



**277-279 Hazel Street
Waterloo**

Transportation Impact Brief

Paradigm Transportation Solutions Limited

2025-05
230707



Project Summary

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Client:

1000383288 Ontario Inc.

150 Consumer Road, Unit 303

Toronto, ON M2J 1P9

Consultant Project Team

Jim Mallett, M.A.Sc., P.Eng., PTOE

Andrew Steinsky, P.Eng., PTOE, PTP,
RSP1

**Paradigm Transportation
Solutions Limited**

5A-150 Pinebush Road
Cambridge ON N1R 8J8

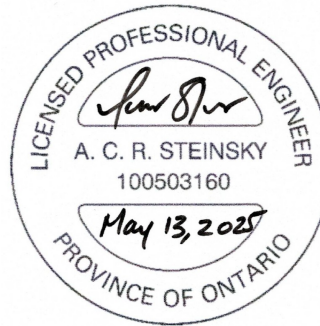
p: 519.896.3163

905.381.2229

416.479.9684

www.ptsl.com

277-279 Hazel Street, Waterloo Transportation Impact Brief



Andrew Steinsky, P.Eng., PTOE, PTP

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Executive Summary

Content

1000383288 Ontario Inc. retained Paradigm Transportation Solutions Limited (Paradigm) to prepare this Transportation Impact Brief (TIB) for a proposed residential development at 277-279 Hazel Street in the City of Waterloo.

The purpose of this study is to identify and assess the potential transportation impact(s) of the development and identify the need for, and type(s) of remedial measure(s) to support the development.

Development Concept

The site is on the west side of Hazel Street between Hickory Street West and Balsam Street. It comprises two lots, known municipally as 277 Hazel Street and 279 Hazel Street. Each lot is occupied by a single storey residential dwelling. Vehicle access to each lot is provided by an all-moves driveway connection to Hazel Street.

The property owner proposes to combine the land parcels, demolish the existing uses, and construct a six-storey residential building with 40 units comprising 40 bedrooms. Vehicle access is proposed via an all-moves driveway connection to Hazel Street, adjacent to the north property line.

Findings and Conclusions

Based on the analyses contained herein, the findings of this report are as follows:

- ▶ Under existing conditions, the study intersections (Albert Street and Hickory Street, and Hazel Street and Hickory Street) are operating at acceptable levels of service and within capacity. There are no critical movements.
- ▶ Redevelopment of the site is estimated to generate 15 trips in the weekday AM peak hour, and 16 trips in the weekday PM peak hour.
- ▶ Under 2030 background traffic conditions (that is, without the proposed development) all study intersections (except Albert Street and Hickory Street) are forecast to operate at acceptable levels of service and within capacity. In the PM peak hour, the eastbound and westbound approaches on Hickory Street at Albert Street are forecast to operate at LOS E and LOS F respectively, but with v/c ratios no greater than 0.75.



- ▶ Under 2030 total traffic conditions (that is, without the proposed development) all study intersections (except Albert Street and Hickory Street) are forecast to operate at acceptable levels of service and within capacity. In the PM peak hour, the eastbound and westbound approaches on Hickory Street at Albert Street are forecast to operate at LOS E and LOS F respectively, but with v/c ratios no greater than 0.78. The site driveway is forecast to operate at LOS A.
- ▶ All-way stop control and traffic control signals are not warranted at Albert Street and Hickory Street under existing, 2030 background, or 2030 total traffic conditions.

Based on the findings of this study, it is concluded that the proposed redevelopment is forecast to have a negligible impact on traffic operations at the study area intersections.

Recommendations

Based on the findings and conclusions of this study, it is recommended the site be considered for approval with no requirement for off-site transportation network improvements. It is recommended the City of Waterloo monitor vehicular and pedestrian volumes at Albert Street and Hickory Street to determine when, and if, other forms of traffic control are warranted.



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1 Introduction

1.1 Overview

1000383288 Ontario Inc. retained Paradigm Transportation Solutions Limited (Paradigm) to prepare this Transportation Impact Brief (TIB) for a proposed residential development at 277-279 Hazel Street in the City of Waterloo. **Figure 1.1** Illustrates the site location and study area.

1.2 Purpose and Scope

The purpose of this study is to identify and assess the potential transportation impact(s) of the development and identify the need for, and type(s) of remedial measure(s) to support the development.

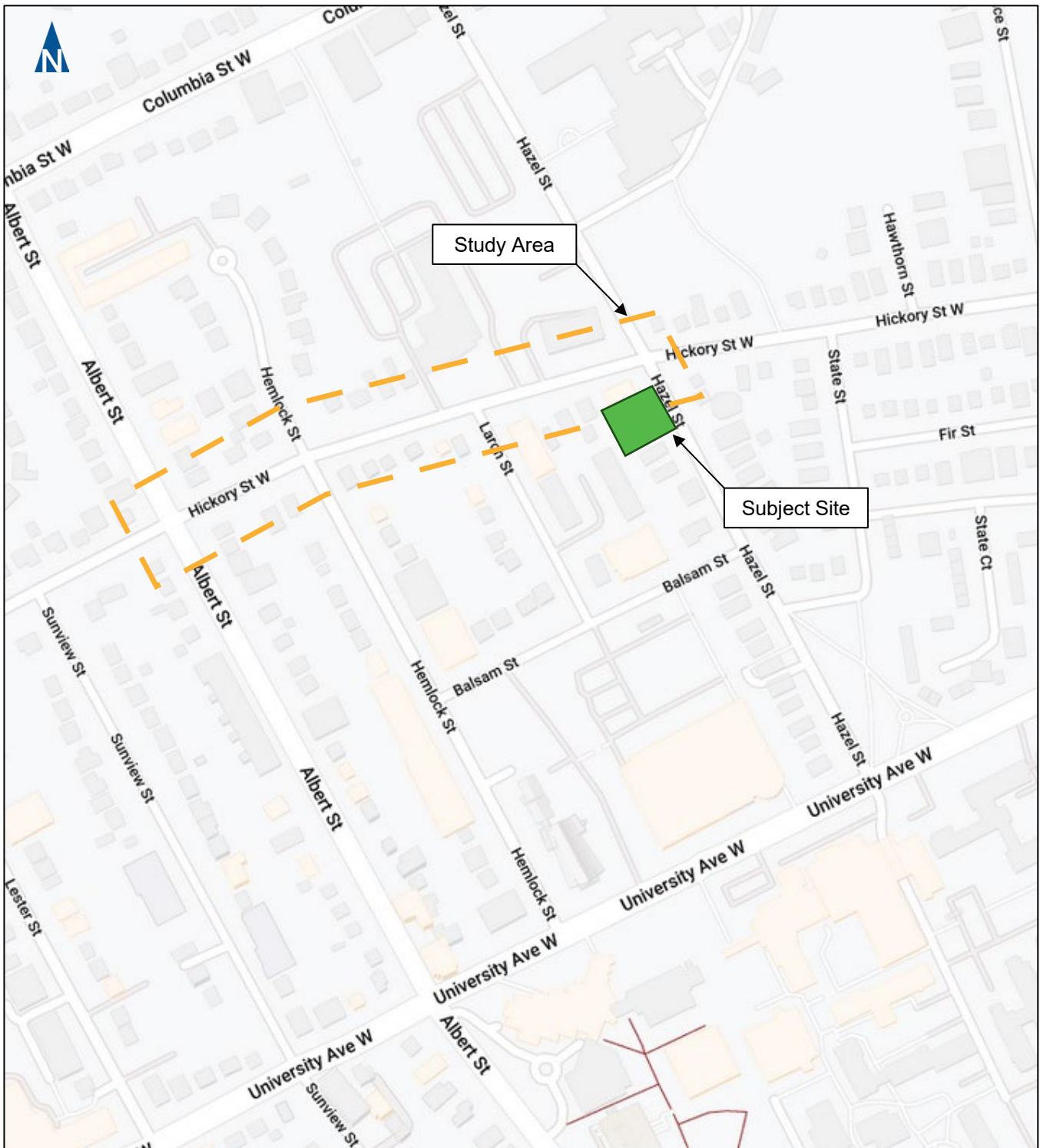
The study scope, developed in consultation with the City of Waterloo (the City) via email in February 2024, includes:

- ▶ An assessment of traffic operations at:
 - Albert Street and Hickory Street; and
 - Hazel Street and Hickory Street.
- ▶ Estimates of background traffic growth at a horizon years five years from the date of this study;
- ▶ Estimates of the trips generated by the expansion;
- ▶ Analyses of the impacts of the future traffic on the intersections noted above; and
- ▶ The identification of remedial measures, if necessary, to support the development.

Appendix A contains the pre-study consultation material and responses from the City. This study has been prepared in general accordance with the Region of Waterloo *Transportation Impact Study Guidelines*¹ any comments received from City staff during pre-study consultation.

¹ Region of Waterloo, *Transportation Impact Study Guidelines*, (Kitchener: Region of Waterloo, 2014).





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Site Location and Study Area

277-279 Hazel Street TIB
230707

Figure 1.1

2 Existing Conditions

2.1 Road Network

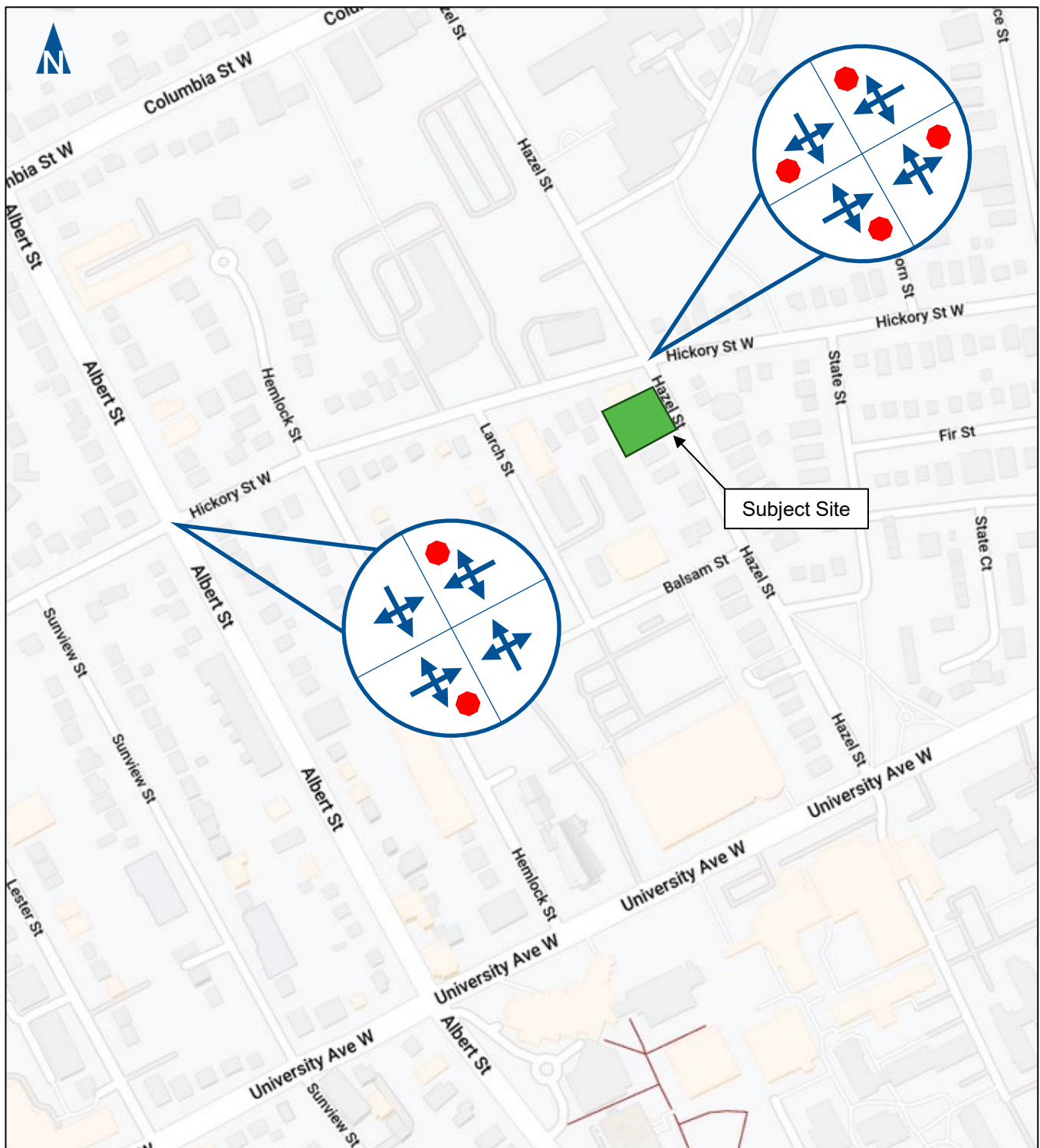
The primary roads in the study area comprise Albert Street, Hazel Street, and Hickory Street, all of which operate under City of Waterloo jurisdiction.² Each road is described as follows:

- ▶ **Albert Street** is a north-south, two-lane major collector road with an undivided urban cross-section. The speed limit is not posted and is assumed to be 50 km/h. Sidewalks are provided on both sides of the road between Columbia Street West and University Avenue West. Parking and stopping is not permitted on either side of the road between Columbia Street West and University Avenue West.
- ▶ **Hazel Street** is a north-south, two-lane minor collector road with an undivided urban cross-section. The posted speed limit is 30 km/h north of Hickory Street. South of Hickory Street, the road operates with an unposted speed limit of 50 km/h. Sidewalks are provided on both sides of the road between Columbia Street West and University Avenue West.
- ▶ **Hickory Street** is an east-west, two-lane local road with an undivided urban cross-section. The speed limit is not posted and is assumed to be 50 km/h. Sidewalks are provided on both sides of the road between Lester Street and King Street North. Parking is permitted on the south side of the road, but not on the north side.

Figure 2.1 illustrates the existing lane configurations and traffic at the study intersections.

² City of Waterloo, *Official Plan, Schedule E (Road Classification System)*, (Waterloo: City of Waterloo, 2018).





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Existing Lane Configurations and Traffic Control

2.2 Traffic Volumes

To assess intersection operations, turning movements counts are used to quantify the movement of vehicles through an intersection. Existing traffic data at an intersection or on a road segment forms the foundation for the analysis. The TMCs are usually conducted in such a manner to identify the peak periods at an intersection. This ensures the level of service analyses is conducted under an intersection's worst-case operating conditions.

Paradigm conducted turning movement counts at both study intersections on Wednesday February 28, 2024 from 7:00 AM to 10:00 AM, 11:30 AM to 1:30 PM, 3:00 PM to 6:00 PM. All vehicle, pedestrian, and cyclist movements were recorded in 15-minute intervals and vehicles classified by type. **Appendix B** contains the raw turning movement count data.

Figure 2.2 illustrates the existing weekday AM peak hour and weekday PM peak hour traffic volumes, respectively.

2.3 Traffic Operations

The quality of intersection operations at signalized and unsignalized intersections is evaluated in terms of level of service (LOS) and volume-to-capacity (v/c) as defined by the Highway Capacity Manual (HCM). LOS is evaluated based on the average control delay per vehicle and includes deceleration delay, queue move-up delay, stopped delay, and final acceleration delay. Volume-to-capacity is calculated as the ratio of the total vehicular volume demand for each movement as compared to the theoretical capacity for each movement.

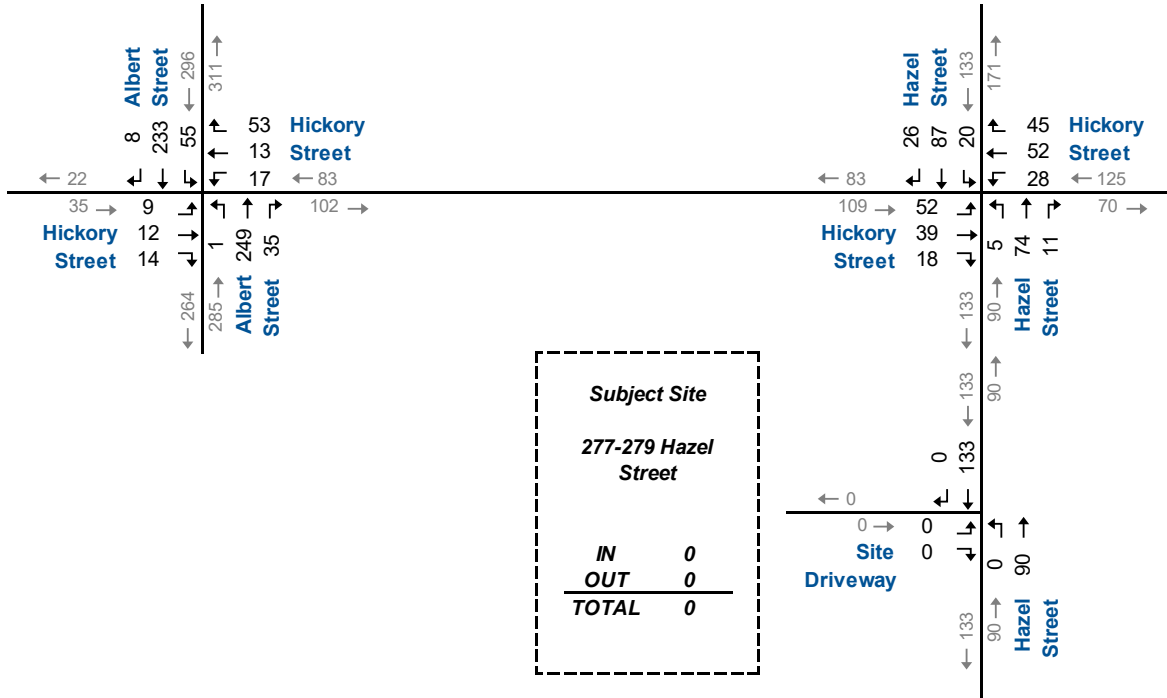
For signalized intersections, LOS ranges from LOS A (less than 10 seconds of average delay) to LOS F (greater than 80 seconds of average delay). For unsignalized intersections, LOS ranges from LOS A (less than 10 seconds of average delay) to LOS F (greater than 50 seconds of average delay). Capacity is evaluated in terms of the ratio of the traffic volume demand to the theoretical capacity, with an at capacity condition represented by a v/c ratio of 1.00 (that is, the volume demand equals the theoretical capacity).

Under City of Waterloo *Transportation Impact Study Guidelines* define critical intersections as those where the average control delay per vehicle is greater than 55 seconds (for signalized intersections) or 35 seconds (for unsignalized intersections). Both delays correspond to LOS E.

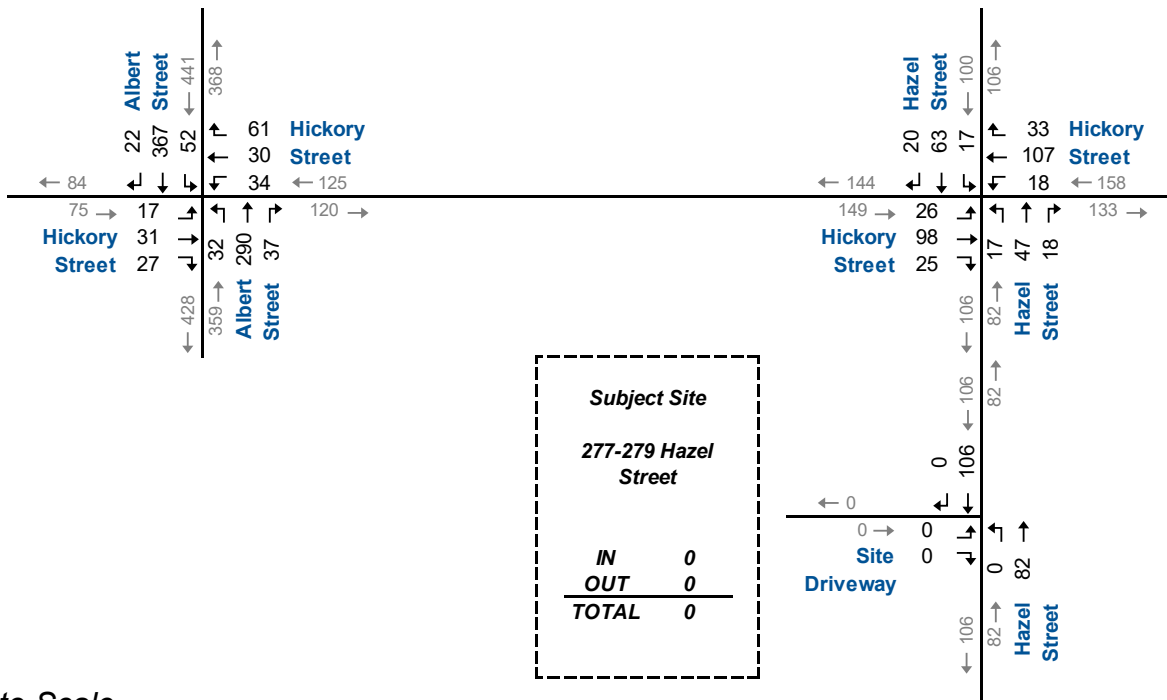




AM Peak Hour



PM Peak Hour



Not to Scale



Existing Traffic Volumes

Critical movements, regardless of control type, are defined as those where:

- ▶ The average control delay for individual movements is greater than 55 seconds;
- ▶ The estimated 95th percentile queue length for an exclusive movement exceeds the available lane storage;
- ▶ The estimated 95th percentile queue length for an individual movement blocks an existing access;
- ▶ Exclusive turning lanes are inaccessible because of queue lengths in adjacent through lanes; and/or
- ▶ Poor quality of service is provided to non-auto modes.

The operations of the study intersections have been modelled and analyzed using Synchro 11, which implements the methodology of the Highway Capacity Manual (HCM). The model reflects the following parameters:

- ▶ Existing lane configurations and traffic control;
- ▶ Saturation flow rates, and peak hour factors as defined in the Region of Waterloo *Transportation Impact Study Requirements for Capacity Analysis, Roundabouts, and Signal Warrants*³;
- ▶ Heavy vehicle percentages and pedestrian volumes as extracted from the turning movement counts;
- ▶ Synchro default values for all other inputs.

The operational analysis in this study considers three separate measures of effectiveness:

- ▶ The level of service (LOS) based on the average control delay or each vehicle, for each turning movement;
- ▶ The volume-to-capacity (v/c) ratio for each movement: and
- ▶ The estimated 95th percentile queue length(s).

Table 2.1 summarizes the existing intersection operations. The analysis indicates both study intersections are operating at acceptable levels of service and within capacity. There are no critical movements. **Appendix C** contains the supporting detailed Synchro reports.

³ Region of Waterloo, *Transportation Impact Studies (TIS) Requirements for Capacity Analysis, Roundabouts, Signal Warrants*, (Kitchener: Region of Waterloo, n.d.).



