

2025-08-13
Project: (250261)

Rob Gazzola
Blackdoor (Westhill) Inc.
75 Sheffield Street
North York, ON M6M 3E9

**RE: PROPOSED RESIDENTIAL DEVELOPMENT, 36 WESTHILL DRIVE,
WATERLOO, ON TRANSPORTATION IMPACT BRIEF**

Blackdoor (Westhill) Inc. retained Paradigm Transportation Solutions Limited (Paradigm) to conduct this Transportation Impact Brief (TIB) for a proposed residential development located at 36 Westhill Drive in Waterloo, Ontario. **Figure 1** (attached) illustrates the site location.

Purpose and Scope

This study reviews the forecast impacts of the site-generated traffic at nearby existing and proposed intersections and identifies any remedial measures, if necessary, to support the development. The scope of the study, developed in consultation with the City of Waterloo via e-mail in May 2025, includes:

- ▶ An assessment of current traffic and site conditions within the study area;
- ▶ Estimates of future non-development (background) traffic growth;
- ▶ Estimates of the site-traffic generated by the development;
- ▶ An assessment of future traffic impacts near and at the proposed site access for five-years from the date the study is commissioned; and
- ▶ Identification of any necessary mitigation measures to support the proposed 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 Traffic Impact Study (TIS) Guidelines¹ and direction provided by the City staff during pre-study consultation.

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

Roadway Characteristics

Ira Needles Boulevard is a four-lane, 60 km/h regional arterial roadway within the study area.² The roadway has a centre median along with a multi-use path and a sidewalk provided on the east and west sides of the roadway, respectively.

Westhill Drive is a two-lane, 40 km/h local road within the study area. Along the frontages for The Westhill Retirement Residence and the apartment building at 7 Westhill Drive, a sidewalk is provided (west side of the roadway).

Turning Movement Counts

Paradigm conducted turning movement counts (TMCs) at the intersection of Ira Needles Boulevard and Westhill Drive in January 2025. **Appendix B** contains the raw turning movement count data.

Land Use Code (LUC) 210 (Single-family Detached Housing) from the Institute of Transportation Engineers (ITE) Trip Generation manual³ was used to estimate the trips entering/exiting the driveway for the existing single-family home at 36 Westhill Drive during the AM and PM peak hours. Under existing conditions, 36 Westhill Drive is forecast to generate one trip during both the AM and PM peak hours. It is also noted that the existing 36 Westhill Drive trip generation is already captured at the intersection of Ira Needles Boulevard and Westhill Drive.

Figure 2 (attached) illustrates the base year weekday AM and weekday PM traffic volumes.

Development Concept

Development Description

The subject site is proposed to have the existing single-family home demolished and be developed into two apartment buildings (one with six storeys and the other with eight storeys) totaling 140 units.

Vehicle access is proposed via two all-moves driveway connections to Westhill Drive. It is assumed that the existing driveway at 36 Westhill Drive will be removed and shifted closer to the northern property boundary (northern site access). Therefore, only one additional driveway (southern site access) will be constructed to serve the proposed development.

With the addition of site traffic, the northern site access is analyzed as an offset four-legged intersection that includes the proposed driveway for the 41 Westhill Drive⁴ development.

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

³ Institute of Transportation Engineers, *Trip Generation Manual*, 11th ed., (Washington DC: ITE, 2021).

⁴ Paradigm Transportation Solutions Limited, *Proposed Residential Development, 41 Westhill Drive, Waterloo, ON Transportation Impact Brief*, (Cambridge: PTSL, 2025).



Currently, the proposed driveway location for the 41 Westhill Drive development is assumed to align with the existing single family home driveway for 36 Westhill Drive.

Figure 3 (attached) illustrates the site concept plan.

Site Trip Generation

The ITE Trip Generation manual methods forecast site-generated trips. LUC 221 (Multi-family Housing, Mid-Rise) was used to estimate the site trip generation.

Table 1 summarizes the forecast site-generated trips indicating 50 trips in weekday AM peak hour and 55 trips in the weekday PM peak hour.

TABLE 1: FORECAST SITE GENERATED TRIPS

LUC	Unit Count	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
221	140	11	39	50	34	21	55

LUC 221 – AM: $T = 0.44(X) - 11.61$ | PM: $T = 0.39(X) + 0.34$

Table 2 summarizes the estimated trip distribution which is based on the existing distribution and 2022 Transportation Tomorrow Survey (TTS) Data.⁵ The trip distribution is appropriate for this study because both travel directions on Ira Needles Boulevard provide connections to employment areas.

