%	0%		11.4%	11.8%	10.5%	5.3%	0%		9.1%	5.6%	13.4%	12.5%	0%		11.8%	-
Lights	108	319	31	0		458	44	373	71	0		488	45	136	89	1		271	67	219	21	0		307	-
Lights %	98.2%	94.9%	86.1%	0%		95%	86.3%	87.8%	94.7%	0%		88.6%	88.2%	89.5%	94.7%	100%		90.9%	94.4%	86.6%	87.5%	0%		88.2%	-
Single-Unit Trucks	1	11	3	0		15	5	28	2	0		35	3	10	3	0		16	1	19	3	0		23	-
Single-Unit Trucks %	0.9%	3.3%	8.3%	0%		3.1%	9.8%	6.6%	2.7%	0%		6.4%	5.9%	6.6%	3.2%	0%		5.4%	1.4%	7.5%	12.5%	0%		6.6%	-
Buses	1	1	2	0		4	1	3	0	0		4	1	2	1	0		4	2	2	0	0		4	-
Buses %	0.9%	0.3%	5.6%	0%		0.8%	2%	0.7%	0%	0%		0.7%	2%	1.3%	1.1%	0%		1.3%	2.8%	0.8%	0%	0%		1.1%	-
Articulated Trucks	0	5	0	0		5	1	21	2	0		24	2	4	1	0		7	1	13	0	0		14	-
Articulated Trucks %	0%	1.5%	0%	0%		1%	2%	4.9%	2.7%	0%		4.4%	3.9%	2.6%	1.1%	0%		2.3%	1.4%	5.1%	0%	0%		4%	-



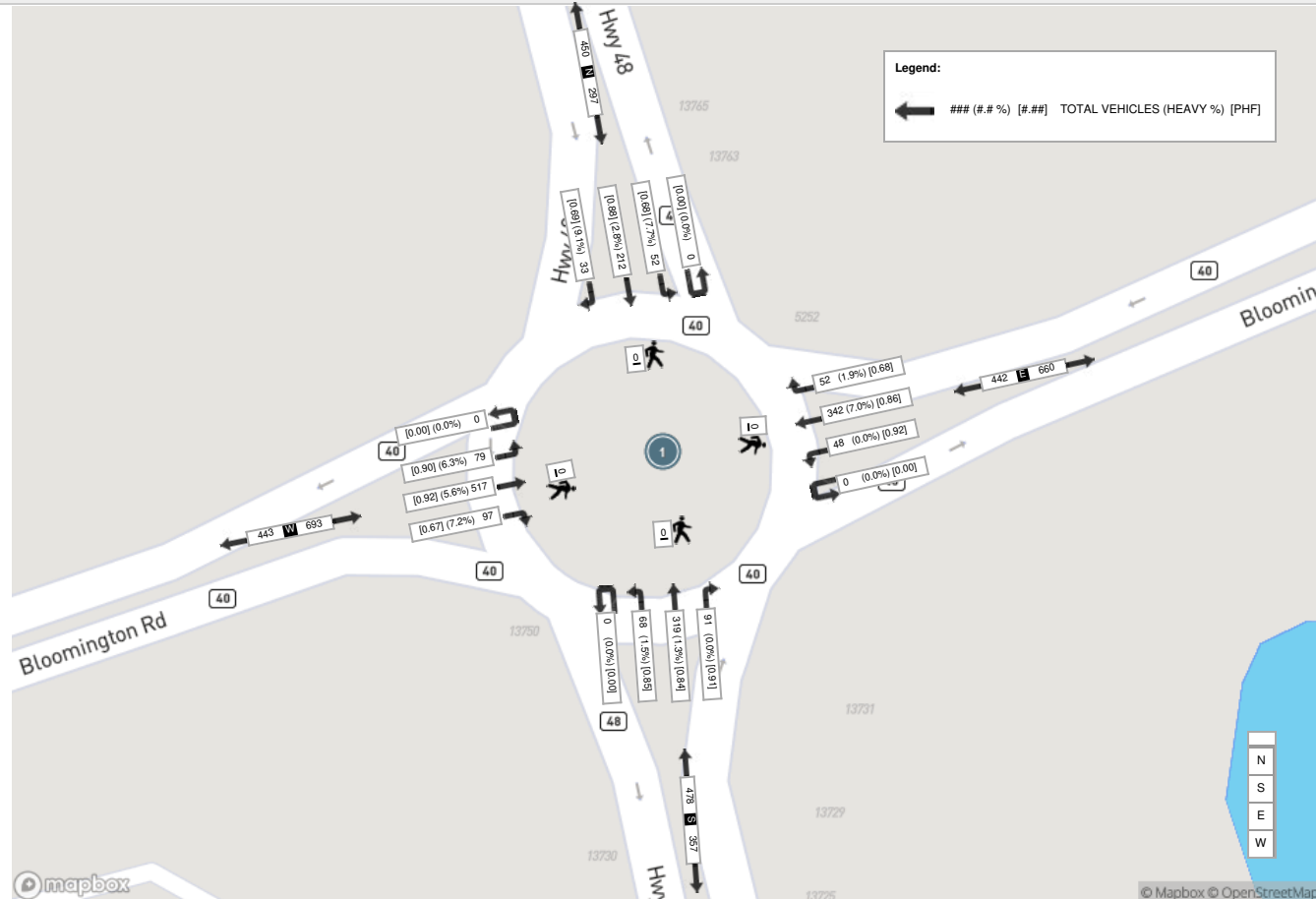
Peak Hour: 04:15 PM - 05:15 PM Weather: Light Rain (1.86 °C)

Start Time	Southbound HWY 48						Westbound BLOOMINGTON RD						Northbound HWY 48						Eastbound BLOOMINGTON RD						Int. Total (15 min)
	Right	Thru	Left	UTurn	Peds	Approach Total	Right	Thru	Left	UTurn	Peds	Approach Total	Right	Thru	Left	UTurn	Peds	Approach Total	Right	Thru	Left	UTurn	Peds	Approach Total	
16:15:00	9	60	12	0	0	81	14	71	10	0	0	95	25	95	20	0	0	140	14	120	17	0	0	151	467
16:30:00	12	52	12	0	0	76	19	83	13	0	0	115	21	69	18	0	0	108	21	141	19	0	0	181	480
16:45:00	6	46	9	0	0	61	8	89	13	0	0	110	21	76	15	0	0	112	26	141	21	0	0	188	471
17:00:00	6	54	19	0	0	79	11	99	12	0	0	122	24	79	15	0	0	118	36	115	22	0	0	173	492
Grand Total	33	212	52	0	0	297	52	342	48	0	0	442	91	319	68	0	0	478	97	517	79	0	0	693	1910
Approach%	11.1%	71.4%	17.5%	0%		-	11.8%	77.4%	10.9%	0%		-	19%	66.7%	14.2%	0%		-	14%	74.6%	11.4%	0%		-	-
Totals %	1.7%	11.1%	2.7%	0%		15.5%	2.7%	17.9%	2.5%	0%		23.1%	4.8%	16.7%	3.6%	0%		25%	5.1%	27.1%	4.1%	0%		36.3%	-
PHF	0.69	0.88	0.68	0		0.92	0.68	0.86	0.92	0		0.91	0.91	0.84	0.85	0		0.85	0.67	0.92	0.9	0		0.92	-
Heavy	3	6	4	0		13	1	24	0	0		25	0	4	1	0		5	7	29	5	0		41	-
Heavy %	9.1%	2.8%	7.7%	0%		4.4%	1.9%	7%	0%	0%		5.7%	0%	1.3%	1.5%	0%		1%	7.2%	5.6%	6.3%	0%		5.9%	-
Lights	30	206	48	0		284	51	318	48	0		417	91	315	67	0		473	90	488	74	0		652	-
Lights %	90.9%	97.2%	92.3%	0%		95.6%	98.1%	93%	100%	0%		94.3%	100%	98.7%	98.5%	0%		99%	92.8%	94.4%	93.7%	0%		94.1%	-
Single-Unit Trucks	3	5	3	0		11	1	19	0	0		20	0	3	0	0		3	3	18	2	0		23	-
Single-Unit Trucks %	9.1%	2.4%	5.8%	0%		3.7%	1.9%	5.6%	0%	0%		4.5%	0%	0.9%	0%	0%		0.6%	3.1%	3.5%	2.5%	0%		3.3%	-
Buses	0	1	1	0		2	0	0	0	0		0	0	1	0	0		1	2	3	0	0		5	-
Buses %	0%	0.5%	1.9%	0%		0.7%	0%	0%	0%	0%		0%	0%	0.3%	0%	0%		0.2%	2.1%	0.6%	0%	0%		0.7%	-
Articulated Trucks	0	0	0	0		0	0	5	0	0		5	0	0	1	0		1	2	8	3	0		13	-
Articulated Trucks %	0%	0%	0%	0%		0%	0%	1.5%	0%	0%		1.1%	0%	0%	1.5%	0%		0.2%	2.1%	1.5%	3.8%	0%		1.9%	-

Peak Hour: 07:30 AM - 08:30 AM Weather:

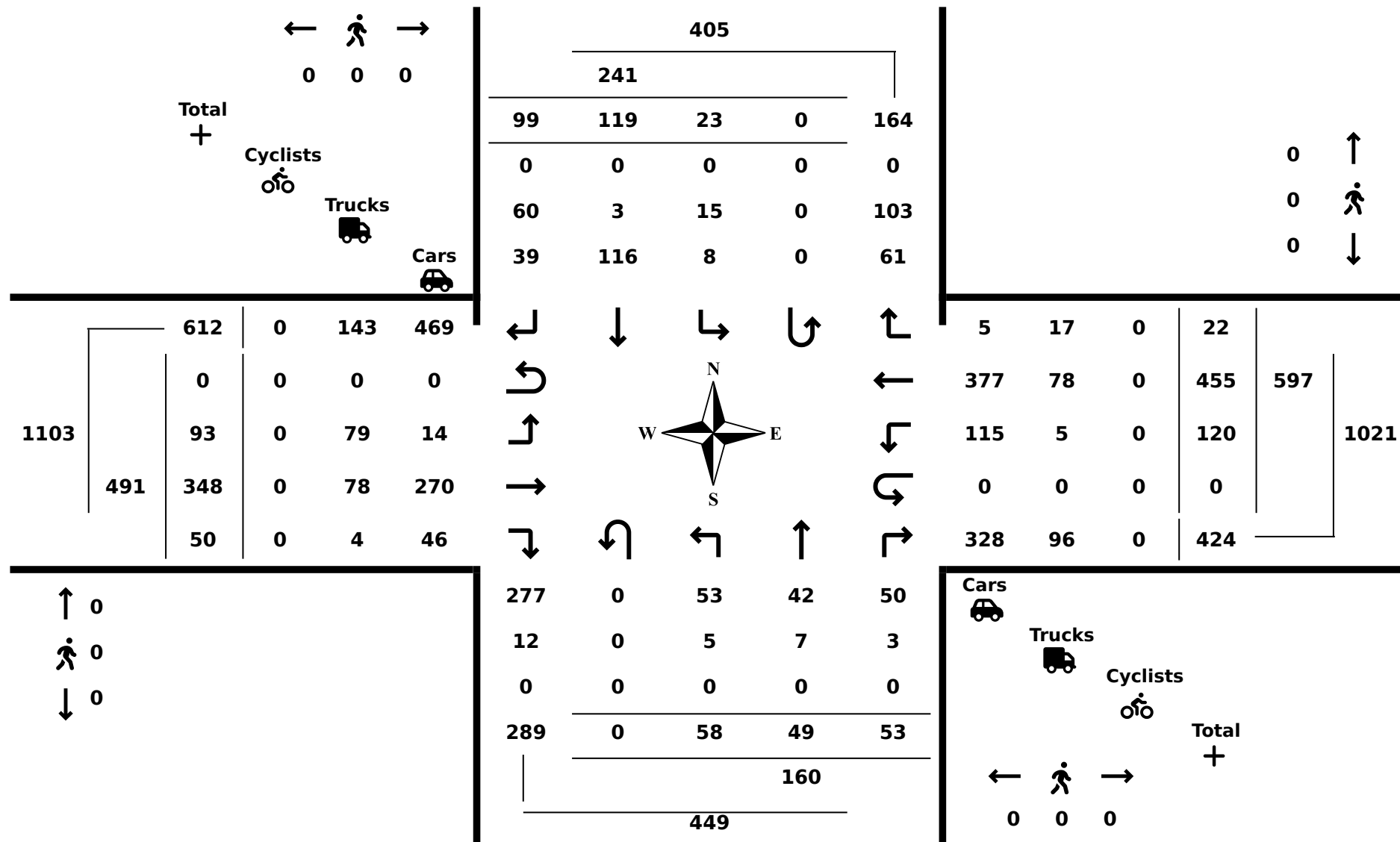


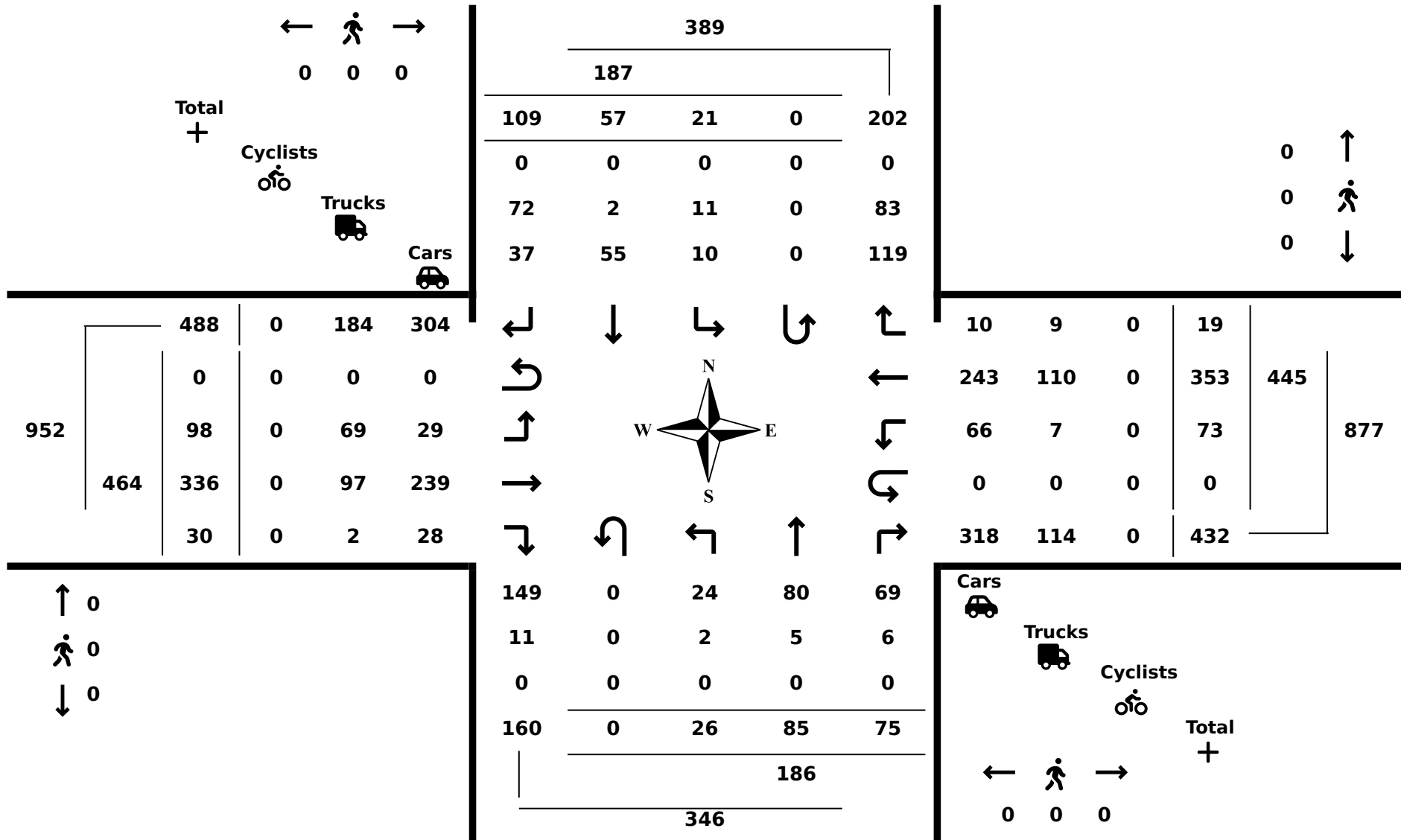
Peak Hour: 04:15 PM - 05:15 PM Weather: Light Rain (1.86 °C)

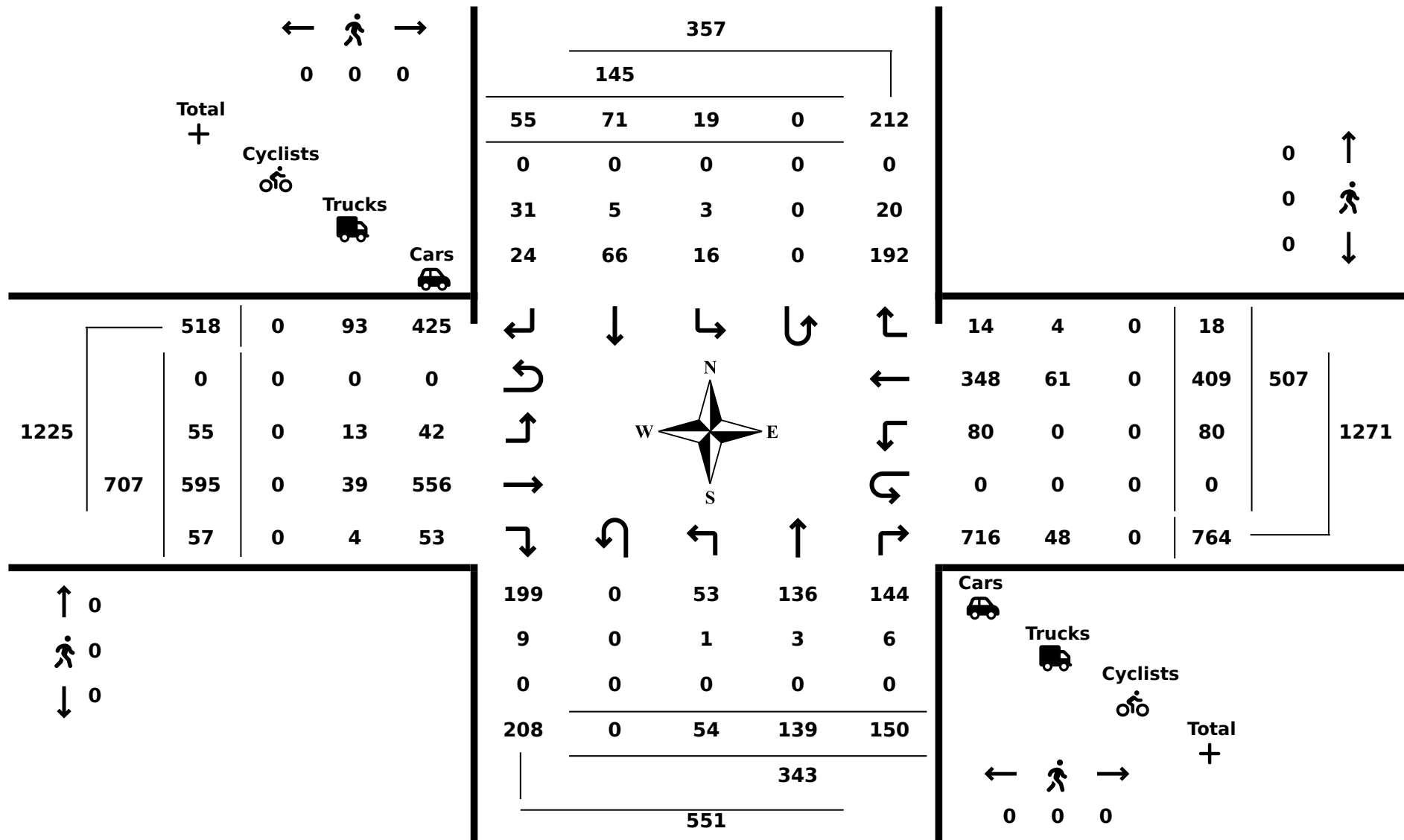


Turning Movement Diagram

Location:	Bloomington Road @ Ninth Line	Municipality:	
Jurisdiction:	Start Date: 09/05/2023 07:45:00	End Date:	09/05/2023 08:45:00







LOCATION: Bloomington Rd (YR 40) & Ninth Line (YR 69)		MUNICIPALITY: Stouffville		N ↑
CTCS: 345		COMPUTER SYSTEM: Centrac		
MODE/COMMENT: SA with APS & RLC		CONTROLLER/CABINET TYPE: Econolite Cobalt / TS2T1		
PREPARED/CHECKED BY: AM		CONFLICT FLASH: Red & Red		
PREPARATION DATE: July 11, 2022		DESIGN WALK SPEED: 1.0 m/s (FDW based on full crossing at 1.2 m/s)		
IMPLEMENTATION DATE: August 11, 2022		CHANNEL/DROP:		
NEMA Phase (York)		Free	Phase Mode	Remarks
		24 Hrs daily		
	Local Plan	Pattern 99		
	System Plan	Plan 99		
1. E/B Left Turn Arrow	WLK FDW MIN 7 EXT 3 MAX1 20 MAX2 0 AMB 3 ALR 1 SPLIT		Callable/Extendable by Setback Loop	<u>Emergency vehicle pre-emption 3:</u> Serve EWG/EWDW min 20 secs and up to 100 secs if there are continuous emergency calls in EW direction.
2. Westbound	WLK 7 FDW 19 MIN 50 EXT 0 MAX1 50 MAX2 0 AMB 5.0 ALR 2.5 SPLIT	0	Fixed	NS phase is callable by vehicle or pedestrian actuation. If a vehicle call is received, the minimum NSG is served. If ongoing vehicle demand exists on the stopbar loop, the NSG is capable of providing vehicle extensions up to the maximum green split during coordinated operation or MAX1 during Free operation. If a pedestrian call is received, the pedestrian minimum will be served. The NSWK & NSFDF are only displayed on the pedestrian signal heads if a pedestrian call is received. Extension time is based on vehicle demand. Unused extension time is given to the EWG.
3.	WLK FDW MIN EXT MAX1 MAX2 AMB ALR SPLIT			
4. Southbound	WLK 7 FDW 17 MIN 15 EXT 3 MAX1 30 MAX2 0 AMB 4.5 ALR 3.0 SPLIT	0	Callable by stopbar loop and/or pushbutton; Extendable by stopbar loop.	During coordinated operation, the signal constantly cycles through main street FDW to improve response time to side street vehicle and pedestrian demand.
	WLK FDW MIN EXT MAX1 MAX2 AMB ALR SPLIT			During free plan, signal rests in EWWK and does not cycle through EWFD unless there is side street vehicle or pedestrian demand.
	WLK FDW MIN EXT MAX1 MAX2 AMB ALR SPLIT			EWFD reverts to EWWK if there is no side street demand at the end of the EWFD.
6. Eastbound	WLK 7 FDW 19 MIN 50 EXT 0 MAX1 50 MAX2 0 AMB 5.0 ALR 2.5 SPLIT	0	Fixed	APS Extended Push Activation = 3 sec When activated, APS is on for 7 seconds. EBLT Advance installation
7.	WLK FDW MIN EXT MAX1 MAX2 AMB ALR SPLIT			<u>LEGEND:</u> SA - Semi-Actuated signal WLK - Walk time FDW - Flashing Don't Walk time MIN - Minimum green time EXT - Extension time MAX1 - Maximum green time 1 MAX2 - Maximum green time 2 AMB - Amber ALR -All Red CL - Cycle Length OF - Offset VP - Vehicle Permissive NSWK - North/South Walk EWWK - East/West Walk NSG - North/South Green EWG - East/West Green NSFD - North/South Flashing Don't Walk EWFD - East/West Flashing Don't Walk TSP - Transit Priority APS - Audible Pedestrian Signal RLC - Red Light Camera
8. Northbound	WLK 7 FDW 17 MIN 15 EXT 3 MAX1 30 MAX2 0 AMB 4.5 ALR 3.0 SPLIT	0	Callable by stopbar loop and/or pushbutton; Extendable by stopbar loop.	
	CL OF VP	0 (FREE) 0 (FREE) 0 (FREE)		