TABLE 2.1: EXISTING TRAFFIC OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Albert Strete and Hickory Street	TWSC	LOS	<	B	>	B	<	B	>	B	<	A	>	A	<	A	>	A	
			Delay	<	14	>	14	<	13	>	13	<	8	>	8	<	8	>	2	
			V/C	<	0.08	>		<	0.16	>		<	0.00	>		<	0.05	>		
			Q	<	2	>		<	5	>		<	0	>		<	1	>		
PM Peak Hour	Hazel Street and Hickory Street	AWSC	Ex	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail.	<	-	>		<	-	>		<	-	>		<	-	>		
			LOS	<	A	>	A	<	A	>	A	<	A	>	A	<	A	>	A	A
			Delay	<	9	>	9	<	8	>	8	<	9	>	9	<	9	>	9	
AM Peak Hour	Albert Strete and Hickory Street	TWSC	V/C	<	0.14	>		<	0.15	>		<	0.12	>		<	0.17	>		
			Q	<	1	>		<	1	>		<	0	>		<	1	>		
			Ex	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail.	<	-	>		<	-	>		<	-	>		<	-	>		
PM Peak Hour	Hazel Street and Hickory Street	AWSC	LOS	<	C	>	C	<	D	>	D	<	A	>	A	<	A	>	A	
			Delay	<	25	>	25	<	27	>	27	<	8	>	1	<	8	>	1	
			V/C	<	0.29	>		<	0.44	>		<	0.03	>		<	0.05	>		
			Q	<	9	>		<	16	>		<	1	>		<	1	>		
PM Peak Hour	Albert Strete and Hickory Street	TWSC	Ex	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail.	<	-	>		<	-	>		<	-	>		<	-	>		
			LOS	<	A	>	A	<	A	>	A	<	A	>	A	<	A	>	A	A
			Delay	<	9	>	9	<	9	>	9	<	8	>	8	<	8	>	8	
PM Peak Hour	Hazel Street and Hickory Street	AWSC	V/C	<	0.18	>		<	0.19	>		<	0.11	>		<	0.13	>		
			Q	<	1	>		<	1	>		<	0	>		<	0	>		
			Ex	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail.	<	-	>		<	-	>		<	-	>		<	-	>		

MOE - Measure of Effectiveness

LOS - Level of Service

Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)

Ex. - Existing Available Storage (m)

Avail. - Available Storage (m)

TWSC - Two-Way Stop Control

AWSC - All-Way Stop Control

<- Shared Left/Through Lane

>- Shared Right/Through Lane



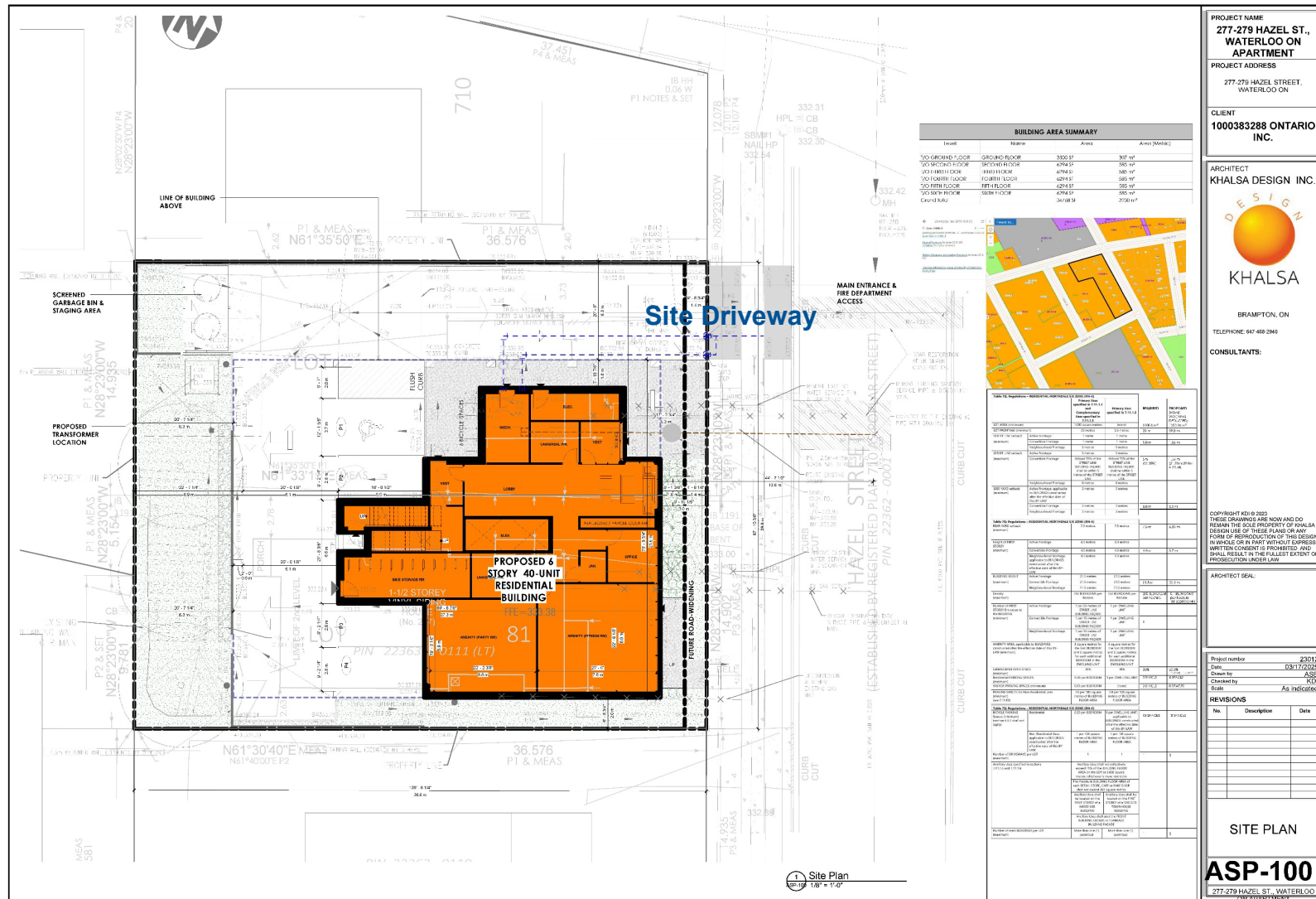
3 Development Concept

The site is on the west side of Hazel Street between Hickory Street West and Balsam Street. It comprises two lots, known municipally as 277 Hazel Street and 279 Hazel Street. Each lot is occupied by a single storey residential dwelling. Vehicle access to each lot is provided by an all-moves driveway connection to Hazel Street.

The surrounding land uses are generally residential, except for some institutional land uses on both sides of Hazel Street, north of Hickory Street, namely Waterloo Collegiate Institute and the Northdale Science Research Centre.

The property owner proposes to combine the land parcels, demolish the existing uses, and construct a six-storey residential building with 40 units comprising 40 bedrooms. Vehicle access is proposed via an all-moves driveway connection to Hazel Street, adjacent to the north property line. **Figure 3.1** illustrates the proposed concept plan. Build-out is estimated before 2030.





4 Future Conditions

4.1 Horizon Years

Consistent with the Region of Waterloo *Transportation Impact Study Guidelines*⁴ the forecasting and analysis of future traffic conditions reflects a horizon year five years from the date of this study, representative of 2030.

4.2 Forecast Background Traffic

The future traffic volumes are estimated to consist of non-site traffic (background traffic) and traffic generated by the subject site.

Background traffic volumes reflect an annual growth rate of 2% compounded per annum applied to all existing movements. This rate is intended to capture future traffic generated by development outside of the study area. City of Waterloo staff confirmed the use of this growth rate during pre-study consultation.

The forecast background traffic volumes also include traffic generated by three in-stream or approved developments, identified by City staff during pre-study consultation. All three sites are proposed as six-storey apartment buildings with varying numbers of residential units. The traffic assignments for each site have been extracted from the respective transportation impact studies for each site:

- ▶ 34-38 Hickory Street (47 units)⁵;
- ▶ 309-311 Hawthorn Street (55 units)⁶; and
- ▶ 83-85 Hickory Street and 265-267 Hemlock Street (168 units).⁷

Appendix D contains the background development traffic volumes. **Figure 4.1** illustrates the forecast 2030 background traffic volumes.

⁴ Region of Waterloo, *Transportation Impact Study Guidelines*, (Kitchener: Region of Waterloo, 2014), 7.

⁵ Paradigm Transportation Solutions Limited, *34-38 Hickory Street Transportation Impact Study*, (Cambridge: PTSL, 2021).

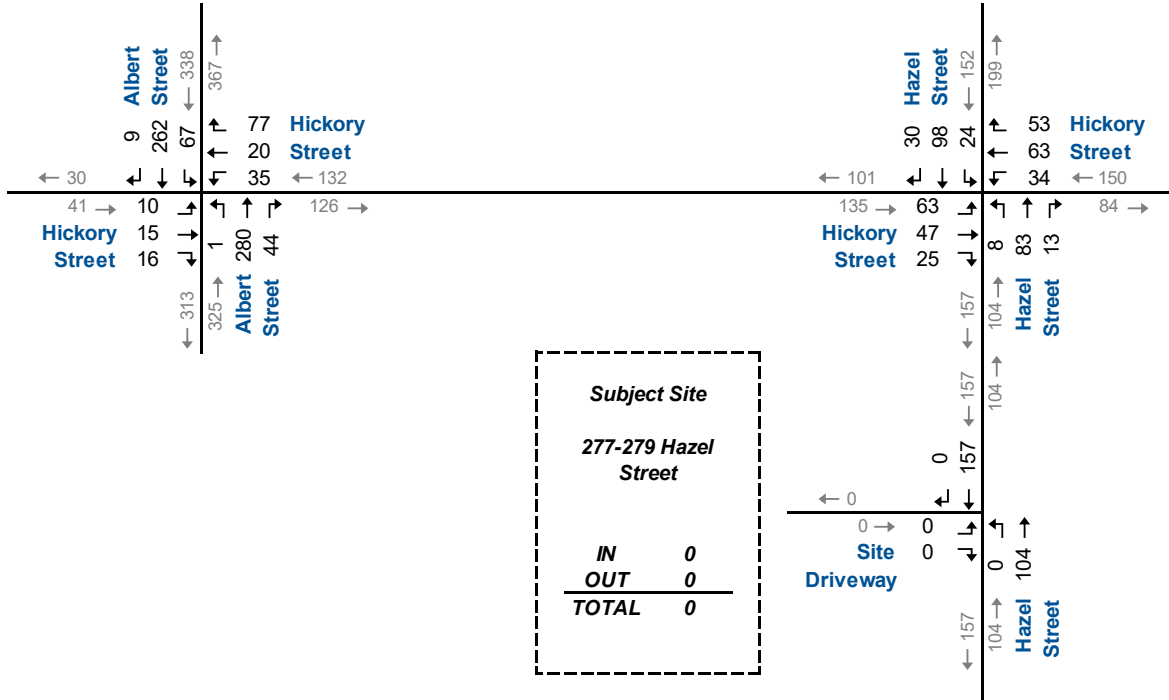
⁶ WSP, *Proposed Residential Development at 309-311 Hawthorn Street, City of Waterloo, Transportation Impact Study*, (Thornhill: WSP, 2022).

⁷ Paradigm Transportation Solutions Limited, *83-85 Hickory Street and 265-267 Hemlock Street Transportation Impact Study*, (Cambridge: PTSL, 2022).

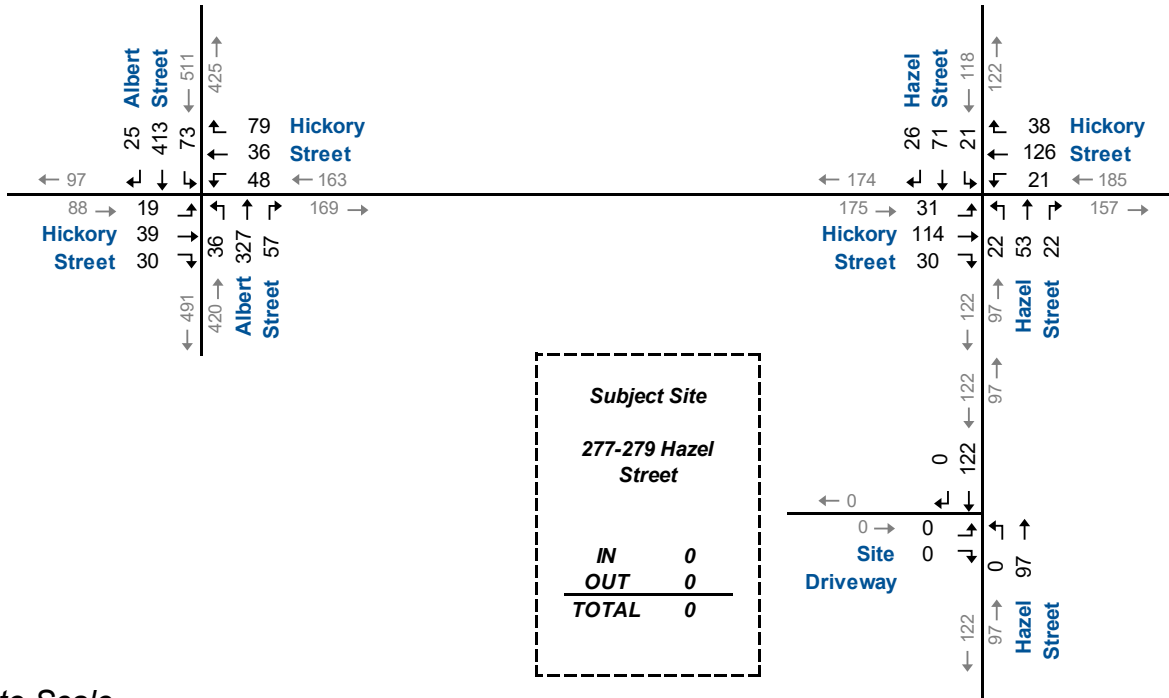




AM Peak Hour



PM Peak Hour



Not to Scale



2030 Background Traffic Volumes

4.3 Forecast Site Traffic

4.3.1 Trip Generation

The site trip generation reflects information in the Institute of Transportation Engineers (ITE) *Trip Generation Manual*⁸ for land use code 221 (Multifamily Housing, Mid-Rise). LUC 221 is described as “apartments and condominiums located in a building that has between four and ten floors of living space. Access to individual dwelling units is through an outside building entrance, a lobby, elevator, and a set of hallways.” ITE does not publish trip generation rates per bedroom, therefore, Paradigm has relied on the trip generation rates published per unit.

Table 4.1 summarizes the estimated trip generation based on the number of dwelling units. The site is estimated to generate 15 trips in the weekday AM peak hour and 16 trips in the weekday PM peak hour. **Appendix E** contains the ITE trip generation worksheets extracted from the *Trip Generation Manual*.

TABLE 4.1: ESTIMATED TRIP GENERATION

LUC	AM Peak Hour				PM Peak Hour			
	Rate	In	Out	Total	Rate	In	Out	Total
LUC 221 (40 units)	0.37	3	12	15	0.39	10	6	16

Notes:

1. Average Rate: 0.37 trips per dwelling unit (23% entering, 77% exiting)
2. Average Rate: 0.39 trips per dwelling unit (61% entering, 39% exiting)

4.3.2 Trip Distribution and Assignment

The estimated trip distribution is based on the existing travel patterns documented in the turning movement count data. The use of existing travel patterns is considered appropriate based on the consistency between the proposed residential land use, and the surrounding land uses, which are predominantly residential. **Table 4.2** summarizes the estimated trip distribution.

Figure 4.2 illustrates the estimated site traffic assignment in the weekday AM peak hour and weekday PM peak hour. Site generated traffic volumes have been assigned to the study area road network based on the most logical routing to and from the subject site.

⁸ Institute of Transportation Engineers, *Trip Generation Manual*, 11th ed., (Washington, DC: ITE, 2021).



TABLE 4.2: ESTIMATED TRIP DISTRIBUTION

Origin/Destination	AM Peak Hour		PM Peak Hour	
	In	Out	In	Out
North via Albert Street	30%	30%	35%	30%
North via Hazel Street	15%	20%	10%	10%
South via Albert Street	30%	25%	30%	35%
South via Hazel Street	5%	15%	5%	10%
East via Hickory Street	15%	5%	15%	10%
West via Hickory Street	5%	0%	5%	5%
Total	100%	100%	100%	100%

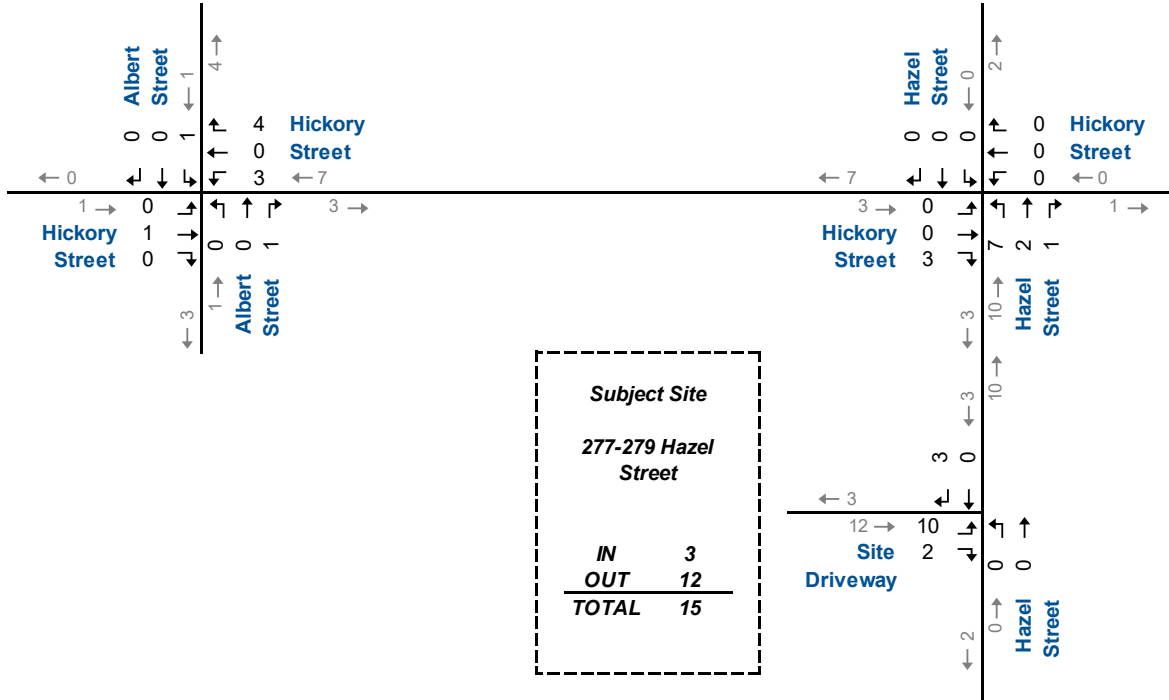
4.4 Future Total Traffic

Figure 4.3 illustrates the forecast 2030 total (background and site traffic) traffic volumes.

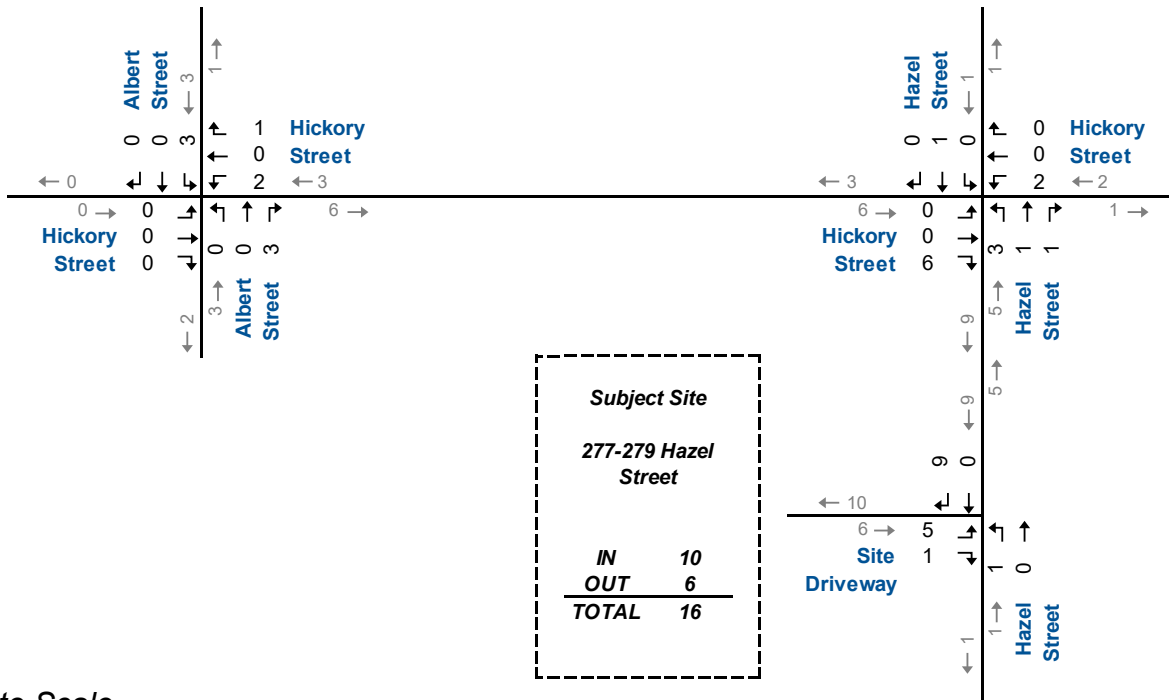




AM Peak Hour



PM Peak Hour



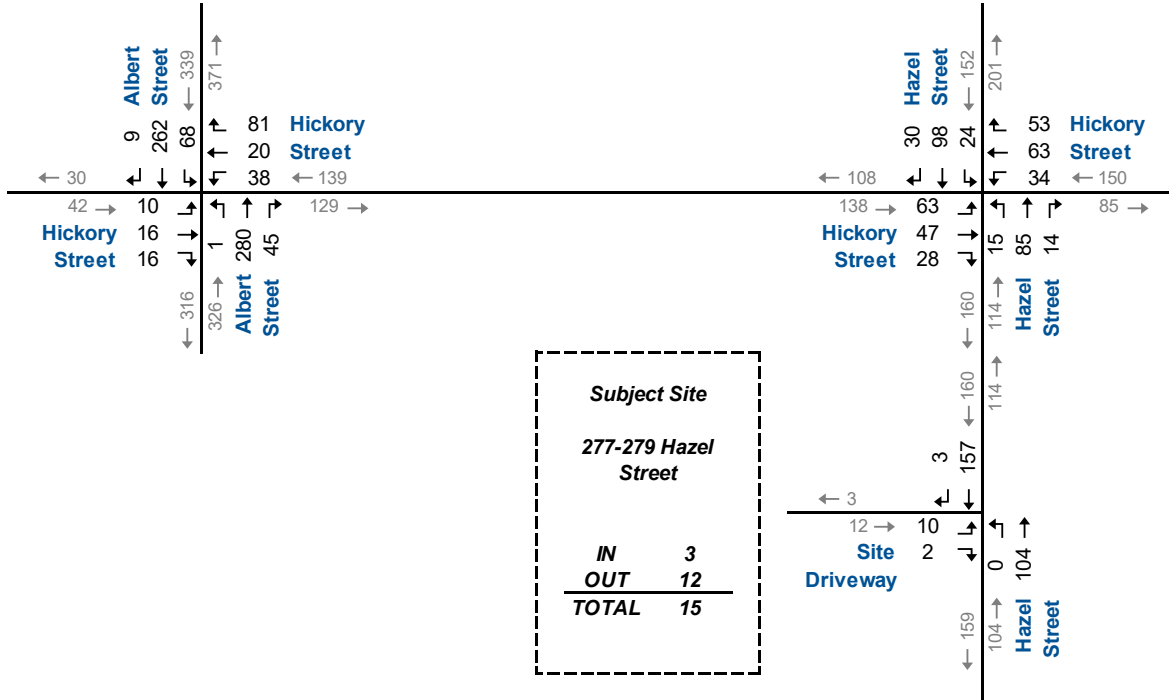
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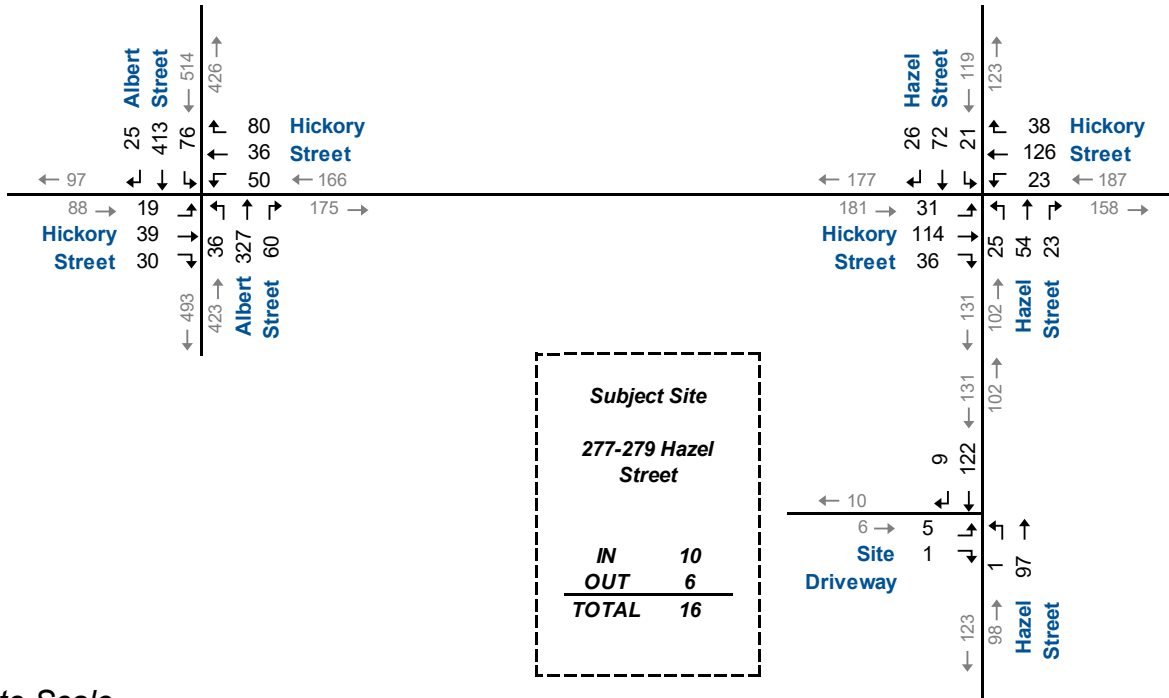
Site Generated Traffic Volumes



AM Peak Hour



PM Peak Hour



Not to Scale



2030 Total Traffic Volumes

5 Traffic Operations Assessment

5.1 2030 Background Traffic

The analysis of 2030 background traffic conditions follow the same methodology used for existing traffic conditions. **Table 5.1** summarizes the forecast intersection operations; critical movements are noted in yellow. All study intersections (except Albert Street and Hickory Street) are forecast to operate at acceptable levels of service and within capacity.

In the PM peak hour, the eastbound and westbound approaches on Hickory Street at Albert Street are forecast to operate at LOS E and LOS F, respectively. However, both approaches are forecast to operate with v/c ratios no greater than 0.75. This combination of level of service and v/c ratio indicates the volume of traffic on Albert Street provides limited opportunities for side-street traffic to enter the traffic stream. The shared lane configuration also results in delays for left and through movements imparted onto right-turning movements.

Appendix F contains the supporting detailed Synchro reports.

5.2 2030 Total Traffic

The analysis of 2030 total traffic conditions follow the same methodology used for existing and background conditions. **Table 5.2** summarizes the forecast intersection operations; critical movements are noted in yellow. Like the 2030 future background conditions, all study intersections (except Albert Street and Hickory Street) are forecast to operate at acceptable levels of service and within capacity. The site driveway is forecast to operate at LOS A in both the weekday AM peak hour and weekday PM peak hour.

In the PM peak hour, the eastbound and westbound approaches on Hickory Street at Albert Street are forecast to operate at LOS E and LOS F, respectively. However, both approaches are forecast to operate with v/c ratios no greater than 0.78 (an increase of 0.03 from 2030 background conditions). This combination of level of service and v/c ratio indicates the volume of traffic on Albert Street provides limited opportunity for side-street traffic to enter the traffic stream. The shared lane configuration on Hazel Street also results in delays for left and through movements imparted onto right-turning movements.