TABLE 2: ESTIMATED TRIP DISTRIBUTION

Origin/Destination	AM Peak Hour		PM Peak Hour	
	In	Out	In	Out
North via Ira Needles Boulevard	55%	55%	60%	45%
South via Ira Needles Boulevard	45%	45%	40%	55%
Total	100%	100%	100%	100%

Figure 4 (attached) illustrates the weekday AM and weekday PM peak hour trip assignment.

⁵ Data Management Group, *Transportation Tomorrow Survey 2022*, University of Toronto, 2025, <http://www.transportationtomorrow.on.ca/>



With the presence of a centre median on Ira Needles Boulevard, left-turn movements are anticipated to be not permitted under future traffic conditions and the following travel arrangements are assumed to leave/access the site:

- ▶ Trips entering the site from the north via Ira Needles Boulevard first travel south to make a U-turn at the Ira Needles Boulevard and Thorndale Drive roundabout then travel north on Ira Needles Boulevard to reach the site; and
- ▶ Trips leaving the site to the south via Ira Needles Boulevard first travel north to make a U-turn at the Ira Needles Boulevard and Erb Street West roundabout then travel south on Ira Needles Boulevard to complete the site departure.

It is noted that the centre median on Ira Needles Boulevard has no impact on travel arrangements for trips:

- ▶ Leaving the site to the north via Ira Needles Boulevard; and
- ▶ Entering the site from the south via Ira Needles Boulevard

Future Traffic Volumes

Future background traffic volumes on Ira Needles Boulevard and Westhill Drive reflect a generalized growth rate of 1.5% per annum.

In addition, the following developments were included in the background traffic volumes. Although, it is assumed that the generalized growth rate of 1.5% will capture traffic from other sources of remaining nearby background development:

- ▶ 635 Erb Street West and 12 Westhill Drive (414 Westhaven Street)⁶: The development is located north of the subject site between Westhill Drive and Westhaven Street along the south side of Erb Street West. The development is forecast to generate 137 and 161 trips during the AM and PM peak hours, respectively; and
- ▶ 41 Westhill Drive⁷: The development is located west of the subject site and across the street along Westhill Drive. The development is forecast to generate 13 and 22 trips during the AM and PM peak hours, respectively. To remain conservative, it assumed that the 41 Westhill Drive development does not have direct access to Ira Needles Boulevard and all 41 Westhill Drive trips travel through the intersection of Ira Needles Boulevard at Westhill Drive.

Appendix C contains future background traffic volumes.

⁶ Paradigm Transportation Solutions Limited, *635 Erb Street West & 12 Westhill Drive Waterloo ON Transportation Impact Study*, (Cambridge: PTSL, 2021).

⁷ Paradigm Transportation Solutions Limited, *Proposed Residential Development, 41 Westhill Drive, Waterloo, ON Transportation Impact Brief*, (Cambridge: PTSL, 2025).



Figure 5 (attached) illustrates the forecast background traffic volumes at the five-year (2030), horizon. **Figure 6** (attached) illustrates the forecast total traffic volumes at the five-year horizon.

Traffic Operations

Level of service conditions on the existing road network have been assessed using Synchro 12 which implements the methodologies of the Highway Capacity Manual (HCM). The analysis reflects the existing lane configurations and traffic control at the driveway. The analysis considers three separate measures of performance: the level of service (LOS), volume to capacity (v/c) ratio, and 95th percentile queues for each movement.

As noted in the Region of Waterloo TIS guidelines, movements are considered critical under the following conditions:

- ▶ Estimated 95th percentile queue length for an exclusive movement exceeds the available storage space;
- ▶ Exclusive turning lanes are inaccessible because of queue lengths in adjacent through lanes;
- ▶ Estimated 95th percentile queue length for an individual movement will block an existing access; and
- ▶ The average control delay for individual movements is greater than 55 seconds.

Intersections are considered critical under the following conditions:

- ▶ An unsignalized intersection has an average control delay larger than 35 seconds (LOS E or F); and
- ▶ A signalized intersection has an average control delay larger than 55 seconds (LOS E or F).