NOTES:



AADT Midblocks Report

Description	2013	2015	2017	2023
Bloomington Road btwn Highway 48 & Thornbay Drive	16752	16865	18116	22011

Appendix B – Existing Traffic Capacity Analysis Results

HCM Unsignalized Intersection Capacity Analysis

1: Highway 48 & Bloomington Road

02/08/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Right Turn Channelized												
Traffic Volume (veh/h)	24	341	71	75	513	51	94	152	51	36	336	110
Future Volume (veh/h)	24	341	71	75	513	51	94	152	51	36	336	110
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	24	348	72	77	523	52	96	155	52	37	343	112
Approach Volume (veh/h)	444			652			303			492		
Crossing Volume (veh/h)	457			275			409			696		
High Capacity (veh/h)	966			1116			1004			797		
High v/c (veh/h)	0.46			0.58			0.30			0.62		
Low Capacity (veh/h)	783			918			817			634		
Low v/c (veh/h)	0.57			0.71			0.37			0.78		
Intersection Summary												
Maximum v/c High	0.62											
Maximum v/c Low	0.78											
Intersection Capacity Utilization	66.1%			ICU Level of Service					C			

HCM 2010 Roundabout
1: Highway 48 & Bloomington Road

02/08/2024

Intersection									
Intersection Delay, s/veh	11.1								
Intersection LOS	B								
Approach	EB		WB		NB		SB		
Entry Lanes	2		2		2		2		
Conflicting Circle Lanes	2		2		2		2		
Adj Approach Flow, veh/h	444		652		303		492		
Demand Flow Rate, veh/h	587		815		331		516		
Vehicles Circulating, veh/h	483		300		553		857		
Vehicles Exiting, veh/h	890		584		517		258		
Follow-Up Headway, s	3.186		3.186		3.186		3.186		
Ped Vol Crossing Leg, #/h	0		0		0		0		
Ped Cap Adj	1.000		1.000		1.000		1.000		
Approach Delay, s/veh	11.3		11.2		7.7		12.9		
Approach LOS	B		B		A		B		
Lane	Left	Right	Left	Right	Left	Right	Left	Right	
Designated Moves	LT	TR	LT	TR	LT	TR	LT	TR	
Assumed Moves	LT	TR	LT	TR	LT	TR	LT	TR	
RT Channelized									
Lane Util	0.470	0.530	0.470	0.530	0.471	0.529	0.471	0.529	
Critical Headway, s	4.293	4.113	4.293	4.113	4.293	4.113	4.293	4.113	
Entry Flow, veh/h	276	311	383	432	156	175	243	273	
Cap Entry Lane, veh/h	787	806	902	916	746	767	594	620	
Entry HV Adj Factor	0.756	0.757	0.800	0.800	0.913	0.918	0.951	0.955	
Flow Entry, veh/h	209	235	307	346	142	161	231	261	
Cap Entry, veh/h	595	610	722	733	681	704	565	592	
V/C Ratio	0.351	0.386	0.424	0.472	0.209	0.228	0.409	0.440	
Control Delay, s/veh	11.0	11.5	10.7	11.6	7.7	7.8	12.7	13.0	
LOS	B	B	B	B	A	A	B	B	
95th %tile Queue, veh	2	2	2	3	1	1	2	2	

Timings

2: Ninth Line & Bloomington Road

02/08/2024



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	93	436	50	120	543	22	58	49	23	119
Future Volume (vph)	93	436	50	120	543	22	58	49	23	119
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	NA
Protected Phases	1	6			2			8		4
Permitted Phases	6		6	2		2	8		4	
Detector Phase	1	6	6	2	2	2	8	8	4	4
Switch Phase										
Minimum Initial (s)	7.0	50.0	50.0	50.0	50.0	50.0	15.0	15.0	15.0	15.0
Minimum Split (s)	11.5	57.5	57.5	57.5	57.5	57.5	31.5	31.5	32.5	32.5
Total Split (s)	24.0	57.5	57.5	57.5	57.5	57.5	37.5	37.5	37.5	37.5
Total Split (%)	20.2%	48.3%	48.3%	48.3%	48.3%	48.3%	31.5%	31.5%	31.5%	31.5%
Yellow Time (s)	3.0	5.0	5.0	5.0	5.0	5.0	4.5	4.5	4.5	4.5
All-Red Time (s)	1.0	2.5	2.5	2.5	2.5	2.5	3.0	3.0	4.0	4.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	8.5	8.5
Lead/Lag	Lead			Lag	Lag	Lag				
Lead-Lag Optimize?	Yes			Yes	Yes	Yes				
Recall Mode	None	Max	Max	Max	Max	Max	None	None	None	None
Act Effect Green (s)	65.2	61.7	61.7	50.7	50.7	50.7	21.3	21.3	20.3	20.3
Actuated g/C Ratio	0.66	0.63	0.63	0.52	0.52	0.52	0.22	0.22	0.21	0.21
v/c Ratio	0.36	0.53	0.05	0.27	0.76	0.05	0.30	0.28	0.15	0.73
Control Delay	10.9	13.5	2.6	18.4	29.9	0.2	37.6	22.2	35.1	46.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	10.9	13.5	2.6	18.4	29.9	0.2	37.6	22.2	35.1	46.6
LOS	B	B	A	B	C	A	D	C	D	D
Approach Delay		12.2			26.9			27.8		45.5
Approach LOS		B			C			C		D

Intersection Summary

Cycle Length: 119

Actuated Cycle Length: 98.2

Natural Cycle: 105

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.76

Intersection Signal Delay: 24.5

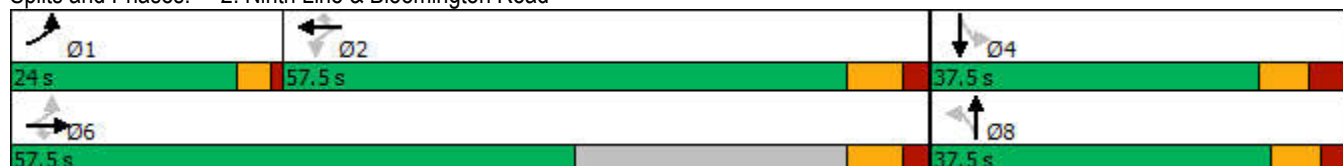
Intersection LOS: C

Intersection Capacity Utilization 134.2%

ICU Level of Service H

Analysis Period (min) 15

Splits and Phases: 2: Ninth Line & Bloomington Road



Queues

2: Ninth Line & Bloomington Road

02/08/2024



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	97	454	52	125	566	23	60	106	24	227
v/c Ratio	0.36	0.53	0.05	0.27	0.76	0.05	0.30	0.28	0.15	0.73
Control Delay	10.9	13.5	2.6	18.4	29.9	0.2	37.6	22.2	35.1	46.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	10.9	13.5	2.6	18.4	29.9	0.2	37.6	22.2	35.1	46.6
Queue Length 50th (m)	6.2	44.5	0.0	13.8	88.1	0.0	10.3	10.4	4.0	37.3
Queue Length 95th (m)	16.1	88.8	4.9	33.7	#187.7	0.0	23.3	26.0	11.7	67.3
Internal Link Dist (m)	654.8		639.7		1312.7		782.8			
Turn Bay Length (m)	90.0		38.0	164.0		27.0	74.0		72.0	
Base Capacity (vph)	341	1051	1153	471	748	502	288	524	237	432
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	0.28	0.43	0.05	0.27	0.76	0.05	0.21	0.20	0.10	0.53

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

2: Ninth Line & Bloomington Road

02/08/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	93	436	50	120	543	22	58	49	53	23	119	99
Future Volume (vph)	93	436	50	120	543	22	58	49	53	23	119	99
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.98	1.00	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	1.00	0.85	1.00	0.92		1.00	0.93	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	976	1377	1495	1734	1450	892	1656	1595		1094	1369	
Flt Permitted	0.30	1.00	1.00	0.50	1.00	1.00	0.53	1.00		0.69	1.00	
Satd. Flow (perm)	306	1377	1495	914	1450	892	932	1595		793	1369	
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)	97	454	52	125	566	23	60	51	55	24	124	103
RTOR Reduction (vph)	0	0	19	0	0	11	0	35	0	0	26	0
Lane Group Flow (vph)	97	454	33	125	566	12	60	71	0	24	201	0
Confl. Peds. (#/hr)				1		1						
Heavy Vehicles (%)	85%	38%	8%	4%	31%	77%	9%	14%	6%	65%	3%	61%
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	1	6			2			8			4	
Permitted Phases	6		6	2		2	8			4		
Actuated Green, G (s)	62.5	62.5	62.5	50.6	50.6	50.6	21.3	21.3		20.3	20.3	
Effective Green, g (s)	62.5	62.5	62.5	50.6	50.6	50.6	21.3	21.3		20.3	20.3	
Actuated g/C Ratio	0.63	0.63	0.63	0.51	0.51	0.51	0.22	0.22		0.21	0.21	
Clearance Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
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)	247	871	945	468	742	456	200	343		162	281	
v/s Ratio Prot	0.03	c0.33			c0.39			0.04			c0.15	
v/s Ratio Perm	0.22		0.02	0.14		0.01	0.06			0.03		
v/c Ratio	0.39	0.52	0.03	0.27	0.76	0.03	0.30	0.21		0.15	0.71	
Uniform Delay, d1	9.6	9.9	6.8	13.6	19.3	11.9	32.5	31.8		32.2	36.6	
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	1.0	2.2	0.1	1.4	7.3	0.1	0.8	0.3		0.4	8.3	
Delay (s)	10.7	12.2	6.9	15.0	26.6	12.0	33.3	32.1		32.6	44.9	
Level of Service	B	B	A	B	C	B	C	C		C	D	
Approach Delay (s)		11.5			24.1			32.6			43.7	
Approach LOS		B			C			C			D	
Intersection Summary												
HCM 2000 Control Delay			23.4									
HCM 2000 Volume to Capacity ratio			0.74									
Actuated Cycle Length (s)			98.8									
Intersection Capacity Utilization			134.2%									
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

3: Site Access & Bloomington Road

02/08/2024

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	428	0	0	700	0	0
Future Volume (Veh/h)	428	0	0	700	0	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)	465	0	0	761	0	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			465		1226	465
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			465		1226	465
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		100	100
cM capacity (veh/h)			1107		199	602
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	465	761	0			
Volume Left	0	0	0			
Volume Right	0	0	0			
cSH	1700	1107	1700			
Volume to Capacity	0.27	0.00	0.00			
Queue Length 95th (m)	0.0	0.0	0.0			
Control Delay (s)	0.0	0.0	0.0			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	0.0			
Approach LOS			A			
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization			40.2%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

1: Highway 48 & Bloomington Road

02/08/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Right Turn Channelized												
Traffic Volume (veh/h)	79	533	97	48	358	52	68	319	91	52	212	33
Future Volume (veh/h)	79	533	97	48	358	52	68	319	91	52	212	33
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	81	549	100	49	369	54	70	329	94	54	219	34
Approach Volume (veh/h)	730			472			493			307		
Crossing Volume (veh/h)	322			480			684			488		
High Capacity (veh/h)	1075			948			805			942		
High v/c (veh/h)	0.68			0.50			0.61			0.33		
Low Capacity (veh/h)	881			768			641			762		
Low v/c (veh/h)	0.83			0.61			0.77			0.40		
Intersection Summary												
Maximum v/c High	0.68											
Maximum v/c Low	0.83											
Intersection Capacity Utilization	68.5%			ICU Level of Service					C			

HCM 2010 Roundabout

1: Highway 48 & Bloomington Road

02/08/2024

Intersection									
Intersection Delay, s/veh	9.5								
Intersection LOS	A								
Approach	EB		WB		NB		SB		
Entry Lanes	2		2		2		2		
Conflicting Circle Lanes	2		2		2		2		
Adj Approach Flow, veh/h	730		472		493		307		
Demand Flow Rate, veh/h	791		514		497		321		
Vehicles Circulating, veh/h	333		489		742		530		
Vehicles Exiting, veh/h	518		750		382		473		
Follow-Up Headway, s	3.186		3.186		3.186		3.186		
Ped Vol Crossing Leg, #/h	0		0		0		0		
Ped Cap Adj	1.000		1.000		1.000		1.000		
Approach Delay, s/veh	10.1		8.9		10.7		7.2		
Approach LOS	B		A		B		A		
Lane	Left	Right	Left	Right	Left	Right	Left	Right	
Designated Moves	LT	TR	LT	TR	LT	TR	LT	TR	
Assumed Moves	LT	TR	LT	TR	LT	TR	LT	TR	
RT Channelized									
Lane Util	0.470	0.530	0.471	0.529	0.471	0.529	0.470	0.530	
Critical Headway, s	4.293	4.113	4.293	4.113	4.293	4.113	4.293	4.113	
Entry Flow, veh/h	372	419	242	272	234	263	151	170	
Cap Entry Lane, veh/h	880	895	783	802	648	672	759	780	
Entry HV Adj Factor	0.922	0.923	0.917	0.920	0.990	0.993	0.957	0.958	
Flow Entry, veh/h	343	387	222	250	232	261	144	163	
Cap Entry, veh/h	811	826	718	739	641	667	727	747	
V/C Ratio	0.423	0.468	0.309	0.339	0.361	0.391	0.199	0.218	
Control Delay, s/veh	9.8	10.5	8.8	9.0	10.6	10.8	7.2	7.2	
LOS	A	B	A	A	B	B	A	A	
95th %tile Queue, veh	2	3	1	2	2	2	1	1	

Timings

2: Ninth Line & Bloomington Road

02/08/2024

										
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	55	611	57	80	425	18	54	139	19	71
Future Volume (vph)	55	611	57	80	425	18	54	139	19	71
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	NA
Protected Phases	1	6			2			8		4
Permitted Phases	6		6	2		2	8		4	
Detector Phase	1	6	6	2	2	2	8	8	4	4
Switch Phase										
Minimum Initial (s)	7.0	50.0	50.0	50.0	50.0	50.0	15.0	15.0	15.0	15.0
Minimum Split (s)	11.5	57.5	57.5	57.5	57.5	57.5	31.5	31.5	32.5	32.5
Total Split (s)	24.0	57.5	57.5	57.5	57.5	57.5	37.5	37.5	37.5	37.5
Total Split (%)	20.2%	48.3%	48.3%	48.3%	48.3%	48.3%	31.5%	31.5%	31.5%	31.5%
Yellow Time (s)	3.0	5.0	5.0	5.0	5.0	5.0	4.5	4.5	4.5	4.5
All-Red Time (s)	1.0	2.5	2.5	2.5	2.5	2.5	3.0	3.0	4.0	4.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	8.5	8.5
Lead/Lag	Lead			Lag	Lag	Lag				
Lead-Lag Optimize?	Yes			Yes	Yes	Yes				
Recall Mode	None	Max	Max	Max	Max	Max	None	None	None	None
Act Effect Green (s)	63.1	59.6	59.6	50.5	50.5	50.5	22.8	22.8	21.7	21.7
Actuated g/C Ratio	0.65	0.61	0.61	0.52	0.52	0.52	0.23	0.23	0.22	0.22
v/c Ratio	0.16	0.68	0.07	0.29	0.60	0.03	0.22	0.79	0.20	0.45
Control Delay	8.2	17.4	4.0	19.4	22.4	0.1	32.9	45.2	36.3	30.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.2	17.4	4.0	19.4	22.4	0.1	32.9	45.2	36.3	30.6
LOS	A	B	A	B	C	A	C	D	D	C
Approach Delay		15.6			21.2			43.2		31.3
Approach LOS		B			C			D		C

Intersection Summary

Cycle Length: 119

Actuated Cycle Length: 97.5

Natural Cycle: 105

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.79

Intersection Signal Delay: 24.1

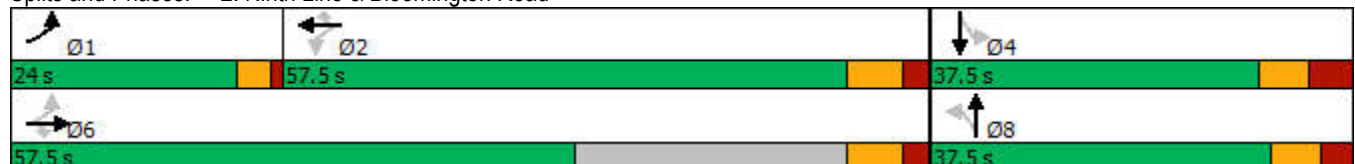
Intersection LOS: C

Intersection Capacity Utilization 115.4%

ICU Level of Service H

Analysis Period (min) 15

Splits and Phases: 2: Ninth Line & Bloomington Road



Queues

2: Ninth Line & Bloomington Road

02/08/2024



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	65	719	67	94	500	21	64	340	22	149
v/c Ratio	0.16	0.68	0.07	0.29	0.60	0.03	0.22	0.79	0.20	0.45
Control Delay	8.2	17.4	4.0	19.4	22.4	0.1	32.9	45.2	36.3	30.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.2	17.4	4.0	19.4	22.4	0.1	32.9	45.2	36.3	30.6
Queue Length 50th (m)	4.3	86.9	1.2	10.6	69.5	0.0	10.6	57.2	3.7	20.5
Queue Length 95th (m)	10.3	136.5	6.7	24.5	112.5	0.0	21.2	84.6	10.5	37.2
Internal Link Dist (m)	654.8				639.7		1312.7		782.8	
Turn Bay Length (m)	90.0			38.0	164.0			27.0	74.0	72.0
Base Capacity (vph)	537	1336	1168	324	833	689	383	557	147	437
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	0.12	0.54	0.06	0.29	0.60	0.03	0.17	0.61	0.15	0.34
Intersection Summary										

HCM Signalized Intersection Capacity Analysis

2: Ninth Line & Bloomington Road

02/08/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	55	611	57	80	425	18	54	139	150	19	71	55
Future Volume (vph)	55	611	57	80	425	18	54	139	150	19	71	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	0.99	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	0.92		1.00	0.93	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1456	1743	1509	1794	1610	1258	1770	1701		1556	1383	
Flt Permitted	0.35	1.00	1.00	0.33	1.00	1.00	0.66	1.00		0.30	1.00	
Satd. Flow (perm)	535	1743	1509	628	1610	1258	1234	1701		490	1383	
Peak-hour factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Adj. Flow (vph)	65	719	67	94	500	21	64	164	176	22	84	65
RTOR Reduction (vph)	0	0	19	0	0	10	0	33	0	0	24	0
Lane Group Flow (vph)	65	719	48	94	500	11	64	307	0	22	125	0
Confl. Peds. (#/hr)				10		16						
Heavy Vehicles (%)	24%	9%	7%	0%	18%	22%	2%	2%	4%	16%	7%	56%
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	1	6			2			8			4	
Permitted Phases	6		6	2		2	8			4		
Actuated Green, G (s)	60.5	60.5	60.5	50.5	50.5	50.5	22.8	22.8		21.8	21.8	
Effective Green, g (s)	60.5	60.5	60.5	50.5	50.5	50.5	22.8	22.8		21.8	21.8	
Actuated g/C Ratio	0.62	0.62	0.62	0.51	0.51	0.51	0.23	0.23		0.22	0.22	
Clearance Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
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)	385	1072	928	322	827	646	286	394		108	306	
v/s Ratio Prot	0.01	c0.41			0.31			c0.18			0.09	
v/s Ratio Perm	0.09		0.03	0.15		0.01	0.05			0.04		
v/c Ratio	0.17	0.67	0.05	0.29	0.60	0.02	0.22	0.78		0.20	0.41	
Uniform Delay, d1	8.8	12.4	7.5	13.7	16.9	11.7	30.6	35.4		31.2	32.7	
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	0.2	3.3	0.1	2.3	3.3	0.0	0.4	9.4		0.9	0.9	
Delay (s)	9.1	15.7	7.6	16.0	20.1	11.8	31.0	44.8		32.1	33.6	
Level of Service	A	B	A	B	C	B	C	D		C	C	
Approach Delay (s)		14.6			19.2			42.6			33.4	
Approach LOS		B			B			D			C	
Intersection Summary												
HCM 2000 Control Delay			23.1									C
HCM 2000 Volume to Capacity ratio			0.74									
Actuated Cycle Length (s)			98.3							20.0		
Intersection Capacity Utilization			115.4%									H
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

3: Site Access & Bloomington Road

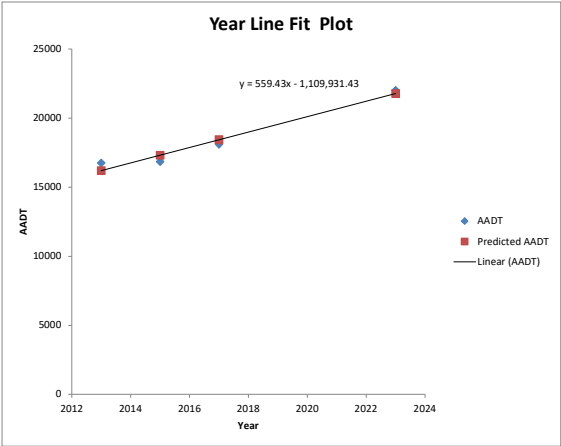
02/08/2024

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	676	0	0	534	0	0
Future Volume (Veh/h)	676	0	0	534	0	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)	735	0	0	580	0	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			735		1315	735
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			735		1315	735
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		100	100
cM capacity (veh/h)			879		176	423
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	735	580	0			
Volume Left	0	0	0			
Volume Right	0	0	0			
cSH	1700	879	1700			
Volume to Capacity	0.43	0.00	0.00			
Queue Length 95th (m)	0.0	0.0	0.0			
Control Delay (s)	0.0	0.0	0.0			
Lane LOS						
Approach Delay (s)	0.0	0.0	0.0			
Approach LOS						
Intersection Summary						
Average Delay						
			0.0			
Intersection Capacity Utilization			38.9%	ICU Level of Service		A
Analysis Period (min)			15			

Appendix C – AADT Analysis

Year	AADT	SUMMARY OUTPUT							
2013	16752								
2015	16865	<u>Regression Statistics</u>							
2017	18116	Multiple R 0.981655							
2023	22011	R Square 0.963647							
		Adjusted R 0.945471							
2024	22355	Standard E 574.9538							
		Observatio 4							
2029	25152								
		<u>ANOVA</u>							
			df	SS	MS	F	Significance F		
Regression			1	17525778	17525778	53.01655	0.018345		
Residual			2	661143.7	330571.9				
Total			3	18186922					
				Coefficient	Standard Err	t Stat	P-value	Lower 95%	Upper 95%
Intercept				-1109931	154969.3	-7.16227	0.018942	-1776710	-443153
Year				559.4286	76.83143	7.281246	0.018345	228.8496	890.0075