Appendix G contains the detailed Synchro reports.



TABLE 5.1: 2030 BACKGROUND TRAFFIC OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Albert Strete and Hickory Street	TWSC	LOS	<	C	>	C	<	C	>	C	<	A	>	A	<	A	>	A	
			Delay	<	17	>	17	<	17	>	17	<	8	>	8	<	8	>	2	
			V/C	<	0.12	>		<	0.30	>		<	0.00	>		<	0.06	>		
			Q	<	3	>		<	9	>		<	0	>		<	2	>		
PM Peak Hour	Albert Strete and Hickory Street	TWSC	Ex	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail.	<	-	>		<	-	>		<	-	>		<	-	>		
			LOS	<	A	>	A	<	A	>	A	<	A	>	A	<	A	>	A	A
			Delay	<	9	>	9	<	9	>	9	<	9	>	9	<	9	>	9	9
AM Peak Hour	Hazel Street and Hickory Street	AWSC	V/C	<	0.18	>		<	0.19	>		<	0.15	>		<	0.20	>		
			Q	<	1	>		<	1	>		<	1	>		<	1	>		
			Ex	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail.	<	-	>		<	-	>		<	-	>		<	-	>		
PM Peak Hour	Albert Strete and Hickory Street	TWSC	LOS	<	E	>	E	<	F	>	F	<	A	>	A	<	A	>	A	
			Delay	<	38	>	38	<	58	>	58	<	9	>	1	<	9	>	1	
			V/C	<	0.45	>		<	0.75	>		<	0.03	>		<	0.07	>		
			Q	<	16	>		<	38	>		<	1	>		<	2	>		
PM Peak Hour	Hazel Street and Hickory Street	AWSC	Ex	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail.	<	-	>		<	-	>		<	-	>		<	-	>		
			LOS	<	A	>	A	<	A	>	A	<	A	>	A	<	A	>	A	A
			Delay	<	9	>	9	<	9	>	9	<	9	>	9	<	9	>	9	9
PM Peak Hour	Hazel Street and Hickory Street	AWSC	V/C	<	0.22	>		<	0.23	>		<	0.13	>		<	0.16	>		
			Q	<	1	>		<	1	>		<	0	>		<	1	>		
			Ex	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail.	<	-	>		<	-	>		<	-	>		<	-	>		

MOE - Measure of Effectiveness

LOS - Level of Service

Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)

Ex. - Existing Available Storage (m)

Avail. - Available Storage (m)

TWSC - Two-Way Stop Control

AWSC - All-Way Stop Control

<- Shared Left/Through Lane

>- Shared Right/Through Lane



TABLE 5.2: 2030 TOTAL TRAFFIC OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Albert Strete and Hickory Street	TWSC	LOS Delay V/C Q Ex Avail.	< < < < <	C 17 0.12 3 -	> > > > >	C 17	< < < < <	C 17 0.32 11 -	> > > > >	C 17	< < < < <	A 8 0.00 0 -	> > > > >	A 0	< < < < <	A 8 0.06 2 -	> > > > >	A 2	
	Hazel Street and Hickory Street	AWSC	LOS Delay V/C Q Ex Avail.	< < < < <	A 9 0.19 1 -	> > > > >	A 9	< < < < <	A 9 0.19 1 -	> > > > >	A 9	< < < < <	A 9 0.16 1 -	> > > > >	A 9	< < < < <	A 9 0.21 1 -	> > > > >	A 9	A 9
	Hazel Street and Site Driveway	TWSC	LOS Delay V/C Q Ex Avail.	A 10 0.02 0 -	< < < < <	> > > > >	A 10	<				< < < < <	A 0 0.00 0 -	> > > > >	A 0	< < < < <	A 0 0.00 0 -	> > > > >	A 0	
PM Peak Hour	Albert Strete and Hickory Street	TWSC	LOS Delay V/C Q Ex Avail.	< < < < <	E 39 0.46 17 -	> > > > >	E 39	< < < < <	F 64 0.78 41 -	> > > > >	F 64	< < < < <	A 9 0.03 1 -	> > > > >	A 1	< < < < <	A 9 0.07 2 -	> > > > >	A 1	
	Hazel Street and Hickory Street	AWSC	LOS Delay V/C Q Ex Avail.	< < < < <	A 9 0.23 1 -	> > > > >	A 9	< < < < <	A 9 0.24 1 -	> > > > >	A 9	< < < < <	A 9 0.14 1 -	> > > > >	A 9	< < < < <	A 9 0.16 1 -	> > > > >	A 9	A 9
	Hazel Street and Site Driveway	TWSC	LOS Delay V/C Q Ex Avail.	A 10 0.01 0 -	< < < < <	> > > > >	A 10	<				< < < < <	A 0 0.00 0 -	> > > > >	A 0	< < < < <	A 0 0.00 0 -	> > > > >	A 0	

MOE - Measure of Effectiveness

LOS - Level of Service

Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)

Ex. - Existing Available Storage (m)

Avail. - Available Storage (m)

TWSC - Two-Way Stop Control

AWSC - All-Way Stop Control

<- Shared Left/Through Lane

>- Shared Right/Through Lane



5.3 Remedial Measures

The traffic operation analyses presented in **Section 5.1** and **Section 5.2** indicate the eastbound and westbound approaches on Hickory Street at Albert Street are forecast to operate at LOS E and LOS F with or without the proposed development. Traffic control modifications, such as all-way stop control, or traffic control signals may improve traffic operations, if either control modification was warranted.

5.3.1 Traffic Control Modifications – All-Way Stop Control

The warrant for all-way stop control is defined in Ontario Traffic Manual (OTM) Book 5.⁹ For collector roads and rural arterial roads, all-way stop control is warranted, where:

- ▶ The total vehicle volume on all intersection approaches exceeds 375 vehicles per hour for each of the highest eight hours of the day; and
- ▶ The volume split does not exceed 70/30 (that is the minor street must not be less than 30% of the total volume entering the intersection) as measured over the entire eight-hour count period; and
- ▶ The combined vehicle and pedestrian volume on the minor street
 - exceeds 150 units per hour (all vehicles plus pedestrians wishing to enter the intersection) for each of the same eight hours as the total volume; or
 - exceeds 120 units per hour (all vehicles plus pedestrians wishing to enter the intersection) for each of the same eight hours as the total volume, with an average delay to all minor street traffic (vehicles and pedestrians) of greater than 30 seconds for the entire eight-hour period.

To estimate eight-hour traffic volumes at Albert Street and Hickory Street under opening-year background traffic and total traffic conditions, Paradigm

- ▶ Applied the 2% growth rate noted in **Section 4.2** to all movements at the intersection across the eight highest hours of observed traffic volumes at the intersection (specifically 7 AM to 10 AM, 11:30 AM to 1:30 PM and 3 PM to 6 PM);

⁹ Ontario Ministry of Transportation, *Ontario Traffic Manual Book 5: Regulatory Signs*, (Toronto: Queen's Printer for Ontario, 2021).



- ▶ Estimated the daily trip generation for the following background developments and the proposed development using the *ITE Trip Generation Manual*:
 - 34-38 Hickory Street (47 units); and
 - 83-85 Hickory Street and 265-267 Hemlock Street (168 units).
- ▶ Estimated the hourly distribution of the daily trip generation based on data published for each applicable land use code in the *ITE Trip Generation Manual*;
- ▶ Assigned the hourly volumes to the road network based on the trip distribution summarized in **Table 4.2**; and
- ▶ Added the eight-hour site generated traffic volumes to the eight-hour background traffic volumes.

Appendix H contains the detailed calculations and assignment of the eight-hour site-generated traffic volumes under background and total traffic conditions. **Table 5.3** summarizes the estimated site-generated traffic volumes by hour at the intersection for those movements where site-generated traffic is assigned.

Appendix I contains the all-way stop control warrants and indicates all-way stop control is not warranted at Albert Street and Hickory Street under existing, 2030 future background conditions, or 2030 future total conditions.

5.3.2 Traffic Control Modifications – Traffic Control Signals

The warrant for traffic control signals is defined in Ontario Traffic Manual (OTM) Book 12. The warrant is based on Justification 7 (Projected Volumes) which combines Justification 1 (Minimum Vehicular Volume) and Justification 2 (Delay to Cross Traffic). Justification 7 estimates the need for traffic control signals based on the average hourly volume, estimated using the respective AM peak hour and PM peak hour volumes. For existing intersections with forecast traffic, both Justification 1A and 1B, or Justification 2A and 2B must be greater than 120%.

Appendix J contains the warrant analysis worksheets. **Table 5.4** summarizes the results of the analysis, indicating traffic control signals are not warranted at either horizon year. It is recommended the City of Waterloo monitor vehicular and pedestrian volumes at Albert Street and Hickory Street to determine when, and if, other forms of traffic control are warranted.



TABLE 5.3: EIGHT-HOUR SITE GENERATED TRAFFIC ASSIGNMENTS – ALBERT STREET AND HICKORY STREET

Hour	Inbound			Outbound		
	SBL	EBT	NBR	WBL	WBT	WBR
7 AM to 8 AM	1	0	1	3	0	4
8 AM to 9 AM	1	0	1	3	0	3
9 AM to 10 AM	1	0	1	2	0	2
11:30 AM to 12:30 PM	1	0	1	1	0	1
12:30 PM to 1:30 PM	1	0	1	1	0	1
3 PM to 4 PM	2	0	2	1	0	1
4 PM to 5 PM	3	0	2	1	0	2
5 PM to 6 PM	4	1	4	1	0	2

TABLE 5.4: SIGNAL WARRANT ANALYSIS – ALBERT STREET AND HICKORY STREET

Horizon Year	Justification				Warranted ¹
	1A	1B	2A	2B	
2030 Background	70%	62%	55%	79%	No
2030 Total	71%	64%	56%	80%	No

Notes:

1. For existing intersections with forecast traffic, both Justification 1A and 1B, or Justification 2A and 2B must be greater than 120%.



6 Conclusions and Recommendations

6.1 Findings and Conclusions

Based on the analyses contained herein, the findings of this report are as follows:

- ▶ Under existing conditions, the study intersections (Albert Street and Hickory Street, and Hazel Street and Hickory Street) are operating at acceptable levels of service and within capacity. There are no critical movements.
- ▶ Redevelopment of the site is estimated to generate 15 trips in the weekday AM peak hour, and 16 trips in the weekday PM peak hour.
- ▶ Under 2030 background traffic conditions (that is, without the proposed development) all study intersections (except Albert Street and Hickory Street) are forecast to operate at acceptable levels of service and within capacity. In the PM peak hour, the eastbound and westbound approaches on Hickory Street at Albert Street are forecast to operate at LOS E and LOS F respectively, but with v/c ratios no greater than 0.75.
- ▶ Under 2030 total traffic conditions (that is, without the proposed development) all study intersections (except Albert Street and Hickory Street) are forecast to operate at acceptable levels of service and within capacity. In the PM peak hour, the eastbound and westbound approaches on Hickory Street at Albert Street are forecast to operate at LOS E and LOS F respectively, but with v/c ratios no greater than 0.78. The site driveway is forecast to operate at LOS A.
- ▶ All-way stop control and traffic control signals are not warranted at Albert Street and Hickory Street under existing, 2030 background, or 2030 total traffic conditions.

Based on the findings of this study, it is concluded that the proposed redevelopment is forecast to have a negligible impact on traffic operations at the study area intersections.

6.2 Recommendations

Based on the findings and conclusions of this study, it is recommended the site be considered for approval with no requirement for off-site transportation network improvements. It is recommended the City of Waterloo monitor vehicular and pedestrian volumes at Albert Street and Hickory Street to determine when, and if, other forms of traffic control are warranted.



Appendix A

Pre-Study Consultation Notes



Andrew Steinsky

From: Ainsley Rego <Ainsley.Rego@waterloo.ca>
Sent: February 27, 2024 12:52 PM
To: Andrew Steinsky
Subject: RE: (230707) - 277-279 Hazel Street - Terms of Reference

Follow Up Flag: Follow up
Flag Status: Completed

Hi Andrew,

Thank you for reaching out. Based on the development proposal (25 units, 14 parking spaces) a full study is not required. A letter or brief summarizing the below information is sufficient. Please see my responses in red.

Let me know if you have any questions or concerns.

Best,



Ainsley Rego, BES (she/her)

Engineering Technologist – Traffic

Transportation Engineering, Integrated Planning & Public Works, City of Waterloo

265 Lexington Court PO Box 337 Station Waterloo Waterloo, ON N2J 4A8

P: 1.519.886.2310 **ext.** 30336 **F:** 1.519.886.5788 **TTY:** 1.866.786.3941 **E:** ainsley.rego@waterloo.ca

From: Andrew Steinsky <asteinsky@ptsl.com>
Sent: Monday, February 26, 2024 1:34 PM
To: Ainsley Rego <Ainsley.Rego@waterloo.ca>
Subject: [EXTERNAL] (230707) - 277-279 Hazel Street - Terms of Reference

Hi Ainsley,

We've been retained to prepare a Transportation Impact Study for a proposed residential development at 277-279 Hazel Street in the City of Waterloo. The site is on the west side of Hazel Street, south of Hickory Street. The redevelopment proposes a six-storey residential building with 25 units and 14 parking spaces.

Based on the attached Record of Consultation dated July 5, 2023, we propose to carry out the work plan below. Can City staff please review, and provide agreement or comments with each task? Items in bold are requests for information from the City.

Work Plan:

1. **Study Area:** We will review and analyze the following intersections for the weekday AM peak hour and weekday PM peak hour:
 - a. Albert Street and Hickory Street (unsignalized);
 - b. Hazel Street and Hickory Street (unsignalized); and
 - c. Hazel Street and Site Driveway
2. **Traffic Data:** We will conduct eight-hour turning movement counts at the study intersections during a typical weekday.

3. **Horizon Years:** Five years from date of study.
4. **Background Traffic:** We will estimate future background traffic by applying a growth rate to the existing traffic volumes on Albert Street, Hazel Street, and Hickory Street and adding approved/in-stream developments near the site. **Can the City confirm which developments should be included in the background traffic forecasts, if any.**
 - **34 – 38 Hickory Street**
 - **309 – 311 Hawthorn Street**
 - **83-85 Hickory Street West & 265-267 Hemlock Street**

Can the City also confirm an appropriate growth rate(s) to be used? – 2%

5. **Trip Generation:** We will estimate the trip generation of the site using trip generation data in the ITE *Trip Generation Manual (11th edition)*. Trips will be assigned to the road network based on existing travel patterns and TTS trip distribution information.
6. **Operational Analyses:** We will analyze the operations of the study intersections using Synchro, summarizing level of service (LOS), volume-to-capacity (v/c) ratios, and 95th percentile queues. We will identify critical movements and identify the need for potential remedial measures (for example auxiliary turn lanes or intersection control improvements).

Thanks,

Andrew Steinsky, P.Eng., PTP

Project Manager, Associate
(he/him)



5A-150 Pinebush Road, Cambridge ON N1R 8J8
p: 416.479.9684 x507
m: 416.316.0654
e: asteinsky@ptsl.com
w: www.ptsl.com

Office Hours: 07:30 – 5:30 M-Th, closed Fridays

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Appendix B

Turning Movement Count Data





Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Albert Street & Hickory Street
Site Code: 230707
Start Date: 03/05/2024
Page No: 1

Turning Movement Data

Start Time	Hickory Street Eastbound						Hickory Street Westbound						Albert Street Northbound						Albert Street Southbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
7:00 AM	1	1	1	0	1	3	1	1	2	0	1	4	1	20	0	0	0	21	1	26	0	0	0	27	55
7:15 AM	3	1	2	0	2	6	0	1	5	0	1	6	0	20	5	0	1	25	1	17	0	0	0	18	55
7:30 AM	0	1	1	0	5	2	1	1	1	0	2	3	0	34	9	0	2	43	7	30	0	0	0	37	85
7:45 AM	1	6	4	0	2	11	3	3	8	0	3	14	2	67	12	0	1	81	13	35	1	0	0	49	155
Hourly Total	5	9	8	0	10	22	5	6	16	0	7	27	3	141	26	0	4	170	22	108	1	0	0	131	350
8:00 AM	5	5	3	0	4	13	6	3	22	0	5	31	2	58	25	0	3	85	21	45	2	0	0	68	197
8:15 AM	1	1	5	0	2	7	3	4	18	0	11	25	1	52	4	0	4	57	13	63	2	0	2	78	167
8:30 AM	2	3	3	0	1	8	3	2	5	0	4	10	1	63	5	0	2	69	11	53	2	0	2	66	153
8:45 AM	1	3	3	0	16	7	5	4	8	0	3	17	0	76	1	0	3	77	10	72	2	0	3	84	185
Hourly Total	9	12	14	0	23	35	17	13	53	0	23	83	4	249	35	0	12	288	55	233	8	0	7	296	702
9:00 AM	4	4	1	0	10	9	4	3	2	0	3	9	1	49	5	0	5	55	2	51	3	0	5	56	129
9:15 AM	1	3	4	0	2	8	2	4	8	0	5	14	1	51	5	0	3	57	6	46	1	0	1	53	132
9:30 AM	3	1	3	0	5	7	6	3	10	0	13	19	3	37	10	0	6	50	12	34	2	0	5	48	124
9:45 AM	2	4	1	0	9	7	3	6	6	0	12	15	2	52	11	0	7	65	9	46	4	0	3	59	146
Hourly Total	10	12	9	0	26	31	15	16	26	0	33	57	7	189	31	0	21	227	29	177	10	0	14	216	531
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11:30 AM	5	5	2	0	8	12	4	5	9	0	10	18	5	82	15	0	9	102	11	49	4	0	8	64	196
11:45 AM	1	2	4	0	2	7	7	7	11	0	2	25	6	56	9	0	5	71	8	59	2	0	2	69	172
Hourly Total	6	7	6	0	10	19	11	12	20	0	12	43	11	138	24	0	14	173	19	108	6	0	10	133	368
12:00 PM	6	10	1	0	0	17	5	1	8	0	8	14	1	63	12	0	1	76	10	60	1	0	5	71	178
12:15 PM	4	2	4	0	12	10	3	6	10	0	13	19	4	60	9	0	7	73	12	51	5	0	5	68	170
12:30 PM	3	6	7	0	1	16	10	9	16	0	12	35	6	62	13	0	3	81	9	69	6	0	4	84	216
12:45 PM	3	3	6	0	6	12	10	8	14	0	23	32	2	75	13	0	8	90	13	57	2	0	15	72	206
Hourly Total	16	21	18	0	19	55	28	24	48	0	56	100	13	260	47	0	19	320	44	237	14	0	29	295	770
1:00 PM	5	11	3	0	4	19	8	6	13	0	16	27	2	67	12	0	3	81	7	56	0	0	13	63	190
1:15 PM	4	2	4	0	9	10	6	7	11	0	12	24	2	53	6	0	8	61	4	60	1	0	9	65	160
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hourly Total	9	13	7	0	13	29	14	13	24	0	28	51	4	120	18	0	11	142	11	116	1	0	22	128	350
3:00 PM	4	5	7	0	6	16	2	2	14	0	16	18	1	74	10	0	6	85	8	56	3	0	4	67	186
3:15 PM	2	6	3	0	2	11	8	10	9	0	8	27	5	73	13	0	4	91	7	52	3	0	2	62	191
3:30 PM	3	5	10	0	7	18	6	8	16	0	11	30	2	53	8	0	4	63	12	58	6	0	6	76	187
3:45 PM	5	8	9	0	11	22	9	6	8	0	25	23	3	63	10	0	10	76	13	66	8	0	3	87	208
Hourly Total	14	24	29	0	26	67	25	26	47	0	60	98	11	263	41	0	24	315	40	232	20	0	15	292	772
4:00 PM	4	6	4	0	13	14	8	7	10	0	16	25	2	69	16	0	6	87	8	69	7	0	9	84	210
4:15 PM	3	4	10	0	13	17	4	5	9	0	18	18	6	70	14	0	7	90	12	74	9	0	10	95	220

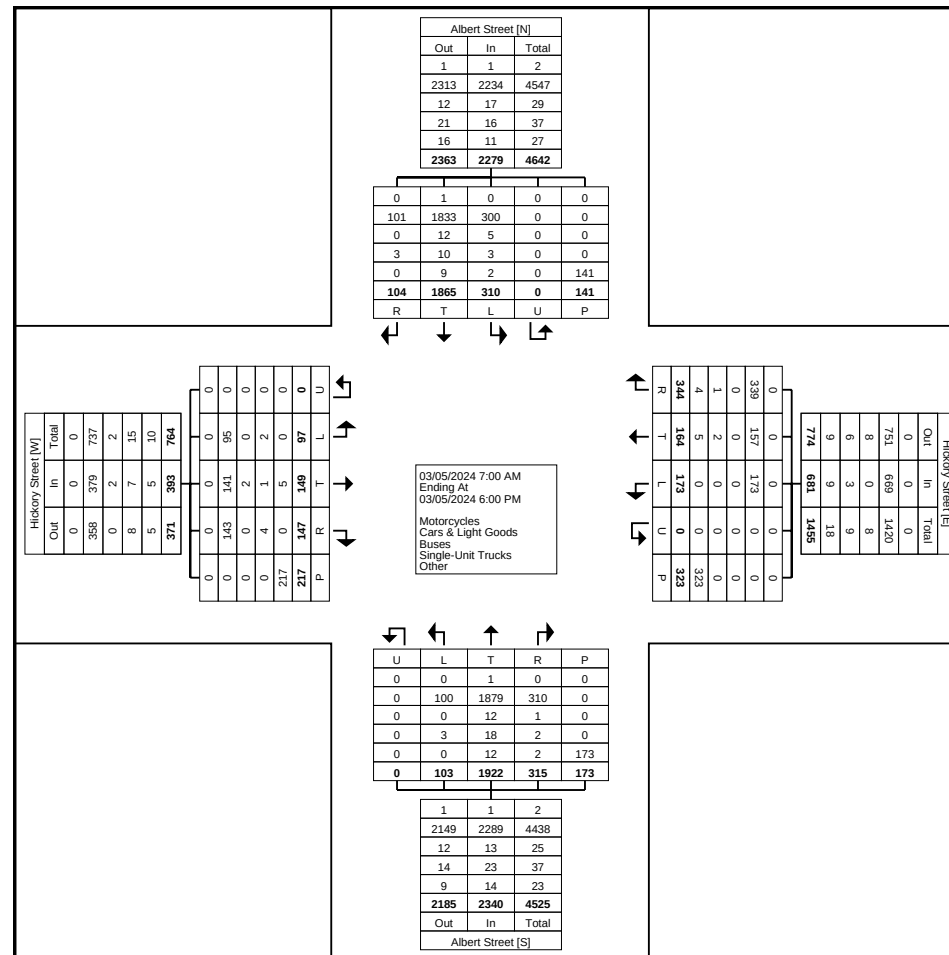
4:30 PM	2	6	6	0	6	14	9	7	13	0	8	29	2	74	8	0	7	84	7	84	3	0	6	94	221
4:45 PM	5	6	6	0	8	17	7	4	9	0	11	20	6	85	8	0	6	99	5	95	7	0	1	107	243
Hourly Total	14	22	26	0	40	62	28	23	41	0	53	92	16	298	46	0	26	360	32	322	26	0	26	380	894
5:00 PM	3	8	9	0	8	20	14	7	16	0	15	37	8	70	11	0	6	89	13	96	4	0	2	113	259
5:15 PM	3	4	6	0	11	13	10	10	17	0	15	37	9	70	8	0	13	87	19	114	6	0	5	139	276
5:30 PM	6	13	6	0	11	25	3	9	19	0	15	31	9	65	10	0	9	84	15	62	5	0	8	82	222
5:45 PM	2	4	9	0	20	15	3	5	17	0	6	25	8	59	18	0	14	85	11	60	3	0	3	74	199
Hourly Total	14	29	30	0	50	73	30	31	69	0	51	130	34	264	47	0	42	345	58	332	18	0	18	408	956
Grand Total	97	149	147	0	217	393	173	164	344	0	323	681	103	1922	315	0	173	2340	310	1865	104	0	141	2279	5693
Approach %	24.7	37.9	37.4	0.0	-	-	25.4	24.1	50.5	0.0	-	-	4.4	82.1	13.5	0.0	-	-	13.6	81.8	4.6	0.0	-	-	-
Total %	1.7	2.6	2.6	0.0	-	6.9	3.0	2.9	6.0	0.0	-	12.0	1.8	33.8	5.5	0.0	-	41.1	5.4	32.8	1.8	0.0	-	40.0	-
Motorcycles	0	0	0	0	-	0	0	0	0	0	-	0	0	1	0	0	-	1	0	1	0	0	-	1	2
% Motorcycles	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.1	0.0	-	-	0.0	0.0	0.1	0.0	-	-	0.0	0.0
Cars & Light Goods	95	141	143	0	-	379	173	157	339	0	-	669	100	1879	310	0	-	2289	300	1833	101	0	-	2234	5571
% Cars & Light Goods	97.9	94.6	97.3	-	-	96.4	100.0	95.7	98.5	-	-	98.2	97.1	97.8	98.4	-	-	97.8	96.8	98.3	97.1	-	-	98.0	97.9
Buses	0	2	0	0	-	2	0	0	0	0	-	0	0	12	1	0	-	13	5	12	0	0	-	17	32
% Buses	0.0	1.3	0.0	-	-	0.5	0.0	0.0	0.0	-	-	0.0	0.0	0.6	0.3	-	-	0.6	1.6	0.6	0.0	-	-	0.7	0.6
Single-Unit Trucks	2	1	4	0	-	7	0	2	1	0	-	3	3	18	2	0	-	23	3	10	3	0	-	16	49
% Single-Unit Trucks	2.1	0.7	2.7	-	-	1.8	0.0	1.2	0.3	-	-	0.4	2.9	0.9	0.6	-	-	1.0	1.0	0.5	2.9	-	-	0.7	0.9
Articulated Trucks	0	0	0	0	-	0	0	0	0	0	-	0	0	2	0	0	-	2	0	1	0	0	-	1	3
% Articulated Trucks	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.1	0.0	-	-	0.1	0.0	0.1	0.0	-	-	0.0	0.1
Bicycles on Road	0	5	0	0	-	5	0	5	4	0	-	9	0	10	2	0	-	12	2	8	0	0	-	10	36
% Bicycles on Road	0.0	3.4	0.0	-	-	1.3	0.0	3.0	1.2	-	-	1.3	0.0	0.5	0.6	-	-	0.5	0.6	0.4	0.0	-	-	0.4	0.6
Bicycles on Crosswalk	-	-	-	-	7	-	-	-	-	-	8	-	-	-	-	-	2	-	-	-	-	-	1	-	-
% Bicycles on Crosswalk	-	-	-	-	3.2	-	-	-	-	-	2.5	-	-	-	-	-	1.2	-	-	-	-	-	0.7	-	-
Pedestrians	-	-	-	-	210	-	-	-	-	-	315	-	-	-	-	-	171	-	-	-	-	-	140	-	-
% Pedestrians	-	-	-	-	96.8	-	-	-	-	-	97.5	-	-	-	-	-	98.8	-	-	-	-	-	99.3	-	-