Existing Traffic Operations

Table 3 summarizes the level of service conditions for the weekday AM and PM peak hours under existing traffic conditions. All study area intersections are forecast to operate at acceptable levels of service during the weekday AM and weekday PM peak hours with no critical movements noted. **Appendix D** contains the detailed Synchro reports.

Future Background Traffic Operations

Table 4 summarizes the level of service conditions for the weekday AM and PM peak hours under future background traffic conditions. All study area intersections are forecast to operate at acceptable levels of service during the weekday AM and weekday PM peak hours with no critical movements noted. **Appendix E** contains the detailed Synchro reports.



Future Total Traffic Operations

Table 5 summarizes the level of service conditions for the weekday AM and PM peak hours under future total traffic conditions. All study area intersections are forecast to operate at acceptable levels of service during the weekday AM and weekday PM peak hours with no critical movements noted.

With the addition of the site-generated traffic volumes, the approach delays at the existing study area intersections increases by nine seconds or less during the AM and PM peak hours.

Appendix F contains the detailed Synchro reports.

TABLE 3: 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	Ira Needles Boulevard & Private Driveway/Westhill Drive	TWSC	LOS Delay V/C Q			A 0 0.00 0	A 0			B 11 0.03 1	B 11		A 0 0.00 0	A 0 0.00 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0	
	Westhill Drive & Private Driveway	TWSC	LOS Delay V/C Q					A 9 0.00 0		> > >	A 9		A 0 0.00 0	A 0 0.00 0	A 0	A 0 0.00 0	A 0 0.00 0		A 0	
PM Peak Hour	Ira Needles Boulevard & Private Driveway/Westhill Drive	TWSC	LOS Delay V/C Q			A 0 0.00 0	A 0			B 13 0.08 2	B 13		A 0 0.00 0	A 0 0.00 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0	
	Westhill Drive & Private Driveway	TWSC	LOS Delay V/C Q					A 0 0.00 0		> > >	A 0		A 0 0.00 0	A 0 0.00 0	A 0	A 0 0.00 0	A 0 0.00 0		A 0	

MOE - Measure of Effectiveness

LOS - Level of Service

Delay - Average Delay per Vehicle in Seconds

V/C - Volume to Capacity Ratio

Q - 95th Percentile Queue Length (m)

TWSC - Two-Way Stop Control

< / > - Shared Movement



TABLE 4: 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	Ira Needles Boulevard & Private Driveway/Westhill Drive	TWSC	LOS Delay V/C Q			A 0 0.00 0	A 0			B 12 0.06 2	B 12		A 0 0.00 0	A 0 0.00 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0	
	Westhill Drive & Private Driveway	TWSC	LOS Delay V/C Q	< < <	A 8 0.01 0	> > >	A 8	< < <	A 9 0.00 0	> > >	A 9	A 7 0.00 0	A 0 0.00 0	A 0 0.00 0	A 1	A 0 0.00 0	A 0 0.00 0	A 0 0.00 0	A 0	
PM Peak Hour	Ira Needles Boulevard & Private Driveway/Westhill Drive	TWSC	LOS Delay V/C Q			A 0 0.00 0	A 0			B 14 0.11 3	B 14		A 0 0.00 0	A 0 0.00 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0	
	Westhill Drive & Private Driveway	TWSC	LOS Delay V/C Q	< < <	A 8 0.01 0	> > >	A 9	< < <	A 0 0.00 0	> > >	A 0	A 7 0.01 0	A 0 0.00 0	A 0 0.00 0	A 3	A 0 0.00 0	A 0 0.00 0	A 0 0.00 0	A 0	

MOE - Measure of Effectiveness

LOS - Level of Service

Delay - Average Delay per Vehicle in Seconds

V/C - Volume to Capacity Ratio

Q - 95th Percentile Queue Length (m)