RESIDUAL OUTPUT			
<u>Observation</u>	<u>predicted AAI</u>	<u>Residuals</u>	
1	16198.29	553.7143	
2	17317.14	-452.143	
3	18436	-320	
4	21792.57	218.4286	



Appendix D – Capacity Analysis – Future Background 2029

HCM Unsignalized Intersection Capacity Analysis

1: Highway 48 & Bloomington Road

02/09/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Right Turn Channelized												
Traffic Volume (veh/h)	24	373	71	75	566	51	94	168	51	36	371	110
Future Volume (veh/h)	24	373	71	75	566	51	94	168	51	36	371	110
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	24	381	72	77	578	52	96	171	52	37	379	112
Approach Volume (veh/h)	477				707			319			528	
Crossing Volume (veh/h)	493				291			442			751	
High Capacity (veh/h)	939				1102			978			763	
High v/c (veh/h)	0.51				0.64			0.33			0.69	
Low Capacity (veh/h)	759				905			794			604	
Low v/c (veh/h)	0.63				0.78			0.40			0.87	
Intersection Summary												
Maximum v/c High	0.69											
Maximum v/c Low	0.87											
Intersection Capacity Utilization	69.9%				ICU Level of Service				C			

HCM 2010 Roundabout
1: Highway 48 & Bloomington Road

02/09/2024

Intersection									
Intersection Delay, s/veh	12.4								
Intersection LOS	B								
Approach	EB		WB		NB		SB		
Entry Lanes	2		2		2		2		
Conflicting Circle Lanes	2		2		2		2		
Adj Approach Flow, veh/h	477		707		319		528		
Demand Flow Rate, veh/h	633		886		349		554		
Vehicles Circulating, veh/h	521		318		599		928		
Vehicles Exiting, veh/h	961		630		555		276		
Follow-Up Headway, s	3.186		3.186		3.186		3.186		
Ped Vol Crossing Leg, #/h	0		0		0		0		
Ped Cap Adj	1.000		1.000		1.000		1.000		
Approach Delay, s/veh	12.4		12.3		8.2		14.9		
Approach LOS	B		B		A		B		
Lane	Left	Right	Left	Right	Left	Right	Left	Right	
Designated Moves	LT	TR	LT	TR	LT	TR	LT	TR	
Assumed Moves	LT	TR	LT	TR	LT	TR	LT	TR	
RT Channelized									
Lane Util	0.471	0.529	0.470	0.530	0.470	0.530	0.469	0.531	
Critical Headway, s	4.293	4.113	4.293	4.113	4.293	4.113	4.293	4.113	
Entry Flow, veh/h	298	335	416	470	164	185	260	294	
Cap Entry Lane, veh/h	764	785	890	904	721	743	563	590	
Entry HV Adj Factor	0.753	0.755	0.799	0.798	0.915	0.914	0.955	0.952	
Flow Entry, veh/h	224	253	332	375	150	169	248	280	
Cap Entry, veh/h	575	592	711	721	660	679	538	562	
V/C Ratio	0.390	0.427	0.467	0.520	0.227	0.249	0.462	0.498	
Control Delay, s/veh	12.1	12.7	11.8	12.9	8.2	8.3	14.6	15.1	
LOS	B	B	B	B	A	A	B	C	
95th %tile Queue, veh	2	2	2	3	1	1	2	3	

Timings

2: Ninth Line & Bloomington Road

02/09/2024

										
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	93	480	50	120	600	22	58	54	23	131
Future Volume (vph)	93	480	50	120	600	22	58	54	23	131
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	NA
Protected Phases	1	6			2			8		4
Permitted Phases	6		6	2		2	8		4	
Detector Phase	1	6	6	2	2	2	8	8	4	4
Switch Phase										
Minimum Initial (s)	7.0	50.0	50.0	50.0	50.0	50.0	15.0	15.0	15.0	15.0
Minimum Split (s)	11.5	57.5	57.5	57.5	57.5	57.5	31.5	31.5	32.5	32.5
Total Split (s)	24.0	57.5	57.5	57.5	57.5	57.5	37.5	37.5	37.5	37.5
Total Split (%)	20.2%	48.3%	48.3%	48.3%	48.3%	48.3%	31.5%	31.5%	31.5%	31.5%
Yellow Time (s)	3.0	5.0	5.0	5.0	5.0	5.0	4.5	4.5	4.5	4.5
All-Red Time (s)	1.0	2.5	2.5	2.5	2.5	2.5	3.0	3.0	4.0	4.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	8.5	8.5
Lead/Lag	Lead			Lag	Lag	Lag				
Lead-Lag Optimize?	Yes			Yes	Yes	Yes				
Recall Mode	None	Max	Max	Max	Max	Max	None	None	None	None
Act Effect Green (s)	65.3	61.7	61.7	50.6	50.6	50.6	21.9	21.9	20.9	20.9
Actuated g/C Ratio	0.66	0.62	0.62	0.51	0.51	0.51	0.22	0.22	0.21	0.21
v/c Ratio	0.40	0.58	0.05	0.28	0.84	0.05	0.30	0.29	0.14	0.76
Control Delay	12.3	15.1	2.8	19.0	35.9	0.2	37.8	23.7	34.9	48.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.3	15.1	2.8	19.0	35.9	0.2	37.8	23.7	34.9	48.4
LOS	B	B	A	B	D	A	D	C	C	D
Approach Delay		13.7			32.1			28.6		47.2
Approach LOS		B			C			C		D

Intersection Summary

Cycle Length: 119

Actuated Cycle Length: 98.8

Natural Cycle: 105

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.84

Intersection Signal Delay: 27.5

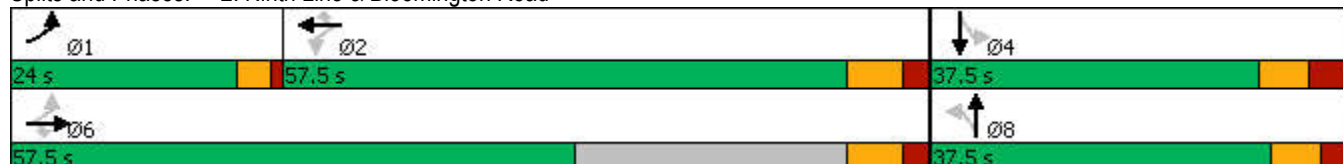
Intersection LOS: C

Intersection Capacity Utilization 134.6%

ICU Level of Service H

Analysis Period (min) 15

Splits and Phases: 2: Ninth Line & Bloomington Road



Queues

2: Ninth Line & Bloomington Road

02/09/2024



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	97	500	52	125	625	23	60	111	24	239
v/c Ratio	0.40	0.58	0.05	0.28	0.84	0.05	0.30	0.29	0.14	0.76
Control Delay	12.3	15.1	2.8	19.0	35.9	0.2	37.8	23.7	34.9	48.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.3	15.1	2.8	19.0	35.9	0.2	37.8	23.7	34.9	48.4
Queue Length 50th (m)	6.5	53.3	0.2	14.2	107.0	0.0	10.3	12.0	4.0	40.7
Queue Length 95th (m)	16.1	102.9	5.1	34.1	#218.2	0.0	23.5	28.1	11.7	72.2
Internal Link Dist (m)	654.8				639.7		1312.7		782.8	
Turn Bay Length (m)	90.0			38.0	164.0			27.0	74.0	72.0
Base Capacity (vph)	317	1044	1145	448	743	499	274	519	234	433
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	0.31	0.48	0.05	0.28	0.84	0.05	0.22	0.21	0.10	0.55

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

2: Ninth Line & Bloomington Road

02/09/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	93	480	50	120	600	22	58	54	53	23	131	99
Future Volume (vph)	93	480	50	120	600	22	58	54	53	23	131	99
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.98	1.00	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	1.00	0.85	1.00	0.93		1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	976	1377	1495	1734	1450	892	1656	1598		1094	1388	
Flt Permitted	0.25	1.00	1.00	0.48	1.00	1.00	0.51	1.00		0.69	1.00	
Satd. Flow (perm)	258	1377	1495	876	1450	892	892	1598		789	1388	
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)	97	500	52	125	625	23	60	56	55	24	136	103
RTOR Reduction (vph)	0	0	19	0	0	11	0	31	0	0	24	0
Lane Group Flow (vph)	97	500	33	125	625	12	60	80	0	24	215	0
Confl. Peds. (#/hr)				1		1						
Heavy Vehicles (%)	85%	38%	8%	4%	31%	77%	9%	14%	6%	65%	3%	61%
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	1	6			2			8			4	
Permitted Phases	6		6	2		2	8			4		
Actuated Green, G (s)	62.6	62.6	62.6	50.6	50.6	50.6	21.9	21.9		20.9	20.9	
Effective Green, g (s)	62.6	62.6	62.6	50.6	50.6	50.6	21.9	21.9		20.9	20.9	
Actuated g/C Ratio	0.63	0.63	0.63	0.51	0.51	0.51	0.22	0.22		0.21	0.21	
Clearance Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
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)	220	866	940	445	737	453	196	351		165	291	
v/s Ratio Prot	0.04	c0.36			c0.43			0.05			c0.16	
v/s Ratio Perm	0.24		0.02	0.14		0.01	0.07			0.03		
v/c Ratio	0.44	0.58	0.04	0.28	0.85	0.03	0.31	0.23		0.15	0.74	
Uniform Delay, d1	10.9	10.7	7.0	14.0	21.1	12.2	32.4	31.9		32.0	36.8	
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	1.4	2.8	0.1	1.6	11.6	0.1	0.9	0.3		0.4	9.5	
Delay (s)	12.3	13.5	7.1	15.6	32.8	12.3	33.3	32.2		32.4	46.2	
Level of Service	B	B	A	B	C	B	C	C		C	D	
Approach Delay (s)		12.8			29.4			32.6			45.0	
Approach LOS		B			C			C			D	
Intersection Summary												
HCM 2000 Control Delay			26.1				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.80									
Actuated Cycle Length (s)			99.5				Sum of lost time (s)			20.0		
Intersection Capacity Utilization			134.6%				ICU Level of Service			H		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

3: Site Access & Bloomington Road

02/09/2024

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	471	0	0	777	0	0
Future Volume (Veh/h)	471	0	0	777	0	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)	512	0	0	845	0	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			512	1357		512
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			512	1357		512
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	100		100
cM capacity (veh/h)			1064	166		566
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	512	845	0			
Volume Left	0	0	0			
Volume Right	0	0	0			
cSH	1700	1064	1700			
Volume to Capacity	0.30	0.00	0.00			
Queue Length 95th (m)	0.0	0.0	0.0			
Control Delay (s)	0.0	0.0	0.0			
Lane LOS						
Approach Delay (s)	0.0	0.0	0.0			
Approach LOS						
Intersection Summary						
Average Delay						
			0.0			
Intersection Capacity Utilization			44.2%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

1: Highway 48 & Bloomington Road

02/09/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Right Turn Channelized												
Traffic Volume (veh/h)	79	598	97	48	401	52	68	352	91	52	234	33
Future Volume (veh/h)	79	598	97	48	401	52	68	352	91	52	234	33
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	81	616	100	49	413	54	70	363	94	54	241	34
Approach Volume (veh/h)	797			516			527			329		
Crossing Volume (veh/h)	344			514			751			532		
High Capacity (veh/h)	1057			923			763			910		
High v/c (veh/h)	0.75			0.56			0.69			0.36		
Low Capacity (veh/h)	865			745			604			734		
Low v/c (veh/h)	0.92			0.69			0.87			0.45		
Intersection Summary												
Maximum v/c High	0.75											
Maximum v/c Low	0.92											
Intersection Capacity Utilization	73.0%			ICU Level of Service					D			

HCM 2010 Roundabout

1: Highway 48 & Bloomington Road

02/09/2024

Intersection									
Intersection Delay, s/veh	10.6								
Intersection LOS	B								
Approach	EB		WB		NB		SB		
Entry Lanes	2		2		2		2		
Conflicting Circle Lanes	2		2		2		2		
Adj Approach Flow, veh/h	797		516		527		329		
Demand Flow Rate, veh/h	864		562		532		343		
Vehicles Circulating, veh/h	355		524		815		578		
Vehicles Exiting, veh/h	566		823		404		508		
Follow-Up Headway, s	3.186		3.186		3.186		3.186		
Ped Vol Crossing Leg, #/h	0		0		0		0		
Ped Cap Adj	1.000		1.000		1.000		1.000		
Approach Delay, s/veh	11.3		9.8		12.2		7.7		
Approach LOS	B		A		B		A		
Lane	Left	Right	Left	Right	Left	Right	Left	Right	
Designated Moves	LT	TR	LT	TR	LT	TR	LT	TR	
Assumed Moves	LT	TR	LT	TR	LT	TR	LT	TR	
RT Channelized									
Lane Util	0.470	0.530	0.470	0.530	0.470	0.530	0.469	0.531	
Critical Headway, s	4.293	4.113	4.293	4.113	4.293	4.113	4.293	4.113	
Entry Flow, veh/h	406	458	264	298	250	282	161	182	
Cap Entry Lane, veh/h	866	881	763	783	613	639	732	754	
Entry HV Adj Factor	0.922	0.922	0.918	0.917	0.991	0.991	0.960	0.957	
Flow Entry, veh/h	374	422	242	273	248	280	155	174	
Cap Entry, veh/h	798	812	700	718	608	633	703	722	
V/C Ratio	0.469	0.520	0.346	0.381	0.408	0.442	0.220	0.241	
Control Delay, s/veh	10.8	11.7	9.6	10.0	12.0	12.3	7.7	7.8	
LOS	B	B	A	A	B	B	A	A	
95th %tile Queue, veh	3	3	2	2	2	2	1	1	

Timings

2: Ninth Line & Bloomington Road

02/09/2024



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	55	685	57	80	476	18	54	153	19	78
Future Volume (vph)	55	685	57	80	476	18	54	153	19	78
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	NA
Protected Phases	1	6			2			8		4
Permitted Phases	6		6	2		2	8		4	
Detector Phase	1	6	6	2	2	2	8	8	4	4
Switch Phase										
Minimum Initial (s)	7.0	50.0	50.0	50.0	50.0	50.0	15.0	15.0	15.0	15.0
Minimum Split (s)	11.5	57.5	57.5	57.5	57.5	57.5	31.5	31.5	32.5	32.5
Total Split (s)	24.0	57.5	57.5	57.5	57.5	57.5	37.5	37.5	37.5	37.5
Total Split (%)	20.2%	48.3%	48.3%	48.3%	48.3%	48.3%	31.5%	31.5%	31.5%	31.5%
Yellow Time (s)	3.0	5.0	5.0	5.0	5.0	5.0	4.5	4.5	4.5	4.5
All-Red Time (s)	1.0	2.5	2.5	2.5	2.5	2.5	3.0	3.0	4.0	4.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	8.5	8.5
Lead/Lag	Lead			Lag	Lag	Lag				
Lead-Lag Optimize?	Yes			Yes	Yes	Yes				
Recall Mode	None	Max	Max	Max	Max	Max	None	None	None	None
Act Effect Green (s)	63.2	59.6	59.6	50.5	50.5	50.5	23.7	23.7	22.7	22.7
Actuated g/C Ratio	0.64	0.61	0.61	0.51	0.51	0.51	0.24	0.24	0.23	0.23
v/c Ratio	0.17	0.76	0.07	0.37	0.68	0.03	0.22	0.81	0.21	0.46
Control Delay	8.8	21.3	4.1	23.2	25.4	0.1	32.5	46.5	36.5	31.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.8	21.3	4.1	23.2	25.4	0.1	32.5	46.5	36.5	31.5
LOS	A	C	A	C	C	A	C	D	D	C
Approach Delay		19.2			24.3			44.3		32.1
Approach LOS		B			C			D		C

Intersection Summary

Cycle Length: 119

Actuated Cycle Length: 98.5

Natural Cycle: 105

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.81

Intersection Signal Delay: 26.6

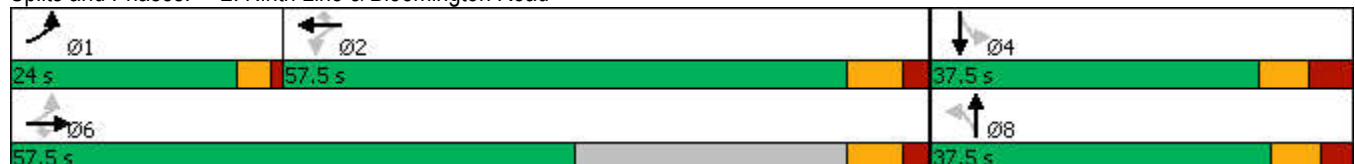
Intersection LOS: C

Intersection Capacity Utilization 115.8%

ICU Level of Service H

Analysis Period (min) 15

Splits and Phases: 2: Ninth Line & Bloomington Road



Queues

2: Ninth Line & Bloomington Road

02/09/2024



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	65	806	67	94	560	21	64	356	22	157
v/c Ratio	0.17	0.76	0.07	0.37	0.68	0.03	0.22	0.81	0.21	0.46
Control Delay	8.8	21.3	4.1	23.2	25.4	0.1	32.5	46.5	36.5	31.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.8	21.3	4.1	23.2	25.4	0.1	32.5	46.5	36.5	31.5
Queue Length 50th (m)	4.5	111.7	1.3	11.6	85.4	0.0	10.6	61.7	3.7	22.6
Queue Length 95th (m)	10.3	166.9	6.7	27.0	132.2	0.0	21.2	90.1	10.6	40.0
Internal Link Dist (m)	654.8				639.7		1312.7		782.8	
Turn Bay Length (m)	90.0			38.0	164.0			27.0	74.0	72.0
Base Capacity (vph)	499	1323	1157	253	825	683	376	553	136	436
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	0.13	0.61	0.06	0.37	0.68	0.03	0.17	0.64	0.16	0.36

Intersection Summary

HCM Signalized Intersection Capacity Analysis

2: Ninth Line & Bloomington Road

02/09/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	55	685	57	80	476	18	54	153	150	19	78	55
Future Volume (vph)	55	685	57	80	476	18	54	153	150	19	78	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.95	1.00	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	1.00	0.85	1.00	0.93		1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1456	1743	1509	1797	1610	1258	1770	1708		1556	1400	
Flt Permitted	0.30	1.00	1.00	0.26	1.00	1.00	0.66	1.00		0.28	1.00	
Satd. Flow (perm)	460	1743	1509	496	1610	1258	1225	1708		458	1400	
Peak-hour factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Adj. Flow (vph)	65	806	67	94	560	21	64	180	176	22	92	65
RTOR Reduction (vph)	0	0	20	0	0	10	0	30	0	0	22	0
Lane Group Flow (vph)	65	806	47	94	560	11	64	326	0	22	135	0
Confl. Peds. (#/hr)				10		16						
Heavy Vehicles (%)	24%	9%	7%	0%	18%	22%	2%	2%	4%	16%	7%	56%
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	1	6			2			8			4	
Permitted Phases	6		6	2		2	8			4		
Actuated Green, G (s)	60.5	60.5	60.5	50.5	50.5	50.5	23.7	23.7		22.7	22.7	
Effective Green, g (s)	60.5	60.5	60.5	50.5	50.5	50.5	23.7	23.7		22.7	22.7	
Actuated g/C Ratio	0.61	0.61	0.61	0.51	0.51	0.51	0.24	0.24		0.23	0.23	
Clearance Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
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)	340	1063	920	252	819	640	292	408		104	320	
v/s Ratio Prot	0.01	c0.46			0.35			c0.19			0.10	
v/s Ratio Perm	0.10		0.03	0.19		0.01	0.05			0.05		
v/c Ratio	0.19	0.76	0.05	0.37	0.68	0.02	0.22	0.80		0.21	0.42	
Uniform Delay, d1	9.8	14.0	7.8	14.8	18.3	12.1	30.3	35.5		31.0	32.7	
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	0.3	5.1	0.1	4.2	4.6	0.0	0.4	10.4		1.0	0.9	
Delay (s)	10.1	19.1	7.9	18.9	22.9	12.1	30.7	45.9		32.0	33.6	
Level of Service	B	B	A	B	C	B	C	D		C	C	
Approach Delay (s)		17.7			22.0			43.6			33.4	
Approach LOS		B			C			D			C	
Intersection Summary												
HCM 2000 Control Delay			25.2									
HCM 2000 Volume to Capacity ratio			0.82									
Actuated Cycle Length (s)			99.2									
Intersection Capacity Utilization			115.8%									
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

3: Site Access & Bloomington Road

02/09/2024

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	759	0	0	599	0	0
Future Volume (Veh/h)	759	0	0	599	0	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)	825	0	0	651	0	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			825			825
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			825			825
tC, single (s)			4.1			6.2
tC, 2 stage (s)						
tF (s)			2.2			3.3
p0 queue free %			100			100
cM capacity (veh/h)			814			376
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	825	651	0			
Volume Left	0	0	0			
Volume Right	0	0	0			
cSH	1700	814	1700			
Volume to Capacity	0.49	0.00	0.00			
Queue Length 95th (m)	0.0	0.0	0.0			
Control Delay (s)	0.0	0.0	0.0			
Lane LOS						
Approach Delay (s)	0.0	0.0	0.0			
Approach LOS						
Intersection Summary						
Average Delay						
			0.0			
Intersection Capacity Utilization			43.3%	ICU Level of Service		A
Analysis Period (min)			15			

Appendix E – Capacity Analysis – Future Background 2034

HCM Unsignalized Intersection Capacity Analysis

1: Highway 48 & Bloomington Road

02/14/2024

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Right Turn Channelized													
Traffic Volume (veh/h)	24	408	71	75	626	51	94	185	51	36	410	110	
Future Volume (veh/h)	24	408	71	75	626	51	94	185	51	36	410	110	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	
Hourly flow rate (vph)	24	416	72	77	639	52	96	189	52	37	418	112	
Approach Volume (veh/h)	512			768			337			567			
Crossing Volume (veh/h)	532			309			477			812			
High Capacity (veh/h)	910			1087			951			726			
High v/c (veh/h)	0.56			0.71			0.35			0.78			
Low Capacity (veh/h)	734			891			770			572			
Low v/c (veh/h)	0.70			0.86			0.44			0.99			
Intersection Summary													
Maximum v/c High	0.78												
Maximum v/c Low	0.99												
Intersection Capacity Utilization	74.0%			ICU Level of Service						D			