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

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

Count Name: Albert Street & Hickory Street
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Turning Movement Data Plot



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

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

Count Name: Albert Street & Hickory Street
Site Code: 230707
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Turning Movement Peak Hour Data (8:00 AM)

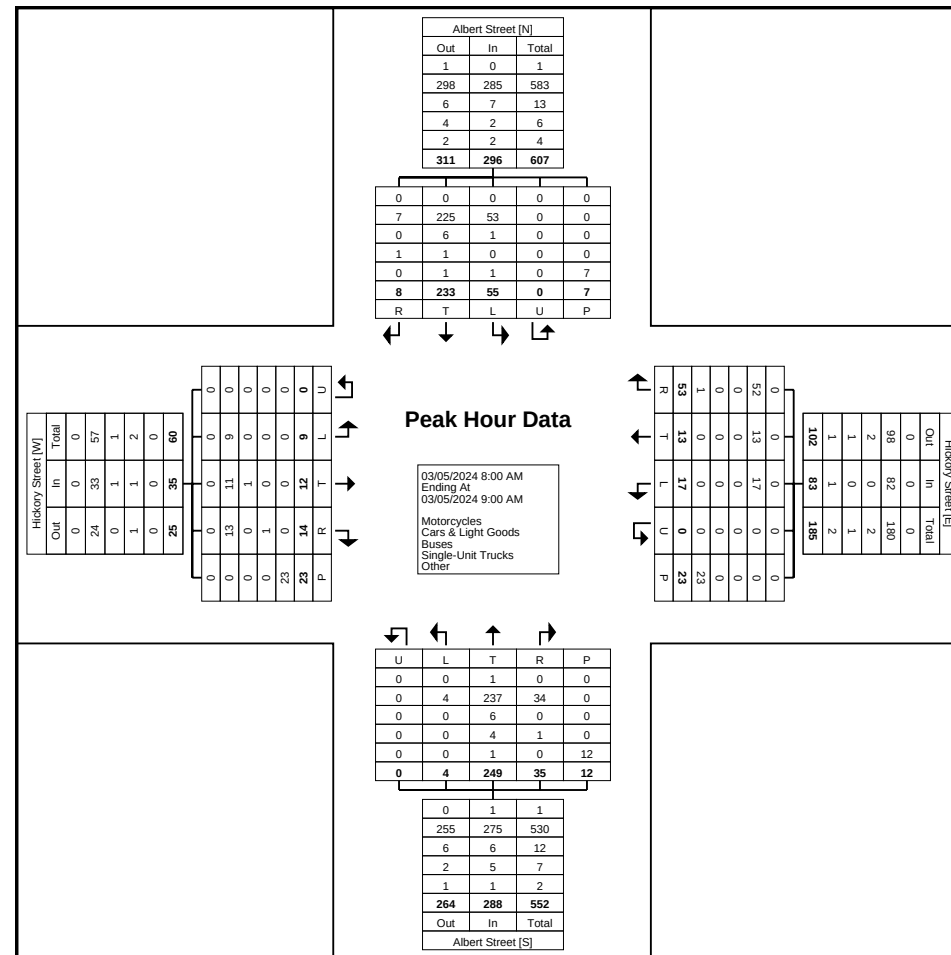
Start Time	Hickory Street Eastbound						Hickory Street Westbound						Albert Street Northbound						Albert Street Southbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
8:00 AM	5	5	3	0	4	13	6	3	22	0	5	31	2	58	25	0	3	85	21	45	2	0	0	68	197
8:15 AM	1	1	5	0	2	7	3	4	18	0	11	25	1	52	4	0	4	57	13	63	2	0	2	78	167
8:30 AM	2	3	3	0	1	8	3	2	5	0	4	10	1	63	5	0	2	69	11	53	2	0	2	66	153
8:45 AM	1	3	3	0	16	7	5	4	8	0	3	17	0	76	1	0	3	77	10	72	2	0	3	84	185
Total	9	12	14	0	23	35	17	13	53	0	23	83	4	249	35	0	12	288	55	233	8	0	7	296	702
Approach %	25.7	34.3	40.0	0.0	-	-	20.5	15.7	63.9	0.0	-	-	1.4	86.5	12.2	0.0	-	-	18.6	78.7	2.7	0.0	-	-	-
Total %	1.3	1.7	2.0	0.0	-	5.0	2.4	1.9	7.5	0.0	-	11.8	0.6	35.5	5.0	0.0	-	41.0	7.8	33.2	1.1	0.0	-	42.2	-
PHF	0.450	0.600	0.700	0.000	-	0.673	0.708	0.813	0.602	0.000	-	0.669	0.500	0.819	0.350	0.000	-	0.847	0.655	0.809	1.000	0.000	-	0.881	0.891
Motorcycles	0	0	0	0	-	0	0	0	0	0	-	0	0	1	0	0	-	1	0	0	0	0	-	0	1
% Motorcycles	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.4	0.0	-	-	0.3	0.0	0.0	0.0	-	-	0.0	0.1
Cars & Light Goods	9	11	13	0	-	33	17	13	52	0	-	82	4	237	34	0	-	275	53	225	7	0	-	285	675
% Cars & Light Goods	100.0	91.7	92.9	-	-	94.3	100.0	100.0	98.1	-	-	98.8	100.0	95.2	97.1	-	-	95.5	96.4	96.6	87.5	-	-	96.3	96.2
Buses	0	1	0	0	-	1	0	0	0	0	-	0	0	6	0	0	-	6	1	6	0	0	-	7	14
% Buses	0.0	8.3	0.0	-	-	2.9	0.0	0.0	0.0	-	-	0.0	0.0	2.4	0.0	-	-	2.1	1.8	2.6	0.0	-	-	2.4	2.0
Single-Unit Trucks	0	0	1	0	-	1	0	0	0	0	-	0	0	4	1	0	-	5	0	1	1	0	-	2	8
% Single-Unit Trucks	0.0	0.0	7.1	-	-	2.9	0.0	0.0	0.0	-	-	0.0	0.0	1.6	2.9	-	-	1.7	0.0	0.4	12.5	-	-	0.7	1.1
Articulated Trucks	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Articulated Trucks	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0
Bicycles on Road	0	0	0	0	-	0	0	0	1	0	-	1	0	1	0	0	-	1	1	1	0	0	-	2	4
% Bicycles on Road	0.0	0.0	0.0	-	-	0.0	0.0	0.0	1.9	-	-	1.2	0.0	0.4	0.0	-	-	0.3	1.8	0.4	0.0	-	-	0.7	0.6
Bicycles on Crosswalk	-	-	-	-	2	-	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	8.7	-	-	-	-	-	4.3	-	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	-	21	-	-	-	-	-	22	-	-	-	-	-	12	-	-	-	-	-	7	-	-
% Pedestrians	-	-	-	-	91.3	-	-	-	-	-	95.7	-	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Albert Street & Hickory Street
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Paradigm Transportation Solutions Limited
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519-896-3163 cbowness@ptsl.com

Count Name: Albert Street & Hickory Street
Site Code: 230707
Start Date: 03/05/2024
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Turning Movement Peak Hour Data (12:15 PM)

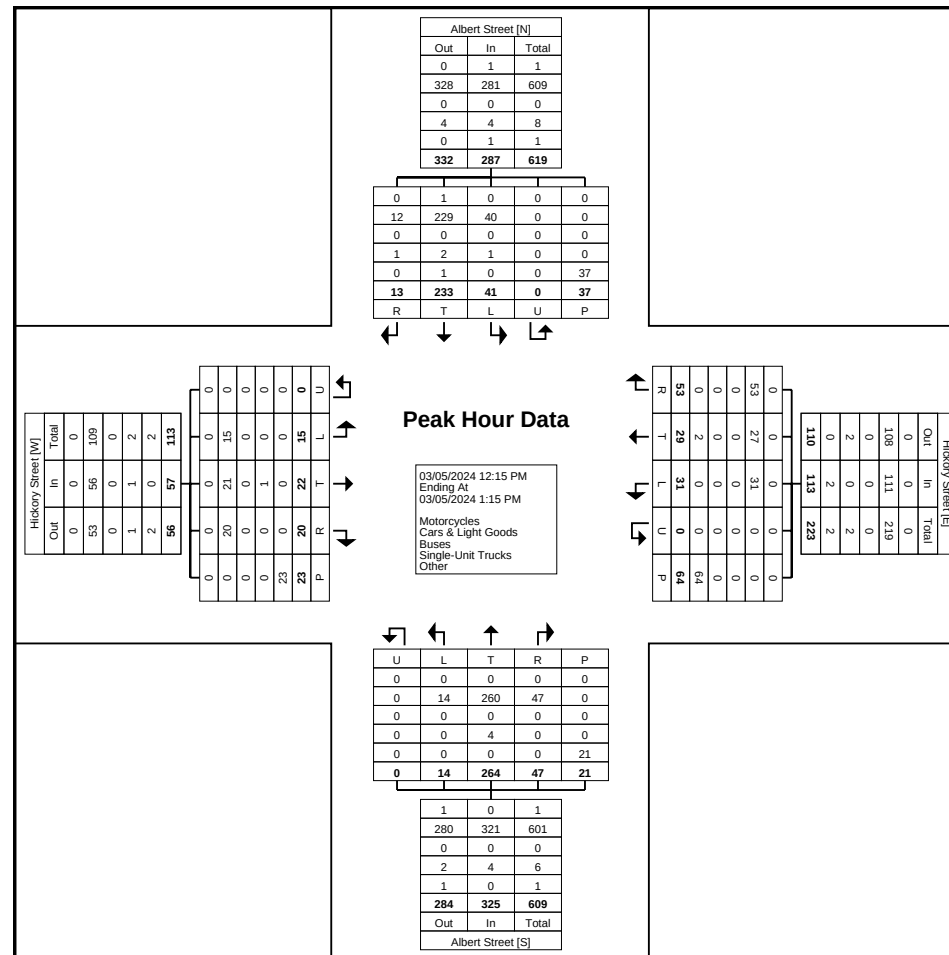
Start Time	Hickory Street Eastbound						Hickory Street Westbound						Albert Street Northbound						Albert Street Southbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
12:15 PM	4	2	4	0	12	10	3	6	10	0	13	19	4	60	9	0	7	73	12	51	5	0	5	68	170
12:30 PM	3	6	7	0	1	16	10	9	16	0	12	35	6	62	13	0	3	81	9	69	6	0	4	84	216
12:45 PM	3	3	6	0	6	12	10	8	14	0	23	32	2	75	13	0	8	90	13	57	2	0	15	72	206
1:00 PM	5	11	3	0	4	19	8	6	13	0	16	27	2	67	12	0	3	81	7	56	0	0	13	63	190
Total	15	22	20	0	23	57	31	29	53	0	64	113	14	264	47	0	21	325	41	233	13	0	37	287	782
Approach %	26.3	38.6	35.1	0.0	-	-	27.4	25.7	46.9	0.0	-	-	4.3	81.2	14.5	0.0	-	-	14.3	81.2	4.5	0.0	-	-	-
Total %	1.9	2.8	2.6	0.0	-	7.3	4.0	3.7	6.8	0.0	-	14.5	1.8	33.8	6.0	0.0	-	41.6	5.2	29.8	1.7	0.0	-	36.7	-
PHF	0.750	0.500	0.714	0.000	-	0.750	0.775	0.806	0.828	0.000	-	0.807	0.583	0.880	0.904	0.000	-	0.903	0.788	0.844	0.542	0.000	-	0.854	0.905
Motorcycles	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	1	0	0	-	1	1
% Motorcycles	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.4	0.0	-	-	0.3	0.1
Cars & Light Goods	15	21	20	0	-	56	31	27	53	0	-	111	14	260	47	0	-	321	40	229	12	0	-	281	769
% Cars & Light Goods	100.0	95.5	100.0	-	-	98.2	100.0	93.1	100.0	-	-	98.2	100.0	98.5	100.0	-	-	98.8	97.6	98.3	92.3	-	-	97.9	98.3
Buses	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Buses	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0
Single-Unit Trucks	0	1	0	0	-	1	0	0	0	0	-	0	0	4	0	0	-	4	1	2	1	0	-	4	9
% Single-Unit Trucks	0.0	4.5	0.0	-	-	1.8	0.0	0.0	0.0	-	-	0.0	0.0	1.5	0.0	-	-	1.2	2.4	0.9	7.7	-	-	1.4	1.2
Articulated Trucks	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Articulated Trucks	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0
Bicycles on Road	0	0	0	0	-	0	0	2	0	0	-	2	0	0	0	0	-	0	0	1	0	0	-	1	3
% Bicycles on Road	0.0	0.0	0.0	-	-	0.0	0.0	6.9	0.0	-	-	1.8	0.0	0.0	0.0	-	-	0.0	0.0	0.4	0.0	-	-	0.3	0.4
Bicycles on Crosswalk	-	-	-	-	2	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	8.7	-	-	-	-	-	1.6	-	-	-	-	-	4.8	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	-	21	-	-	-	-	-	63	-	-	-	-	-	20	-	-	-	-	-	37	-	-
% Pedestrians	-	-	-	-	91.3	-	-	-	-	-	98.4	-	-	-	-	-	95.2	-	-	-	-	-	100.0	-	-



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Albert Street & Hickory Street
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Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

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Count Name: Albert Street & Hickory Street
Site Code: 230707
Start Date: 03/05/2024
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Turning Movement Peak Hour Data (4:45 PM)

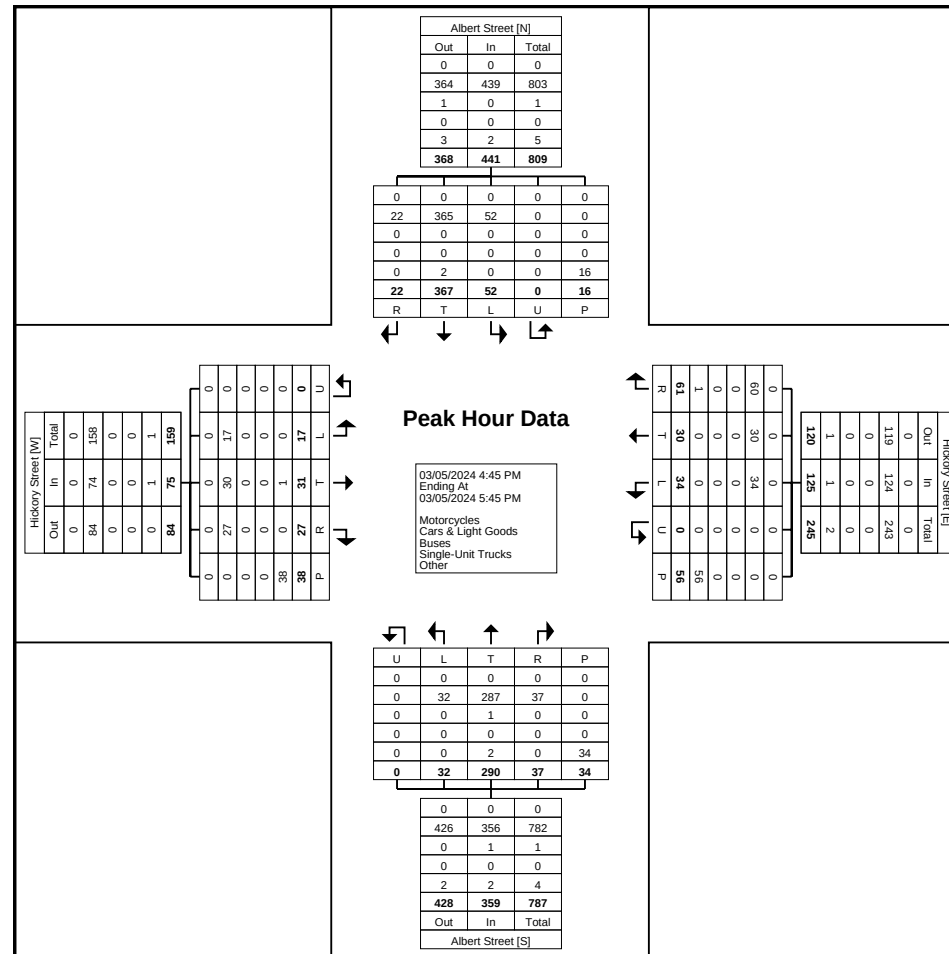
Start Time	Hickory Street Eastbound						Hickory Street Westbound						Albert Street Northbound						Albert Street Southbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
4:45 PM	5	6	6	0	8	17	7	4	9	0	11	20	6	85	8	0	6	99	5	95	7	0	1	107	243
5:00 PM	3	8	9	0	8	20	14	7	16	0	15	37	8	70	11	0	6	89	13	96	4	0	2	113	259
5:15 PM	3	4	6	0	11	13	10	10	17	0	15	37	9	70	8	0	13	87	19	114	6	0	5	139	276
5:30 PM	6	13	6	0	11	25	3	9	19	0	15	31	9	65	10	0	9	84	15	62	5	0	8	82	222
Total	17	31	27	0	38	75	34	30	61	0	56	125	32	290	37	0	34	359	52	367	22	0	16	441	1000
Approach %	22.7	41.3	36.0	0.0	-	-	27.2	24.0	48.8	0.0	-	-	8.9	80.8	10.3	0.0	-	-	11.8	83.2	5.0	0.0	-	-	-
Total %	1.7	3.1	2.7	0.0	-	7.5	3.4	3.0	6.1	0.0	-	12.5	3.2	29.0	3.7	0.0	-	35.9	5.2	36.7	2.2	0.0	-	44.1	-
PHF	0.708	0.596	0.750	0.000	-	0.750	0.607	0.750	0.803	0.000	-	0.845	0.889	0.853	0.841	0.000	-	0.907	0.684	0.805	0.786	0.000	-	0.793	0.906
Motorcycles	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Motorcycles	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0
Cars & Light Goods	17	30	27	0	-	74	34	30	60	0	-	124	32	287	37	0	-	356	52	365	22	0	-	439	993
% Cars & Light Goods	100.0	96.8	100.0	-	-	98.7	100.0	100.0	98.4	-	-	99.2	100.0	99.0	100.0	-	-	99.2	100.0	99.5	100.0	-	-	99.5	99.3
Buses	0	0	0	0	-	0	0	0	0	0	-	0	0	1	0	0	-	1	0	0	0	0	-	0	1
% Buses	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.3	0.0	-	-	0.3	0.0	0.0	0.0	-	-	0.0	0.1
Single-Unit Trucks	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Single-Unit Trucks	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0
Articulated Trucks	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Articulated Trucks	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0
Bicycles on Road	0	1	0	0	-	1	0	0	1	0	-	1	0	2	0	0	-	2	0	2	0	0	-	2	6
% Bicycles on Road	0.0	3.2	0.0	-	-	1.3	0.0	0.0	1.6	-	-	0.8	0.0	0.7	0.0	-	-	0.6	0.0	0.5	0.0	-	-	0.5	0.6
Bicycles on Crosswalk	-	-	-	-	2	-	-	-	-	-	2	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	5.3	-	-	-	-	-	3.6	-	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	-	36	-	-	-	-	-	54	-	-	-	-	-	34	-	-	-	-	-	16	-	-
% Pedestrians	-	-	-	-	94.7	-	-	-	-	-	96.4	-	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

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519-896-3163 cbowness@pts1.com

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Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

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

Count Name: Hazel Street & Hickory Street
Site Code: 230707
Start Date: 03/05/2024
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Turning Movement Data

Start Time	Hickory Street Eastbound						Hickory Street Westbound						Hazel Street Northbound						Hazel Street Southbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
7:00 AM	0	3	1	0	2	4	0	4	1	0	2	5	0	2	0	0	0	2	0	2	0	0	2	2	13
7:15 AM	1	6	0	0	1	7	1	3	2	0	4	6	0	5	3	0	1	8	0	4	0	0	3	4	25
7:30 AM	6	9	1	0	3	16	1	4	7	0	8	12	0	8	2	0	3	10	2	6	0	0	3	8	46
7:45 AM	17	16	1	0	5	34	9	7	6	0	14	22	0	22	1	0	4	23	6	23	6	0	10	35	114
Hourly Total	24	34	3	0	11	61	11	18	16	0	28	45	0	37	6	0	8	43	8	35	6	0	18	49	198
8:00 AM	26	12	12	0	14	50	5	19	31	0	41	55	4	30	4	0	10	38	5	32	14	0	15	51	194
8:15 AM	9	5	1	0	14	15	6	19	3	0	19	28	1	17	3	0	15	21	7	20	6	0	18	33	97
8:30 AM	0	6	4	0	8	10	8	7	5	0	5	20	0	5	3	0	11	8	2	12	0	0	11	14	52
8:45 AM	3	8	3	0	3	14	0	11	8	0	7	19	0	9	1	0	6	10	2	16	6	0	8	24	67
Hourly Total	38	31	20	0	39	89	19	56	47	0	72	122	5	61	11	0	42	77	16	80	26	0	52	122	410
9:00 AM	4	6	1	0	8	11	3	9	2	0	2	14	1	6	2	0	8	9	4	6	0	0	5	10	44
9:15 AM	3	9	3	0	6	15	1	12	2	0	11	15	3	5	4	0	5	12	4	5	2	0	9	11	53
9:30 AM	4	11	3	0	15	18	2	8	5	0	3	15	2	6	4	0	7	12	1	11	5	0	20	17	62
9:45 AM	3	13	8	0	17	24	5	16	5	0	17	26	2	7	2	0	13	11	1	11	2	0	13	14	75
Hourly Total	14	39	15	0	46	68	11	45	14	0	33	70	8	24	12	0	33	44	10	33	9	0	47	52	234
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11:30 AM	10	18	4	0	18	32	1	16	8	0	14	25	3	11	6	0	13	20	5	10	1	0	10	16	93
11:45 AM	2	13	3	0	10	18	5	17	7	0	11	29	1	11	0	0	10	12	4	4	5	0	11	13	72
Hourly Total	12	31	7	0	28	50	6	33	15	0	25	54	4	22	6	0	23	32	9	14	6	0	21	29	165
12:00 PM	0	23	4	0	12	27	8	15	4	0	8	27	5	7	5	0	9	17	3	4	3	0	10	10	81
12:15 PM	6	20	3	0	7	29	10	16	3	0	8	29	1	10	1	0	7	12	5	10	6	0	8	21	91
12:30 PM	6	16	8	0	20	30	1	22	5	0	9	28	4	4	0	0	7	8	6	8	3	0	9	17	83
12:45 PM	7	16	10	0	33	33	6	31	10	0	13	47	4	13	4	0	21	21	6	13	6	0	16	25	126
Hourly Total	19	75	25	0	72	119	25	84	22	0	38	131	14	34	10	0	44	58	20	35	18	0	43	73	381
1:00 PM	4	21	3	0	13	28	2	18	6	0	8	26	2	8	8	0	7	18	5	14	3	0	12	22	94
1:15 PM	4	11	5	0	10	20	4	17	4	0	6	25	4	7	4	0	8	15	0	5	2	0	7	7	67
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hourly Total	8	32	8	0	23	48	6	35	10	0	14	51	6	15	12	0	15	33	5	19	5	0	19	29	161
3:00 PM	5	17	5	0	9	27	1	8	5	0	8	14	1	9	3	0	7	13	4	10	2	0	12	16	70
3:15 PM	4	17	7	0	3	28	1	20	9	0	8	30	3	8	4	0	9	15	7	12	2	0	4	21	94
3:30 PM	4	17	9	0	10	30	8	19	8	0	16	35	1	9	5	0	16	15	9	12	7	0	10	28	108
3:45 PM	9	28	10	0	16	47	7	17	9	0	18	33	3	21	9	0	20	33	8	14	7	0	10	29	142
Hourly Total	22	79	31	0	38	132	17	64	31	0	50	112	8	47	21	0	52	76	28	48	18	0	36	94	414
4:00 PM	7	17	6	0	15	30	8	23	8	0	17	39	3	18	4	0	13	25	1	7	4	0	6	12	106
4:15 PM	4	27	3	0	13	34	7	17	8	0	13	32	2	10	3	0	12	15	5	11	5	0	18	21	102