TWSC - Two-Way Stop Control

< / > - Shared Movement



TABLE 5: TOTAL TRAFFIC OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																Overall
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Ira Needles Boulevard & Private Driveway/Westhill Drive	TWSC	LOS Delay V/C Q			A 0 0.00 0	A 0			B 12 0.12 3	B 12		A 0 0 0	A 0 0.00 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0	
	Westhill Drive & Private Driveway/Northern Site Access	TWSC	LOS Delay V/C Q	< < < <	A 8 0.01 0	> > > >	A 8	< < < <	A 9 0.02 1	> > > >	A 9	A 7 0.00 0	A 0 0.00 0	A 0 0.00 0	A 1	A 0 0.00 0	A 0 0.00 0	A 0 0.00 0	A 0	
	Westhill Drive & Southern Site Access	TWSC	LOS Delay V/C Q					A 9 0.02 1		> > > >	A 9		A 0 0.00 0	A 0 0.00 0	A 0	A 0 0.00 0	A 0 0.00 0		A 0	
PM Peak Hour	Ira Needles Boulevard & Private Driveway/Westhill Drive	TWSC	LOS Delay V/C Q			A 0 0.00 0	A 0			B 14 0.16 4	B 14		A 0 0 0	A 0 0.00 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0	
	Westhill Drive & Private Driveway/Northern Site Access	TWSC	LOS Delay V/C Q	< < < <	A 8 0.01 0	> > > >	A 9	< < < <	A 9 0.01 0	> > > >	A 9	A 7 0.01 0	A 0 0.00 0	A 0 0.00 0	A 2	A 0 0.00 0	A 0 0.00 0	A 0 0.00 0	A 0	
	Westhill Drive & Southern Site Access	TWSC	LOS Delay V/C Q					A 9 0.01 0		> > > >	A 9		A 0 0.00 0	A 0 0.00 0	A 0	A 0 0.00 0	A 0 0.00 0		A 0	

MOE - Measure of Effectiveness

LOS - Level of Service

Delay - Average Delay per Vehicle in Seconds

V/C - Volume to Capacity Ratio

Q - 95th Percentile Queue Length (m)

TWSC - Two-Way Stop Control

< / > - Shared Movement

Transportation Demand Management

The following strategies and tools already exist in the surrounding area, including existing active transportation and transit facilities, or can be implemented into the site design to encourage the use of alternative modes of transportation.

Walking

The landscaping plan should consider additional amenities such as lighting and soft landscaping to enhance the pedestrian realm and to prioritize pedestrians.

All on-site sidewalks should be well-lit and should conform to the Accessibility for Ontarians with Disabilities Act (AODA) design standards.

The Waterloo Commons, Westside Marketplace, and West Quarter shopping plazas are located at the roundabout intersection of Erb Street West and Erbsville Road/Ira Needles Boulevard (6-minute walk) north of the subject site. Therefore, future residents have an



opportunity to access multiple commercial establishments within walking distance. Additionally, The Boardwalk shopping plaza (15-minute walk south of the subject site) also provides more potential on-foot access to commercial establishments for future residents.

Cycling

Figure 7 illustrates the existing cycling network. Cycle lanes are provided on both sides of Ira Needles Boulevard/Erbsville Road and Erb Street West.

Bicycle parking is also required at a rate of 0.6 spaces/unit (50/50 split between Type A and Type B).⁸ Therefore, the development requires a total of 84 bicycle parking spaces (42 Type A and 42 Type B).

Transit

Grand River Transit⁹ (GRT) operates four bus routes and one light rail route within the study area. **Figure 8** illustrates the existing transit service. The routes include:

- ▶ Route 13 (Laurelwood);
- ▶ Route 29 (Keats-University); and
- ▶ Route 202 (iXpress University).

The closest transit stops to the subject site provide both seating and shelter and include:

- ▶ Stop 3903: Located in the northeast corner of the Ira Needles Boulevard and Thorndale Drive/The Boardwalk roundabout (350 m from the subject site, 5-minute walk);
- ▶ Stop 3904: Located in the northwest corner of the Ira Needles Boulevard and Thorndale Drive/The Boardwalk roundabout (500 m from the subject site, 7-minute walk);
- ▶ Stop 3905: Located on the east side of Ira Needles Boulevard in front of the 7 Westhill Drive apartment building (400 m from the subject site, 5-minute walk); and
- ▶ Stop 3906: Located on the west side of Ira Needles Boulevard directly south of the Waterloo Commons Plaza Access (600 m from the subject site, 9-minute walk).

All routes that serve the subject site generally operate with headways of 30 minutes or less during the weekday AM and weekday PM peak hours. The nearby transit routes also provide good connectivity to the broader network and key destinations within the Region including shopping centres, downtown areas, and post secondary educational institutions.

Assistance for pedestrian access between the subject site and nearby transit stops is provided via Pedestrian Crossovers (PXOs) at the roundabouts of:

- ▶ Ira Needles Boulevard and Thorndale Drive/The Boardwalk; and

⁸ City of Waterloo Zoning By-law 2018-050, *Section 6.6 Bicycle Parking Spaces*.