HCM 2010 Roundabout
1: Highway 48 & Bloomington Road

02/14/2024

Intersection									
Intersection Delay, s/veh	14.1								
Intersection LOS	B								
Approach	EB		WB		NB		SB		
Entry Lanes	2		2		2		2		
Conflicting Circle Lanes	2		2		2		2		
Adj Approach Flow, veh/h	512		768		337		567		
Demand Flow Rate, veh/h	681		964		369		595		
Vehicles Circulating, veh/h	562		338		647		1006		
Vehicles Exiting, veh/h	1039		678		596		296		
Follow-Up Headway, s	3.186		3.186		3.186		3.186		
Ped Vol Crossing Leg, #/h	0		0		0		0		
Ped Cap Adj	1.000		1.000		1.000		1.000		
Approach Delay, s/veh	13.8		13.9		8.8		17.7		
Approach LOS	B		B		A		C		
Lane	Left	Right	Left	Right	Left	Right	Left	Right	
Designated Moves	LT	TR	LT	TR	LT	TR	LT	TR	
Assumed Moves	LT	TR	LT	TR	LT	TR	LT	TR	
RT Channelized									
Lane Util	0.470	0.530	0.470	0.530	0.469	0.531	0.471	0.529	
Critical Headway, s	4.293	4.113	4.293	4.113	4.293	4.113	4.293	4.113	
Entry Flow, veh/h	320	361	453	511	173	196	280	315	
Cap Entry Lane, veh/h	741	762	877	892	696	718	531	559	
Entry HV Adj Factor	0.752	0.751	0.797	0.796	0.916	0.912	0.952	0.954	
Flow Entry, veh/h	241	271	361	407	158	179	267	301	
Cap Entry, veh/h	557	573	699	710	637	655	506	533	
V/C Ratio	0.432	0.473	0.517	0.573	0.249	0.273	0.527	0.564	
Control Delay, s/veh	13.4	14.2	13.1	14.5	8.8	8.9	17.4	17.9	
LOS	B	B	B	B	A	A	C	C	
95th %tile Queue, veh	2	3	3	4	1	1	3	3	

Timings

2: Ninth Line & Bloomington Road

02/14/2024

										
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	93	529	50	120	664	22	58	60	23	145
Future Volume (vph)	93	529	50	120	664	22	58	60	23	145
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	NA
Protected Phases	1	6			2			8		4
Permitted Phases	6		6	2		2	8		4	
Detector Phase	1	6	6	2	2	2	8	8	4	4
Switch Phase										
Minimum Initial (s)	7.0	50.0	50.0	50.0	50.0	50.0	15.0	15.0	15.0	15.0
Minimum Split (s)	11.5	57.5	57.5	57.5	57.5	57.5	31.5	31.5	32.5	32.5
Total Split (s)	24.0	57.5	57.5	57.5	57.5	57.5	37.5	37.5	37.5	37.5
Total Split (%)	20.2%	48.3%	48.3%	48.3%	48.3%	48.3%	31.5%	31.5%	31.5%	31.5%
Yellow Time (s)	3.0	5.0	5.0	5.0	5.0	5.0	4.5	4.5	4.5	4.5
All-Red Time (s)	1.0	2.5	2.5	2.5	2.5	2.5	3.0	3.0	4.0	4.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	8.5	8.5
Lead/Lag	Lead			Lag	Lag	Lag				
Lead-Lag Optimize?	Yes			Yes	Yes	Yes				
Recall Mode	None	Max	Max	Max	Max	Max	None	None	None	None
Act Effect Green (s)	65.4	61.8	61.8	50.7	50.7	50.7	22.7	22.7	21.6	21.6
Actuated g/C Ratio	0.66	0.62	0.62	0.51	0.51	0.51	0.23	0.23	0.22	0.22
v/c Ratio	0.46	0.65	0.05	0.29	0.94	0.05	0.31	0.30	0.14	0.78
Control Delay	14.8	17.2	2.9	19.8	48.3	0.2	38.1	25.4	34.7	50.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.8	17.2	2.9	19.8	48.3	0.2	38.1	25.4	34.7	50.4
LOS	B	B	A	B	D	A	D	C	C	D
Approach Delay		15.8			42.7			29.7		49.1
Approach LOS		B			D			C		D

Intersection Summary

Cycle Length: 119

Actuated Cycle Length: 99.7

Natural Cycle: 105

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.94

Intersection Signal Delay: 33.0

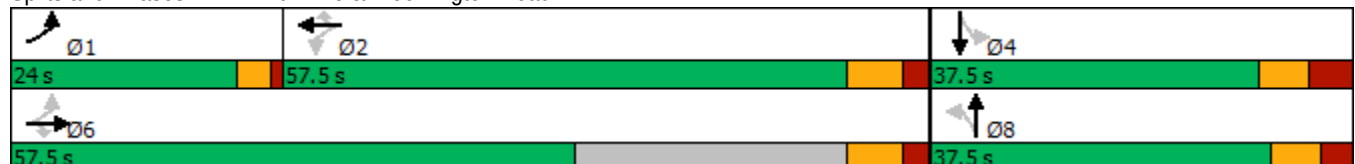
Intersection LOS: C

Intersection Capacity Utilization 135.3%

ICU Level of Service H

Analysis Period (min) 15

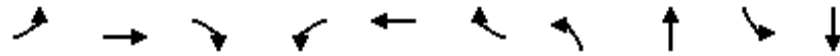
Splits and Phases: 2: Ninth Line & Bloomington Road



Queues

2: Ninth Line & Bloomington Road

02/14/2024



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	97	551	52	125	692	23	60	118	24	254
v/c Ratio	0.46	0.65	0.05	0.29	0.94	0.05	0.31	0.30	0.14	0.78
Control Delay	14.8	17.2	2.9	19.8	48.3	0.2	38.1	25.4	34.7	50.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.8	17.2	2.9	19.8	48.3	0.2	38.1	25.4	34.7	50.4
Queue Length 50th (m)	6.8	64.7	0.2	14.8	132.8	0.0	10.4	14.1	4.1	44.7
Queue Length 95th (m)	16.1	120.7	5.1	34.7	#252.6	0.0	23.7	31.1	11.7	77.6
Internal Link Dist (m)		654.8			639.7			1312.7		782.8
Turn Bay Length (m)	90.0		38.0	164.0		27.0	74.0		72.0	
Base Capacity (vph)	291	1036	1137	425	737	496	256	512	231	434
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	0.33	0.53	0.05	0.29	0.94	0.05	0.23	0.23	0.10	0.59

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

2: Ninth Line & Bloomington Road

02/14/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	93	529	50	120	664	22	58	60	53	23	145	99
Future Volume (vph)	93	529	50	120	664	22	58	60	53	23	145	99
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.98	1.00	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	1.00	0.85	1.00	0.93		1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	976	1377	1495	1734	1450	892	1656	1603		1094	1410	
Flt Permitted	0.20	1.00	1.00	0.46	1.00	1.00	0.48	1.00		0.68	1.00	
Satd. Flow (perm)	205	1377	1495	836	1450	892	843	1603		784	1410	
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)	97	551	52	125	692	23	60	62	55	24	151	103
RTOR Reduction (vph)	0	0	19	0	0	11	0	27	0	0	21	0
Lane Group Flow (vph)	97	551	33	125	692	12	60	91	0	24	233	0
Confl. Peds. (#/hr)				1		1						
Heavy Vehicles (%)	85%	38%	8%	4%	31%	77%	9%	14%	6%	65%	3%	61%
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	1	6			2			8			4	
Permitted Phases	6		6	2		2	8			4		
Actuated Green, G (s)	62.8	62.8	62.8	50.7	50.7	50.7	22.6	22.6		21.6	21.6	
Effective Green, g (s)	62.8	62.8	62.8	50.7	50.7	50.7	22.6	22.6		21.6	21.6	
Actuated g/C Ratio	0.63	0.63	0.63	0.50	0.50	0.50	0.23	0.23		0.22	0.22	
Clearance Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
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)	190	861	935	422	732	450	189	360		168	303	
v/s Ratio Prot	0.04	c0.40			c0.48			0.06			c0.17	
v/s Ratio Perm	0.28		0.02	0.15		0.01	0.07			0.03		
v/c Ratio	0.51	0.64	0.04	0.30	0.95	0.03	0.32	0.25		0.14	0.77	
Uniform Delay, d1	12.8	11.7	7.2	14.5	23.5	12.5	32.5	32.0		31.9	37.0	
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	2.3	3.6	0.1	1.8	22.3	0.1	1.0	0.4		0.4	11.1	
Delay (s)	15.1	15.4	7.3	16.3	45.8	12.6	33.4	32.3		32.3	48.2	
Level of Service	B	B	A	B	D	B	C	C		C	D	
Approach Delay (s)		14.7			40.5			32.7			46.8	
Approach LOS		B			D			C			D	
Intersection Summary												
HCM 2000 Control Delay			31.7				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.88									
Actuated Cycle Length (s)			100.4				Sum of lost time (s)			20.0		
Intersection Capacity Utilization			135.3%				ICU Level of Service			H		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

3: Site Access & Bloomington Road

02/14/2024

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↱			↱	↘↙	
Traffic Volume (veh/h)	518	0	0	863	0	0
Future Volume (Veh/h)	518	0	0	863	0	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)	563	0	0	938	0	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			563		1501	563
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			563		1501	563
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		100	100
cM capacity (veh/h)			1019		136	530
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	563	938	0			
Volume Left	0	0	0			
Volume Right	0	0	0			
cSH	1700	1019	1700			
Volume to Capacity	0.33	0.00	0.00			
Queue Length 95th (m)	0.0	0.0	0.0			
Control Delay (s)	0.0	0.0	0.0			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	0.0			
Approach LOS			A			
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization			48.8%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

1: Highway 48 & Bloomington Road

02/14/2024

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Right Turn Channelized													
Traffic Volume (veh/h)	79	670	97	48	449	52	68	389	91	52	258	33	
Future Volume (veh/h)	79	670	97	48	449	52	68	389	91	52	258	33	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	
Hourly flow rate (vph)	81	691	100	49	463	54	70	401	94	54	266	34	
Approach Volume (veh/h)	872			566			565			354			
Crossing Volume (veh/h)	369			552			826			582			
High Capacity (veh/h)	1036			895			718			874			
High v/c (veh/h)	0.84			0.63			0.79			0.41			
Low Capacity (veh/h)	846			721			565			702			
Low v/c (veh/h)	1.03			0.79			1.00			0.50			
Intersection Summary													
Maximum v/c High	0.84												
Maximum v/c Low	1.03												
Intersection Capacity Utilization	78.0%			ICU Level of Service						D			

HCM 2010 Roundabout

1: Highway 48 & Bloomington Road

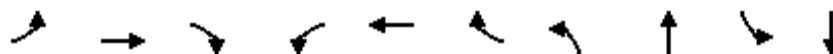
02/14/2024

Intersection									
Intersection Delay, s/veh	12.0								
Intersection LOS	B								
Approach	EB		WB		NB		SB		
Entry Lanes	2		2		2		2		
Conflicting Circle Lanes	2		2		2		2		
Adj Approach Flow, veh/h	872		566		565		354		
Demand Flow Rate, veh/h	946		618		570		369		
Vehicles Circulating, veh/h	381		562		897		634		
Vehicles Exiting, veh/h	622		905		430		546		
Follow-Up Headway, s	3.186		3.186		3.186		3.186		
Ped Vol Crossing Leg, #/h	0		0		0		0		
Ped Cap Adj	1.000		1.000		1.000		1.000		
Approach Delay, s/veh	12.8		10.9		14.2		8.4		
Approach LOS	B		B		B		A		
Lane	Left	Right	Left	Right	Left	Right	Left	Right	
Designated Moves	LT	TR	LT	TR	LT	TR	LT	TR	
Assumed Moves	LT	TR	LT	TR	LT	TR	LT	TR	
RT Channelized									
Lane Util	0.470	0.530	0.469	0.531	0.470	0.530	0.469	0.531	
Critical Headway, s	4.293	4.113	4.293	4.113	4.293	4.113	4.293	4.113	
Entry Flow, veh/h	445	501	290	328	268	302	173	196	
Cap Entry Lane, veh/h	849	865	741	762	577	603	702	725	
Entry HV Adj Factor	0.921	0.922	0.917	0.915	0.991	0.992	0.962	0.957	
Flow Entry, veh/h	410	462	266	300	266	299	166	188	
Cap Entry, veh/h	782	798	680	697	571	598	676	694	
V/C Ratio	0.524	0.579	0.391	0.430	0.465	0.501	0.246	0.270	
Control Delay, s/veh	12.2	13.4	10.6	11.2	14.0	14.4	8.3	8.5	
LOS	B	B	B	B	B	B	A	A	
95th %tile Queue, veh	3	4	2	2	2	3	1	1	

Timings

2: Ninth Line & Bloomington Road

02/14/2024



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	55	769	57	80	534	18	54	169	19	87
Future Volume (vph)	55	769	57	80	534	18	54	169	19	87
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	NA
Protected Phases	1	6			2			8		4
Permitted Phases	6		6	2		2	8		4	
Detector Phase	1	6	6	2	2	2	8	8	4	4
Switch Phase										
Minimum Initial (s)	7.0	50.0	50.0	50.0	50.0	50.0	15.0	15.0	15.0	15.0
Minimum Split (s)	11.5	57.5	57.5	57.5	57.5	57.5	31.5	31.5	32.5	32.5
Total Split (s)	24.0	57.5	57.5	57.5	57.5	57.5	37.5	37.5	37.5	37.5
Total Split (%)	20.2%	48.3%	48.3%	48.3%	48.3%	48.3%	31.5%	31.5%	31.5%	31.5%
Yellow Time (s)	3.0	5.0	5.0	5.0	5.0	5.0	4.5	4.5	4.5	4.5
All-Red Time (s)	1.0	2.5	2.5	2.5	2.5	2.5	3.0	3.0	4.0	4.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	8.5	8.5
Lead/Lag	Lead			Lag	Lag	Lag				
Lead-Lag Optimize?	Yes			Yes	Yes	Yes				
Recall Mode	None	Max	Max	Max	Max	Max	None	None	None	None
Act Effect Green (s)	63.2	59.7	59.7	50.6	50.6	50.6	24.7	24.7	23.7	23.7
Actuated g/C Ratio	0.63	0.60	0.60	0.51	0.51	0.51	0.25	0.25	0.24	0.24
v/c Ratio	0.20	0.87	0.07	0.54	0.77	0.03	0.21	0.83	0.22	0.47
Control Delay	9.5	28.4	4.2	35.0	30.1	0.1	32.2	48.5	37.2	32.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	9.5	28.4	4.2	35.0	30.1	0.1	32.2	48.5	37.2	32.4
LOS	A	C	A	C	C	A	C	D	D	C
Approach Delay		25.7			29.8			46.1		33.0
Approach LOS		C			C			D		C

Intersection Summary

Cycle Length: 119

Actuated Cycle Length: 99.6

Natural Cycle: 105

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.87

Intersection Signal Delay: 31.3

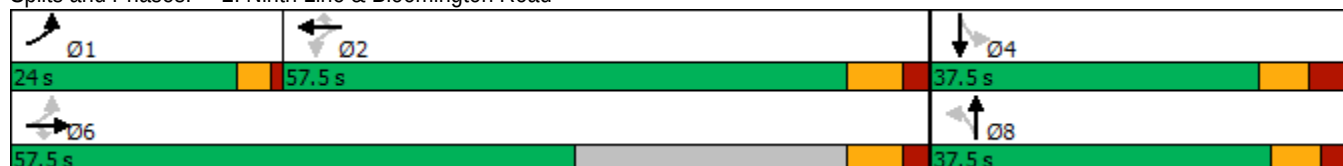
Intersection LOS: C

Intersection Capacity Utilization 116.6%

ICU Level of Service H

Analysis Period (min) 15

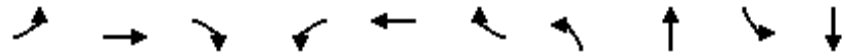
Splits and Phases: 2: Ninth Line & Bloomington Road



Queues

2: Ninth Line & Bloomington Road

02/14/2024



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	65	905	67	94	628	21	64	375	22	167
v/c Ratio	0.20	0.87	0.07	0.54	0.77	0.03	0.21	0.83	0.22	0.47
Control Delay	9.5	28.4	4.2	35.0	30.1	0.1	32.2	48.5	37.2	32.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	9.5	28.4	4.2	35.0	30.1	0.1	32.2	48.5	37.2	32.4
Queue Length 50th (m)	4.9	149.1	1.4	13.5	107.5	0.0	10.6	67.2	3.7	25.2
Queue Length 95th (m)	10.3	209.0	6.7	33.9	157.4	0.0	21.2	96.7	10.7	43.3
Internal Link Dist (m)	654.8				639.7		1312.7		782.8	
Turn Bay Length (m)	90.0			38.0	164.0			27.0	74.0	72.0
Base Capacity (vph)	458	1310	1146	174	817	677	369	548	123	435
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	0.14	0.69	0.06	0.54	0.77	0.03	0.17	0.68	0.18	0.38
Intersection Summary										

HCM Signalized Intersection Capacity Analysis

2: Ninth Line & Bloomington Road

02/14/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	55	769	57	80	534	18	54	169	150	19	87	55
Future Volume (vph)	55	769	57	80	534	18	54	169	150	19	87	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.95	1.00	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	1.00	0.85	1.00	0.93		1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1456	1743	1509	1799	1610	1257	1770	1716		1556	1419	
Flt Permitted	0.25	1.00	1.00	0.18	1.00	1.00	0.65	1.00		0.26	1.00	
Satd. Flow (perm)	377	1743	1509	345	1610	1257	1214	1716		421	1419	
Peak-hour factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Adj. Flow (vph)	65	905	67	94	628	21	64	199	176	22	102	65
RTOR Reduction (vph)	0	0	20	0	0	10	0	27	0	0	19	0
Lane Group Flow (vph)	65	905	47	94	628	11	64	348	0	22	148	0
Confl. Peds. (#/hr)				10		16						
Heavy Vehicles (%)	24%	9%	7%	0%	18%	22%	2%	2%	4%	16%	7%	56%
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	1	6			2			8			4	
Permitted Phases	6		6	2		2	8			4		
Actuated Green, G (s)	60.6	60.6	60.6	50.6	50.6	50.6	24.7	24.7		23.7	23.7	
Effective Green, g (s)	60.6	60.6	60.6	50.6	50.6	50.6	24.7	24.7		23.7	23.7	
Actuated g/C Ratio	0.60	0.60	0.60	0.50	0.50	0.50	0.25	0.25		0.24	0.24	
Clearance Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
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)	292	1053	911	174	812	634	298	422		99	335	
v/s Ratio Prot	0.01	c0.52			0.39			c0.20			0.10	
v/s Ratio Perm	0.12		0.03	0.27		0.01	0.05			0.05		
v/c Ratio	0.22	0.86	0.05	0.54	0.77	0.02	0.21	0.82		0.22	0.44	
Uniform Delay, d1	11.2	16.3	8.1	16.9	20.2	12.4	30.1	35.7		30.9	32.7	
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	0.4	9.1	0.1	11.5	7.1	0.0	0.4	12.3		1.1	0.9	
Delay (s)	11.6	25.5	8.2	28.4	27.3	12.5	30.4	48.1		32.0	33.6	
Level of Service	B	C	A	C	C	B	C	D		C	C	
Approach Delay (s)		23.5			27.0			45.5			33.4	
Approach LOS		C			C			D			C	
Intersection Summary												
HCM 2000 Control Delay			29.4									C
HCM 2000 Volume to Capacity ratio			0.90									
Actuated Cycle Length (s)			100.3							20.0		
Intersection Capacity Utilization			116.6%									H
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

3: Site Access & Bloomington Road

02/14/2024

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	851	0	0	672	0	0
Future Volume (Veh/h)	851	0	0	672	0	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)	925	0	0	730	0	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			925	1655		925
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			925	1655		925
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	100		100
cM capacity (veh/h)			747	109		329
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	925	730	0			
Volume Left	0	0	0			
Volume Right	0	0	0			
cSH	1700	747	1700			
Volume to Capacity	0.54	0.00	0.00			
Queue Length 95th (m)	0.0	0.0	0.0			
Control Delay (s)	0.0	0.0	0.0			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	0.0			
Approach LOS			A			
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization			48.1%		ICU Level of Service	
					A	
Analysis Period (min)			15			

Appendix F – Capacity Analysis – Future Total 2029 – Option 1

HCM Unsignalized Intersection Capacity Analysis

1: Highway 48 & Bloomington Road

02/09/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Right Turn Channelized												
Traffic Volume (veh/h)	24	411	71	75	603	51	94	168	51	36	371	110
Future Volume (veh/h)	24	411	71	75	603	51	94	168	51	36	371	110
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	24	419	72	77	615	52	96	171	52	37	379	112
Approach Volume (veh/h)	515			744			319			528		
Crossing Volume (veh/h)	493			291			480			788		
High Capacity (veh/h)	939			1102			948			740		
High v/c (veh/h)	0.55			0.68			0.34			0.71		
Low Capacity (veh/h)	759			905			768			584		
Low v/c (veh/h)	0.68			0.82			0.42			0.90		
Intersection Summary												
Maximum v/c High	0.71											
Maximum v/c Low	0.90											
Intersection Capacity Utilization	71.9%			ICU Level of Service			C					

HCM 2010 Roundabout
1: Highway 48 & Bloomington Road

02/09/2024

Intersection									
Intersection Delay, s/veh	13.8								
Intersection LOS	B								
Approach	EB		WB		NB		SB		
Entry Lanes	2		2		2		2		
Conflicting Circle Lanes	2		2		2		2		
Adj Approach Flow, veh/h	515		744		319		528		
Demand Flow Rate, veh/h	715		964		349		554		
Vehicles Circulating, veh/h	521		318		681		1006		
Vehicles Exiting, veh/h	1039		712		555		276		
Follow-Up Headway, s	3.186		3.186		3.186		3.186		
Ped Vol Crossing Leg, #/h	0		0		0		0		
Ped Cap Adj	1.000		1.000		1.000		1.000		
Approach Delay, s/veh	14.2		13.8		8.9		16.4		
Approach LOS	B		B		A		C		
Lane	Left	Right	Left	Right	Left	Right	Left	Right	
Designated Moves	LT	TR	LT	TR	LT	TR	LT	TR	
Assumed Moves	LT	TR	LT	TR	LT	TR	LT	TR	
RT Channelized									
Lane Util	0.470	0.530	0.470	0.530	0.470	0.530	0.469	0.531	
Critical Headway, s	4.293	4.113	4.293	4.113	4.293	4.113	4.293	4.113	
Entry Flow, veh/h	336	379	453	511	164	185	260	294	
Cap Entry Lane, veh/h	764	785	890	904	678	702	531	559	
Entry HV Adj Factor	0.721	0.720	0.772	0.772	0.915	0.914	0.955	0.952	
Flow Entry, veh/h	242	273	350	394	150	169	248	280	
Cap Entry, veh/h	551	565	687	698	620	641	507	532	
V/C Ratio	0.440	0.483	0.509	0.565	0.242	0.264	0.489	0.526	
Control Delay, s/veh	13.8	14.6	13.1	14.5	8.9	8.9	16.2	16.7	
LOS	B	B	B	B	A	A	C	C	
95th %tile Queue, veh	2	3	3	4	1	1	3	3	