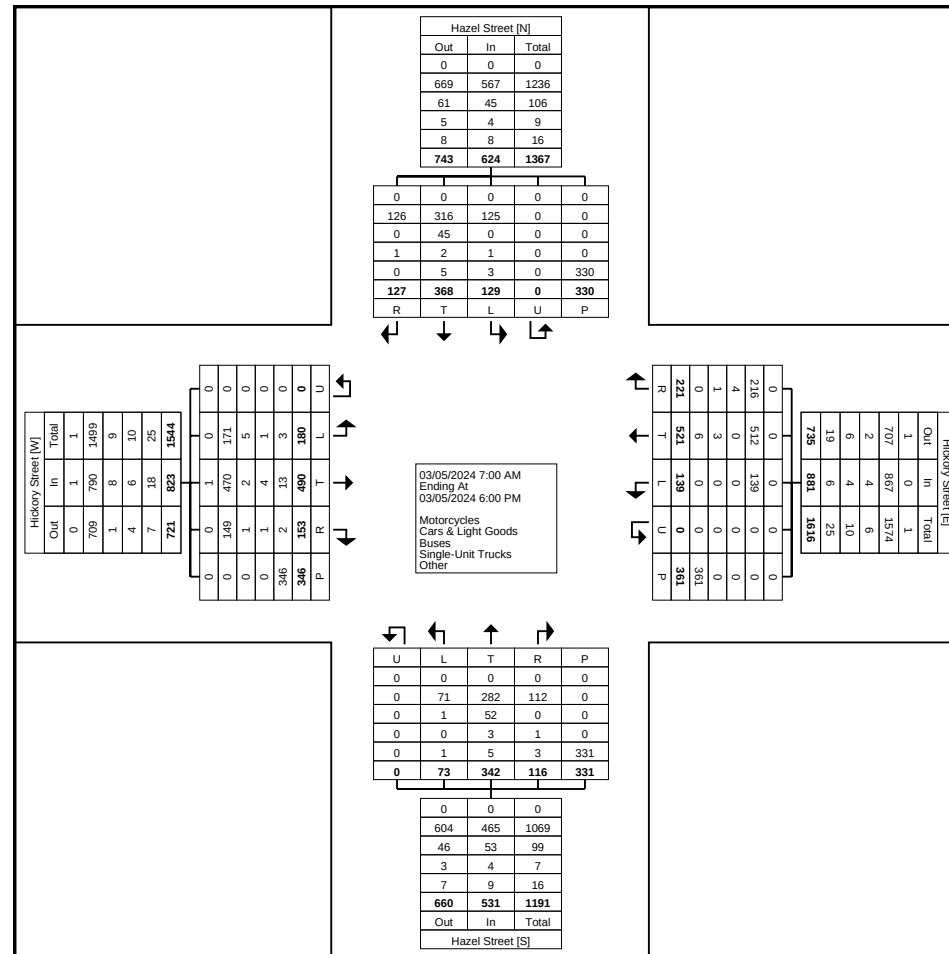
4:30 PM	1	16	7	0	7	24	3	19	11	0	16	33	4	11	7	0	3	22	5	16	3	0	11	24	103
4:45 PM	5	11	3	0	7	19	8	20	6	0	10	34	2	16	6	0	16	24	5	7	7	0	8	19	96
Hourly Total	17	71	19	0	42	107	26	79	33	0	56	138	11	55	20	0	44	86	16	41	19	0	43	76	407
5:00 PM	2	26	5	0	12	33	5	26	13	0	12	44	6	13	7	0	21	26	7	22	3	0	16	32	135
5:15 PM	10	24	8	0	9	42	5	32	6	0	15	43	5	11	1	0	19	17	4	15	10	0	19	29	131
5:30 PM	13	26	10	0	11	49	4	25	7	0	12	36	4	9	6	0	17	19	2	16	4	0	7	22	126
5:45 PM	1	22	2	0	15	25	4	24	7	0	6	35	2	14	4	0	13	20	4	10	3	0	9	17	97
Hourly Total	26	98	25	0	47	149	18	107	33	0	45	158	17	47	18	0	70	82	17	63	20	0	51	100	489
Grand Total	180	490	153	0	346	823	139	521	221	0	361	881	73	342	116	0	331	531	129	368	127	0	330	624	2859
Approach %	21.9	59.5	18.6	0.0	-	-	15.8	59.1	25.1	0.0	-	-	13.7	64.4	21.8	0.0	-	-	20.7	59.0	20.4	0.0	-	-	-
Total %	6.3	17.1	5.4	0.0	-	28.8	4.9	18.2	7.7	0.0	-	30.8	2.6	12.0	4.1	0.0	-	18.6	4.5	12.9	4.4	0.0	-	21.8	-
Motorcycles	0	1	0	0	-	1	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	1
% Motorcycles	0.0	0.2	0.0	-	-	0.1	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0
Cars & Light Goods	171	470	149	0	-	790	139	512	216	0	-	867	71	282	112	0	-	465	125	316	126	0	-	567	2689
% Cars & Light Goods	95.0	95.9	97.4	-	-	96.0	100.0	98.3	97.7	-	-	98.4	97.3	82.5	96.6	-	-	87.6	96.9	85.9	99.2	-	-	90.9	94.1
Buses	5	2	1	0	-	8	0	0	4	0	-	4	1	52	0	0	-	53	0	45	0	0	-	45	110
% Buses	2.8	0.4	0.7	-	-	1.0	0.0	0.0	1.8	-	-	0.5	1.4	15.2	0.0	-	-	10.0	0.0	12.2	0.0	-	-	7.2	3.8
Single-Unit Trucks	1	4	1	0	-	6	0	3	1	0	-	4	0	3	1	0	-	4	1	2	1	0	-	4	18
% Single-Unit Trucks	0.6	0.8	0.7	-	-	0.7	0.0	0.6	0.5	-	-	0.5	0.0	0.9	0.9	-	-	0.8	0.8	0.5	0.8	-	-	0.6	0.6
Articulated Trucks	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Articulated Trucks	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0
Bicycles on Road	3	13	2	0	-	18	0	6	0	0	-	6	1	5	3	0	-	9	3	5	0	0	-	8	41
% Bicycles on Road	1.7	2.7	1.3	-	-	2.2	0.0	1.2	0.0	-	-	0.7	1.4	1.5	2.6	-	-	1.7	2.3	1.4	0.0	-	-	1.3	1.4
Bicycles on Crosswalk	-	-	-	-	1	-	-	-	-	-	5	-	-	-	-	-	2	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	0.3	-	-	-	-	-	1.4	-	-	-	-	-	0.6	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	-	345	-	-	-	-	-	356	-	-	-	-	-	329	-	-	-	-	-	330	-	-
% Pedestrians	-	-	-	-	99.7	-	-	-	-	-	98.6	-	-	-	-	-	99.4	-	-	-	-	-	100.0	-	-



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Hazel Street & Hickory Street
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Turning Movement Data Plot



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

Count Name: Hazel Street & Hickory Street
Site Code: 230707
Start Date: 03/05/2024
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Turning Movement Peak Hour Data (7:45 AM)

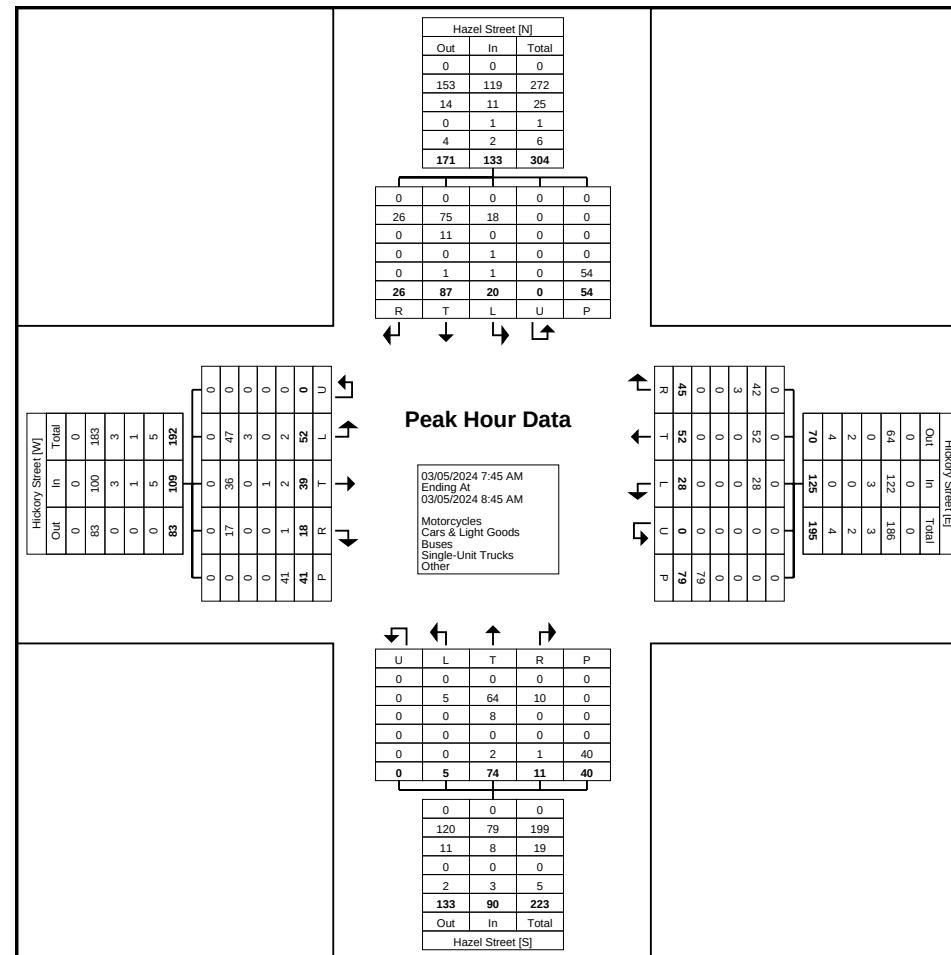
Start Time	Hickory Street Eastbound						Hickory Street Westbound						Hazel Street Northbound						Hazel Street Southbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
7:45 AM	17	16	1	0	5	34	9	7	6	0	14	22	0	22	1	0	4	23	6	23	6	0	10	35	114
8:00 AM	26	12	12	0	14	50	5	19	31	0	41	55	4	30	4	0	10	38	5	32	14	0	15	51	194
8:15 AM	9	5	1	0	14	15	6	19	3	0	19	28	1	17	3	0	15	21	7	20	6	0	18	33	97
8:30 AM	0	6	4	0	8	10	8	7	5	0	5	20	0	5	3	0	11	8	2	12	0	0	11	14	52
Total	52	39	18	0	41	109	28	52	45	0	79	125	5	74	11	0	40	90	20	87	26	0	54	133	457
Approach %	47.7	35.8	16.5	0.0	-	-	22.4	41.6	36.0	0.0	-	-	5.6	82.2	12.2	0.0	-	-	15.0	65.4	19.5	0.0	-	-	-
Total %	11.4	8.5	3.9	0.0	-	23.9	6.1	11.4	9.8	0.0	-	27.4	1.1	16.2	2.4	0.0	-	19.7	4.4	19.0	5.7	0.0	-	29.1	-
PHF	0.500	0.609	0.375	0.000	-	0.545	0.778	0.684	0.363	0.000	-	0.568	0.313	0.617	0.688	0.000	-	0.592	0.714	0.680	0.464	0.000	-	0.652	0.589
Motorcycles	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Motorcycles	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0
Cars & Light Goods	47	36	17	0	-	100	28	52	42	0	-	122	5	64	10	0	-	79	18	75	26	0	-	119	420
% Cars & Light Goods	90.4	92.3	94.4	-	-	91.7	100.0	100.0	93.3	-	-	97.6	100.0	86.5	90.9	-	-	87.8	90.0	86.2	100.0	-	-	89.5	91.9
Buses	3	0	0	0	-	3	0	0	3	0	-	3	0	8	0	0	-	8	0	11	0	0	-	11	25
% Buses	5.8	0.0	0.0	-	-	2.8	0.0	0.0	6.7	-	-	2.4	0.0	10.8	0.0	-	-	8.9	0.0	12.6	0.0	-	-	8.3	5.5
Single-Unit Trucks	0	1	0	0	-	1	0	0	0	0	-	0	0	0	0	0	-	0	1	0	0	0	-	1	2
% Single-Unit Trucks	0.0	2.6	0.0	-	-	0.9	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	5.0	0.0	0.0	-	-	0.8	0.4
Articulated Trucks	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Articulated Trucks	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0
Bicycles on Road	2	2	1	0	-	5	0	0	0	0	-	0	0	2	1	0	-	3	1	1	0	0	-	2	10
% Bicycles on Road	3.8	5.1	5.6	-	-	4.6	0.0	0.0	0.0	-	-	0.0	0.0	2.7	9.1	-	-	3.3	5.0	1.1	0.0	-	-	1.5	2.2
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	0.0	-	-	-	-	-	1.3	-	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	-	41	-	-	-	-	-	78	-	-	-	-	-	40	-	-	-	-	-	54	-	-
% Pedestrians	-	-	-	-	100.0	-	-	-	-	-	98.7	-	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Hazel Street & Hickory Street
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Turning Movement Peak Hour Data Plot (7:45 AM)



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

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Count Name: Hazel Street & Hickory Street
Site Code: 230707
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Turning Movement Peak Hour Data (12:15 PM)

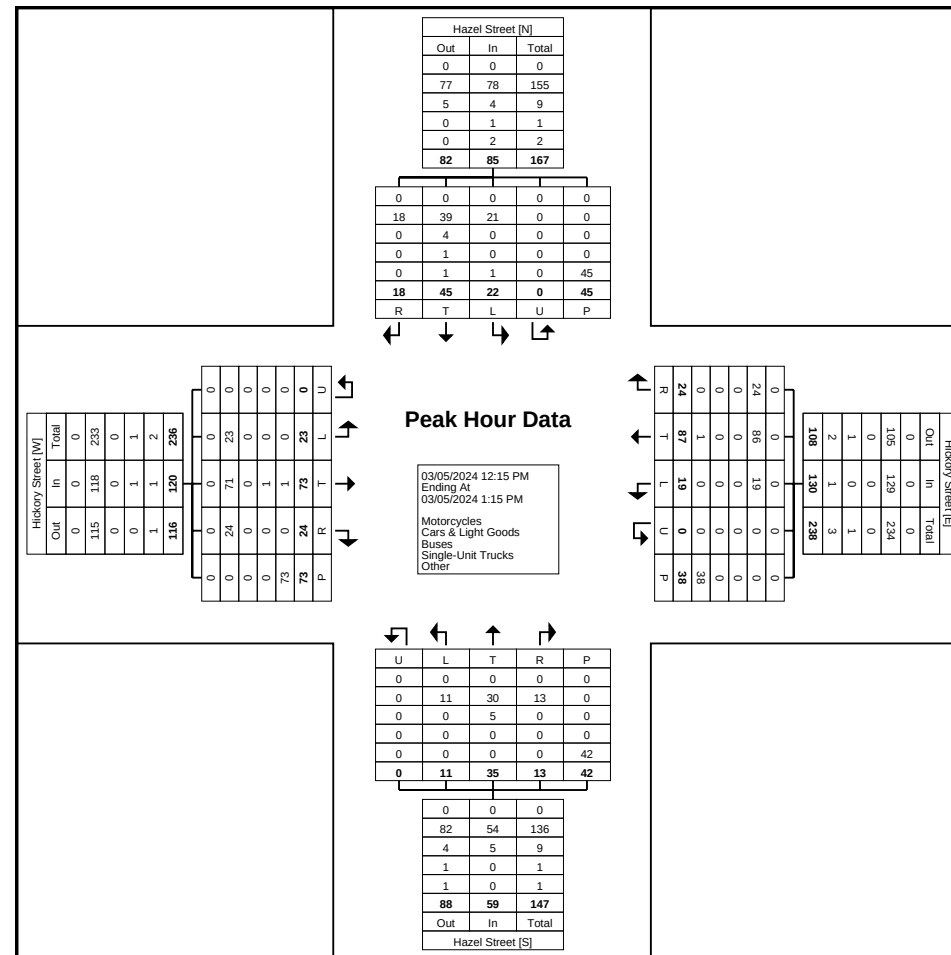
Start Time	Hickory Street Eastbound						Hickory Street Westbound						Hazel Street Northbound						Hazel Street Southbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
12:15 PM	6	20	3	0	7	29	10	16	3	0	8	29	1	10	1	0	7	12	5	10	6	0	8	21	91
12:30 PM	6	16	8	0	20	30	1	22	5	0	9	28	4	4	0	0	7	8	6	8	3	0	9	17	83
12:45 PM	7	16	10	0	33	33	6	31	10	0	13	47	4	13	4	0	21	21	6	13	6	0	16	25	126
1:00 PM	4	21	3	0	13	28	2	18	6	0	8	26	2	8	8	0	7	18	5	14	3	0	12	22	94
Total	23	73	24	0	73	120	19	87	24	0	38	130	11	35	13	0	42	59	22	45	18	0	45	85	394
Approach %	19.2	60.8	20.0	0.0	-	-	14.6	66.9	18.5	0.0	-	-	18.6	59.3	22.0	0.0	-	-	25.9	52.9	21.2	0.0	-	-	-
Total %	5.8	18.5	6.1	0.0	-	30.5	4.8	22.1	6.1	0.0	-	33.0	2.8	8.9	3.3	0.0	-	15.0	5.6	11.4	4.6	0.0	-	21.6	-
PHF	0.821	0.869	0.600	0.000	-	0.909	0.475	0.702	0.600	0.000	-	0.691	0.688	0.673	0.406	0.000	-	0.702	0.917	0.804	0.750	0.000	-	0.850	0.782
Motorcycles	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Motorcycles	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0
Cars & Light Goods	23	71	24	0	-	118	19	86	24	0	-	129	11	30	13	0	-	54	21	39	18	0	-	78	379
% Cars & Light Goods	100.0	97.3	100.0	-	-	98.3	100.0	98.9	100.0	-	-	99.2	100.0	85.7	100.0	-	-	91.5	95.5	86.7	100.0	-	-	91.8	96.2
Buses	0	0	0	0	-	0	0	0	0	0	-	0	0	5	0	0	-	5	0	4	0	0	-	4	9
% Buses	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	14.3	0.0	-	-	8.5	0.0	8.9	0.0	-	-	4.7	2.3
Single-Unit Trucks	0	1	0	0	-	1	0	0	0	0	-	0	0	0	0	0	-	0	0	1	0	0	-	1	2
% Single-Unit Trucks	0.0	1.4	0.0	-	-	0.8	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	2.2	0.0	-	-	1.2	0.5
Articulated Trucks	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Articulated Trucks	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0
Bicycles on Road	0	1	0	0	-	1	0	1	0	0	-	1	0	0	0	0	-	0	1	1	0	0	-	2	4
% Bicycles on Road	0.0	1.4	0.0	-	-	0.8	0.0	1.1	0.0	-	-	0.8	0.0	0.0	0.0	-	-	0.0	4.5	2.2	0.0	-	-	2.4	1.0
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	-	73	-	-	-	-	-	38	-	-	-	-	-	42	-	-	-	-	-	45	-	-
% Pedestrians	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-



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Count Name: Hazel Street & Hickory Street
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Turning Movement Peak Hour Data (5:00 PM)

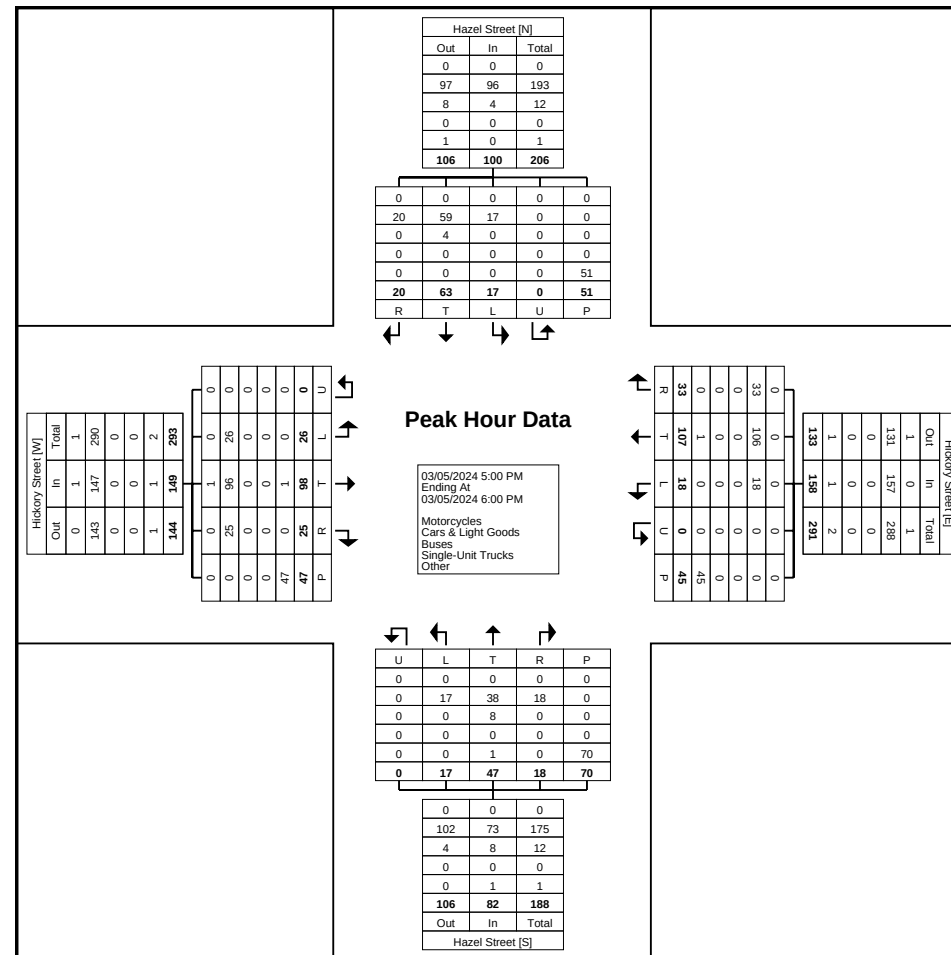
Start Time	Hickory Street Eastbound						Hickory Street Westbound						Hazel Street Northbound						Hazel Street Southbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
5:00 PM	2	26	5	0	12	33	5	26	13	0	12	44	6	13	7	0	21	26	7	22	3	0	16	32	135
5:15 PM	10	24	8	0	9	42	5	32	6	0	15	43	5	11	1	0	19	17	4	15	10	0	19	29	131
5:30 PM	13	26	10	0	11	49	4	25	7	0	12	36	4	9	6	0	17	19	2	16	4	0	7	22	126
5:45 PM	1	22	2	0	15	25	4	24	7	0	6	35	2	14	4	0	13	20	4	10	3	0	9	17	97
Total	26	98	25	0	47	149	18	107	33	0	45	158	17	47	18	0	70	82	17	63	20	0	51	100	489
Approach %	17.4	65.8	16.8	0.0	-	-	11.4	67.7	20.9	0.0	-	-	20.7	57.3	22.0	0.0	-	-	17.0	63.0	20.0	0.0	-	-	-
Total %	5.3	20.0	5.1	0.0	-	30.5	3.7	21.9	6.7	0.0	-	32.3	3.5	9.6	3.7	0.0	-	16.8	3.5	12.9	4.1	0.0	-	20.4	-
PHF	0.500	0.942	0.625	0.000	-	0.760	0.900	0.836	0.635	0.000	-	0.898	0.708	0.839	0.643	0.000	-	0.788	0.607	0.716	0.500	0.000	-	0.781	0.906
Motorcycles	0	1	0	0	-	1	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	1
% Motorcycles	0.0	1.0	0.0	-	-	0.7	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.2
Cars & Light Goods	26	96	25	0	-	147	18	106	33	0	-	157	17	38	18	0	-	73	17	59	20	0	-	96	473
% Cars & Light Goods	100.0	98.0	100.0	-	-	98.7	100.0	99.1	100.0	-	-	99.4	100.0	80.9	100.0	-	-	89.0	100.0	93.7	100.0	-	-	96.0	96.7
Buses	0	0	0	0	-	0	0	0	0	0	-	0	0	8	0	0	-	8	0	4	0	0	-	4	12
% Buses	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	17.0	0.0	-	-	9.8	0.0	6.3	0.0	-	-	4.0	2.5
Single-Unit Trucks	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Single-Unit Trucks	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0
Articulated Trucks	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Articulated Trucks	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0
Bicycles on Road	0	1	0	0	-	1	0	1	0	0	-	1	0	1	0	0	-	1	0	0	0	0	-	0	3
% Bicycles on Road	0.0	1.0	0.0	-	-	0.7	0.0	0.9	0.0	-	-	0.6	0.0	2.1	0.0	-	-	1.2	0.0	0.0	0.0	-	-	0.0	0.6
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	1	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-	-	-	-	1.4	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	-	47	-	-	-	-	-	45	-	-	-	-	-	69	-	-	-	-	-	51	-	-
% Pedestrians	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-	-	-	-	98.6	-	-	-	-	-	100.0	-	-



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Hazel Street & Hickory Street
Site Code: 230707
Start Date: 03/05/2024
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Appendix C