⁹ "Grand River Transit Map," Region of Waterloo, 2025, <https://www.grt.ca/en/schedules-maps/system-map.aspx>.



- ▶ Erb Street West and Erbsville Road/Ira Needles Boulevard.

Travel Planning/Education/Promotion

Increasing awareness of sustainable transportation opportunities for residents and visitors of the subject site should be considered by the developer. Residents should be provided with a welcome package that outlines the available transit routes and active transportation options such as the development's proximity to the existing bicycle network. A travel plan will engage and educate residents on the available sustainable modes of travel and how to overcome obstacles that maybe perceived.

General education of all modes of transportation, including their benefits and how to make the best use of them, are a key component to TDM success. The strategies require cooperation and coordination with several partners, including transit providers, building owners, area municipalities as well as residents.

By educating about sustainable modes of travel as well as providing travel demand management tools and incentives, TDM can be further integrated within the development to promote all modes of transportation.

Conclusions and Recommendations

Based on the investigations carried out, it is concluded that:

- ▶ **Site Trip Generation:** The development is forecast to generate 50 trips in the weekday AM peak hour and 55 trips in the weekday PM peak hour.
- ▶ **Existing and Future Traffic Conditions:** The study area intersections are currently operating within acceptable levels of service with no critical movements noted during the AM and PM peak hours.
- ▶ **Transportation Demand Management:** The site is well served by alternate mode infrastructure including:
 - Sidewalk/multi-use path and cycle lanes provided along Ira Needles Boulevard;
 - Multiple transit stops within a 10-minute walking distance from the subject site; and
 - Multiple commercial establishments within a 20-minute walking distance from the subject site.



Based on the findings of this study, it is recommended that the development be considered for approval.

Yours very truly,

PARADIGM TRANSPORTATION SOLUTIONS LIMITED



Erica Bayley

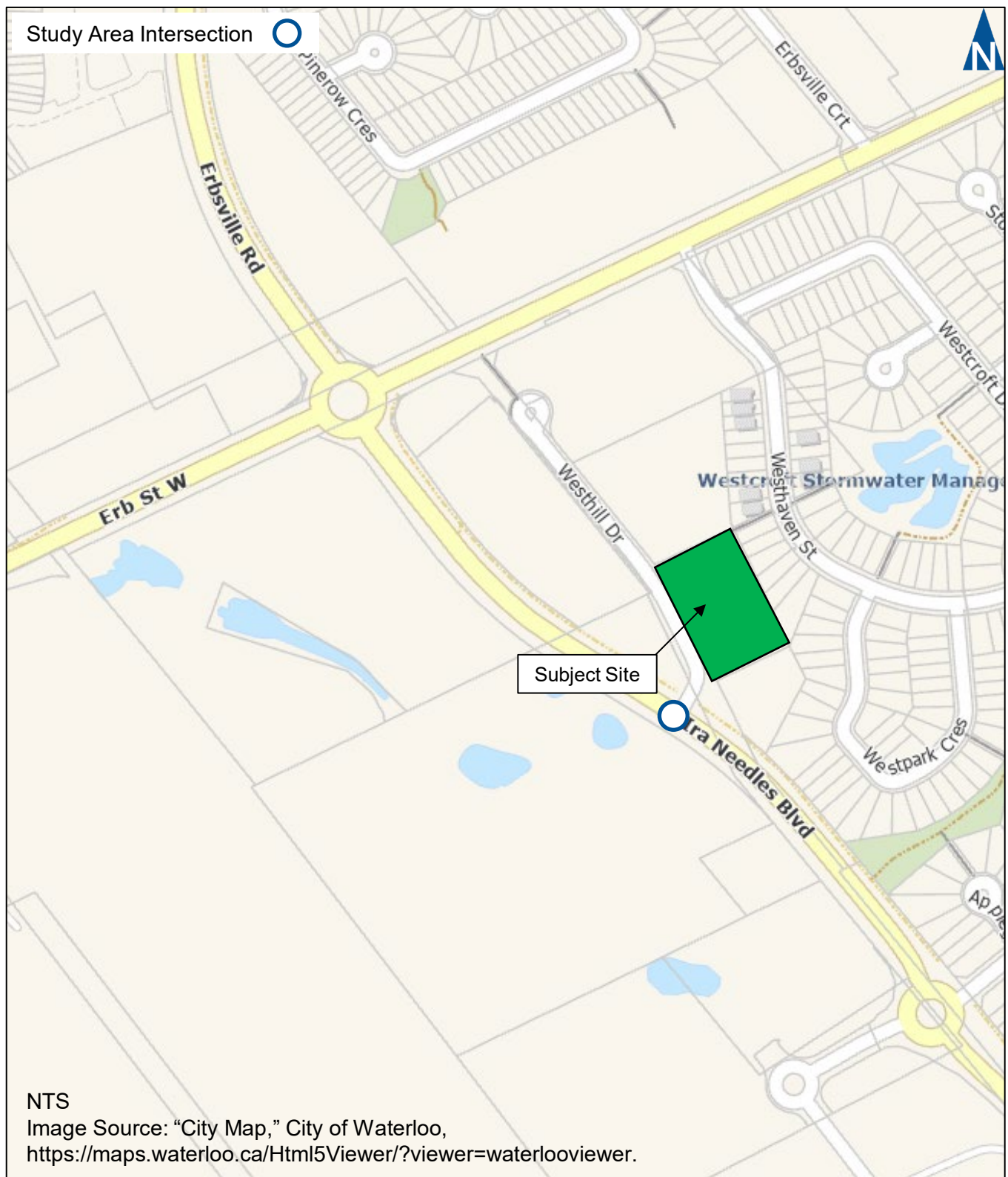
P.Eng.