Timings

2: Ninth Line & Bloomington Road

02/09/2024



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	93	480	50	120	600	22	58	54	23	131
Future Volume (vph)	93	480	50	120	600	22	58	54	23	131
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	NA
Protected Phases	1	6			2			8		4
Permitted Phases	6		6	2		2	8		4	
Detector Phase	1	6	6	2	2	2	8	8	4	4
Switch Phase										
Minimum Initial (s)	7.0	50.0	50.0	50.0	50.0	50.0	15.0	15.0	15.0	15.0
Minimum Split (s)	11.5	57.5	57.5	57.5	57.5	57.5	31.5	31.5	32.5	32.5
Total Split (s)	24.0	57.5	57.5	57.5	57.5	57.5	37.5	37.5	37.5	37.5
Total Split (%)	20.2%	48.3%	48.3%	48.3%	48.3%	48.3%	31.5%	31.5%	31.5%	31.5%
Yellow Time (s)	3.0	5.0	5.0	5.0	5.0	5.0	4.5	4.5	4.5	4.5
All-Red Time (s)	1.0	2.5	2.5	2.5	2.5	2.5	3.0	3.0	4.0	4.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	8.5	8.5
Lead/Lag	Lead			Lag	Lag	Lag				
Lead-Lag Optimize?	Yes			Yes	Yes	Yes				
Recall Mode	None	Max	Max	Max	Max	Max	None	None	None	None
Act Effect Green (s)	65.3	61.7	61.7	50.6	50.6	50.6	21.9	21.9	20.9	20.9
Actuated g/C Ratio	0.66	0.62	0.62	0.51	0.51	0.51	0.22	0.22	0.21	0.21
v/c Ratio	0.40	0.58	0.05	0.28	0.84	0.05	0.30	0.29	0.14	0.76
Control Delay	12.3	15.1	2.8	19.0	35.9	0.2	37.8	23.7	34.9	48.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.3	15.1	2.8	19.0	35.9	0.2	37.8	23.7	34.9	48.4
LOS	B	B	A	B	D	A	D	C	C	D
Approach Delay		13.7			32.1			28.6		47.2
Approach LOS		B			C			C		D

Intersection Summary

Cycle Length: 119

Actuated Cycle Length: 98.8

Natural Cycle: 105

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.84

Intersection Signal Delay: 27.5

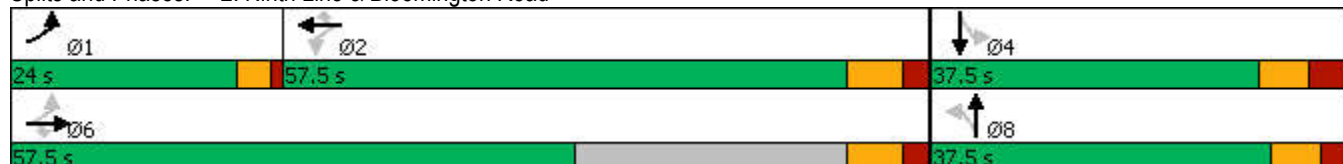
Intersection LOS: C

Intersection Capacity Utilization 134.6%

ICU Level of Service H

Analysis Period (min) 15

Splits and Phases: 2: Ninth Line & Bloomington Road



Queues

2: Ninth Line & Bloomington Road

02/09/2024



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	97	500	52	125	625	23	60	111	24	239
v/c Ratio	0.40	0.58	0.05	0.28	0.84	0.05	0.30	0.29	0.14	0.76
Control Delay	12.3	15.1	2.8	19.0	35.9	0.2	37.8	23.7	34.9	48.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.3	15.1	2.8	19.0	35.9	0.2	37.8	23.7	34.9	48.4
Queue Length 50th (m)	6.5	53.3	0.2	14.2	107.0	0.0	10.3	12.0	4.0	40.7
Queue Length 95th (m)	16.1	102.9	5.1	34.1	#218.2	0.0	23.5	28.1	11.7	72.2
Internal Link Dist (m)	654.8				639.7		1312.7		782.8	
Turn Bay Length (m)	90.0		38.0	164.0		27.0	74.0		72.0	
Base Capacity (vph)	317	1044	1145	448	743	499	274	519	234	433
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	0.31	0.48	0.05	0.28	0.84	0.05	0.22	0.21	0.10	0.55

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

2: Ninth Line & Bloomington Road

02/09/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	93	480	50	120	600	22	58	54	53	23	131	99
Future Volume (vph)	93	480	50	120	600	22	58	54	53	23	131	99
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.98	1.00	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	1.00	0.85	1.00	0.93		1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	976	1377	1495	1734	1450	892	1656	1598		1094	1388	
Flt Permitted	0.25	1.00	1.00	0.48	1.00	1.00	0.51	1.00		0.69	1.00	
Satd. Flow (perm)	258	1377	1495	876	1450	892	892	1598		789	1388	
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)	97	500	52	125	625	23	60	56	55	24	136	103
RTOR Reduction (vph)	0	0	19	0	0	11	0	31	0	0	24	0
Lane Group Flow (vph)	97	500	33	125	625	12	60	80	0	24	215	0
Confl. Peds. (#/hr)				1		1						
Heavy Vehicles (%)	85%	38%	8%	4%	31%	77%	9%	14%	6%	65%	3%	61%
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	1	6			2			8			4	
Permitted Phases	6		6	2		2	8			4		
Actuated Green, G (s)	62.6	62.6	62.6	50.6	50.6	50.6	21.9	21.9		20.9	20.9	
Effective Green, g (s)	62.6	62.6	62.6	50.6	50.6	50.6	21.9	21.9		20.9	20.9	
Actuated g/C Ratio	0.63	0.63	0.63	0.51	0.51	0.51	0.22	0.22		0.21	0.21	
Clearance Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
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)	220	866	940	445	737	453	196	351		165	291	
v/s Ratio Prot	0.04	c0.36			c0.43			0.05			c0.16	
v/s Ratio Perm	0.24		0.02	0.14		0.01	0.07			0.03		
v/c Ratio	0.44	0.58	0.04	0.28	0.85	0.03	0.31	0.23		0.15	0.74	
Uniform Delay, d1	10.9	10.7	7.0	14.0	21.1	12.2	32.4	31.9		32.0	36.8	
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	1.4	2.8	0.1	1.6	11.6	0.1	0.9	0.3		0.4	9.5	
Delay (s)	12.3	13.5	7.1	15.6	32.8	12.3	33.3	32.2		32.4	46.2	
Level of Service	B	B	A	B	C	B	C	C		C	D	
Approach Delay (s)		12.8			29.4			32.6			45.0	
Approach LOS		B			C			C			D	
Intersection Summary												
HCM 2000 Control Delay			26.1				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.80									
Actuated Cycle Length (s)			99.5				Sum of lost time (s)			20.0		
Intersection Capacity Utilization			134.6%				ICU Level of Service			H		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

3: Site Access & Bloomington Road

02/09/2024

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	471	38	0	777	37	0
Future Volume (Veh/h)	471	38	0	777	37	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)	512	41	0	845	40	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			553		1378	532
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			553		1378	532
tC, single (s)			4.1		7.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		4.4	3.3
p0 queue free %			100		60	100
cM capacity (veh/h)			1027		100	551
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	553	845	40			
Volume Left	0	0	40			
Volume Right	41	0	0			
cSH	1700	1027	100			
Volume to Capacity	0.33	0.00	0.40			
Queue Length 95th (m)	0.0	0.0	13.2			
Control Delay (s)	0.0	0.0	63.5			
Lane LOS						
Approach Delay (s)	0.0	0.0	63.5			
Approach LOS						
Intersection Summary						
Average Delay						
			1.8			
Intersection Capacity Utilization			50.9%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

1: Highway 48 & Bloomington Road

02/09/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Right Turn Channelized												
Traffic Volume (veh/h)	79	636	97	48	438	52	68	352	91	52	234	33
Future Volume (veh/h)	79	636	97	48	438	52	68	352	91	52	234	33
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	81	656	100	49	452	54	70	363	94	54	241	34
Approach Volume (veh/h)	837			555			527			329		
Crossing Volume (veh/h)	344			514			791			571		
High Capacity (veh/h)	1057			923			738			882		
High v/c (veh/h)	0.79			0.60			0.71			0.37		
Low Capacity (veh/h)	865			745			583			709		
Low v/c (veh/h)	0.97			0.74			0.90			0.46		
Intersection Summary												
Maximum v/c High	0.79											
Maximum v/c Low	0.97											
Intersection Capacity Utilization	75.1%			ICU Level of Service			D					

HCM 2010 Roundabout

1: Highway 48 & Bloomington Road

02/09/2024

Intersection									
Intersection Delay, s/veh	11.8								
Intersection LOS	B								
Approach	EB		WB		NB		SB		
Entry Lanes	2		2		2		2		
Conflicting Circle Lanes	2		2		2		2		
Adj Approach Flow, veh/h	837		555		527		329		
Demand Flow Rate, veh/h	941		642		532		343		
Vehicles Circulating, veh/h	355		524		892		658		
Vehicles Exiting, veh/h	646		900		404		508		
Follow-Up Headway, s	3.186		3.186		3.186		3.186		
Ped Vol Crossing Leg, #/h	0		0		0		0		
Ped Cap Adj	1.000		1.000		1.000		1.000		
Approach Delay, s/veh	12.7		11.3		13.3		8.3		
Approach LOS	B		B		B		A		
Lane	Left	Right	Left	Right	Left	Right	Left	Right	
Designated Moves	LT	TR	LT	TR	LT	TR	LT	TR	
Assumed Moves	LT	TR	LT	TR	LT	TR	LT	TR	
RT Channelized									
Lane Util	0.470	0.530	0.470	0.530	0.470	0.530	0.469	0.531	
Critical Headway, s	4.293	4.113	4.293	4.113	4.293	4.113	4.293	4.113	
Entry Flow, veh/h	442	499	302	340	250	282	161	182	
Cap Entry Lane, veh/h	866	881	763	783	579	605	690	713	
Entry HV Adj Factor	0.890	0.889	0.864	0.865	0.991	0.991	0.960	0.957	
Flow Entry, veh/h	393	444	261	294	248	280	155	174	
Cap Entry, veh/h	771	784	659	678	574	600	662	683	
V/C Ratio	0.511	0.566	0.396	0.434	0.432	0.466	0.233	0.255	
Control Delay, s/veh	12.0	13.2	11.0	11.5	13.1	13.5	8.3	8.3	
LOS	B	B	B	B	B	B	A	A	
95th %tile Queue, veh	3	4	2	2	2	2	1	1	

Timings

2: Ninth Line & Bloomington Road

02/09/2024



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	55	685	57	80	476	18	54	153	19	78
Future Volume (vph)	55	685	57	80	476	18	54	153	19	78
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	NA
Protected Phases	1	6			2			8		4
Permitted Phases	6		6	2		2	8		4	
Detector Phase	1	6	6	2	2	2	8	8	4	4
Switch Phase										
Minimum Initial (s)	7.0	50.0	50.0	50.0	50.0	50.0	15.0	15.0	15.0	15.0
Minimum Split (s)	11.5	57.5	57.5	57.5	57.5	57.5	31.5	31.5	32.5	32.5
Total Split (s)	24.0	57.5	57.5	57.5	57.5	57.5	37.5	37.5	37.5	37.5
Total Split (%)	20.2%	48.3%	48.3%	48.3%	48.3%	48.3%	31.5%	31.5%	31.5%	31.5%
Yellow Time (s)	3.0	5.0	5.0	5.0	5.0	5.0	4.5	4.5	4.5	4.5
All-Red Time (s)	1.0	2.5	2.5	2.5	2.5	2.5	3.0	3.0	4.0	4.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	8.5	8.5
Lead/Lag	Lead			Lag	Lag	Lag				
Lead-Lag Optimize?	Yes			Yes	Yes	Yes				
Recall Mode	None	Max	Max	Max	Max	Max	None	None	None	None
Act Effect Green (s)	63.2	59.6	59.6	50.5	50.5	50.5	23.7	23.7	22.7	22.7
Actuated g/C Ratio	0.64	0.61	0.61	0.51	0.51	0.51	0.24	0.24	0.23	0.23
v/c Ratio	0.17	0.76	0.07	0.37	0.68	0.03	0.22	0.81	0.21	0.46
Control Delay	8.8	21.3	4.1	23.2	25.4	0.1	32.5	46.5	36.5	31.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.8	21.3	4.1	23.2	25.4	0.1	32.5	46.5	36.5	31.5
LOS	A	C	A	C	C	A	C	D	D	C
Approach Delay		19.2			24.3			44.3		32.1
Approach LOS		B			C			D		C

Intersection Summary

Cycle Length: 119

Actuated Cycle Length: 98.5

Natural Cycle: 105

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.81

Intersection Signal Delay: 26.6

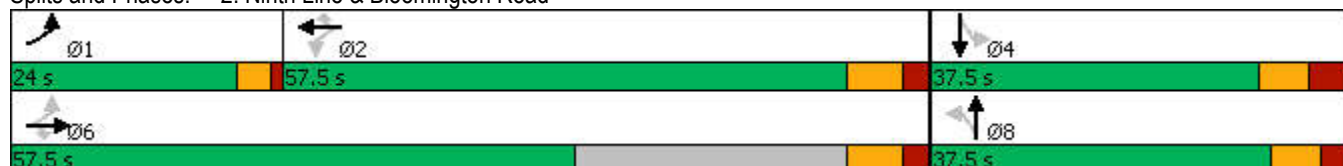
Intersection LOS: C

Intersection Capacity Utilization 115.8%

ICU Level of Service H

Analysis Period (min) 15

Splits and Phases: 2: Ninth Line & Bloomington Road



Queues

2: Ninth Line & Bloomington Road

02/09/2024



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	65	806	67	94	560	21	64	356	22	157
v/c Ratio	0.17	0.76	0.07	0.37	0.68	0.03	0.22	0.81	0.21	0.46
Control Delay	8.8	21.3	4.1	23.2	25.4	0.1	32.5	46.5	36.5	31.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.8	21.3	4.1	23.2	25.4	0.1	32.5	46.5	36.5	31.5
Queue Length 50th (m)	4.5	111.7	1.3	11.6	85.4	0.0	10.6	61.7	3.7	22.6
Queue Length 95th (m)	10.3	166.9	6.7	27.0	132.2	0.0	21.2	90.1	10.6	40.0
Internal Link Dist (m)	654.8				639.7		1312.7		782.8	
Turn Bay Length (m)	90.0			38.0	164.0			27.0	74.0	72.0
Base Capacity (vph)	499	1323	1157	253	825	683	376	553	136	436
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	0.13	0.61	0.06	0.37	0.68	0.03	0.17	0.64	0.16	0.36
Intersection Summary										

HCM Signalized Intersection Capacity Analysis

2: Ninth Line & Bloomington Road

02/09/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	55	685	57	80	476	18	54	153	150	19	78	55
Future Volume (vph)	55	685	57	80	476	18	54	153	150	19	78	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.95	1.00	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	1.00	0.85	1.00	0.93		1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1456	1743	1509	1797	1610	1258	1770	1708		1556	1400	
Flt Permitted	0.30	1.00	1.00	0.26	1.00	1.00	0.66	1.00		0.28	1.00	
Satd. Flow (perm)	460	1743	1509	496	1610	1258	1225	1708		458	1400	
Peak-hour factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Adj. Flow (vph)	65	806	67	94	560	21	64	180	176	22	92	65
RTOR Reduction (vph)	0	0	20	0	0	10	0	30	0	0	22	0
Lane Group Flow (vph)	65	806	47	94	560	11	64	326	0	22	135	0
Confl. Peds. (#/hr)				10		16						
Heavy Vehicles (%)	24%	9%	7%	0%	18%	22%	2%	2%	4%	16%	7%	56%
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	1	6			2			8			4	
Permitted Phases	6		6	2		2	8			4		
Actuated Green, G (s)	60.5	60.5	60.5	50.5	50.5	50.5	23.7	23.7		22.7	22.7	
Effective Green, g (s)	60.5	60.5	60.5	50.5	50.5	50.5	23.7	23.7		22.7	22.7	
Actuated g/C Ratio	0.61	0.61	0.61	0.51	0.51	0.51	0.24	0.24		0.23	0.23	
Clearance Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
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)	340	1063	920	252	819	640	292	408		104	320	
v/s Ratio Prot	0.01	c0.46			0.35			c0.19			0.10	
v/s Ratio Perm	0.10		0.03	0.19		0.01	0.05			0.05		
v/c Ratio	0.19	0.76	0.05	0.37	0.68	0.02	0.22	0.80		0.21	0.42	
Uniform Delay, d1	9.8	14.0	7.8	14.8	18.3	12.1	30.3	35.5		31.0	32.7	
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	0.3	5.1	0.1	4.2	4.6	0.0	0.4	10.4		1.0	0.9	
Delay (s)	10.1	19.1	7.9	18.9	22.9	12.1	30.7	45.9		32.0	33.6	
Level of Service	B	B	A	B	C	B	C	D		C	C	
Approach Delay (s)		17.7			22.0			43.6			33.4	
Approach LOS		B			C			D			C	
Intersection Summary												
HCM 2000 Control Delay			25.2									
HCM 2000 Volume to Capacity ratio			0.82									
Actuated Cycle Length (s)			99.2									
Intersection Capacity Utilization			115.8%									
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

3: Site Access & Bloomington Road

02/09/2024

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	759	38	0	599	37	0
Future Volume (Veh/h)	759	38	0	599	37	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)	825	41	0	651	40	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			866			1496
vC1, stage 1 conf vol						846
vC2, stage 2 conf vol						
vCu, unblocked vol			866			1496
tC, single (s)			4.1			7.4
tC, 2 stage (s)						6.2
tF (s)			2.2			4.4
p0 queue free %			100			51
cM capacity (veh/h)			786			82
						365
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	866	651	40			
Volume Left	0	0	40			
Volume Right	41	0	0			
cSH	1700	786	82			
Volume to Capacity	0.51	0.00	0.49			
Queue Length 95th (m)	0.0	0.0	16.4			
Control Delay (s)	0.0	0.0	84.6			
Lane LOS				F		
Approach Delay (s)	0.0	0.0	84.6			
Approach LOS				F		
Intersection Summary						
Average Delay			2.2			
Intersection Capacity Utilization			52.2%		ICU Level of Service	
Analysis Period (min)			15		A	

Appendix G – Capacity Analysis – Future Total 2029 – Option 2

HCM Unsignalized Intersection Capacity Analysis

1: Highway 48 & Bloomington Road

02/09/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Right Turn Channelized												
Traffic Volume (veh/h)	24	373	71	75	566	51	94	168	51	36	371	110
Future Volume (veh/h)	24	373	71	75	566	51	94	168	51	36	371	110
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	24	381	72	77	578	52	96	171	52	37	379	112
Approach Volume (veh/h)	477				707			319			528	
Crossing Volume (veh/h)	493				291			442			751	
High Capacity (veh/h)	939				1102			978			763	
High v/c (veh/h)	0.51				0.64			0.33			0.69	
Low Capacity (veh/h)	759				905			794			604	
Low v/c (veh/h)	0.63				0.78			0.40			0.87	
Intersection Summary												
Maximum v/c High	0.69											
Maximum v/c Low	0.87											
Intersection Capacity Utilization	69.9%				ICU Level of Service				C			

HCM 2010 Roundabout
1: Highway 48 & Bloomington Road

02/09/2024

Intersection									
Intersection Delay, s/veh	12.4								
Intersection LOS	B								
Approach	EB		WB		NB		SB		
Entry Lanes	2		2		2		2		
Conflicting Circle Lanes	2		2		2		2		
Adj Approach Flow, veh/h	477		707		319		528		
Demand Flow Rate, veh/h	633		886		349		554		
Vehicles Circulating, veh/h	521		318		599		928		
Vehicles Exiting, veh/h	961		630		555		276		
Follow-Up Headway, s	3.186		3.186		3.186		3.186		
Ped Vol Crossing Leg, #/h	0		0		0		0		
Ped Cap Adj	1.000		1.000		1.000		1.000		
Approach Delay, s/veh	12.4		12.3		8.2		14.9		
Approach LOS	B		B		A		B		
Lane	Left	Right	Left	Right	Left	Right	Left	Right	
Designated Moves	LT	TR	LT	TR	LT	TR	LT	TR	
Assumed Moves	LT	TR	LT	TR	LT	TR	LT	TR	
RT Channelized									
Lane Util	0.471	0.529	0.470	0.530	0.470	0.530	0.469	0.531	
Critical Headway, s	4.293	4.113	4.293	4.113	4.293	4.113	4.293	4.113	
Entry Flow, veh/h	298	335	416	470	164	185	260	294	
Cap Entry Lane, veh/h	764	785	890	904	721	743	563	590	
Entry HV Adj Factor	0.753	0.755	0.799	0.798	0.915	0.914	0.955	0.952	
Flow Entry, veh/h	224	253	332	375	150	169	248	280	
Cap Entry, veh/h	575	592	711	721	660	679	538	562	
V/C Ratio	0.390	0.427	0.467	0.520	0.227	0.249	0.462	0.498	
Control Delay, s/veh	12.1	12.7	11.8	12.9	8.2	8.3	14.6	15.1	
LOS	B	B	B	B	A	A	B	C	
95th %tile Queue, veh	2	2	2	3	1	1	2	3	

Timings

2: Ninth Line & Bloomington Road

02/09/2024

										
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	93	517	50	120	638	22	58	54	23	131
Future Volume (vph)	93	517	50	120	638	22	58	54	23	131
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	NA
Protected Phases	1	6			2			8		4
Permitted Phases	6		6	2		2	8		4	
Detector Phase	1	6	6	2	2	2	8	8	4	4
Switch Phase										
Minimum Initial (s)	7.0	50.0	50.0	50.0	50.0	50.0	15.0	15.0	15.0	15.0
Minimum Split (s)	11.5	57.5	57.5	57.5	57.5	57.5	31.5	31.5	32.5	32.5
Total Split (s)	24.0	57.5	57.5	57.5	57.5	57.5	37.5	37.5	37.5	37.5
Total Split (%)	20.2%	48.3%	48.3%	48.3%	48.3%	48.3%	31.5%	31.5%	31.5%	31.5%
Yellow Time (s)	3.0	5.0	5.0	5.0	5.0	5.0	4.5	4.5	4.5	4.5
All-Red Time (s)	1.0	2.5	2.5	2.5	2.5	2.5	3.0	3.0	4.0	4.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	8.5	8.5
Lead/Lag	Lead			Lag	Lag	Lag				
Lead-Lag Optimize?	Yes			Yes	Yes	Yes				
Recall Mode	None	Max	Max	Max	Max	Max	None	None	None	None
Act Effect Green (s)	65.3	61.7	61.7	50.6	50.6	50.6	21.9	21.9	20.9	20.9
Actuated g/C Ratio	0.66	0.62	0.62	0.51	0.51	0.51	0.22	0.22	0.21	0.21
v/c Ratio	0.43	0.65	0.05	0.29	0.92	0.05	0.30	0.29	0.14	0.76
Control Delay	13.4	17.3	2.8	19.3	45.6	0.2	37.8	23.7	34.9	48.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.4	17.3	2.8	19.3	45.6	0.2	37.8	23.7	34.9	48.4
LOS	B	B	A	B	D	A	D	C	C	D
Approach Delay		15.7			40.3			28.6		47.2
Approach LOS		B			D			C		D