Existing Traffic Operations Reports



Lanes, Volumes, Timings

1: Albert Street & Hickory Street

Existing: AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (vph)	9	12	14	17	13	53	1	249	35	55	233	8
Future Volume (vph)	9	12	14	17	13	53	1	249	35	55	233	8
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.946			0.914			0.983			0.996	
Flt Protected		0.987			0.990						0.991	
Satd. Flow (prot)	0	1371	0	0	1385	0	0	1467	0	0	1479	0
Flt Permitted		0.987			0.990						0.991	
Satd. Flow (perm)	0	1371	0	0	1385	0	0	1467	0	0	1479	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		111.5			125.2			138.8			120.8	
Travel Time (s)		8.0			9.0			10.0			8.7	
Confl. Peds. (#/hr)	7		12	12		7	23		23	23		23
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	8%	7%	0%	0%	2%	0%	4%	3%	4%	3%	13%
Adj. Flow (vph)	9	12	14	17	13	53	1	249	35	55	233	8
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	35	0	0	83	0	0	285	0	0	296	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	
Intersection Summary												
Area Type:	Other											
Control Type: Unsignalized												
Intersection Capacity Utilization 57.5%												
Analysis Period (min) 15												
ICU Level of Service B												

HCM 6th TWSC

1: Albert Street & Hickory Street

Existing: AM Peak Hour

Intersection												
Int Delay, s/veh	2.9											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	9	12	14	17	13	53	1	249	35	55	233	8
Future Vol, veh/h	9	12	14	17	13	53	1	249	35	55	233	8
Conflicting Peds, #/hr	7	0	12	12	0	7	23	0	23	23	0	23
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	0	8	7	0	0	2	0	4	3	4	3	13
Mvmt Flow	9	12	14	17	13	53	1	249	35	55	233	8
Major/Minor												
Minor2	Minor1		Major1		Major2							
Conflicting Flow All	679	679	272	664	666	297	264	0	0	307	0	0
Stage 1	370	370	-	292	292	-	-	-	-	-	-	-
Stage 2	309	309	-	372	374	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.58	6.27	7.1	6.5	6.22	4.1	-	-	4.14	-	-
Critical Hdwy Stg 1	6.1	5.58	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.58	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4.072	3.363	3.5	4	3.318	2.2	-	-	2.236	-	-
Pot Cap-1 Maneuver	368	366	755	377	383	742	1312	-	-	1242	-	-
Stage 1	654	610	-	720	675	-	-	-	-	-	-	-
Stage 2	705	649	-	653	621	-	-	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	310	333	733	335	349	723	1286	-	-	1218	-	-
Mov Cap-2 Maneuver	310	333	-	335	349	-	-	-	-	-	-	-
Stage 1	641	567	-	706	662	-	-	-	-	-	-	-
Stage 2	636	636	-	588	578	-	-	-	-	-	-	-
Approach												
EB	WB		NB		SB							
HCM Control Delay, s	14.4		13.3		0		1.5					
HCM LOS	B		B									
Minor Lane/Major Mvmt												
NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR					
Capacity (veh/h)	1286	-	-	416	515	1218	-	-				
HCM Lane V/C Ratio	0.001	-	-	0.084	0.161	0.045	-	-				
HCM Control Delay (s)	7.8	0	-	14.4	13.3	8.1	0	-				
HCM Lane LOS	A	A	-	B	B	A	A	-				
HCM 95th %tile Q(veh)	0	-	-	0.3	0.6	0.1	-	-				

Lanes, Volumes, Timings

2: Hazel Street & Hickory Street

Existing: AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (vph)	52	39	18	28	52	45	5	74	11	20	87	26
Future Volume (vph)	52	39	18	28	52	45	5	74	11	20	87	26
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.978			0.951			0.983			0.974	
Flt Protected		0.977			0.989			0.997			0.993	
Satd. Flow (prot)	0	1363	0	0	1422	0	0	1336	0	0	1355	0
Flt Permitted		0.977			0.989			0.997			0.993	
Satd. Flow (perm)	0	1363	0	0	1422	0	0	1336	0	0	1355	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		131.1			177.2			136.6			111.4	
Travel Time (s)		9.4			12.8			9.8			8.0	
Confl. Peds. (#/hr)	54		40	40		54	41		79	79		41
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	10%	8%	6%	0%	0%	7%	20%	14%	9%	10%	14%	0%
Adj. Flow (vph)	52	39	18	28	52	45	5	74	11	20	87	26
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	109	0	0	125	0	0	90	0	0	133	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Stop			Stop	
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization	37.5%											
Analysis Period (min)	15											
	ICU Level of Service A											

HCM 6th AWSC

2: Hazel Street & Hickory Street

Existing: AM Peak Hour

Intersection												
Intersection Delay, s/veh	8.5											
Intersection LOS	A											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	52	39	18	28	52	45	5	74	11	20	87	26
Future Vol, veh/h	52	39	18	28	52	45	5	74	11	20	87	26
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	10	8	6	0	0	7	20	14	9	10	14	0
Mvmt Flow	52	39	18	28	52	45	5	74	11	20	87	26
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Approach	EB			WB			NB			SB		
Opposing Approach	WB			EB			SB			NB		
Opposing Lanes	1			1			1			1		
Conflicting Approach Left	SB			NB			EB			WB		
Conflicting Lanes Left	1			1			1			1		
Conflicting Approach Right	NB			SB			WB			EB		
Conflicting Lanes Right	1			1			1			1		
HCM Control Delay	8.6			8.2			8.6			8.6		
HCM LOS	A			A			A			A		
Lane	NBLn1	EBLn1	WBLn1	SBLn1								
Vol Left, %	6%	48%	22%	15%								
Vol Thru, %	82%	36%	42%	65%								
Vol Right, %	12%	17%	36%	20%								
Sign Control	Stop	Stop	Stop	Stop								
Traffic Vol by Lane	90	109	125	133								
LT Vol	5	52	28	20								
Through Vol	74	39	52	87								
RT Vol	11	18	45	26								
Lane Flow Rate	90	109	125	133								
Geometry Grp	1	1	1	1								
Degree of Util (X)	0.122	0.144	0.153	0.171								
Departure Headway (Hd)	4.883	4.749	4.402	4.64								
Convergence, Y/N	Yes	Yes	Yes	Yes								
Cap	733	755	815	773								
Service Time	2.915	2.777	2.429	2.67								
HCM Lane V/C Ratio	0.123	0.144	0.153	0.172								
HCM Control Delay	8.6	8.6	8.2	8.6								
HCM Lane LOS	A	A	A	A								
HCM 95th-tile Q	0.4	0.5	0.5	0.6								

Lanes, Volumes, Timings

1: Albert Street & Hickory Street

Existing: PM Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	17	31	27	34	30	61	32	290	37	52	367	22
Future Volume (vph)	17	31	27	34	30	61	32	290	37	52	367	22
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.951			0.934			0.986			0.993	
Flt Protected		0.989			0.987			0.996			0.994	
Satd. Flow (prot)	0	1440	0	0	1415	0	0	1510	0	0	1517	0
Flt Permitted		0.989			0.987			0.996			0.994	
Satd. Flow (perm)	0	1440	0	0	1415	0	0	1510	0	0	1517	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		111.5			125.2			138.8			120.8	
Travel Time (s)		8.0			9.0			10.0			8.7	
Confl. Peds. (#/hr)	16		34	34		16	38		56	56		38
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	3%	0%	0%	0%	2%	0%	1%	0%	0%	1%	0%
Adj. Flow (vph)	17	31	27	34	30	61	32	290	37	52	367	22
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	75	0	0	125	0	0	359	0	0	441	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization	61.5%				ICU Level of Service B							
Analysis Period (min)	15											

HCM 6th TWSC
1: Albert Street & Hickory Street

Existing: PM Peak Hour

Intersection												
Int Delay, s/veh	5.9											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔			↔			↔			↔		
Traffic Vol, veh/h	17	31	27	34	30	61	32	290	37	52	367	22
Future Vol, veh/h	17	31	27	34	30	61	32	290	37	52	367	22
Conflicting Peds, #/hr	16	0	34	34	0	16	38	0	56	56	0	38
Sign Control	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	0	3	0	0	0	2	0	1	0	0	1	0
Mvmt Flow	17	31	27	34	30	61	32	290	37	52	367	22

Major/Minor	Minor2	Minor1	Major1	Major2								
Conflicting Flow All	954	967	450	974	960	381	427	0	0	383	0	0
Stage 1	520	520	-	429	429	-	-	-	-	-	-	-
Stage 2	434	447	-	545	531	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.53	6.2	7.1	6.5	6.22	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.53	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.53	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4.027	3.3	3.5	4	3.318	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	240	253	613	233	259	666	1143	-	-	1187	-	-
Stage 1	543	530	-	608	587	-	-	-	-	-	-	-
Stage 2	604	572	-	526	529	-	-	-	-	-	-	-
Platoon blocked, %												
Mov Cap-1 Maneuver	172	212	576	170	217	626	1106	-	-	1131	-	-
Mov Cap-2 Maneuver	172	212	-	170	217	-	-	-	-	-	-	-
Stage 1	507	483	-	558	539	-	-	-	-	-	-	-
Stage 2	490	526	-	429	482	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	24.7	26.9	0.7	1
HCM LOS	C	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1106	-	-	257	287	1131	-	-
HCM Lane V/C Ratio	0.029	-	-	0.292	0.436	0.046	-	-
HCM Control Delay (s)	8.4	0	-	24.7	26.9	8.3	0	-
HCM Lane LOS	A	A	-	C	D	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	1.2	2.1	0.1	-	-

Lanes, Volumes, Timings
2: Hazel Street & Hickory Street

Existing: PM Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	26	98	25	18	107	33	17	47	18	17	63	20
Future Volume (vph)	26	98	25	18	107	33	17	47	18	17	63	20
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.977			0.972			0.970			0.973	
Flt Protected		0.991			0.994			0.990			0.992	
Satd. Flow (prot)	0	1491	0	0	1487	0	0	1342	0	0	1442	0
Flt Permitted		0.991			0.994			0.990			0.992	
Satd. Flow (perm)	0	1491	0	0	1487	0	0	1342	0	0	1442	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		131.1			177.2			136.6			111.4	
Travel Time (s)		9.4			12.8			9.8			8.0	
Confl. Peds. (#/hr)	51		70	70		51	47		45	45		47
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	1%	0%	0%	1%	0%	0%	19%	0%	0%	6%	0%
Adj. Flow (vph)	26	98	25	18	107	33	17	47	18	17	63	20
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	149	0	0	158	0	0	82	0	0	100	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control	Stop				Stop				Stop		Stop	

Intersection Summary	
Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	35.3%
Analysis Period (min)	15
ICU Level of Service	A

HCM 6th AWSC

2: Hazel Street & Hickory Street

Existing: PM Peak Hour

Intersection	
Intersection Delay, s/veh	8.4
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	26	98	25	18	107	33	17	47	18	17	63	20
Future Vol, veh/h	26	98	25	18	107	33	17	47	18	17	63	20
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	0	1	0	0	1	0	0	19	0	0	6	0
Mvmt Flow	26	98	25	18	107	33	17	47	18	17	63	20
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	8.5	8.5	8.2	8.3
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	21%	17%	11%	17%
Vol Thru, %	57%	66%	68%	63%
Vol Right, %	22%	17%	21%	20%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	82	149	158	100
LT Vol	17	26	18	17
Through Vol	47	98	107	63
RT Vol	18	25	33	20
Lane Flow Rate	82	149	158	100
Geometry Grp	1	1	1	1
Degree of Util (X)	0.105	0.184	0.193	0.128
Departure Headway (Hd)	4.623	4.438	4.392	4.605
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	775	809	817	778
Service Time	2.655	2.464	2.419	2.636
HCM Lane V/C Ratio	0.106	0.184	0.193	0.129
HCM Control Delay	8.2	8.5	8.5	8.3
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.4	0.7	0.7	0.4

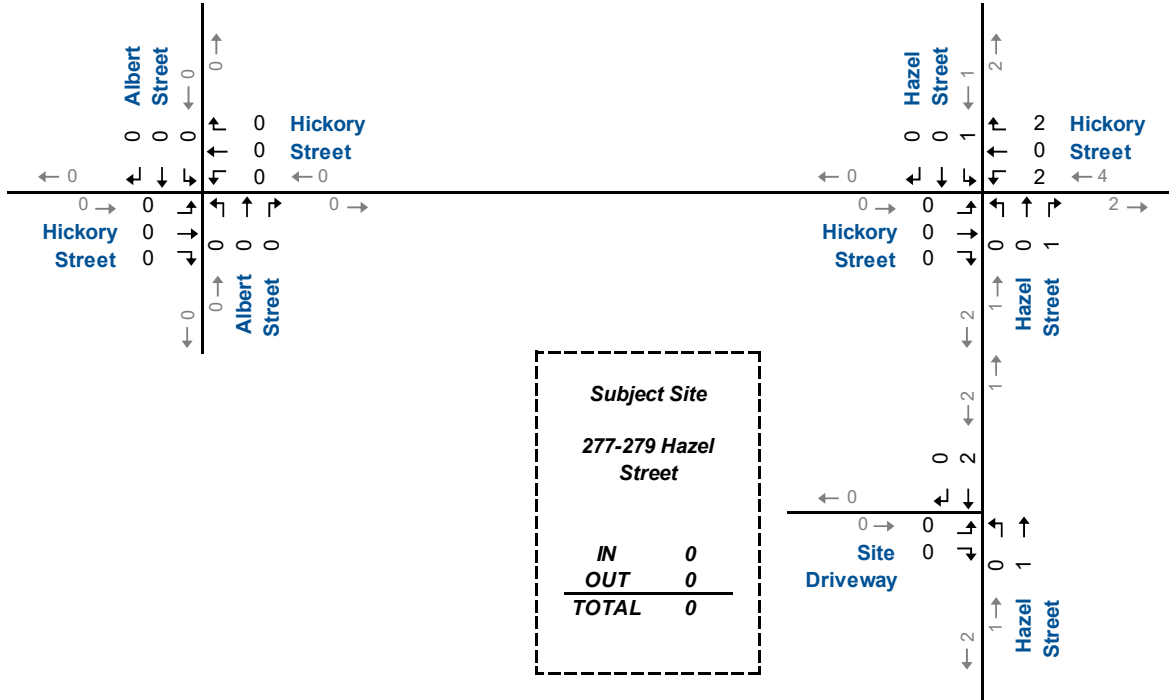
Appendix D

Background Development Traffic Volumes

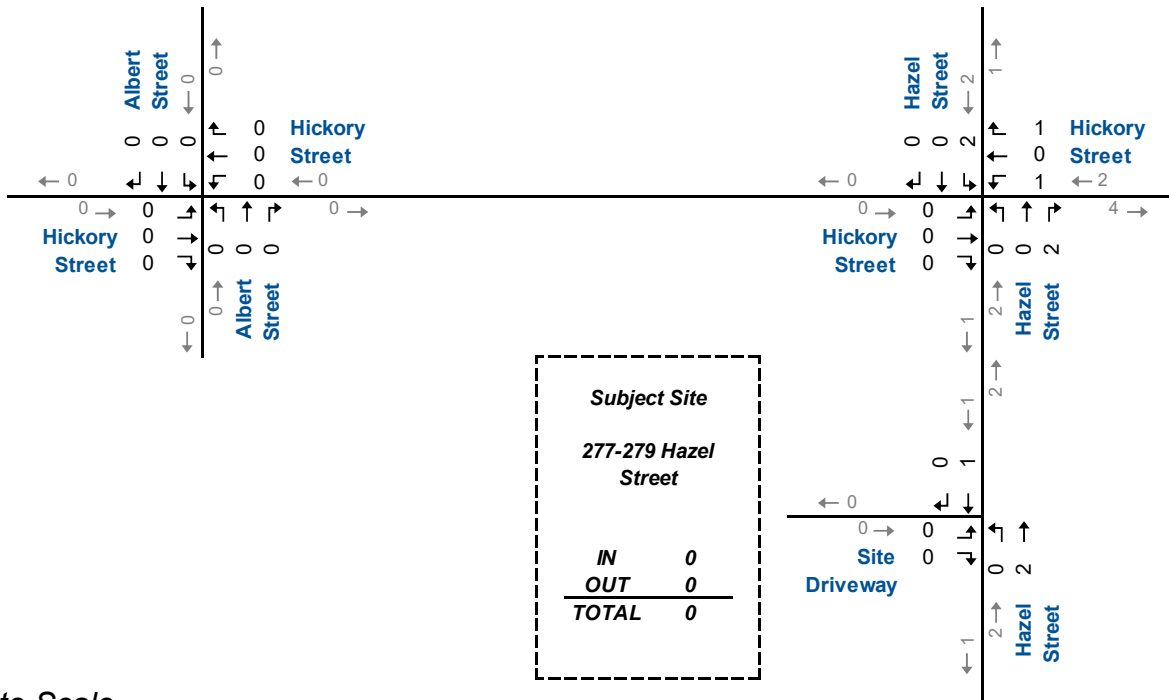




AM Peak Hour



PM Peak Hour



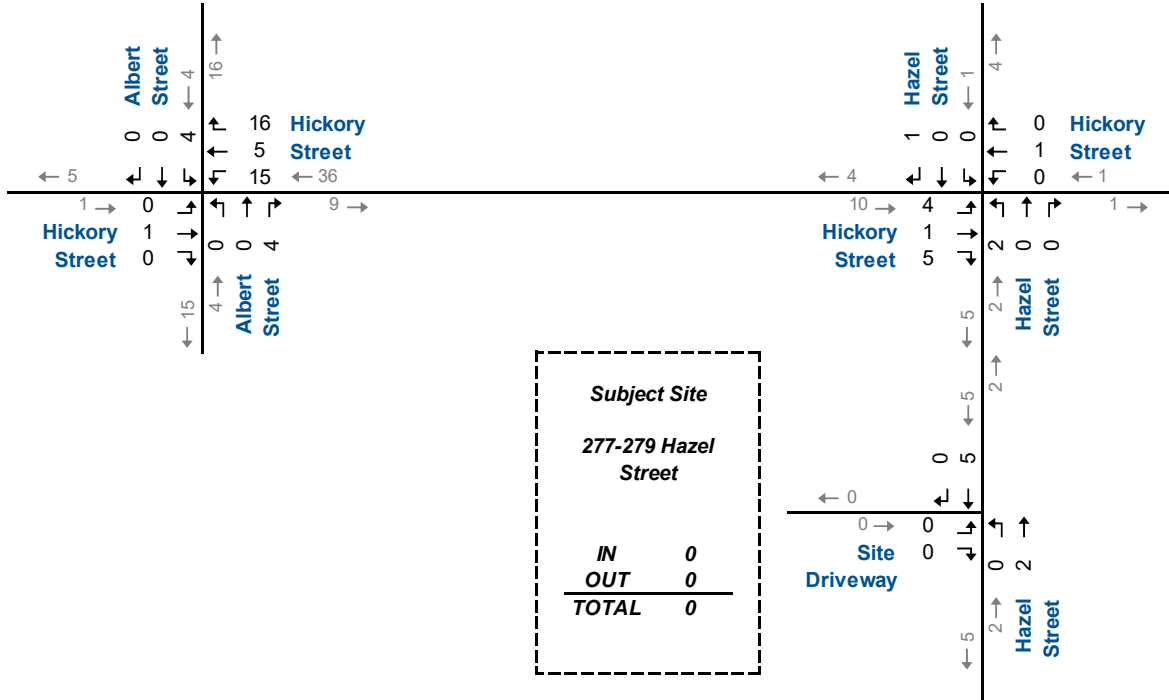
Not to Scale



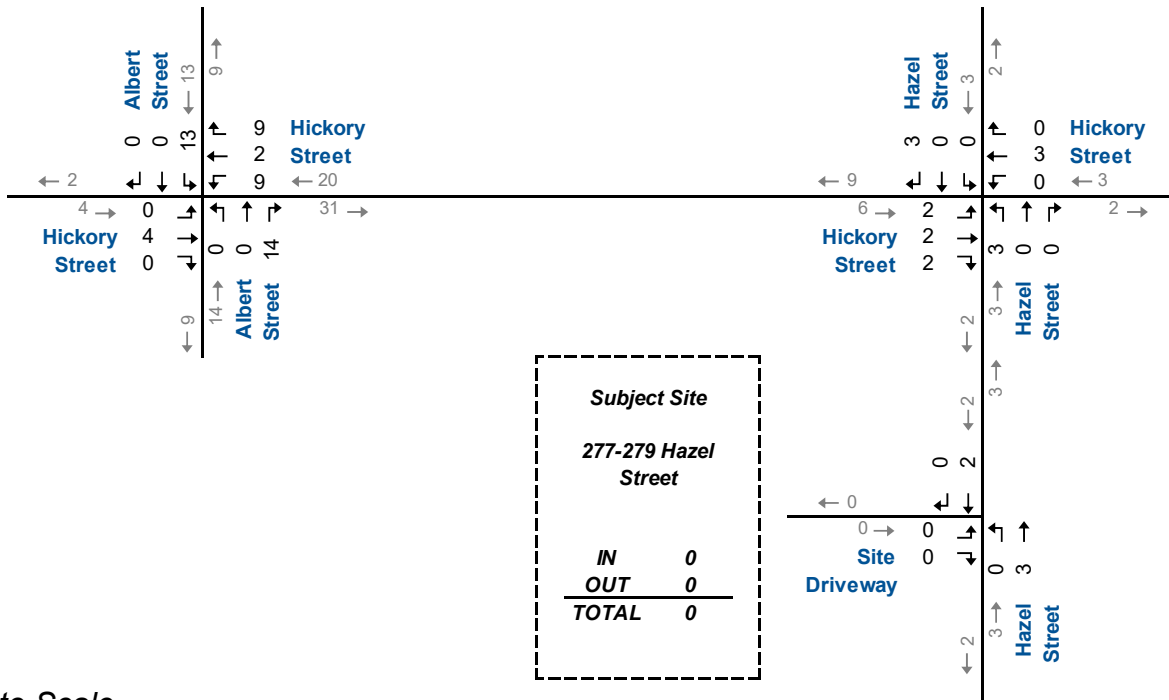
309-311 Hawthorn Street Background Traffic Volume Estimate



AM Peak Hour



PM Peak Hour



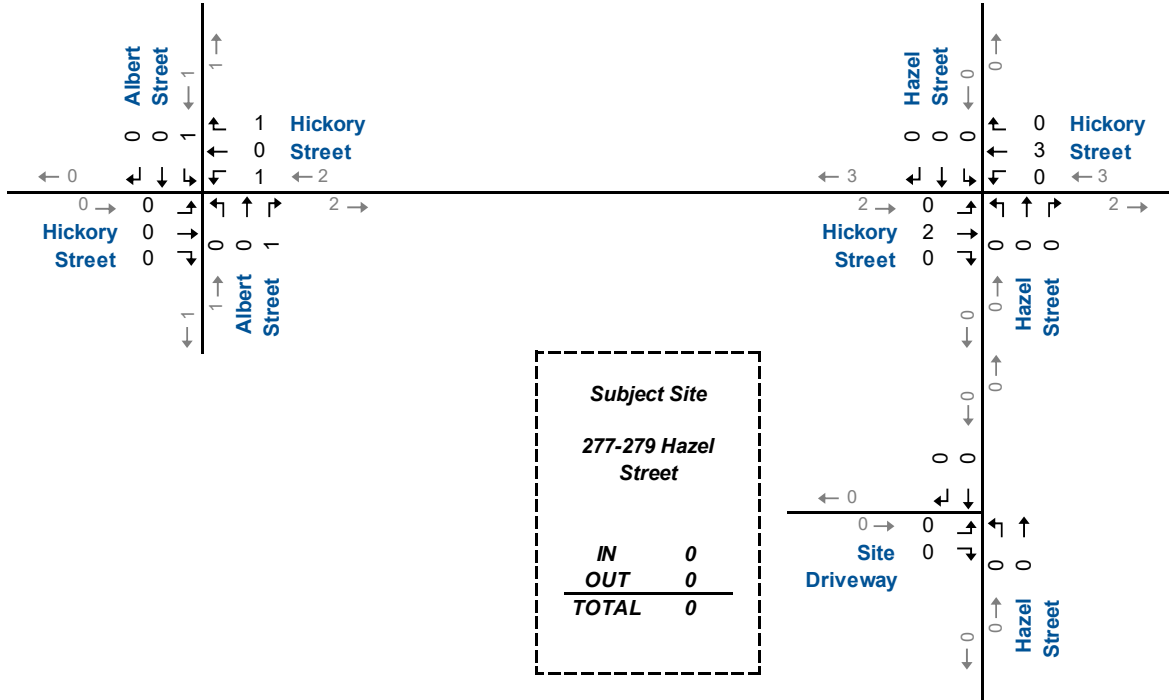
Not to Scale



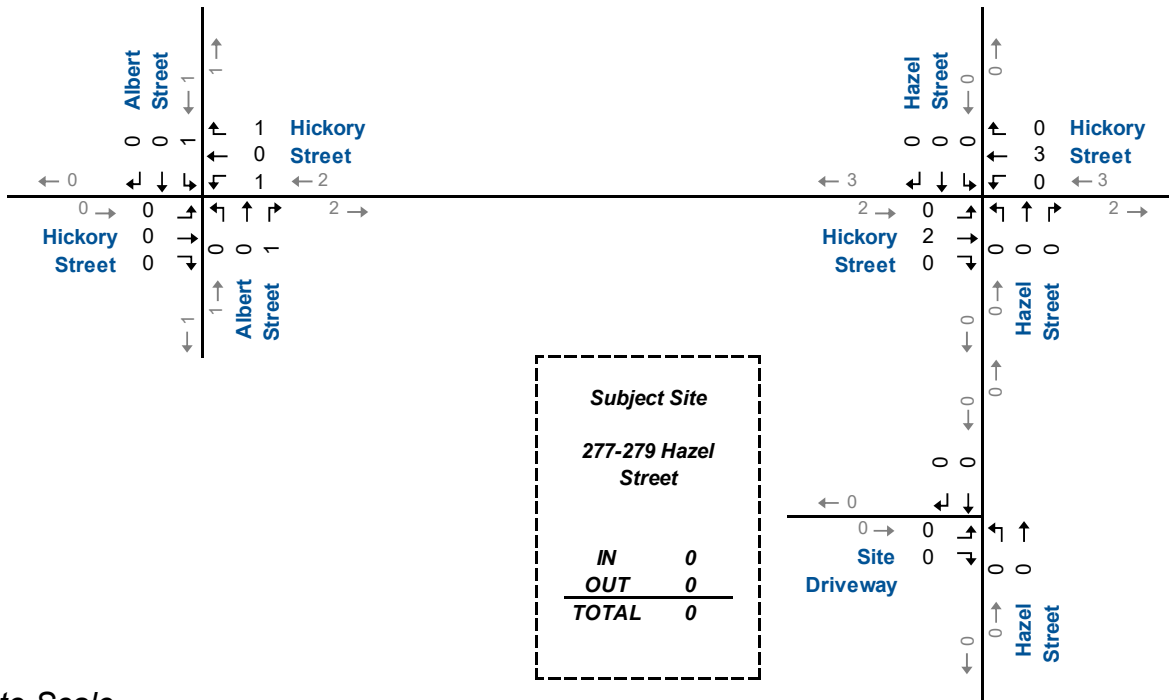
83-85 Hickory Street Background Traffic Volume Estimate



AM Peak Hour



PM Peak Hour



Not to Scale



34-38 Hickory Street Background Traffic Volume Estimate

Appendix E

ITE Trip Generation Manual Excerpts



Land Use: 221

Multifamily Housing (Mid-Rise)

Description

Mid-rise multifamily housing includes apartments and condominiums located in a building that has between four and 10 floors of living space. Access to individual dwelling units is through an outside building entrance, a lobby, elevator, and a set of hallways.