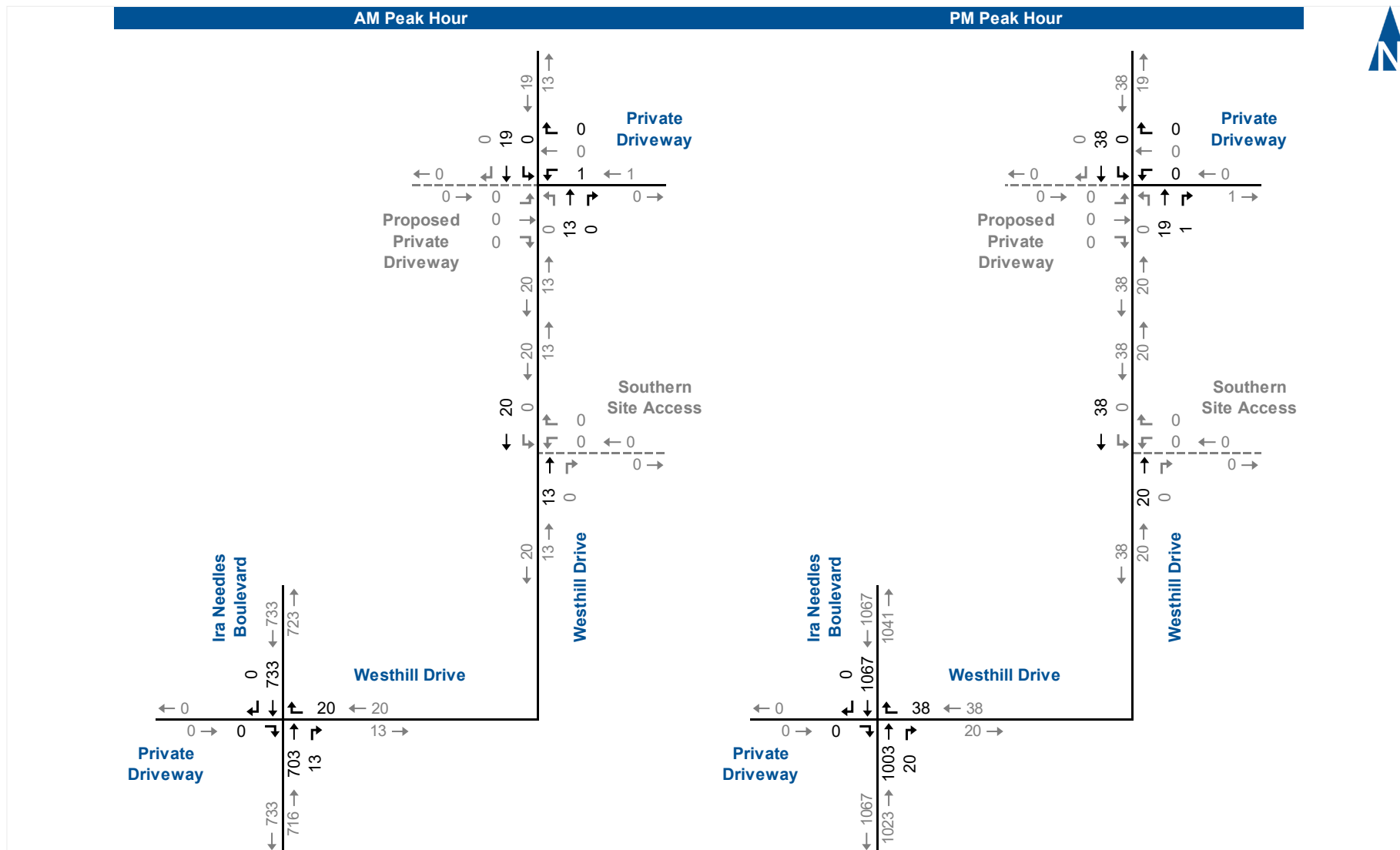
Senior Project Manager, Associate