Intersection Summary

Cycle Length: 119

Actuated Cycle Length: 98.8

Natural Cycle: 105

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.92

Intersection Signal Delay: 31.4

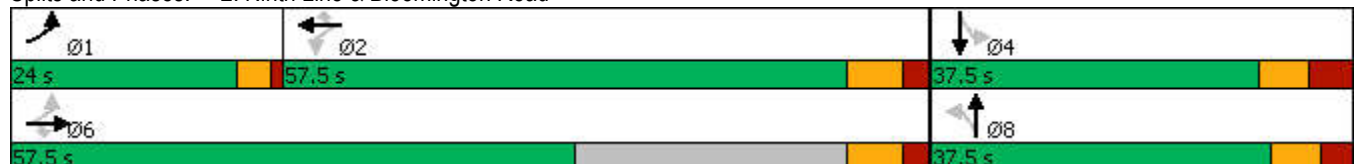
Intersection LOS: C

Intersection Capacity Utilization 134.6%

ICU Level of Service H

Analysis Period (min) 15

Splits and Phases: 2: Ninth Line & Bloomington Road



Queues

2: Ninth Line & Bloomington Road

02/09/2024



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	97	539	52	125	665	23	60	111	24	239
v/c Ratio	0.43	0.65	0.05	0.29	0.92	0.05	0.30	0.29	0.14	0.76
Control Delay	13.4	17.3	2.8	19.3	45.6	0.2	37.8	23.7	34.9	48.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.4	17.3	2.8	19.3	45.6	0.2	37.8	23.7	34.9	48.4
Queue Length 50th (m)	6.5	61.9	0.2	14.3	122.9	0.0	10.3	12.0	4.0	40.7
Queue Length 95th (m)	16.1	121.7	5.1	34.6	#243.7	0.0	23.5	28.1	11.7	72.2
Internal Link Dist (m)		654.8			639.7			1312.7		782.8
Turn Bay Length (m)	90.0		38.0	164.0		27.0	74.0		72.0	
Base Capacity (vph)	303	1000	1145	432	720	499	274	519	234	433
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	0.32	0.54	0.05	0.29	0.92	0.05	0.22	0.21	0.10	0.55

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

2: Ninth Line & Bloomington Road

02/09/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	93	517	50	120	638	22	58	54	53	23	131	99
Future Volume (vph)	93	517	50	120	638	22	58	54	53	23	131	99
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.98	1.00	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	1.00	0.85	1.00	0.93		1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	976	1319	1495	1734	1407	892	1656	1598		1094	1388	
Flt Permitted	0.22	1.00	1.00	0.46	1.00	1.00	0.51	1.00		0.69	1.00	
Satd. Flow (perm)	228	1319	1495	845	1407	892	892	1598		789	1388	
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)	97	539	52	125	665	23	60	56	55	24	136	103
RTOR Reduction (vph)	0	0	19	0	0	11	0	31	0	0	24	0
Lane Group Flow (vph)	97	539	33	125	665	12	60	80	0	24	215	0
Confl. Peds. (#/hr)				1		1						
Heavy Vehicles (%)	85%	44%	8%	4%	35%	77%	9%	14%	6%	65%	3%	61%
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	1	6			2			8			4	
Permitted Phases	6		6	2		2	8			4		
Actuated Green, G (s)	62.6	62.6	62.6	50.6	50.6	50.6	21.9	21.9		20.9	20.9	
Effective Green, g (s)	62.6	62.6	62.6	50.6	50.6	50.6	21.9	21.9		20.9	20.9	
Actuated g/C Ratio	0.63	0.63	0.63	0.51	0.51	0.51	0.22	0.22		0.21	0.21	
Clearance Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
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)	203	829	940	429	715	453	196	351		165	291	
v/s Ratio Prot	0.04	c0.41			c0.47			0.05			c0.16	
v/s Ratio Perm	0.26		0.02	0.15		0.01	0.07			0.03		
v/c Ratio	0.48	0.65	0.04	0.29	0.93	0.03	0.31	0.23		0.15	0.74	
Uniform Delay, d1	11.7	11.6	7.0	14.1	22.8	12.2	32.4	31.9		32.0	36.8	
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	1.8	3.9	0.1	1.7	20.3	0.1	0.9	0.3		0.4	9.5	
Delay (s)	13.5	15.5	7.1	15.8	43.1	12.3	33.3	32.2		32.4	46.2	
Level of Service	B	B	A	B	D	B	C	C		C	D	
Approach Delay (s)		14.6			38.1			32.6			45.0	
Approach LOS		B			D			C			D	
Intersection Summary												
HCM 2000 Control Delay			30.2				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.86									
Actuated Cycle Length (s)			99.5				Sum of lost time (s)			20.0		
Intersection Capacity Utilization			134.6%				ICU Level of Service			H		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

3: Site Access & Bloomington Road

02/09/2024

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	471	0	38	777	0	37
Future Volume (Veh/h)	471	0	38	777	0	37
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)	512	0	41	845	0	40
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			512		1439	512
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			512		1439	512
tC, single (s)			5.1		6.4	7.2
tC, 2 stage (s)						
tF (s)			3.1		3.5	4.2
p0 queue free %			94		100	90
cM capacity (veh/h)			695		139	409
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	512	886	40			
Volume Left	0	41	0			
Volume Right	0	0	40			
cSH	1700	695	409			
Volume to Capacity	0.30	0.06	0.10			
Queue Length 95th (m)	0.0	1.5	2.6			
Control Delay (s)	0.0	1.7	14.8			
Lane LOS			A B			
Approach Delay (s)	0.0	1.7	14.8			
Approach LOS			B			
Intersection Summary						
Average Delay			1.4			
Intersection Capacity Utilization			81.1%	ICU Level of Service		D
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

1: Highway 48 & Bloomington Road

02/09/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Right Turn Channelized												
Traffic Volume (veh/h)	79	598	97	48	401	52	68	352	91	52	234	33
Future Volume (veh/h)	79	598	97	48	401	52	68	352	91	52	234	33
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	81	616	100	49	413	54	70	363	94	54	241	34
Approach Volume (veh/h)	797			516			527			329		
Crossing Volume (veh/h)	344			514			751			532		
High Capacity (veh/h)	1057			923			763			910		
High v/c (veh/h)	0.75			0.56			0.69			0.36		
Low Capacity (veh/h)	865			745			604			734		
Low v/c (veh/h)	0.92			0.69			0.87			0.45		
Intersection Summary												
Maximum v/c High	0.75											
Maximum v/c Low	0.92											
Intersection Capacity Utilization	73.0%			ICU Level of Service			D					

HCM 2010 Roundabout
1: Highway 48 & Bloomington Road

02/09/2024

Intersection									
Intersection Delay, s/veh	10.6								
Intersection LOS	B								
Approach	EB		WB		NB		SB		
Entry Lanes	2		2		2		2		
Conflicting Circle Lanes	2		2		2		2		
Adj Approach Flow, veh/h	797		516		527		329		
Demand Flow Rate, veh/h	864		562		532		343		
Vehicles Circulating, veh/h	355		524		815		578		
Vehicles Exiting, veh/h	566		823		404		508		
Follow-Up Headway, s	3.186		3.186		3.186		3.186		
Ped Vol Crossing Leg, #/h	0		0		0		0		
Ped Cap Adj	1.000		1.000		1.000		1.000		
Approach Delay, s/veh	11.3		9.8		12.2		7.7		
Approach LOS	B		A		B		A		
Lane	Left	Right	Left	Right	Left	Right	Left	Right	
Designated Moves	LT	TR	LT	TR	LT	TR	LT	TR	
Assumed Moves	LT	TR	LT	TR	LT	TR	LT	TR	
RT Channelized									
Lane Util	0.470	0.530	0.470	0.530	0.470	0.530	0.469	0.531	
Critical Headway, s	4.293	4.113	4.293	4.113	4.293	4.113	4.293	4.113	
Entry Flow, veh/h	406	458	264	298	250	282	161	182	
Cap Entry Lane, veh/h	866	881	763	783	613	639	732	754	
Entry HV Adj Factor	0.922	0.922	0.918	0.917	0.991	0.991	0.960	0.957	
Flow Entry, veh/h	374	422	242	273	248	280	155	174	
Cap Entry, veh/h	798	812	700	718	608	633	703	722	
V/C Ratio	0.469	0.520	0.346	0.381	0.408	0.442	0.220	0.241	
Control Delay, s/veh	10.8	11.7	9.6	10.0	12.0	12.3	7.7	7.8	
LOS	B	B	A	A	B	B	A	A	
95th %tile Queue, veh	3	3	2	2	2	2	1	1	

Timings

2: Ninth Line & Bloomington Road

02/09/2024



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	55	722	57	80	514	18	54	153	19	78
Future Volume (vph)	55	722	57	80	514	18	54	153	19	78
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	NA
Protected Phases	1	6			2			8		4
Permitted Phases	6		6	2		2	8		4	
Detector Phase	1	6	6	2	2	2	8	8	4	4
Switch Phase										
Minimum Initial (s)	7.0	50.0	50.0	50.0	50.0	50.0	15.0	15.0	15.0	15.0
Minimum Split (s)	11.5	57.5	57.5	57.5	57.5	57.5	31.5	31.5	32.5	32.5
Total Split (s)	24.0	57.5	57.5	57.5	57.5	57.5	37.5	37.5	37.5	37.5
Total Split (%)	20.2%	48.3%	48.3%	48.3%	48.3%	48.3%	31.5%	31.5%	31.5%	31.5%
Yellow Time (s)	3.0	5.0	5.0	5.0	5.0	5.0	4.5	4.5	4.5	4.5
All-Red Time (s)	1.0	2.5	2.5	2.5	2.5	2.5	3.0	3.0	4.0	4.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	8.5	8.5
Lead/Lag	Lead			Lag	Lag	Lag				
Lead-Lag Optimize?	Yes			Yes	Yes	Yes				
Recall Mode	None	Max	Max	Max	Max	Max	None	None	None	None
Act Effect Green (s)	63.2	59.6	59.6	50.5	50.5	50.5	23.7	23.7	22.7	22.7
Actuated g/C Ratio	0.64	0.61	0.61	0.51	0.51	0.51	0.24	0.24	0.23	0.23
v/c Ratio	0.19	0.83	0.07	0.42	0.77	0.03	0.22	0.81	0.21	0.46
Control Delay	9.0	25.7	4.1	25.9	30.0	0.1	32.5	46.5	36.5	31.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	9.0	25.7	4.1	25.9	30.0	0.1	32.5	46.5	36.5	31.5
LOS	A	C	A	C	C	A	C	D	D	C
Approach Delay		23.1			28.6			44.3		32.1
Approach LOS		C			C			D		C

Intersection Summary

Cycle Length: 119

Actuated Cycle Length: 98.5

Natural Cycle: 105

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.83

Intersection Signal Delay: 29.4

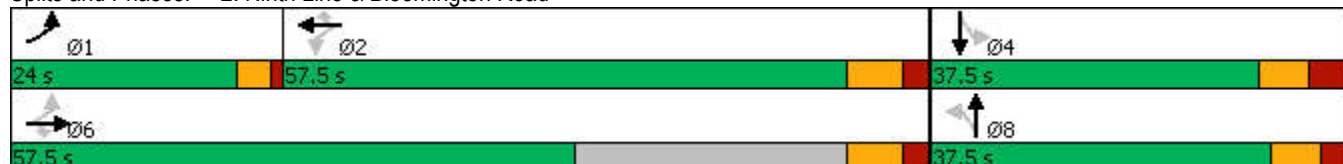
Intersection LOS: C

Intersection Capacity Utilization 115.8%

ICU Level of Service H

Analysis Period (min) 15

Splits and Phases: 2: Ninth Line & Bloomington Road



Queues

2: Ninth Line & Bloomington Road

02/09/2024



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	65	849	67	94	605	21	64	356	22	157
v/c Ratio	0.19	0.83	0.07	0.42	0.77	0.03	0.22	0.81	0.21	0.46
Control Delay	9.0	25.7	4.1	25.9	30.0	0.1	32.5	46.5	36.5	31.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	9.0	25.7	4.1	25.9	30.0	0.1	32.5	46.5	36.5	31.5
Queue Length 50th (m)	4.5	127.8	1.3	12.0	99.7	0.0	10.6	61.7	3.7	22.6
Queue Length 95th (m)	10.3	192.2	6.7	28.9	#156.2	0.0	21.2	90.1	10.6	40.0
Internal Link Dist (m)		654.8			639.7			1312.7		782.8
Turn Bay Length (m)	90.0		38.0	164.0		27.0	74.0		72.0	
Base Capacity (vph)	477	1276	1157	222	785	683	376	553	136	436
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	0.14	0.67	0.06	0.42	0.77	0.03	0.17	0.64	0.16	0.36

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

2: Ninth Line & Bloomington Road

02/09/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	55	722	57	80	514	18	54	153	150	19	78	55
Future Volume (vph)	55	722	57	80	514	18	54	153	150	19	78	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.95	1.00	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	1.00	0.85	1.00	0.93		1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1456	1681	1509	1798	1532	1258	1770	1708		1556	1400	
Flt Permitted	0.27	1.00	1.00	0.23	1.00	1.00	0.66	1.00		0.28	1.00	
Satd. Flow (perm)	408	1681	1509	435	1532	1258	1225	1708		458	1400	
Peak-hour factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Adj. Flow (vph)	65	849	67	94	605	21	64	180	176	22	92	65
RTOR Reduction (vph)	0	0	20	0	0	10	0	30	0	0	22	0
Lane Group Flow (vph)	65	849	47	94	605	11	64	326	0	22	135	0
Confl. Peds. (#/hr)				10		16						
Heavy Vehicles (%)	24%	13%	7%	0%	24%	22%	2%	2%	4%	16%	7%	56%
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	1	6			2			8			4	
Permitted Phases	6		6	2		2	8			4		
Actuated Green, G (s)	60.5	60.5	60.5	50.5	50.5	50.5	23.7	23.7		22.7	22.7	
Effective Green, g (s)	60.5	60.5	60.5	50.5	50.5	50.5	23.7	23.7		22.7	22.7	
Actuated g/C Ratio	0.61	0.61	0.61	0.51	0.51	0.51	0.24	0.24		0.23	0.23	
Clearance Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
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)	312	1025	920	221	779	640	292	408		104	320	
v/s Ratio Prot	0.01	c0.50			0.39			c0.19			0.10	
v/s Ratio Perm	0.11		0.03	0.22		0.01	0.05			0.05		
v/c Ratio	0.21	0.83	0.05	0.43	0.78	0.02	0.22	0.80		0.21	0.42	
Uniform Delay, d1	10.4	15.3	7.8	15.3	19.8	12.1	30.3	35.5		31.0	32.7	
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	0.3	7.7	0.1	5.9	7.5	0.0	0.4	10.4		1.0	0.9	
Delay (s)	10.7	23.0	7.9	21.2	27.2	12.1	30.7	45.9		32.0	33.6	
Level of Service	B	C	A	C	C	B	C	D		C	C	
Approach Delay (s)		21.1			26.0			43.6			33.4	
Approach LOS		C			C			D			C	
Intersection Summary												
HCM 2000 Control Delay			27.7									C
HCM 2000 Volume to Capacity ratio			0.87									
Actuated Cycle Length (s)			99.2							20.0		
Intersection Capacity Utilization			115.8%									H
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

3: Site Access & Bloomington Road

02/09/2024

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	759	0	38	599	0	37
Future Volume (Veh/h)	759	0	38	599	0	37
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)	825	0	41	651	0	40
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			825	1558		825
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			825	1558		825
tC, single (s)			5.1	6.4		7.2
tC, 2 stage (s)						
tF (s)			3.1	3.5		4.2
p0 queue free %			92	100		84
cM capacity (veh/h)			504	115		256
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	825	692	40			
Volume Left	0	41	0			
Volume Right	0	0	40			
cSH	1700	504	256			
Volume to Capacity	0.49	0.08	0.16			
Queue Length 95th (m)	0.0	2.1	4.3			
Control Delay (s)	0.0	2.3	21.6			
Lane LOS	A		C			
Approach Delay (s)	0.0	2.3	21.6			
Approach LOS			C			
Intersection Summary						
Average Delay			1.6			
Intersection Capacity Utilization			72.7%	ICU Level of Service		C
Analysis Period (min)			15			

Appendix H – Capacity Analysis – Future Total 2034 – Option 1

HCM Unsignalized Intersection Capacity Analysis

1: Highway 48 & Bloomington Road

02/14/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Right Turn Channelized												
Traffic Volume (veh/h)	24	446	71	75	663	51	94	185	51	36	410	110
Future Volume (veh/h)	24	446	71	75	663	51	94	185	51	36	410	110
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	24	455	72	77	677	52	96	189	52	37	418	112
Approach Volume (veh/h)	551			806			337			567		
Crossing Volume (veh/h)	532			309			516			850		
High Capacity (veh/h)	910			1087			922			704		
High v/c (veh/h)	0.61			0.74			0.37			0.81		
Low Capacity (veh/h)	734			891			744			553		
Low v/c (veh/h)	0.75			0.90			0.45			1.03		
Intersection Summary												
Maximum v/c High	0.81											
Maximum v/c Low	1.03											
Intersection Capacity Utilization	76.1%			ICU Level of Service					D			

HCM 2010 Roundabout
1: Highway 48 & Bloomington Road

02/14/2024

Intersection									
Intersection Delay, s/veh	15.9								
Intersection LOS	C								
Approach	EB		WB		NB		SB		
Entry Lanes	2		2		2		2		
Conflicting Circle Lanes	2		2		2		2		
Adj Approach Flow, veh/h	551		806		337		567		
Demand Flow Rate, veh/h	767		1047		369		595		
Vehicles Circulating, veh/h	562		338		733		1089		
Vehicles Exiting, veh/h	1122		764		596		296		
Follow-Up Headway, s	3.186		3.186		3.186		3.186		
Ped Vol Crossing Leg, #/h	0		0		0		0		
Ped Cap Adj	1.000		1.000		1.000		1.000		
Approach Delay, s/veh	16.0		15.7		9.6		19.9		
Approach LOS	C		C		A		C		
Lane	Left	Right	Left	Right	Left	Right	Left	Right	
Designated Moves	LT	TR	LT	TR	LT	TR	LT	TR	
Assumed Moves	LT	TR	LT	TR	LT	TR	LT	TR	
RT Channelized									
Lane Util	0.469	0.531	0.470	0.530	0.469	0.531	0.471	0.529	
Critical Headway, s	4.293	4.113	4.293	4.113	4.293	4.113	4.293	4.113	
Entry Flow, veh/h	360	407	492	555	173	196	280	315	
Cap Entry Lane, veh/h	741	762	877	892	652	676	499	527	
Entry HV Adj Factor	0.719	0.717	0.770	0.770	0.916	0.912	0.952	0.954	
Flow Entry, veh/h	259	292	379	427	158	179	267	301	
Cap Entry, veh/h	533	547	675	686	597	617	475	503	
V/C Ratio	0.486	0.534	0.561	0.622	0.265	0.290	0.561	0.597	
Control Delay, s/veh	15.4	16.5	14.7	16.6	9.5	9.6	19.6	20.2	
LOS	C	C	B	C	A	A	C	C	
95th %tile Queue, veh	3	3	4	4	1	1	3	4	

Timings

2: Ninth Line & Bloomington Road

02/14/2024

										
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	93	529	50	120	664	22	58	60	23	145
Future Volume (vph)	93	529	50	120	664	22	58	60	23	145
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	NA
Protected Phases	1	6			2			8		4
Permitted Phases	6		6	2		2	8		4	
Detector Phase	1	6	6	2	2	2	8	8	4	4
Switch Phase										
Minimum Initial (s)	7.0	50.0	50.0	50.0	50.0	50.0	15.0	15.0	15.0	15.0
Minimum Split (s)	11.5	57.5	57.5	57.5	57.5	57.5	31.5	31.5	32.5	32.5
Total Split (s)	24.0	57.5	57.5	57.5	57.5	57.5	37.5	37.5	37.5	37.5
Total Split (%)	20.2%	48.3%	48.3%	48.3%	48.3%	48.3%	31.5%	31.5%	31.5%	31.5%
Yellow Time (s)	3.0	5.0	5.0	5.0	5.0	5.0	4.5	4.5	4.5	4.5
All-Red Time (s)	1.0	2.5	2.5	2.5	2.5	2.5	3.0	3.0	4.0	4.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	8.5	8.5
Lead/Lag	Lead			Lag	Lag	Lag				
Lead-Lag Optimize?	Yes			Yes	Yes	Yes				
Recall Mode	None	Max	Max	Max	Max	Max	None	None	None	None
Act Effect Green (s)	65.4	61.8	61.8	50.7	50.7	50.7	22.7	22.7	21.6	21.6
Actuated g/C Ratio	0.66	0.62	0.62	0.51	0.51	0.51	0.23	0.23	0.22	0.22
v/c Ratio	0.46	0.65	0.05	0.29	0.94	0.05	0.31	0.30	0.14	0.78
Control Delay	14.8	17.2	2.9	19.8	48.3	0.2	38.1	25.4	34.7	50.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.8	17.2	2.9	19.8	48.3	0.2	38.1	25.4	34.7	50.4
LOS	B	B	A	B	D	A	D	C	C	D
Approach Delay		15.8			42.7			29.7		49.1
Approach LOS		B			D			C		D

Intersection Summary

Cycle Length: 119

Actuated Cycle Length: 99.7

Natural Cycle: 105

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.94

Intersection Signal Delay: 33.0

Intersection LOS: C

Intersection Capacity Utilization 135.3%

ICU Level of Service H

Analysis Period (min) 15

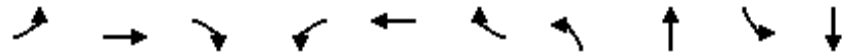
Splits and Phases: 2: Ninth Line & Bloomington Road

		
Ø1	Ø2	Ø4
24 s	57.5 s	37.5 s
		
Ø6		Ø8
57.5 s		37.5 s

Queues

2: Ninth Line & Bloomington Road

02/14/2024



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	97	551	52	125	692	23	60	118	24	254
v/c Ratio	0.46	0.65	0.05	0.29	0.94	0.05	0.31	0.30	0.14	0.78
Control Delay	14.8	17.2	2.9	19.8	48.3	0.2	38.1	25.4	34.7	50.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.8	17.2	2.9	19.8	48.3	0.2	38.1	25.4	34.7	50.4
Queue Length 50th (m)	6.8	64.7	0.2	14.8	132.8	0.0	10.4	14.1	4.1	44.7
Queue Length 95th (m)	16.1	120.7	5.1	34.7	#252.6	0.0	23.7	31.1	11.7	77.6
Internal Link Dist (m)		654.8			639.7			1312.7		782.8
Turn Bay Length (m)	90.0		38.0	164.0		27.0	74.0		72.0	
Base Capacity (vph)	291	1036	1137	425	737	496	256	512	231	434
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	0.33	0.53	0.05	0.29	0.94	0.05	0.23	0.23	0.10	0.59

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

2: Ninth Line & Bloomington Road

02/14/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	93	529	50	120	664	22	58	60	53	23	145	99
Future Volume (vph)	93	529	50	120	664	22	58	60	53	23	145	99
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.98	1.00	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	1.00	0.85	1.00	0.93		1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	976	1377	1495	1734	1450	892	1656	1603		1094	1410	
Flt Permitted	0.20	1.00	1.00	0.46	1.00	1.00	0.48	1.00		0.68	1.00	
Satd. Flow (perm)	205	1377	1495	836	1450	892	843	1603		784	1410	
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)	97	551	52	125	692	23	60	62	55	24	151	103
RTOR Reduction (vph)	0	0	19	0	0	11	0	27	0	0	21	0
Lane Group Flow (vph)	97	551	33	125	692	12	60	91	0	24	233	0
Confl. Peds. (#/hr)				1		1						
Heavy Vehicles (%)	85%	38%	8%	4%	31%	77%	9%	14%	6%	65%	3%	61%
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	1	6			2			8			4	
Permitted Phases	6		6	2		2	8			4		
Actuated Green, G (s)	62.8	62.8	62.8	50.7	50.7	50.7	22.6	22.6		21.6	21.6	
Effective Green, g (s)	62.8	62.8	62.8	50.7	50.7	50.7	22.6	22.6		21.6	21.6	
Actuated g/C Ratio	0.63	0.63	0.63	0.50	0.50	0.50	0.23	0.23		0.22	0.22	
Clearance Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
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)	190	861	935	422	732	450	189	360		168	303	
v/s Ratio Prot	0.04	c0.40			c0.48			0.06			c0.17	
v/s Ratio Perm	0.28		0.02	0.15		0.01	0.07			0.03		
v/c Ratio	0.51	0.64	0.04	0.30	0.95	0.03	0.32	0.25		0.14	0.77	
Uniform Delay, d1	12.8	11.7	7.2	14.5	23.5	12.5	32.5	32.0		31.9	37.0	
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	2.3	3.6	0.1	1.8	22.3	0.1	1.0	0.4		0.4	11.1	
Delay (s)	15.1	15.4	7.3	16.3	45.8	12.6	33.4	32.3		32.3	48.2	
Level of Service	B	B	A	B	D	B	C	C		C	D	
Approach Delay (s)		14.7			40.5			32.7			46.8	
Approach LOS		B			D			C			D	
Intersection Summary												
HCM 2000 Control Delay			31.7				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.88									
Actuated Cycle Length (s)			100.4				Sum of lost time (s)			20.0		
Intersection Capacity Utilization			135.3%				ICU Level of Service			H		
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