Multifamily housing (low-rise) (Land Use 220), multifamily housing (high-rise) (Land Use 222), off-campus student apartment (mid-rise) (Land Use 226), and mid-rise residential with ground-floor commercial (Land Use 231) are related land uses.

Land Use Subcategory

Data are presented for two subcategories for this land use: (1) not close to rail transit and (2) close to rail transit. A site is considered close to rail transit if the walking distance between the residential site entrance and the closest rail transit station entrance is ½ mile or less.

Additional Data

For the six sites for which both the number of residents and the number of occupied dwelling units were available, there were an average of 2.5 residents per occupied dwelling unit.

For the five sites for which the numbers of both total dwelling units and occupied dwelling units were available, an average of 96 percent of the total dwelling units were occupied.

The technical appendices provide supporting information on time-of-day distributions for this land use. The appendices can be accessed through either the ITETripGen web app or the trip generation resource page on the ITE website (<https://www.ite.org/technical-resources/topics/trip-and-parking-generation/>).

It is expected that the number of bedrooms and number of residents are likely correlated to the trips generated by a residential site. To assist in future analysis, trip generation studies of all multifamily housing should attempt to obtain information on occupancy rate and on the mix of residential unit sizes (i.e., number of units by number of bedrooms at the site complex).

The sites were surveyed in the 1990s, the 2000s, the 2010s, and the 2020s in Alberta (CAN), California, District of Columbia, Florida, Georgia, Illinois, Maryland, Massachusetts, Minnesota, Montana, New Jersey, New York, Ontario (CAN), Oregon, Utah, and Virginia.

Source Numbers

168, 188, 204, 305, 306, 321, 818, 857, 862, 866, 901, 904, 910, 949, 951, 959, 963, 964, 966, 967, 969, 970, 1004, 1014, 1022, 1023, 1025, 1031, 1032, 1035, 1047, 1056, 1057, 1058, 1071, 1076

Multifamily Housing (Mid-Rise) Not Close to Rail Transit (221)

Vehicle Trip Ends vs: Dwelling Units

On a: Weekday,

Peak Hour of Adjacent Street Traffic,

One Hour Between 7 and 9 a.m.

Setting/Location: General Urban/Suburban

Number of Studies: 30

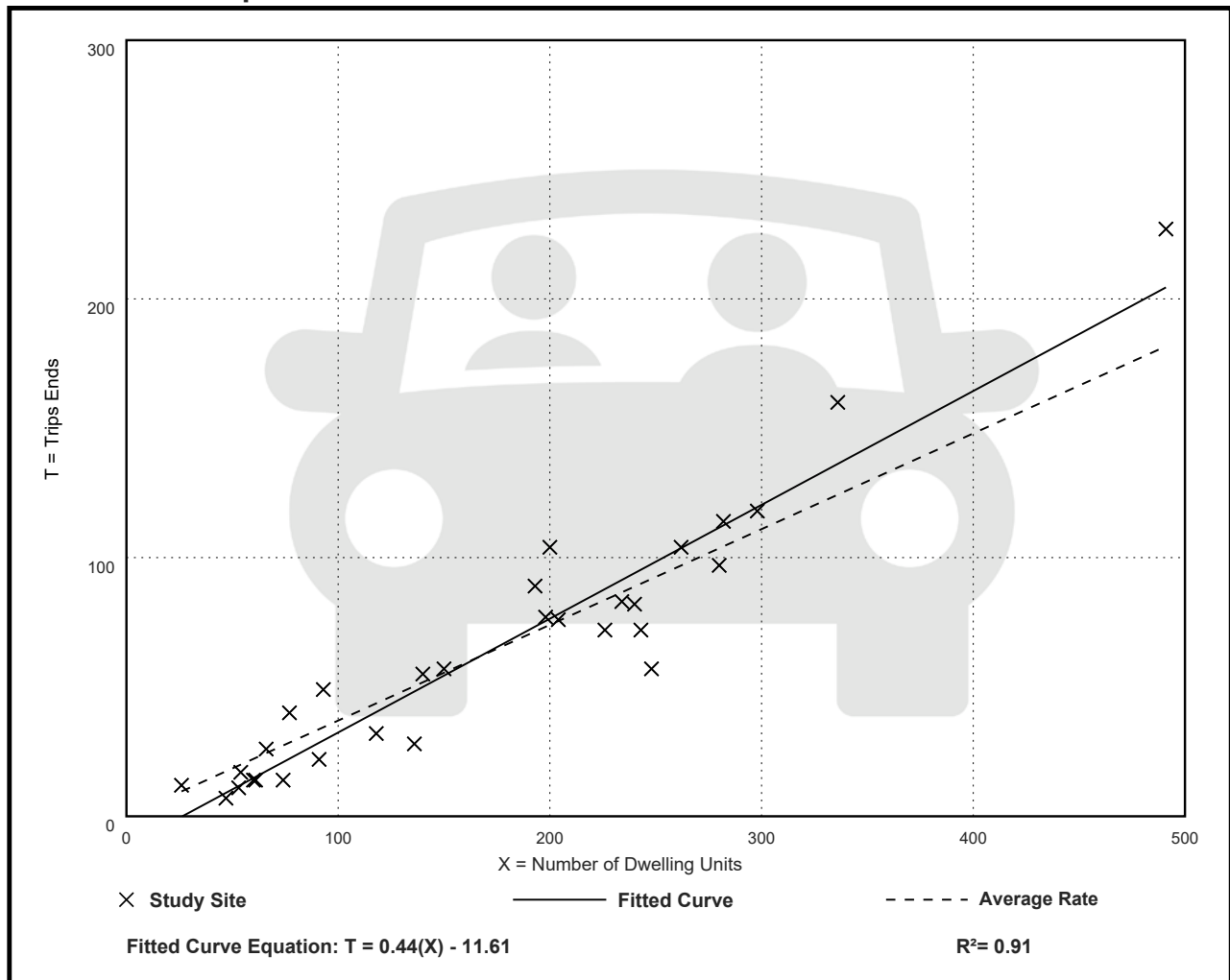
Avg. Num. of Dwelling Units: 173

Directional Distribution: 23% entering, 77% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.37	0.15 - 0.53	0.09

Data Plot and Equation



Multifamily Housing (Mid-Rise) Not Close to Rail Transit (221)

Vehicle Trip Ends vs: Dwelling Units

On a: Weekday,

Peak Hour of Adjacent Street Traffic,

One Hour Between 4 and 6 p.m.

Setting/Location: General Urban/Suburban

Number of Studies: 31

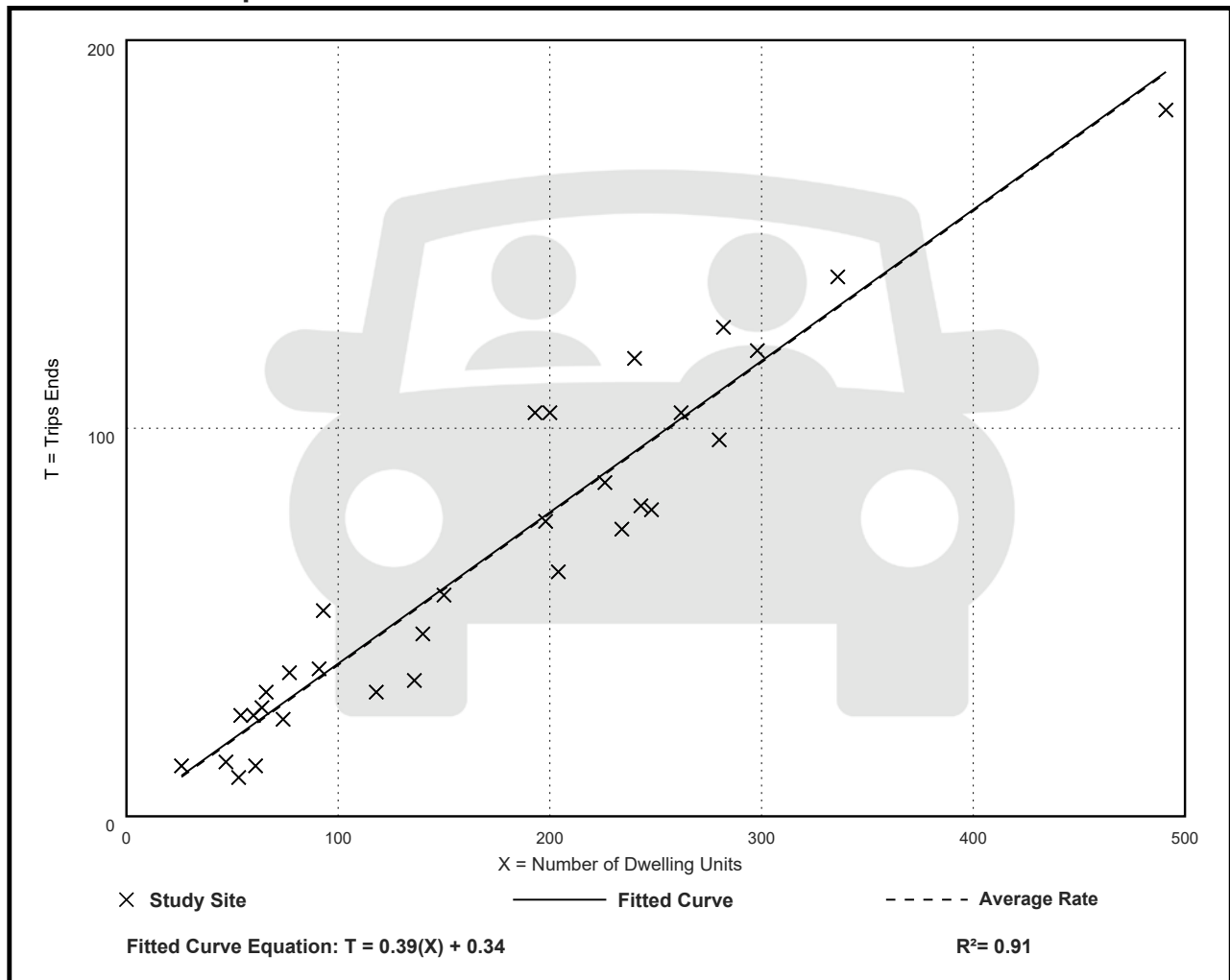
Avg. Num. of Dwelling Units: 169

Directional Distribution: 61% entering, 39% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.39	0.19 - 0.57	0.08

Data Plot and Equation



Appendix F

2030 Background Traffic Operations Reports



Lanes, Volumes, Timings

1: Albert Street & Hickory Street

2030 Background: AM Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	15	16	35	20	77	1	280	44	67	262	9
Future Volume (vph)	10	15	16	35	20	77	1	280	44	67	262	9
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.947			0.921			0.982			0.996	
Flt Protected		0.988			0.987						0.990	
Satd. Flow (prot)	0	1373	0	0	1393	0	0	1466	0	0	1477	0
Flt Permitted		0.988			0.987						0.990	
Satd. Flow (perm)	0	1373	0	0	1393	0	0	1466	0	0	1477	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		111.5			125.2			138.8			120.8	
Travel Time (s)		8.0			9.0			10.0			8.7	
Confl. Peds. (#/hr)	7		12	12		7	23		23	23		23
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	8%	7%	0%	0%	2%	0%	4%	3%	4%	3%	13%
Adj. Flow (vph)	10	15	16	35	20	77	1	280	44	67	262	9
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	41	0	0	132	0	0	325	0	0	338	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization	67.3%											
Analysis Period (min)	15											
ICU Level of Service C												

HCM 6th TWSC

1: Albert Street & Hickory Street

2030 Background: AM Peak Hour

Intersection												
Int Delay, s/veh	4.1											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↕			↔			↕	
Traffic Vol, veh/h	10	15	16	35	20	77	1	280	44	67	262	9
Future Vol, veh/h	10	15	16	35	20	77	1	280	44	67	262	9
Conflicting Peds, #/hr	7	0	12	12	0	7	23	0	23	23	0	23
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	0	8	7	0	0	2	0	4	3	4	3	13
Mvmt Flow	10	15	16	35	20	77	1	280	44	67	262	9
Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	784	773	302	755	755	332	294	0	0	347	0	0
Stage 1	424	424	-	327	327	-	-	-	-	-	-	-
Stage 2	360	349	-	428	428	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.58	6.27	7.1	6.5	6.22	4.1	-	-	4.14	-	-
Critical Hdwy Stg 1	6.1	5.58	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.58	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4.072	3.363	3.5	4	3.318	2.2	-	-	2.236	-	-
Pot Cap-1 Maneuver	313	323	726	328	340	710	1279	-	-	1201	-	-
Stage 1	612	577	-	690	651	-	-	-	-	-	-	-
Stage 2	662	623	-	609	588	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	244	290	705	283	305	692	1254	-	-	1178	-	-
Mov Cap-2 Maneuver	244	290	-	283	305	-	-	-	-	-	-	-
Stage 1	600	528	-	676	638	-	-	-	-	-	-	-
Stage 2	566	611	-	534	538	-	-	-	-	-	-	-
Approach	EB		WB		NB		SB					
HCM Control Delay, s	16.5		16.7		0		1.6					
HCM LOS	C		C									
Minor Lane/Major Mvmt	NBL		NBT	NBR EBLn1WBLn1		SBL	SBT	SBR				
Capacity (veh/h)	1254		-	-	355	439	1178	-	-			
HCM Lane V/C Ratio	0.001		-	-	0.115	0.301	0.057	-	-			
HCM Control Delay (s)	7.9		0	-	16.5	16.7	8.2	0	-			
HCM Lane LOS	A		A	-	C	C	A	A	-			
HCM 95th %tile Q(veh)	0		-	-	0.4	1.2	0.2	-	-			

Lanes, Volumes, Timings

2: Hazel Street & Hickory Street

2030 Background: AM Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	63	47	25	34	63	53	8	83	13	24	98	30
Future Volume (vph)	63	47	25	34	63	53	8	83	13	24	98	30
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt	0.975				0.952				0.983		0.973	
Flt Protected	0.977				0.989				0.996		0.992	
Satd. Flow (prot)	0	1360	0	0	1424	0	0	1333	0	0	1353	0
Flt Permitted	0.977				0.989				0.996		0.992	
Satd. Flow (perm)	0	1360	0	0	1424	0	0	1333	0	0	1353	0
Link Speed (k/h)	50				50				50		50	
Link Distance (m)	131.1				177.2				136.6		111.4	
Travel Time (s)	9.4				12.8				9.8		8.0	
Confl. Peds. (#/hr)	54			40			54	41			79	41
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	10%	8%	6%	0%	0%	7%	20%	14%	9%	10%	14%	0%
Adj. Flow (vph)	63	47	25	34	63	53	8	83	13	24	98	30
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	135	0	0	150	0	0	104	0	0	152	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)	0.0				0.0				0.0		0.0	
Link Offset(m)	0.0				0.0				0.0		0.0	
Crosswalk Width(m)	4.8				4.8				4.8		4.8	
Two way Left Turn Lane												
Headway Factor	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29
Turning Speed (k/h)	25	15		25	15		25	15		25	15	
Sign Control	Stop				Stop				Stop		Stop	
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization	40.7%				ICU Level of Service A							
Analysis Period (min)	15											

HCM 6th AWSC

2: Hazel Street & Hickory Street

2030 Background: AM Peak Hour

Intersection												
Intersection Delay, s/veh	8.9											
Intersection LOS	A											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	63	47	25	34	63	53	8	83	13	24	98	30
Future Vol, veh/h	63	47	25	34	63	53	8	83	13	24	98	30
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	10	8	6	0	0	7	20	14	9	10	14	0
Mvmt Flow	63	47	25	34	63	53	8	83	13	24	98	30
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Approach	EB			WB			NB			SB		
Opposing Approach	WB			EB			SB			NB		
Opposing Lanes	1			1			1			1		
Conflicting Approach Left	SB			NB			EB			WB		
Conflicting Lanes Left	1			1			1			1		
Conflicting Approach Right	NB			SB			WB			EB		
Conflicting Lanes Right	1			1			1			1		
HCM Control Delay	9			8.6			9			9.1		
HCM LOS	A			A			A			A		
Lane	NBLn1	EBLn1	WBLn1	SBLn1								
Vol Left, %	8%	47%	23%	16%								
Vol Thru, %	80%	35%	42%	64%								
Vol Right, %	12%	19%	35%	20%								
Sign Control	Stop	Stop	Stop	Stop								
Traffic Vol by Lane	104	135	150	152								
LT Vol	8	63	34	24								
Through Vol	83	47	63	98								
RT Vol	13	25	53	30								
Lane Flow Rate	104	135	150	152								
Geometry Grp	1	1	1	1								
Degree of Util (X)	0.146	0.182	0.189	0.202								
Departure Headway (Hd)	5.044	4.862	4.536	4.792								
Convergence, Y/N	Yes	Yes	Yes	Yes								
Cap	708	736	789	746								
Service Time	3.094	2.907	2.578	2.837								
HCM Lane V/C Ratio	0.147	0.183	0.19	0.204								
HCM Control Delay	9	9	8.6	9.1								
HCM Lane LOS	A	A	A	A								
HCM 95th-tile Q	0.5	0.7	0.7	0.8								

Lanes, Volumes, Timings
1: Albert Street & Hickory Street

2030 Background: PM Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	19	39	30	48	36	79	36	327	57	73	413	25
Future Volume (vph)	19	39	30	48	36	79	36	327	57	73	413	25
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.954			0.935			0.982			0.993	
Flt Protected		0.989			0.985			0.996			0.993	
Satd. Flow (prot)	0	1443	0	0	1414	0	0	1504	0	0	1516	0
Flt Permitted		0.989			0.985			0.996			0.993	
Satd. Flow (perm)	0	1443	0	0	1414	0	0	1504	0	0	1516	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		111.5			125.2			138.8			120.8	
Travel Time (s)		8.0			9.0			10.0			8.7	
Confl. Peds. (#/hr)	16		34	34		16	38		56	56		38
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	3%	0%	0%	0%	2%	0%	1%	0%	0%	1%	0%
Adj. Flow (vph)	19	39	30	48	36	79	36	327	57	73	413	25
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	88	0	0	163	0	0	420	0	0	511	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization	77.1%						ICU Level of Service D					
Analysis Period (min)	15											

HCM 6th TWSC
1: Albert Street & Hickory Street

2030 Background: PM Peak Hour

Intersection												
Int Delay, s/veh	11.7											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔			↔			↔			↔		
Traffic Vol, veh/h	19	39	30	48	36	79	36	327	57	73	413	25
Future Vol, veh/h	19	39	30	48	36	79	36	327	57	73	413	25
Conflicting Peds, #/hr	16	0	34	34	0	16	38	0	56	56	0	38
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	0	3	0	0	0	2	0	1	0	0	1	0
Mvmt Flow	19	39	30	48	36	79	36	327	57	73	413	25

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	1111	1122	498	1124	1106	428	476	0	0	440	0	0
Stage 1	610	610	-	484	484	-	-	-	-	-	-	-
Stage 2	501	512	-	640	622	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.53	6.2	7.1	6.5	6.22	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.53	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.53	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4.027	3.3	3.5	4	3.318	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	188	205	576	184	212	627	1097	-	-	1131	-	-
Stage 1	485	483	-	568	555	-	-	-	-	-	-	-
Stage 2	556	535	-	467	482	-	-	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	118	165	541	119	170	589	1062	-	-	1077	-	-
Mov Cap-2 Maneuver	118	165	-	119	170	-	-	-	-	-	-	-
Stage 1	449	426	-	518	506	-	-	-	-	-	-	-
Stage 2	422	488	-	354	425	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	38.1		58.4		0.7		1.2	
HCM LOS	E		F					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1062	-	-	194	218	1077	-	-
HCM Lane V/C Ratio	0.034	-	-	0.454	0.748	0.068	-	-
HCM Control Delay (s)	8.5	0	-	38.1	58.4	8.6	0	-
HCM Lane LOS	A	A	-	E	F	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	2.1	5.1	0.2	-	-

Lanes, Volumes, Timings
2: Hazel Street & Hickory Street

2030 Background: PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (vph)	31	114	30	21	126	38	22	53	22	21	71	26
Future Volume (vph)	31	114	30	21	126	38	22	53	22	21	71	26
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.977			0.972			0.969			0.970	
Flt Protected		0.991			0.994			0.989			0.991	
Satd. Flow (prot)	0	1491	0	0	1487	0	0	1346	0	0	1438	0
Flt Permitted		0.991			0.994			0.989			0.991	
Satd. Flow (perm)	0	1491	0	0	1487	0	0	1346	0	0	1438	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		131.1			177.2			136.6			111.4	
Travel Time (s)		9.4			12.8			9.8			8.0	
Confl. Peds. (#/hr)	51		70	70		51	47		45	45		47
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	1%	0%	0%	1%	0%	0%	19%	0%	0%	6%	0%
Adj. Flow (vph)	31	114	30	21	126	38	22	53	22	21	71	26
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	175	0	0	185	0	0	97	0	0	118	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control	Stop				Stop		Stop				Stop	

Intersection Summary	
Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	38.5%
Analysis Period (min)	15
ICU Level of Service	A

HCM 6th AWSC

2: Hazel Street & Hickory Street

2030 Background: PM Peak Hour

Intersection	
Intersection Delay, s/veh	8.8
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↕			↕			↔	
Traffic Vol, veh/h	31	114	30	21	126	38	22	53	22	21	71	26
Future Vol, veh/h	31	114	30	21	126	38	22	53	22	21	71	26
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	0	1	0	0	1	0	0	19	0	0	6	0
Mvmt Flow	31	114	30	21	126	38	22	53	22	21	71	26
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	8.9	8.9	8.5	8.7
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	23%	18%	11%	18%
Vol Thru, %	55%	65%	68%	60%
Vol Right, %	23%	17%	21%	22%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	97	175	185	118
LT Vol	22	31	21	21
Through Vol	53	114	126	71
RT Vol	22	30	38	26
Lane Flow Rate	97	175	185	118
Geometry Grp	1	1	1	1
Degree of Util (X)	0.129	0.222	0.232	0.156
Departure Headway (Hd)	4.783	4.562	4.519	4.751
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	747	784	792	753
Service Time	2.831	2.603	2.56	2.796
HCM Lane V/C Ratio	0.13	0.223	0.234	0.157
HCM Control Delay	8.5	8.9	8.9	8.7
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.4	0.8	0.9	0.6

Appendix G

2030 Total Traffic Operations Reports



Lanes, Volumes, Timings

1: Albert Street & Hickory Street

2030 Total: AM Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	16	16	38	20	81	1	280	45	68	262	9
Future Volume (vph)	10	16	16	38	20	81	1	280	45	68	262	9
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.949			0.921			0.981			0.996	
Flt Protected		0.988			0.987						0.990	
Satd. Flow (prot)	0	1375	0	0	1393	0	0	1464	0	0	1477	0
Flt Permitted		0.988			0.987						0.990	
Satd. Flow (perm)	0	1375	0	0	1393	0	0	1464	0	0	1477	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		111.5			125.2			138.8			120.8	
Travel Time (s)		8.0			9.0			10.0			8.7	
Confl. Peds. (#/hr)	7		12	12		7	23		23	23		23
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	8%	7%	0%	0%	2%	0%	4%	3%	4%	3%	13%
Adj. Flow (vph)	10	16	16	38	20	81	1	280	45	68	262	9
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	42	0	0	139	0	0	326	0	0	339	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization	68.4%											
Analysis Period (min)	15											
ICU Level of Service C												