3: Site Access & Bloomington Road

02/14/2024

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↱			↰	↘	
Traffic Volume (veh/h)	518	38	0	863	37	0
Future Volume (Veh/h)	518	38	0	863	37	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)	563	41	0	938	40	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			604	1522	584	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			604	1522	584	
tC, single (s)			4.1	7.4	6.2	
tC, 2 stage (s)						
tF (s)			2.2	4.4	3.3	
p0 queue free %			100	49	100	
cM capacity (veh/h)			984	79	516	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	604	938	40			
Volume Left	0	0	40			
Volume Right	41	0	0			
cSH	1700	984	79			
Volume to Capacity	0.36	0.00	0.51			
Queue Length 95th (m)	0.0	0.0	17.1			
Control Delay (s)	0.0	0.0	90.3			
Lane LOS			F			
Approach Delay (s)	0.0	0.0	90.3			
Approach LOS			F			
Intersection Summary						
Average Delay			2.3			
Intersection Capacity Utilization			55.4%	ICU Level of Service		B
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

1: Highway 48 & Bloomington Road

02/14/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Right Turn Channelized												
Traffic Volume (veh/h)	79	708	97	48	486	52	68	389	91	52	258	33
Future Volume (veh/h)	79	708	97	48	486	52	68	389	91	52	258	33
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	81	730	100	49	501	54	70	401	94	54	266	34
Approach Volume (veh/h)	911			604			565			354		
Crossing Volume (veh/h)	369			552			865			620		
High Capacity (veh/h)	1036			895			695			848		
High v/c (veh/h)	0.88			0.67			0.81			0.42		
Low Capacity (veh/h)	846			721			545			679		
Low v/c (veh/h)	1.08			0.84			1.04			0.52		
Intersection Summary												
Maximum v/c High	0.88											
Maximum v/c Low	1.08											
Intersection Capacity Utilization	80.1%			ICU Level of Service			D					

HCM 2010 Roundabout
1: Highway 48 & Bloomington Road

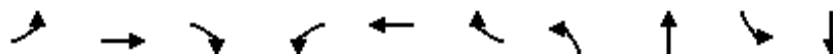
02/14/2024

Intersection									
Intersection Delay, s/veh	13.6								
Intersection LOS	B								
Approach	EB		WB		NB		SB		
Entry Lanes	2		2		2		2		
Conflicting Circle Lanes	2		2		2		2		
Adj Approach Flow, veh/h	911		604		565		354		
Demand Flow Rate, veh/h	1025		700		570		369		
Vehicles Circulating, veh/h	381		562		976		716		
Vehicles Exiting, veh/h	704		984		430		546		
Follow-Up Headway, s	3.186		3.186		3.186		3.186		
Ped Vol Crossing Leg, #/h	0		0		0		0		
Ped Cap Adj	1.000		1.000		1.000		1.000		
Approach Delay, s/veh	14.6		12.6		15.7		9.0		
Approach LOS	B		B		C		A		
Lane	Left	Right	Left	Right	Left	Right	Left	Right	
Designated Moves	LT	TR	LT	TR	LT	TR	LT	TR	
Assumed Moves	LT	TR	LT	TR	LT	TR	LT	TR	
RT Channelized									
Lane Util	0.470	0.530	0.470	0.530	0.470	0.530	0.469	0.531	
Critical Headway, s	4.293	4.113	4.293	4.113	4.293	4.113	4.293	4.113	
Entry Flow, veh/h	482	543	329	371	268	302	173	196	
Cap Entry Lane, veh/h	849	865	741	762	543	571	660	685	
Entry HV Adj Factor	0.888	0.889	0.863	0.863	0.991	0.992	0.962	0.957	
Flow Entry, veh/h	428	483	284	320	266	299	166	188	
Cap Entry, veh/h	754	769	639	658	538	566	635	655	
V/C Ratio	0.568	0.627	0.444	0.487	0.493	0.529	0.262	0.286	
Control Delay, s/veh	13.7	15.4	12.3	13.0	15.5	15.9	9.0	9.1	
LOS	B	C	B	B	C	C	A	A	
95th %tile Queue, veh	4	4	2	3	3	3	1	1	

Timings

2: Ninth Line & Bloomington Road

02/14/2024



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	55	769	57	80	534	18	54	169	19	87
Future Volume (vph)	55	769	57	80	534	18	54	169	19	87
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	NA
Protected Phases	1	6			2			8		4
Permitted Phases	6		6	2		2	8		4	
Detector Phase	1	6	6	2	2	2	8	8	4	4
Switch Phase										
Minimum Initial (s)	7.0	50.0	50.0	50.0	50.0	50.0	15.0	15.0	15.0	15.0
Minimum Split (s)	11.5	57.5	57.5	57.5	57.5	57.5	31.5	31.5	32.5	32.5
Total Split (s)	24.0	57.5	57.5	57.5	57.5	57.5	37.5	37.5	37.5	37.5
Total Split (%)	20.2%	48.3%	48.3%	48.3%	48.3%	48.3%	31.5%	31.5%	31.5%	31.5%
Yellow Time (s)	3.0	5.0	5.0	5.0	5.0	5.0	4.5	4.5	4.5	4.5
All-Red Time (s)	1.0	2.5	2.5	2.5	2.5	2.5	3.0	3.0	4.0	4.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	8.5	8.5
Lead/Lag	Lead			Lag	Lag	Lag				
Lead-Lag Optimize?	Yes			Yes	Yes	Yes				
Recall Mode	None	Max	Max	Max	Max	Max	None	None	None	None
Act Effect Green (s)	63.2	59.7	59.7	50.6	50.6	50.6	24.7	24.7	23.7	23.7
Actuated g/C Ratio	0.63	0.60	0.60	0.51	0.51	0.51	0.25	0.25	0.24	0.24
v/c Ratio	0.20	0.87	0.07	0.54	0.77	0.03	0.21	0.83	0.22	0.47
Control Delay	9.5	28.4	4.2	35.0	30.1	0.1	32.2	48.5	37.2	32.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	9.5	28.4	4.2	35.0	30.1	0.1	32.2	48.5	37.2	32.4
LOS	A	C	A	C	C	A	C	D	D	C
Approach Delay		25.7			29.8			46.1		33.0
Approach LOS		C			C			D		C

Intersection Summary

Cycle Length: 119

Actuated Cycle Length: 99.6

Natural Cycle: 105

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.87

Intersection Signal Delay: 31.3

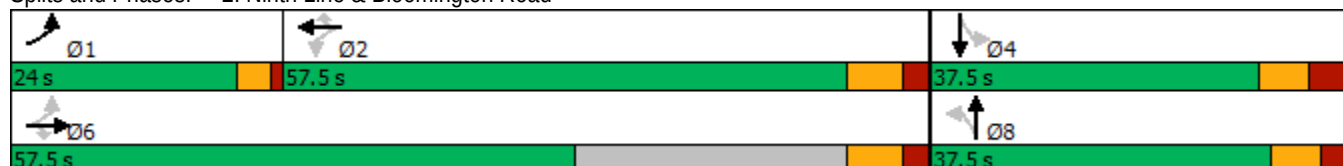
Intersection LOS: C

Intersection Capacity Utilization 116.6%

ICU Level of Service H

Analysis Period (min) 15

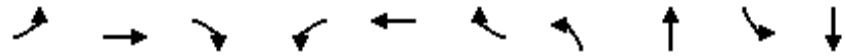
Splits and Phases: 2: Ninth Line & Bloomington Road



Queues

2: Ninth Line & Bloomington Road

02/14/2024



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	65	905	67	94	628	21	64	375	22	167
v/c Ratio	0.20	0.87	0.07	0.54	0.77	0.03	0.21	0.83	0.22	0.47
Control Delay	9.5	28.4	4.2	35.0	30.1	0.1	32.2	48.5	37.2	32.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	9.5	28.4	4.2	35.0	30.1	0.1	32.2	48.5	37.2	32.4
Queue Length 50th (m)	4.9	149.1	1.4	13.5	107.5	0.0	10.6	67.2	3.7	25.2
Queue Length 95th (m)	10.3	209.0	6.7	33.9	157.4	0.0	21.2	96.7	10.7	43.3
Internal Link Dist (m)	654.8				639.7		1312.7		782.8	
Turn Bay Length (m)	90.0			38.0	164.0			27.0	74.0	72.0
Base Capacity (vph)	458	1310	1146	174	817	677	369	548	123	435
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	0.14	0.69	0.06	0.54	0.77	0.03	0.17	0.68	0.18	0.38
Intersection Summary										

HCM Signalized Intersection Capacity Analysis

2: Ninth Line & Bloomington Road

02/14/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	55	769	57	80	534	18	54	169	150	19	87	55
Future Volume (vph)	55	769	57	80	534	18	54	169	150	19	87	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.95	1.00	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	1.00	0.85	1.00	0.93		1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1456	1743	1509	1799	1610	1257	1770	1716		1556	1419	
Flt Permitted	0.25	1.00	1.00	0.18	1.00	1.00	0.65	1.00		0.26	1.00	
Satd. Flow (perm)	377	1743	1509	345	1610	1257	1214	1716		421	1419	
Peak-hour factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Adj. Flow (vph)	65	905	67	94	628	21	64	199	176	22	102	65
RTOR Reduction (vph)	0	0	20	0	0	10	0	27	0	0	19	0
Lane Group Flow (vph)	65	905	47	94	628	11	64	348	0	22	148	0
Confl. Peds. (#/hr)				10		16						
Heavy Vehicles (%)	24%	9%	7%	0%	18%	22%	2%	2%	4%	16%	7%	56%
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	1	6			2			8			4	
Permitted Phases	6		6	2		2	8			4		
Actuated Green, G (s)	60.6	60.6	60.6	50.6	50.6	50.6	24.7	24.7		23.7	23.7	
Effective Green, g (s)	60.6	60.6	60.6	50.6	50.6	50.6	24.7	24.7		23.7	23.7	
Actuated g/C Ratio	0.60	0.60	0.60	0.50	0.50	0.50	0.25	0.25		0.24	0.24	
Clearance Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
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)	292	1053	911	174	812	634	298	422		99	335	
v/s Ratio Prot	0.01	c0.52			0.39			c0.20			0.10	
v/s Ratio Perm	0.12		0.03	0.27		0.01	0.05			0.05		
v/c Ratio	0.22	0.86	0.05	0.54	0.77	0.02	0.21	0.82		0.22	0.44	
Uniform Delay, d1	11.2	16.3	8.1	16.9	20.2	12.4	30.1	35.7		30.9	32.7	
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	0.4	9.1	0.1	11.5	7.1	0.0	0.4	12.3		1.1	0.9	
Delay (s)	11.6	25.5	8.2	28.4	27.3	12.5	30.4	48.1		32.0	33.6	
Level of Service	B	C	A	C	C	B	C	D		C	C	
Approach Delay (s)		23.5			27.0			45.5			33.4	
Approach LOS		C			C			D			C	
Intersection Summary												
HCM 2000 Control Delay			29.4									C
HCM 2000 Volume to Capacity ratio			0.90									
Actuated Cycle Length (s)			100.3							20.0		
Intersection Capacity Utilization			116.6%									H
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

3: Site Access & Bloomington Road

02/14/2024

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	851	38	0	672	37	0
Future Volume (Veh/h)	851	38	0	672	37	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)	925	41	0	730	40	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			966		1676	946
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			966		1676	946
tC, single (s)			4.1		7.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		4.4	3.3
p0 queue free %			100		35	100
cM capacity (veh/h)			721		61	320
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	966	730	40			
Volume Left	0	0	40			
Volume Right	41	0	0			
cSH	1700	721	61			
Volume to Capacity	0.57	0.00	0.65			
Queue Length 95th (m)	0.0	0.0	22.1			
Control Delay (s)	0.0	0.0	137.9			
Lane LOS			F			
Approach Delay (s)	0.0	0.0	137.9			
Approach LOS			F			
Intersection Summary						
Average Delay			3.2			
Intersection Capacity Utilization			57.1%		ICU Level of Service	
Analysis Period (min)			15		B	

Appendix I – Capacity Analysis – Future Total 2034 – Option 2

HCM Unsignalized Intersection Capacity Analysis

1: Highway 48 & Bloomington Road

02/14/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Right Turn Channelized												
Traffic Volume (veh/h)	24	408	71	75	626	51	94	185	51	36	410	110
Future Volume (veh/h)	24	408	71	75	626	51	94	185	51	36	410	110
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	24	416	72	77	639	52	96	189	52	37	418	112
Approach Volume (veh/h)	512				768				337		567	
Crossing Volume (veh/h)	532				309				477		812	
High Capacity (veh/h)	910				1087				951		726	
High v/c (veh/h)	0.56				0.71				0.35		0.78	
Low Capacity (veh/h)	734				891				770		572	
Low v/c (veh/h)	0.70				0.86				0.44		0.99	
Intersection Summary												
Maximum v/c High			0.78									
Maximum v/c Low			0.99									
Intersection Capacity Utilization			74.0%		ICU Level of Service				D			

HCM 2010 Roundabout

1: Highway 48 & Bloomington Road

02/14/2024

Intersection									
Intersection Delay, s/veh	14.1								
Intersection LOS	B								
Approach	EB		WB		NB		SB		
Entry Lanes	2		2		2		2		
Conflicting Circle Lanes	2		2		2		2		
Adj Approach Flow, veh/h	512		768		337		567		
Demand Flow Rate, veh/h	681		964		369		595		
Vehicles Circulating, veh/h	562		338		647		1006		
Vehicles Exiting, veh/h	1039		678		596		296		
Follow-Up Headway, s	3.186		3.186		3.186		3.186		
Ped Vol Crossing Leg, #/h	0		0		0		0		
Ped Cap Adj	1.000		1.000		1.000		1.000		
Approach Delay, s/veh	13.8		13.9		8.8		17.7		
Approach LOS	B		B		A		C		
Lane	Left	Right	Left	Right	Left	Right	Left	Right	
Designated Moves	LT	TR	LT	TR	LT	TR	LT	TR	
Assumed Moves	LT	TR	LT	TR	LT	TR	LT	TR	
RT Channelized									
Lane Util	0.470	0.530	0.470	0.530	0.469	0.531	0.471	0.529	
Critical Headway, s	4.293	4.113	4.293	4.113	4.293	4.113	4.293	4.113	
Entry Flow, veh/h	320	361	453	511	173	196	280	315	
Cap Entry Lane, veh/h	741	762	877	892	696	718	531	559	
Entry HV Adj Factor	0.752	0.751	0.797	0.796	0.916	0.912	0.952	0.954	
Flow Entry, veh/h	241	271	361	407	158	179	267	301	
Cap Entry, veh/h	557	573	699	710	637	655	506	533	
V/C Ratio	0.432	0.473	0.517	0.573	0.249	0.273	0.527	0.564	
Control Delay, s/veh	13.4	14.2	13.1	14.5	8.8	8.9	17.4	17.9	
LOS	B	B	B	B	A	A	C	C	
95th %tile Queue, veh	2	3	3	4	1	1	3	3	

Timings

2: Ninth Line & Bloomington Road

02/14/2024

										
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	93	566	50	120	702	22	58	60	23	145
Future Volume (vph)	93	566	50	120	702	22	58	60	23	145
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	NA
Protected Phases	1	6			2			8		4
Permitted Phases	6		6	2		2	8		4	
Detector Phase	1	6	6	2	2	2	8	8	4	4
Switch Phase										
Minimum Initial (s)	7.0	50.0	50.0	50.0	50.0	50.0	15.0	15.0	15.0	15.0
Minimum Split (s)	11.5	57.5	57.5	57.5	57.5	57.5	31.5	31.5	32.5	32.5
Total Split (s)	24.0	57.5	57.5	57.5	57.5	57.5	37.5	37.5	37.5	37.5
Total Split (%)	20.2%	48.3%	48.3%	48.3%	48.3%	48.3%	31.5%	31.5%	31.5%	31.5%
Yellow Time (s)	3.0	5.0	5.0	5.0	5.0	5.0	4.5	4.5	4.5	4.5
All-Red Time (s)	1.0	2.5	2.5	2.5	2.5	2.5	3.0	3.0	4.0	4.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	8.5	8.5
Lead/Lag	Lead			Lag	Lag	Lag				
Lead-Lag Optimize?	Yes			Yes	Yes	Yes				
Recall Mode	None	Max	Max	Max	Max	Max	None	None	None	None
Act Effect Green (s)	65.8	62.3	62.3	50.7	50.7	50.7	22.6	22.6	21.6	21.6
Actuated g/C Ratio	0.66	0.62	0.62	0.51	0.51	0.51	0.23	0.23	0.22	0.22
v/c Ratio	0.49	0.72	0.05	0.31	1.03	0.05	0.32	0.30	0.14	0.78
Control Delay	16.2	20.0	2.8	20.6	68.8	0.2	38.7	25.8	35.2	51.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.2	20.0	2.8	20.6	68.8	0.2	38.7	25.8	35.2	51.1
LOS	B	C	A	C	E	A	D	C	D	D
Approach Delay		18.3			60.2			30.1		49.7
Approach LOS		B			E			C		D

Intersection Summary

Cycle Length: 119

Actuated Cycle Length: 100.1

Natural Cycle: 105

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 1.03

Intersection Signal Delay: 41.3

Intersection LOS: D

Intersection Capacity Utilization 135.3%

ICU Level of Service H

Analysis Period (min) 15

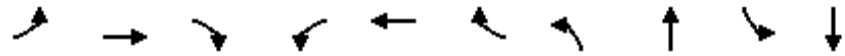
Splits and Phases: 2: Ninth Line & Bloomington Road

		
Ø1	Ø2	Ø4
24 s	57.5 s	37.5 s
		
Ø6		Ø8
57.5 s		37.5 s

Queues

2: Ninth Line & Bloomington Road

02/14/2024



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	97	590	52	125	731	23	60	118	24	254
v/c Ratio	0.49	0.72	0.05	0.31	1.03	0.05	0.32	0.30	0.14	0.78
Control Delay	16.2	20.0	2.8	20.6	68.8	0.2	38.7	25.8	35.2	51.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.2	20.0	2.8	20.6	68.8	0.2	38.7	25.8	35.2	51.1
Queue Length 50th (m)	6.8	75.2	0.2	14.8	~165.4	0.0	10.4	14.1	4.1	44.7
Queue Length 95th (m)	16.1	142.7	5.1	36.3	#285.5	0.0	24.2	31.8	12.0	79.3
Internal Link Dist (m)		654.8			639.7			1312.7		782.8
Turn Bay Length (m)	90.0		38.0	164.0		27.0	74.0		72.0	
Base Capacity (vph)	277	989	1133	409	712	495	255	511	230	433
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	0.35	0.60	0.05	0.31	1.03	0.05	0.24	0.23	0.10	0.59

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.

HCM Signalized Intersection Capacity Analysis

2: Ninth Line & Bloomington Road

02/14/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	93	566	50	120	702	22	58	60	53	23	145	99
Future Volume (vph)	93	566	50	120	702	22	58	60	53	23	145	99
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.98	1.00	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	1.00	0.85	1.00	0.93		1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	976	1319	1495	1734	1407	892	1656	1603		1094	1410	
Flt Permitted	0.17	1.00	1.00	0.44	1.00	1.00	0.48	1.00		0.68	1.00	
Satd. Flow (perm)	174	1319	1495	806	1407	892	840	1603		784	1410	
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)	97	590	52	125	731	23	60	62	55	24	151	103
RTOR Reduction (vph)	0	0	19	0	0	11	0	27	0	0	21	0
Lane Group Flow (vph)	97	590	33	125	731	12	60	91	0	24	233	0
Confl. Peds. (#/hr)				1		1						
Heavy Vehicles (%)	85%	44%	8%	4%	35%	77%	9%	14%	6%	65%	3%	61%
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	1	6			2			8			4	
Permitted Phases	6		6	2		2	8			4		
Actuated Green, G (s)	63.2	63.2	63.2	50.7	50.7	50.7	22.6	22.6		21.6	21.6	
Effective Green, g (s)	63.2	63.2	63.2	50.7	50.7	50.7	22.6	22.6		21.6	21.6	
Actuated g/C Ratio	0.63	0.63	0.63	0.50	0.50	0.50	0.22	0.22		0.21	0.21	
Clearance Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
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)	176	826	937	405	707	448	188	359		168	302	
v/s Ratio Prot	0.05	c0.45			c0.52			0.06			c0.17	
v/s Ratio Perm	0.30		0.02	0.15		0.01	0.07			0.03		
v/c Ratio	0.55	0.71	0.04	0.31	1.03	0.03	0.32	0.25		0.14	0.77	
Uniform Delay, d1	14.0	12.7	7.2	14.7	25.0	12.6	32.7	32.2		32.1	37.3	
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	3.7	5.2	0.1	2.0	42.9	0.1	1.0	0.4		0.4	11.5	
Delay (s)	17.7	17.9	7.2	16.7	67.9	12.7	33.7	32.5		32.5	48.8	
Level of Service	B	B	A	B	E	B	C	C		C	D	
Approach Delay (s)		17.2			59.2			32.9			47.4	
Approach LOS		B			E			C			D	
Intersection Summary												
HCM 2000 Control Delay			40.4									D
HCM 2000 Volume to Capacity ratio			0.94									
Actuated Cycle Length (s)			100.8							20.0		
Intersection Capacity Utilization			135.3%									H
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

3: Site Access & Bloomington Road

02/14/2024

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	518	0	38	863	0	37
Future Volume (Veh/h)	518	0	38	863	0	37
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)	563	0	41	938	0	40
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			563		1583	563
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			563		1583	563
tC, single (s)			5.1		6.4	7.2
tC, 2 stage (s)						
tF (s)			3.1		3.5	4.2
p0 queue free %			94		100	89
cM capacity (veh/h)			660		113	379
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	563	979	40			
Volume Left	0	41	0			
Volume Right	0	0	40			
cSH	1700	660	379			
Volume to Capacity	0.33	0.06	0.11			
Queue Length 95th (m)	0.0	1.6	2.8			
Control Delay (s)	0.0	1.9	15.6			
Lane LOS		A	C			
Approach Delay (s)	0.0	1.9	15.6			
Approach LOS			C			
Intersection Summary						
Average Delay			1.6			
Intersection Capacity Utilization			86.3%		ICU Level of Service	
Analysis Period (min)			15		E	

HCM Unsignalized Intersection Capacity Analysis

1: Highway 48 & Bloomington Road

02/14/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Right Turn Channelized												
Traffic Volume (veh/h)	79	670	97	48	449	52	68	389	91	52	258	33
Future Volume (veh/h)	79	670	97	48	449	52	68	389	91	52	258	33
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	81	691	100	49	463	54	70	401	94	54	266	34
Approach Volume (veh/h)	872			566			565			354		
Crossing Volume (veh/h)	369			552			826			582		
High Capacity (veh/h)	1036			895			718			874		
High v/c (veh/h)	0.84			0.63			0.79			0.41		
Low Capacity (veh/h)	846			721			565			702		
Low v/c (veh/h)	1.03			0.79			1.00			0.50		
Intersection Summary												
Maximum v/c High	0.84											
Maximum v/c Low	1.03											
Intersection Capacity Utilization	78.0%			ICU Level of Service					D			

HCM 2010 Roundabout

1: Highway 48 & Bloomington Road

02/14/2024

Intersection									
Intersection Delay, s/veh	12.0								
Intersection LOS	B								
Approach	EB		WB		NB		SB		
Entry Lanes	2		2		2		2		
Conflicting Circle Lanes	2		2		2		2		
Adj Approach Flow, veh/h	872		566		565		354		
Demand Flow Rate, veh/h	946		618		570		369		
Vehicles Circulating, veh/h	381		562		897		634		
Vehicles Exiting, veh/h	622		905		430		546		
Follow-Up Headway, s	3.186		3.186		3.186		3.186		
Ped Vol Crossing Leg, #/h	0		0		0		0		
Ped Cap Adj	1.000		1.000		1.000		1.000		
Approach Delay, s/veh	12.8		10.9		14.2		8.4		
Approach LOS	B		B		B		A		
Lane	Left	Right	Left	Right	Left	Right	Left	Right	
Designated Moves	LT	TR	LT	TR	LT	TR	LT	TR	
Assumed Moves	LT	TR	LT	TR	LT	TR	LT	TR	
RT Channelized									
Lane Util	0.470	0.530	0.469	0.531	0.470	0.530	0.469	0.531	
Critical Headway, s	4.293	4.113	4.293	4.113	4.293	4.113	4.293	4.113	
Entry Flow, veh/h	445	501	290	328	268	302	173	196	
Cap Entry Lane, veh/h	849	865	741	762	577	603	702	725	
Entry HV Adj Factor	0.921	0.922	0.917	0.915	0.991	0.992	0.962	0.957	
Flow Entry, veh/h	410	462	266	300	266	299	166	188	
Cap Entry, veh/h	782	798	680	697	571	598	676	694	
V/C Ratio	0.524	0.579	0.391	0.430	0.465	0.501	0.246	0.270	
Control Delay, s/veh	12.2	13.4	10.6	11.2	14.0	14.4	8.3	8.5	
LOS	B	B	B	B	B	B	A	A	
95th %tile Queue, veh	3	4	2	2	2	3	1	1	

Timings

2: Ninth Line & Bloomington Road

02/14/2024

										
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	55	806	57	80	572	18	54	169	19	87
Future Volume (vph)	55	806	57	80	572	18	54	169	19	87
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	NA
Protected Phases	1	6			2			8		4
Permitted Phases	6		6	2		2	8		4	
Detector Phase	1	6	6	2	2	2	8	8	4	4
Switch Phase										
Minimum Initial (s)	7.0	50.0	50.0	50.0	50.0	50.0	15.0	15.0	15.0	15.0
Minimum Split (s)	11.5	57.5	57.5	57.5	57.5	57.5	31.5	31.5	32.5	32.5
Total Split (s)	24.0	57.5	57.5	57.5	57.5	57.5	37.5	37.5	37.5	37.5
Total Split (%)	20.2%	48.3%	48.3%	48.3%	48.3%	48.3%	31.5%	31.5%	31.5%	31.5%
Yellow Time (s)	3.0	5.0	5.0	5.0	5.0	5.0	4.5	4.5	4.5	4.5
All-Red Time (s)	1.0	2.5	2.5	2.5	2.5	2.5	3.0	3.0	4.0	4.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	8.5	8.5
Lead/Lag	Lead			Lag	Lag	Lag				
Lead-Lag Optimize?	Yes			Yes	Yes	Yes				
Recall Mode	None	Max	Max	Max	Max	Max	None	None	None	None
Act Effect Green (s)	63.2	59.7	59.7	50.6	50.6	50.6	24.7	24.7	23.7	23.7
Actuated g/C Ratio	0.63	0.60	0.60	0.51	0.51	0.51	0.25	0.25	0.24	0.24
v/c Ratio	0.22	0.94	0.07	0.65	0.87	0.03	0.21	0.83	0.22	0.47
Control Delay	9.8	38.0	4.2	47.5	37.7	0.1	32.2	48.5	37.2	32.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	9.8	38.0	4.2	47.5	37.7	0.1	32.2	48.5	37.2	32.4
LOS	A	D	A	D	D	A	C	D	D	C
Approach Delay		34.2			37.8			46.1		33.0
Approach LOS		C			D			D		C

Intersection Summary

Cycle Length: 119

Actuated Cycle Length: 99.6

Natural Cycle: 105

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.94

Intersection Signal Delay: 37.4

Intersection LOS: D

Intersection Capacity Utilization 116.6%

ICU Level of Service H

Analysis Period (min) 15

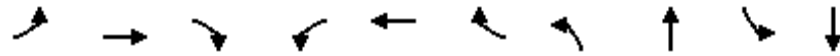
Splits and Phases: 2: Ninth Line & Bloomington Road

		
Ø1	Ø2	Ø4
24 s	57.5 s	37.5 s
		
Ø6		Ø8
57.5 s		37.5 s

Queues

2: Ninth Line & Bloomington Road

02/14/2024



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	65	948	67	94	673	21	64	375	22	167
v/c Ratio	0.22	0.94	0.07	0.65	0.87	0.03	0.21	0.83	0.22	0.47
Control Delay	9.8	38.0	4.2	47.5	37.7	0.1	32.2	48.5	37.2	32.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	9.8	38.0	4.2	47.5	37.7	0.1	32.2	48.5	37.2	32.4
Queue Length 50th (m)	4.9	172.4	1.4	14.7	125.4	0.0	10.6	67.2	3.7	25.2
Queue Length 95th (m)	10.3	#260.9	6.7	#42.8	#197.9	0.0	21.2	96.7	10.7	43.3
Internal Link Dist (m)		654.8			639.7			1312.7		782.8
Turn Bay Length (m)	90.0		38.0	164.0		27.0	74.0		72.0	
Base Capacity (vph)	436	1263	1146	144	777	677	369	548	123	435
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	0.15	0.75	0.06	0.65	0.87	0.03	0.17	0.68	0.18	0.38

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

2: Ninth Line & Bloomington Road

02/14/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	55	806	57	80	572	18	54	169	150	19	87	55
Future Volume (vph)	55	806	57	80	572	18	54	169	150	19	87	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.95	1.00	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	1.00	0.85	1.00	0.93		1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1456	1681	1509	1805	1532	1257	1770	1716		1556	1419	
Flt Permitted	0.21	1.00	1.00	0.15	1.00	1.00	0.65	1.00		0.26	1.00	
Satd. Flow (perm)	326	1681	1509	284	1532	1257	1214	1716		421	1419	
Peak-hour factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Adj. Flow (vph)	65	948	67	94	673	21	64	199	176	22	102	65
RTOR Reduction (vph)	0	0	20	0	0	10	0	27	0	0	19	0
Lane Group Flow (vph)	65	948	47	94	673	11	64	348	0	22	148	0
Confl. Peds. (#/hr)				10		16						
Heavy Vehicles (%)	24%	13%	7%	0%	24%	22%	2%	2%	4%	16%	7%	56%
Turn Type	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	1	6			2			8			4	
Permitted Phases	6		6	2		2	8			4		
Actuated Green, G (s)	60.6	60.6	60.6	50.6	50.6	50.6	24.7	24.7		23.7	23.7	
Effective Green, g (s)	60.6	60.6	60.6	50.6	50.6	50.6	24.7	24.7		23.7	23.7	
Actuated g/C Ratio	0.60	0.60	0.60	0.50	0.50	0.50	0.25	0.25		0.24	0.24	
Clearance Time (s)	4.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5		8.5	8.5	
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)	264	1015	911	143	772	634	298	422		99	335	
v/s Ratio Prot	0.01	c0.56			0.44			c0.20			0.10	
v/s Ratio Perm	0.13		0.03	0.33		0.01	0.05			0.05		
v/c Ratio	0.25	0.93	0.05	0.66	0.87	0.02	0.21	0.82		0.22	0.44	
Uniform Delay, d1	12.0	18.0	8.1	18.4	22.0	12.4	30.1	35.7		30.9	32.7	
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	0.5	16.2	0.1	21.2	12.9	0.0	0.4	12.3		1.1	0.9	
Delay (s)	12.5	34.3	8.2	39.6	34.9	12.5	30.4	48.1		32.0	33.6	
Level of Service	B	C	A	D	C	B	C	D		C	C	
Approach Delay (s)		31.3			34.9			45.5			33.4	
Approach LOS		C			C			D			C	
Intersection Summary												
HCM 2000 Control Delay			35.1		HCM 2000 Level of Service					D		
HCM 2000 Volume to Capacity ratio			0.96									
Actuated Cycle Length (s)			100.3		Sum of lost time (s)					20.0		
Intersection Capacity Utilization			116.6%		ICU Level of Service					H		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

3: Site Access & Bloomington Road

02/14/2024

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↰			↱	↘	↗
Traffic Volume (veh/h)	851	0	38	672	0	37
Future Volume (Veh/h)	851	0	38	672	0	37
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)	925	0	41	730	0	40
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			925		1737	925
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			925		1737	925
tC, single (s)			5.1		6.4	7.2
tC, 2 stage (s)						
tF (s)			3.1		3.5	4.2
p0 queue free %			91		100	82
cM capacity (veh/h)			454		88	220
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	925	771	40			
Volume Left	0	41	0			
Volume Right	0	0	40			
cSH	1700	454	220			
Volume to Capacity	0.54	0.09	0.18			
Queue Length 95th (m)	0.0	2.4	5.2			
Control Delay (s)	0.0	2.8	24.9			
Lane LOS		A	C			
Approach Delay (s)	0.0	2.8	24.9			
Approach LOS			C			
Intersection Summary						
Average Delay			1.8			
Intersection Capacity Utilization			76.4%	ICU Level of Service		D
Analysis Period (min)			15			

Appendix J – Capacity Analysis – 2034 Future Total – Sensitivity Analysis

HCM Unsignalized Intersection Capacity Analysis

3: Site Access & Bloomington Road

03/05/2024

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↱			↰	↘	
Traffic Volume (veh/h)	851	750	0	672	750	0
Future Volume (Veh/h)	851	750	0	672	750	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)	925	815	0	730	815	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			1740		2062	1332
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1740		2062	1332
tC, single (s)			4.1		7.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		4.4	3.3
p0 queue free %			100		0	100
cM capacity (veh/h)			366		32	190
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	1740	730	815			
Volume Left	0	0	815			
Volume Right	815	0	0			
cSH	1700	366	32			
Volume to Capacity	1.02	0.00	25.21			
Queue Length 95th (m)	0.0	0.0	Err			
Control Delay (s)	0.0	0.0	Err			
Lane LOS			F			
Approach Delay (s)	0.0	0.0	Err			
Approach LOS			F			
Intersection Summary						
Average Delay		2480.7				
Intersection Capacity Utilization		138.8%		ICU Level of Service		H
Analysis Period (min)		15				

Appendix K – Queueing Analysis – Future Total 2034

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	4:05	4:05	4:05	4:05	4:05	4:05
End Time	5:15	5:15	5:15	5:15	5:15	5:15
Total Time (min)	70	70	70	70	70	70
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	2915	3162	3085	3164	2952	3055
Vehs Exited	2934	3151	3096	3171	2960	3064
Starting Vehs	205	174	190	198	196	191
Ending Vehs	186	185	179	191	188	189
Travel Distance (km)	7938	8620	8330	8512	7937	8267
Travel Time (hr)	180.2	201.0	194.1	196.6	180.1	190.4
Total Delay (hr)	32.6	40.8	39.2	37.9	32.2	36.5
Total Stops	2379	2821	2692	2730	2367	2601
Fuel Used (l)	590.0	649.9	624.2	639.0	593.2	619.3

Interval #0 Information Seeding

Start Time	4:05
End Time	4:15
Total Time (min)	10
Volumes adjusted by Growth Factors.	
No data recorded this interval.	

Interval #1 Information Recording

Start Time	4:15
End Time	5:15
Total Time (min)	60
Volumes adjusted by Growth Factors.	

Run Number	1	2	3	4	5	Avg
Vehs Entered	2915	3162	3085	3164	2952	3055
Vehs Exited	2934	3151	3096	3171	2960	3064
Starting Vehs	205	174	190	198	196	191
Ending Vehs	186	185	179	191	188	189
Travel Distance (km)	7938	8620	8330	8512	7937	8267
Travel Time (hr)	180.2	201.0	194.1	196.6	180.1	190.4
Total Delay (hr)	32.6	40.8	39.2	37.9	32.2	36.5
Total Stops	2379	2821	2692	2730	2367	2601
Fuel Used (l)	590.0	649.9	624.2	639.0	593.2	619.3

Queuing and Blocking Report

Baseline

02-15-2024

Intersection: 1: Highway 48 & Bloomington Road

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	TR	LT	TR	LT	TR	LT	TR
Maximum Queue (m)	92.4	76.7	59.5	46.8	61.2	44.1	30.0	18.3
Average Queue (m)	47.3	26.9	30.2	11.4	29.9	12.5	14.9	3.8
95th Queue (m)	82.3	66.6	50.4	33.0	52.2	34.1	25.1	12.8
Link Distance (m)	343.3	343.3	203.3	203.3	327.8	327.8	225.2	225.2
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (m)								
Storage Blk Time (%)								
Queuing Penalty (veh)								

Intersection: 2: Ninth Line & Bloomington Road

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	R	L	T	R	L	TR	L	TR
Maximum Queue (m)	78.5	165.5	74.0	30.8	113.8	43.6	44.9	98.1	32.7	58.8
Average Queue (m)	12.5	79.3	13.7	14.6	56.7	3.7	12.3	49.3	6.4	25.8
95th Queue (m)	41.2	138.7	53.1	27.6	96.4	21.2	30.7	86.1	23.8	49.1
Link Distance (m)		660.3			651.5			1321.3		791.4
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (m)	90.0		38.0	164.0		27.0	74.0		72.0	
Storage Blk Time (%)		22			22	0		3	0	0
Queuing Penalty (veh)		25			21	0		2	0	0

Intersection: 3: Site Access & Bloomington Road

Movement	EB	NB
Directions Served	TR	LR
Maximum Queue (m)	1.3	51.1
Average Queue (m)	0.1	18.0
95th Queue (m)	1.3	42.0
Link Distance (m)	1141.4	444.3
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 47

Appendix L – Capacity Analysis – 2034 Future Total – Right Turn Taper

HCM Unsignalized Intersection Capacity Analysis

3: Site Access & Bloomington Road

03/05/2024

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	851	38	0	672	37	0
Future Volume (Veh/h)	851	38	0	672	37	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)	925	41	0	730	40	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			966		1655	925
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			966		1655	925
tC, single (s)			4.1		7.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		4.4	3.3
p0 queue free %			100		37	100
cM capacity (veh/h)			721		64	329
Direction, Lane #	EB 1	EB 2	WB 1	NB 1		
Volume Total	925	41	730	40		
Volume Left	0	0	0	40		
Volume Right	0	41	0	0		
cSH	1700	1700	721	64		
Volume to Capacity	0.54	0.02	0.00	0.63		
Queue Length 95th (m)	0.0	0.0	0.0	21.4		
Control Delay (s)	0.0	0.0	0.0	130.0		
Lane LOS				F		
Approach Delay (s)	0.0		0.0	130.0		
Approach LOS				F		
Intersection Summary						
Average Delay			3.0			
Intersection Capacity Utilization			54.8%	ICU Level of Service	A	
Analysis Period (min)			15			

Appendix M – Terms of Reference

520 Industrial Parkway South, Suite 201
Aurora, Ontario L4G 6W8

Phone: 905-503-2563
www.nexttrans.ca

nexttrans
CONSULTING ENGINEERS

NextEng Consulting Group Inc.

To: Shahid Matloob, Region of York
Monika Dhungana, Town of Whitchurch-Stouffville

From: Janus Mora, Nexttrans Consulting Engineers

Date: December 13, 2023

Re: **Terms of Reference – Transportation Impact Study and Functional Design**
Proposed Site Alteration and Fill Management
5783 Bloomington Road, Town of Whitchurch-Stouffville
Our Project No. NT-23-219

INTRODUCTION

We wish to confirm the following work plan for a proposed site alteration and fill management, located southwest of the intersection of Bloomington Road and Thornbay Drive, municipally known as 5783 Bloomington Road (herein referred to as “the subject site”), in the Town of Whitchurch-Stouffville, within York Region. The subject site is currently occupied by farm buildings. **Figure 1** illustrates the location of the subject site.

Figure 1: Subject Site Location



Based on discussions with the Client, the development proposal seeks to fill the existing site. Vehicular access is proposed via a full movement driveway onto Bloomington Road.

The TIS for the proposed will be conducted in accordance with the York Region Transportation Mobility Plan Guidelines dated November 2016. The following outlines the proposed Terms of Reference for the study.

STUDY AREA & TRAFFIC DATA

The study will assess the weekday AM and PM peak hours. The proposed study area will include the analysis of the following intersections:

- Bloomington Road / Highway 48 (unsignalized);
- Bloomington Road / Thornbay Drive (unsignalized);
- Bloomington Road / Ninth Line (signalized); and,
- Bloomington Road / Existing Site Access.

TRAFFIC ASSESSMENT

The study will focus on weekday AM and PM peak hour traffic operations. Synchro version 10 will be used to assess intersection operations during the peak hours.

BACKGROUND TRAFFIC

General Corridor Growth Rate – Nextrans will consult with Town/Region Transportation staff to establish corridor growth rates to apply to future traffic scenarios.

Road Network Improvements – Nextrans will note any road network improvements identified within the study area and account for any traffic diversions associated with these improvements within in our analysis.

Background Development Traffic – Nextrans requests that the Town of Whitchurch-Stouffville and Region of York provide the relevant background traffic documents of any additional background developments that are required for consideration in our TIS such as the Treasure Hill, Limen and LaFarge Sites in the surrounding area.

TRIP GENERATION, DISTRIBUTION, & ASSIGNMENT

Nextrans proposes to use the Institute of Transportation Engineers (ITE) Trip Generation Manual 11th Edition to determine the site traffic and newly added trips of the proposed development on the surrounding road network. The general trip distribution will be based on a review of 2016 Transportation Tomorrow Survey (TTS) data. Trip assignment will be completed accordingly to reflect the configuration of the proposed site accesses, turning restrictions, and logical routings.

FUTURE TRAFFIC SCENARIOS

Future background and future total analyses for the study area intersections will be conducted over a five (5)-year and 10-year horizon from the current year of 2023, for an analysis year of 2028 and a 2033.

REMEDIAL MEASURES

Under future total conditions, any through or shared through/turning movements at the studied intersections that exceed a V/C ratio of 0.90 or exclusive movements that exceed a V/C ratio of 1.00 will be identified. If remedial actions such as signal optimization are unsuccessful this will also be identified. If remedial measures are to be employed, a scenario will be provided demonstrating the change in intersection operations.

PARKING & LOADING

The site is currently subject to Town of Whitchurch-Stouffville Zoning By-law 2010-001, which will be reviewed for parking and loading requirements.

TRANSPORTATION DEMAND MANAGEMENT

A review of existing nearby transportation facilities and possible initiatives and policies to promote and encourage modes of transportation in lieu of single occupant vehicle (SOV) trips will be made to influence the travel behaviour of employees to reduce travel demand and create a more efficient transportation network.

We trust the enclosed sufficiently addresses your needs. Should you have any questions, please do not hesitate to contact the undersigned.

Yours truly,

NEXTRANS CONSULTING ENGINEERS

A handwritten signature in black ink, appearing to read 'Janus Mora', is positioned above the printed name.

Janus Mora, B.Eng.
Transportation Analyst

From: Schleihauf, David <David.Schleihauf@york.ca>
Sent: January 17, 2024 10:06 AM
To: Janus Mora
Cc: Bui, Vi; Richard Pernicky; Monika Dhungana
Subject: RE: Terms of Reference 5783 Bloomington Road

Hello Janus,

Please find our comments below regarding the TOR.

1. The transportation study shall be consistent with the Region's [Transportation Mobility Plan Guidelines](#) (November 2016) and the Region's [Access Guidelines](#) (November 2020).
2. Due to the volumes and the speed, exclusive turn lanes will be required on Bloomington Road at the access.
3. We accept growth calculations in three different ways, namely from historic AADT analysis, EMME model analysis or from recently approved studies in the area. Please document the approach used in the report.
4. The trip rate should be based on proxy site data, a first principles approach utilizing the maximum allowable fill, or a similar acceptable approach. We are not familiar with a suitable land use code in the ITE Trip Generation Manual.
5. Likewise, the TTS data may be useful for employee based trips, however, the truck trip distribution should be based on market research analysis, or a similar acceptable approach.
6. Traffic Counts, Signal Timings, model outputs, and historical AADTs or model outputs can be purchased through traffic.data@york.ca. (if needed).
7. As per the Region's [2023 10-Year Roads and Transit Capital Construction Program](#), there are no improvements planned in the vicinity of the site.
8. We defer to the Town to provide relevant background developments.

Please note, this is not an approval, the Region will provide additional detailed comments when a study is submitted for review.

Regards,

Our working hours may be different. Please do not feel obligated to reply outside of your scheduled working hours. Let's work together to help foster healthy work-life boundaries.

David Schleihauf, P.Eng. | Senior Transportation Planner, Transportation Development Planning,
Transportation & Infrastructure Planning Branch, Public Works Department

1-877-464-9675 ext. 77857

Our Mission: **Working together to serve our thriving communities – today and tomorrow**

From: Bui, Vi <Vi.Bui@york.ca>
Sent: Friday, January 12, 2024 7:55 AM
To: Schleihauf, David <David.Schleihauf@york.ca>
Cc: janus@nexttrans.ca
Subject: FW: Terms of Reference 5783 Bloomington Road

Hi David, please review.

From: Janus Mora <janus@nextrans.ca>
Sent: Thursday, January 11, 2024 5:32 PM
To: Matloob, Shahid <Shahid.Matloob@york.ca>
Cc: Bui, Vi <Vi.Bui@york.ca>
Subject: Terms of Reference 5783 Bloomington Road

CAUTION! This is an external email. Verify the sender's email address and carefully examine any links or attachments before clicking. If you believe this may be a phishing email, forward it to isitsafe@york.ca then delete it from your inbox. If you think you may have clicked on a phishing link, report it to the IT Service Desk, ext. 71111, and notify your supervisor immediately.

Hello,

Nextrans had submitted A terms of reference for a traffic study for an application located at 5783 Bloomington Road, in the Town of Whitchurch-Stouffville. I would like to ask for confirmation that it has been received.

Thanks,

Janus Mora, B.Eng., EIT
Transportation Analyst

o: 905-503-2563 ext.209
c: 647-463-5437
e: janus@nextrans.ca
w: www.nextrans.ca

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