HCM 6th TWSC

1: Albert Street & Hickory Street

2030 Total: AM Peak Hour

Intersection												
Int Delay, s/veh	4.3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔↔↔↔↔↔↔↔↔↔↔↔											
Traffic Vol, veh/h	10	16	16	38	20	81	1	280	45	68	262	9
Future Vol, veh/h	10	16	16	38	20	81	1	280	45	68	262	9
Conflicting Peds, #/hr	7	0	12	12	0	7	23	0	23	23	0	23
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	0	8	7	0	0	2	0	4	3	4	3	13
Mvmt Flow	10	16	16	38	20	81	1	280	45	68	262	9
Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	788	776	302	759	758	333	294	0	0	348	0	0
Stage 1	426	426	-	328	328	-	-	-	-	-	-	-
Stage 2	362	350	-	431	430	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.58	6.27	7.1	6.5	6.22	4.1	-	-	4.14	-	-
Critical Hdwy Stg 1	6.1	5.58	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.58	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4.072	3.363	3.5	4	3.318	2.2	-	-	2.236	-	-
Pot Cap-1 Maneuver	311	322	726	326	339	709	1279	-	-	1200	-	-
Stage 1	610	576	-	689	651	-	-	-	-	-	-	-
Stage 2	661	622	-	607	587	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	241	289	705	281	304	691	1254	-	-	1177	-	-
Mov Cap-2 Maneuver	241	289	-	281	304	-	-	-	-	-	-	-
Stage 1	598	526	-	675	638	-	-	-	-	-	-	-
Stage 2	561	610	-	531	537	-	-	-	-	-	-	-
Approach	EB			WB			NB			SB		
HCM Control Delay, s	16.6			17			0			1.7		
HCM LOS	C			C								
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR				
Capacity (veh/h)	1254	-	-	351	437	1177	-	-				
HCM Lane V/C Ratio	0.001	-	-	0.12	0.318	0.058	-	-				
HCM Control Delay (s)	7.9	0	-	16.6	17	8.2	0	-				
HCM Lane LOS	A	A	-	C	C	A	A	-				
HCM 95th %tile Q(veh)	0	-	-	0.4	1.4	0.2	-	-				

Lanes, Volumes, Timings

2: Hazel Street & Hickory Street

2030 Total: AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (vph)	63	47	28	34	63	53	15	85	14	24	98	30
Future Volume (vph)	63	47	28	34	63	53	15	85	14	24	98	30
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.973			0.952			0.983			0.973	
Flt Protected		0.978			0.989			0.993			0.992	
Satd. Flow (prot)	0	1359	0	0	1424	0	0	1325	0	0	1353	0
Flt Permitted		0.978			0.989			0.993			0.992	
Satd. Flow (perm)	0	1359	0	0	1424	0	0	1325	0	0	1353	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		131.1			177.2			37.7			111.4	
Travel Time (s)		9.4			12.8			2.7			8.0	
Confl. Peds. (#/hr)	54		40	40		54	41		79	79		41
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	10%	8%	6%	0%	0%	7%	20%	14%	9%	10%	14%	0%
Adj. Flow (vph)	63	47	28	34	63	53	15	85	14	24	98	30
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	138	0	0	150	0	0	114	0	0	152	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 38.5%

ICU Level of Service A

Analysis Period (min) 15

HCM 6th AWSC

2: Hazel Street & Hickory Street

2030 Total: AM Peak Hour

Intersection

Intersection Delay, s/veh 9

Intersection LOS A

Movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	63	47	28	34	63	53	15	85	14	24	98	30
Future Vol, veh/h	63	47	28	34	63	53	15	85	14	24	98	30
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	10	8	6	0	0	7	20	14	9	10	14	0
Mvmt Flow	63	47	28	34	63	53	15	85	14	24	98	30
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	9.1	8.7	9.1	9.1
HCM LOS	A	A	A	A

Lane

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	13%	46%	23%	16%
Vol Thru, %	75%	34%	42%	64%
Vol Right, %	12%	20%	35%	20%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	114	138	150	152
LT Vol	15	63	34	24
Through Vol	85	47	63	98
RT Vol	14	28	53	30
Lane Flow Rate	114	138	150	152
Geometry Grp	1	1	1	1
Degree of Util (X)	0.16	0.187	0.19	0.203
Departure Headway (Hd)	5.067	4.878	4.567	4.814
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	705	733	783	743
Service Time	3.119	2.924	2.612	2.863
HCM Lane V/C Ratio	0.162	0.188	0.192	0.205
HCM Control Delay	9.1	9.1	8.7	9.1
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.6	0.7	0.7	0.8

Lanes, Volumes, Timings

3: Hazel Street & Site Driveway

2030 Total: AM Peak Hour

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	W			W	W	
Traffic Volume (vph)	10	2	0	104	157	3
Future Volume (vph)	10	2	0	104	157	3
Ideal Flow (vphpl)	1765	1765	1650	1650	1650	1650
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.977			0.997		
Flt Protected	0.960					
Satd. Flow (prot)	1655	0	0	1460	1498	0
Flt Permitted	0.960					
Satd. Flow (perm)	1655	0	0	1460	1498	0
Link Speed (k/h)	50			50	50	
Link Distance (m)	79.5			98.9	37.7	
Travel Time (s)	5.7			7.1	2.7	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	0%	13%	10%	0%
Adj. Flow (vph)	10	2	0	104	157	3
Shared Lane Traffic (%)						
Lane Group Flow (vph)	12	0	0	104	160	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.6			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	1.10	1.10	1.20	1.20	1.20	1.20
Turning Speed (k/h)	25	15	25			15
Sign Control	Stop			Free	Free	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	19.7%					
ICU Level of Service	A					
Analysis Period (min)	15					

HCM 6th TWSC

3: Hazel Street & Site Driveway

2030 Total: AM Peak Hour

Intersection						
Int Delay, s/veh	0.4					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	W			W	W	
Traffic Vol, veh/h	10	2	0	104	157	3
Future Vol, veh/h	10	2	0	104	157	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	0	0	0	13	10	0
Mvmt Flow	10	2	0	104	157	3
Major/Minor						
Minor2	Major1		Major2			
Conflicting Flow All	263	159	160	0	-	0
Stage 1	159	-	-	-	-	-
Stage 2	104	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.1	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.2	-	-	-
Pot Cap-1 Maneuver	730	892	1432	-	-	-
Stage 1	875	-	-	-	-	-
Stage 2	925	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	730	892	1432	-	-	-
Mov Cap-2 Maneuver	730	-	-	-	-	-
Stage 1	875	-	-	-	-	-
Stage 2	925	-	-	-	-	-
Approach						
EB	NB		SB			
HCM Control Delay, s	9.9	0	0			
HCM LOS	A					
Minor Lane/Major Mvmt						
NBL	NBT EBLn1	SBT	SBR			
Capacity (veh/h)	1432	-	753	-	-	
HCM Lane V/C Ratio	-	-	0.016	-	-	
HCM Control Delay (s)	0	-	9.9	-	-	
HCM Lane LOS	A	-	A	-	-	
HCM 95th %tile Q(veh)	0	-	0	-	-	

Lanes, Volumes, Timings

1: Albert Street & Hickory Street

2030 Total: PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (vph)	19	39	30	50	36	80	36	327	60	76	413	25
Future Volume (vph)	19	39	30	50	36	80	36	327	60	76	413	25
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.954			0.935			0.981			0.993	
Flt Protected		0.989			0.985			0.996			0.993	
Satd. Flow (prot)	0	1443	0	0	1414	0	0	1503	0	0	1516	0
Flt Permitted		0.989			0.985			0.996			0.993	
Satd. Flow (perm)	0	1443	0	0	1414	0	0	1503	0	0	1516	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		111.5			125.2			138.8			120.8	
Travel Time (s)		8.0			9.0			10.0			8.7	
Confl. Peds. (#/hr)	16		34	34		16	38		56	56		38
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	3%	0%	0%	0%	2%	0%	1%	0%	0%	1%	0%
Adj. Flow (vph)	19	39	30	50	36	80	36	327	60	76	413	25
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	88	0	0	166	0	0	423	0	0	514	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization 78.9%	ICU Level of Service D											
Analysis Period (min) 15												

HCM 6th TWSC

1: Albert Street & Hickory Street

2030 Total: PM Peak Hour

Intersection												
Int Delay, s/veh	12.6											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	19	39	30	50	36	80	36	327	60	76	413	25
Future Vol, veh/h	19	39	30	50	36	80	36	327	60	76	413	25
Conflicting Peds, #/hr	16	0	34	34	0	16	38	0	56	56	0	38
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	0	3	0	0	0	2	0	1	0	0	1	0
Mvmt Flow	19	39	30	50	36	80	36	327	60	76	413	25
Major/Minor												
Minor2			Minor1		Major1		Major2					
Conflicting Flow All	1119	1131	498	1131	1113	429	476	0	0	443	0	0
Stage 1	616	616	-	485	485	-	-	-	-	-	-	-
Stage 2	503	515	-	646	628	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.53	6.2	7.1	6.5	6.22	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.53	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.53	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4.027	3.3	3.5	4	3.318	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	186	203	576	182	210	626	1097	-	-	1128	-	-
Stage 1	481	480	-	567	555	-	-	-	-	-	-	-
Stage 2	555	533	-	464	479	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	116	162	541	117	168	588	1062	-	-	1075	-	-
Mov Cap-2 Maneuver	116	162	-	117	168	-	-	-	-	-	-	-
Stage 1	445	421	-	517	506	-	-	-	-	-	-	-
Stage 2	420	486	-	350	420	-	-	-	-	-	-	-
Approach												
EB			WB		NB		SB					
HCM Control Delay, s	39			63.9			0.7			1.3		
HCM LOS	E			F								
Minor Lane/Major Mvmt												
NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR					
Capacity (veh/h)	1062	-	-	191	213	1075	-	-				
HCM Lane V/C Ratio	0.034	-	-	0.461	0.779	0.071	-	-				
HCM Control Delay (s)	8.5	0	-	39	63.9	8.6	0	-				
HCM Lane LOS	A	A	-	E	F	A	A	-				
HCM 95th %tile Q(veh)	0.1	-	-	2.2	5.5	0.2	-	-				

Lanes, Volumes, Timings

2: Hazel Street & Hickory Street

2030 Total: PM Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	31	114	36	23	126	38	25	54	23	21	72	26
Future Volume (vph)	31	114	36	23	126	38	25	54	23	21	72	26
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.973			0.973			0.970			0.971	
Flt Protected		0.992			0.994			0.988			0.991	
Satd. Flow (prot)	0	1487	0	0	1489	0	0	1350	0	0	1439	0
Flt Permitted		0.992			0.994			0.988			0.991	
Satd. Flow (perm)	0	1487	0	0	1489	0	0	1350	0	0	1439	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		131.1			177.2			37.7			111.4	
Travel Time (s)		9.4			12.8			2.7			8.0	
Confl. Peds. (#/hr)	51		70	70		51	47		45	45		47
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	1%	0%	0%	1%	0%	0%	19%	0%	0%	6%	0%
Adj. Flow (vph)	31	114	36	23	126	38	25	54	23	21	72	26
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	181	0	0	187	0	0	102	0	0	119	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Stop			Stop	
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization	38.6%											
Analysis Period (min)	15											
ICU Level of Service A												

HCM 6th AWSC

2: Hazel Street & Hickory Street

2030 Total: PM Peak Hour

Intersection												
Intersection Delay, s/veh	8.9											
Intersection LOS	A											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	31	114	36	23	126	38	25	54	23	21	72	26
Future Vol, veh/h	31	114	36	23	126	38	25	54	23	21	72	26
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	0	1	0	0	1	0	0	19	0	0	6	0
Mvmt Flow	31	114	36	23	126	38	25	54	23	21	72	26
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Approach	EB			WB			NB			SB		
Opposing Approach	WB			EB			SB			NB		
Opposing Lanes	1			1			1			1		
Conflicting Approach Left	SB			NB			EB			WB		
Conflicting Lanes Left	1			1			1			1		
Conflicting Approach Right	NB			SB			WB			EB		
Conflicting Lanes Right	1			1			1			1		
HCM Control Delay	9			9			8.6			8.7		
HCM LOS	A			A			A			A		
Lane	NBLn1	EBLn1	WBLn1	SBLn1								
Vol Left, %	25%	17%	12%	18%								
Vol Thru, %	53%	63%	67%	61%								
Vol Right, %	23%	20%	20%	22%								
Sign Control	Stop	Stop	Stop	Stop								
Traffic Vol by Lane	102	181	187	119								
LT Vol	25	31	23	21								
Through Vol	54	114	126	72								
RT Vol	23	36	38	26								
Lane Flow Rate	102	181	187	119								
Geometry Grp	1	1	1	1								
Degree of Util (X)	0.136	0.23	0.236	0.158								
Departure Headway (Hd)	4.809	4.565	4.547	4.778								
Convergence, Y/N	Yes	Yes	Yes	Yes								
Cap	743	784	787	747								
Service Time	2.861	2.607	2.589	2.827								
HCM Lane V/C Ratio	0.137	0.231	0.238	0.159								
HCM Control Delay	8.6	9	9	8.7								
HCM Lane LOS	A	A	A	A								
HCM 95th-tile Q	0.5	0.9	0.9	0.6								

Lanes, Volumes, Timings

3: Hazel Street & Site Driveway

2030 Total: PM Peak Hour

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	5	1	1	97	122	9
Future Volume (vph)	5	1	1	97	122	9
Ideal Flow (vphpl)	1765	1765	1650	1650	1650	1650
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.977			0.991		
Flt Protected	0.960			0.999		
Satd. Flow (prot)	1655	0	0	1487	1576	0
Flt Permitted	0.960			0.999		
Satd. Flow (perm)	1655	0	0	1487	1576	0
Link Speed (k/h)	50			50	50	
Link Distance (m)	79.5			98.9	37.7	
Travel Time (s)	5.7			7.1	2.7	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	0%	11%	4%	0%
Adj. Flow (vph)	5	1	1	97	122	9
Shared Lane Traffic (%)						
Lane Group Flow (vph)	6	0	0	98	131	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.6			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	1.10	1.10	1.20	1.20	1.20	1.20
Turning Speed (k/h)	25	15	25			15
Sign Control	Stop			Free	Free	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	18.0%			ICU Level of Service A		
Analysis Period (min)	15					

HCM 6th TWSC

3: Hazel Street & Site Driveway

2030 Total: PM Peak Hour

Intersection						
Int Delay, s/veh	0.3					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	W			W	W	
Traffic Vol, veh/h	5	1	1	97	122	9
Future Vol, veh/h	5	1	1	97	122	9
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	0	0	0	11	4	0
Mvmt Flow	5	1	1	97	122	9
Major/Minor	Minor2	Major1		Major2		
Conflicting Flow All	226	127	131	0	-	0
Stage 1	127	-	-	-	-	-
Stage 2	99	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.1	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.2	-	-	-
Pot Cap-1 Maneuver	767	929	1467	-	-	-
Stage 1	904	-	-	-	-	-
Stage 2	930	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	766	929	1467	-	-	-
Mov Cap-2 Maneuver	766	-	-	-	-	-
Stage 1	903	-	-	-	-	-
Stage 2	930	-	-	-	-	-
Approach	EB	NB		SB		
HCM Control Delay, s	9.6	0.1		0		
HCM LOS	A					
Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR	
Capacity (veh/h)	1467	-	789	-	-	
HCM Lane V/C Ratio	0.001	-	0.008	-	-	
HCM Control Delay (s)	7.5	0	9.6	-	-	
HCM Lane LOS	A	A	A	-	-	
HCM 95th %tile Q(veh)	0	-	0	-	-	

Appendix H

Daily Trip Generation Estimates and Assignments



Land Use Code	221					
Land Use	Multifamily Housing (Mid-Rise)					
Setting	General Urban/Suburban					
Time Period	Weekday					
# Data Sites	7					
	% of 24-Hour Vehicle Trips			Total	In	Out
Time	Total	Entering	Exiting	182	91	91
12:00 - 1:00 AM	0.8%	1.2%	0.4%	1	1	0
1:00 - 2:00 AM	0.4%	0.6%	0.3%	1	1	0
2:00 - 3:00 AM	0.2%	0.3%	0.1%	0	0	0
3:00 - 4:00 AM	0.2%	0.2%	0.2%	0	0	0
4:00 - 5:00 AM	0.3%	0.1%	0.5%	1	0	0
5:00 - 6:00 AM	1.2%	0.4%	2.0%	2	0	2
6:00 - 7:00 AM	4.4%	1.0%	7.8%	8	1	7
7:00 - 8:00 AM	8.6%	2.5%	14.7%	16	2	13
8:00 - 9:00 AM	7.8%	3.0%	12.5%	14	3	11
9:00 - 10:00 AM	4.5%	2.2%	6.9%	8	2	6
10:00 - 11:00 AM	3.7%	2.7%	4.6%	7	2	4
11:00 - 12:00 PM	3.7%	3.4%	4.0%	7	3	4
12:00 - 1:00 PM	4.6%	4.3%	4.8%	8	4	4
1:00 - 2:00 PM	4.4%	4.4%	4.4%	8	4	4
2:00 - 3:00 PM	3.9%	4.1%	3.7%	7	4	3
3:00 - 4:00 PM	4.9%	5.9%	3.8%	9	5	3
4:00 - 5:00 PM	7.2%	9.2%	5.1%	13	8	5
5:00 - 6:00 PM	9.4%	13.1%	5.8%	17	12	5
6:00 - 7:00 PM	9.0%	12.1%	6.0%	16	11	5
7:00 - 8:00 PM	7.4%	9.4%	5.4%	14	9	5
8:00 - 9:00 PM	5.4%	7.7%	3.1%	10	7	3
9:00 - 10:00 PM	4.0%	6.5%	1.5%	7	6	1
10:00 - 11:00 PM	2.6%	3.7%	1.6%	5	3	2
11:00 - 12:00 AM	1.4%	2.1%	0.8%	3	3	4

Albert/Hickory

AM Peak Hour	In	Out
North via Albert Street	30%	30%
West via Hickory Street	5%	0%
South via Albert Street	30%	25%

AM Peak Hour	In	Out
North via Albert Street	35%	30%
West via Hickory Street	5%	5%
South via Albert Street	30%	35%

Hour	SBL	EBT	NBR	WBL	WBT	WBR	Total (All Legs)	Total (Minor)
7:00 - 8:00	1	0	1	3	0	4	9	7
8:00 - 9:00	1	0	1	3	0	3	8	6
9:00 - 10:00	1	0	1	2	0	2	6	4
11:30 - 12:30	1	0	1	1	0	1	4	2
12:30 - 13:30	1	0	1	1	0	1	4	2
15:00 - 16:00	2	0	2	1	0	1	6	2
16:00 - 17:00	3	0	2	1	0	2	8	3
17:00 - 18:00	4	1	4	1	0	2	12	3

Appendix I

All-Way Stop Control Worksheets



ALL-WAY STOP INTERSECTION ANALYSIS

Albert Street and Hickory Street

Existing Volumes

Collector/Rural Arterial Warrant Analysis

Hour Ending	8:00 AM	9:00 AM	10:00 AM	12:30 PM	1:30 PM	4:00 PM	5:00 PM	6:00 PM	TOTAL	<u>WARRANT</u>
Approaching: All Legs	350	702	531	716	772	772	894	956	5693	
Avg Vol all legs >375/h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		YES
Approaching: Minor	49	46	59	122	175	165	154	203	973	
Peds X-ing Major St.	4	19	35	42	63	39	52	60	314	
Minor Ped/Veh X-ing	53	65	94	164	238	204	206	263	1287	
Avg Veh Xing Maj>150/l	No	No	No	Yes	Yes	Yes	Yes	Yes		NO
Approaching: Major	301	656	472	594	597	607	740	753	4720	
%Tot Appr on Major	86%	93%	89%	83%	77%	79%	83%	79%		
% Split on Maj<70?	No	No	No	No	No	No	No	No		NO

An ALL WAY STOP condition WOULD NOT BE recommended for this location under the Collector/Rural Arterial Warrants.

AN ALL WAY STOP IS **NOT WARRANTED**

An All Way Stop is Warranted Based on Traffic Volume if:

- a) The total vehicle volume on all intersection approaches exceeds 375 vehicles per hour for each of the highest eight hours of the day; and
- b) The combined vehicle and pedestrian volume on the minor street exceeds 150 units per hour (all vehicles plus pedestrians wishing to enter the intersection) for each of the same eight hours as the total volume; and
- c) The volume split does not exceed 70/30. Volume on the major street is defined as vehicles only. Volume on the minor street includes all vehicles plus any pedestrians wishing to cross the major roadway.

ALL-WAY STOP INTERSECTION ANALYSIS

Albert Street and Hickory Street

2030 Future Background Volumes

Collector/Rural Arterial Warrant Analysis

Hour Ending	8:00 AM	9:00 AM	10:00 AM	12:30 PM	1:30 PM	4:00 PM	5:00 PM	6:00 PM	TOTAL	<u>WARRANT</u>
Approaching: All Legs	426	813	609	813	878	884	1031	1113	6567	
Avg Vol all legs >375/h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		YES
Approaching: Minor	87	80	82	146	205	194	185	241	1220	
Peds X-ing Major St.	4	19	35	42	63	39	52	60	314	
Minor Ped/Veh X-ing	91	99	117	188	268	233	237	301	1534	
Avg Veh Xing Maj>150/l	No	No	No	Yes	Yes	Yes	Yes	Yes		NO
Approaching: Major	339	733	527	667	673	690	846	872	5347	
%Tot Appr on Major	80%	90%	87%	82%	77%	78%	82%	78%		
% Split on Maj<70?	No	No	No	No	No	No	No	No		NO

An ALL WAY STOP condition WOULD NOT BE recommended for this location under the Collector/Rural Arterial Warrants.

AN ALL WAY STOP IS **NOT WARRANTED**

An All Way Stop is Warranted Based on Traffic Volume if:

- a) The total vehicle volume on all intersection approaches exceeds 375 vehicles per hour for each of the highest eight hours of the day; and
- b) The combined vehicle and pedestrian volume on the minor street exceeds 150 units per hour (all vehicles plus pedestrians wishing to enter the intersection) for each of the same eight hours as the total volume; and
- c) The volume split does not exceed 70/30. Volume on the major street is defined as vehicles only. Volume on the minor street includes all vehicles plus any pedestrians wishing to cross the major roadway.

ALL-WAY STOP INTERSECTION ANALYSIS

Albert Street and Hickory Street

2030 Future Total Volumes

Collector/Rural Arterial Warrant Analysis

Hour Ending	8:00 AM	9:00 AM	10:00 AM	12:30 PM	1:30 PM	4:00 PM	5:00 PM	6:00 PM	TOTAL	<u>WARRANT</u>
Approaching: All Legs	435	821	613	817	882	890	1039	1125	6622	
Avg Vol all legs >375/h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		YES
Approaching: Minor	94	86	86	148	207	196	188	244	1249	
Peds X-ing Major St.	4	19	35	42	63	39	52	60	314	
Minor Ped/Veh X-ing	98	105	121	190	270	235	240	304	1563	
Avg Veh Xing Maj>150/l	No	No	No	Yes	Yes	Yes	Yes	Yes		NO
Approaching: Major	341	735	527	669	675	694	851	881	5373	
%Tot Appr on Major	78%	90%	86%	82%	77%	78%	82%	78%		
% Split on Maj<70?	No	No	No	No	No	No	No	No		NO

An ALL WAY STOP condition WOULD NOT BE recommended for this location under the Collector/Rural Arterial Warrants.

AN ALL WAY STOP IS **NOT WARRANTED**

An All Way Stop is Warranted Based on Traffic Volume if:

- a) The total vehicle volume on all intersection approaches exceeds 375 vehicles per hour for each of the highest eight hours of the day; and
- b) The combined vehicle and pedestrian volume on the minor street exceeds 150 units per hour (all vehicles plus pedestrians wishing to enter the intersection) for each of the same eight hours as the total volume; and
- c) The volume split does not exceed 70/30. Volume on the major street is defined as vehicles only. Volume on the minor street includes all vehicles plus any pedestrians wishing to cross the major roadway.

Appendix J

Traffic Control Signal Warrant Worksheets



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



Horizon Year: 2030 Future Background
Region/City/Township: Waterloo, Waterloo Region

Major Street: Albert Street
Minor Street: Hickory Street

North/South?: Y

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

PM Forecast Only? N

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

Time Period	Major Street Albert Street						Minor Street Hickory Street						Peds Crossing
	Northbound			Southbound			Eastbound			Westbound			
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	1	280	44	67	262	9	10	15	16	35	20	77	19
PM Peak Hour	36	327	57	73	413	25	19	39	30	48	36	79	50
Average Hourly Volume	9	152	25	35	169	9	7	14	12	21	14	39	17

Warrant	AHV
1A - All	505
1B - Minor	106
2A - Major	399
2B - Cross	59

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	All Approaches	480	720	600	900	505
					% Fulfilled	70%

1B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	Minor Street Approaches	120	170	120	170	106
					% Fulfilled	62%

Warrant 2 - Delay To Cross Traffic

2A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	Major Street Approaches	480	720	600	900	399
					% Fulfilled	55%

2B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	Traffic Crossing Major Street	50	75	120	170	59
					% Fulfilled	79%

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



Horizon Year: 2030 Future Total
Region/City/Township: Waterloo, Waterloo Region

Major Street: Albert Street
Minor Street: Hickory Street

North/South?: Y

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

PM Forecast Only? N

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

Time Period	Major Street Albert Street						Minor Street Hickory Street						Peds Crossing
	Northbound			Southbound			Eastbound			Westbound			
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	1	280	45	68	262	9	10	16	16	38	20	81	19
PM Peak Hour	36	327	60	76	413	25	19	39	30	50	36	80	50
Average Hourly Volume	9	152	26	36	169	9	7	14	12	22	14	40	17

Warrant	AHV
1A - All	509
1B - Minor	109
2A - Major	401
2B - Cross	61

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	All Approaches	480	720	600	900	509
					% Fulfilled	71%

1B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	Minor Street Approaches	120	170	120	170	109
					% Fulfilled	64%

Warrant 2 - Delay To Cross Traffic

2A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	Major Street Approaches	480	720	600	900	401
					% Fulfilled	56%

2B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	Traffic Crossing Major Street	50	75	120	170	61
					% Fulfilled	81%