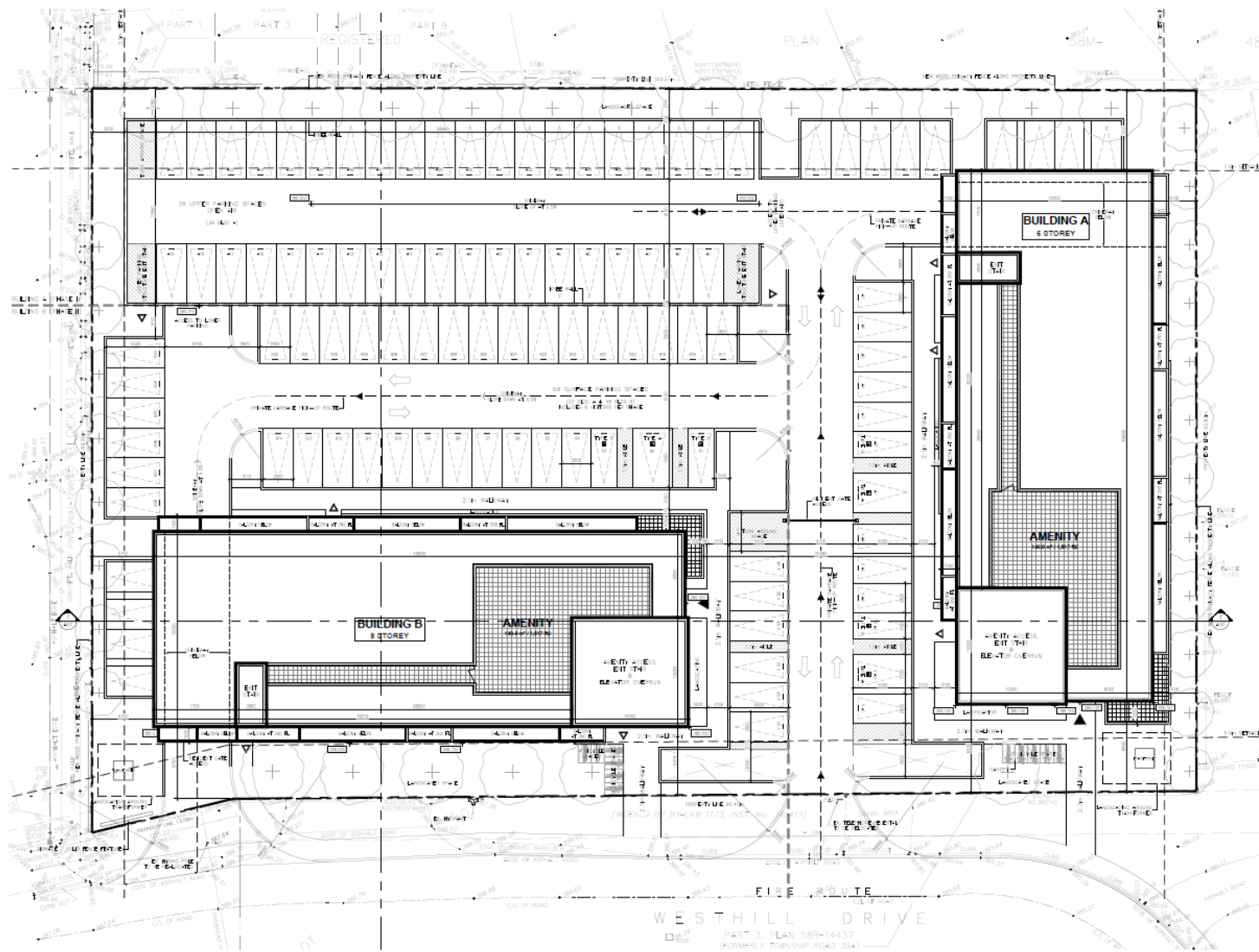


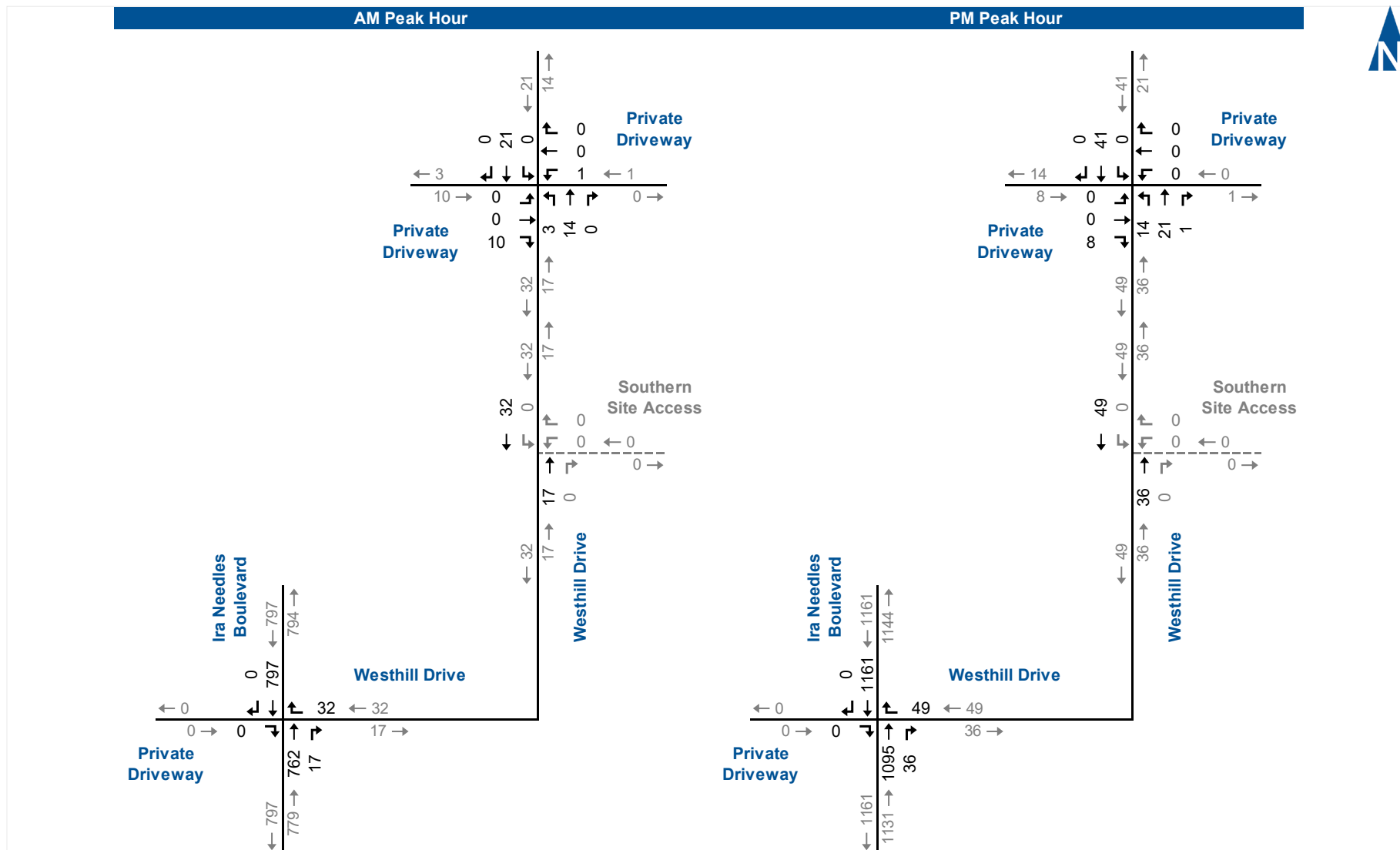
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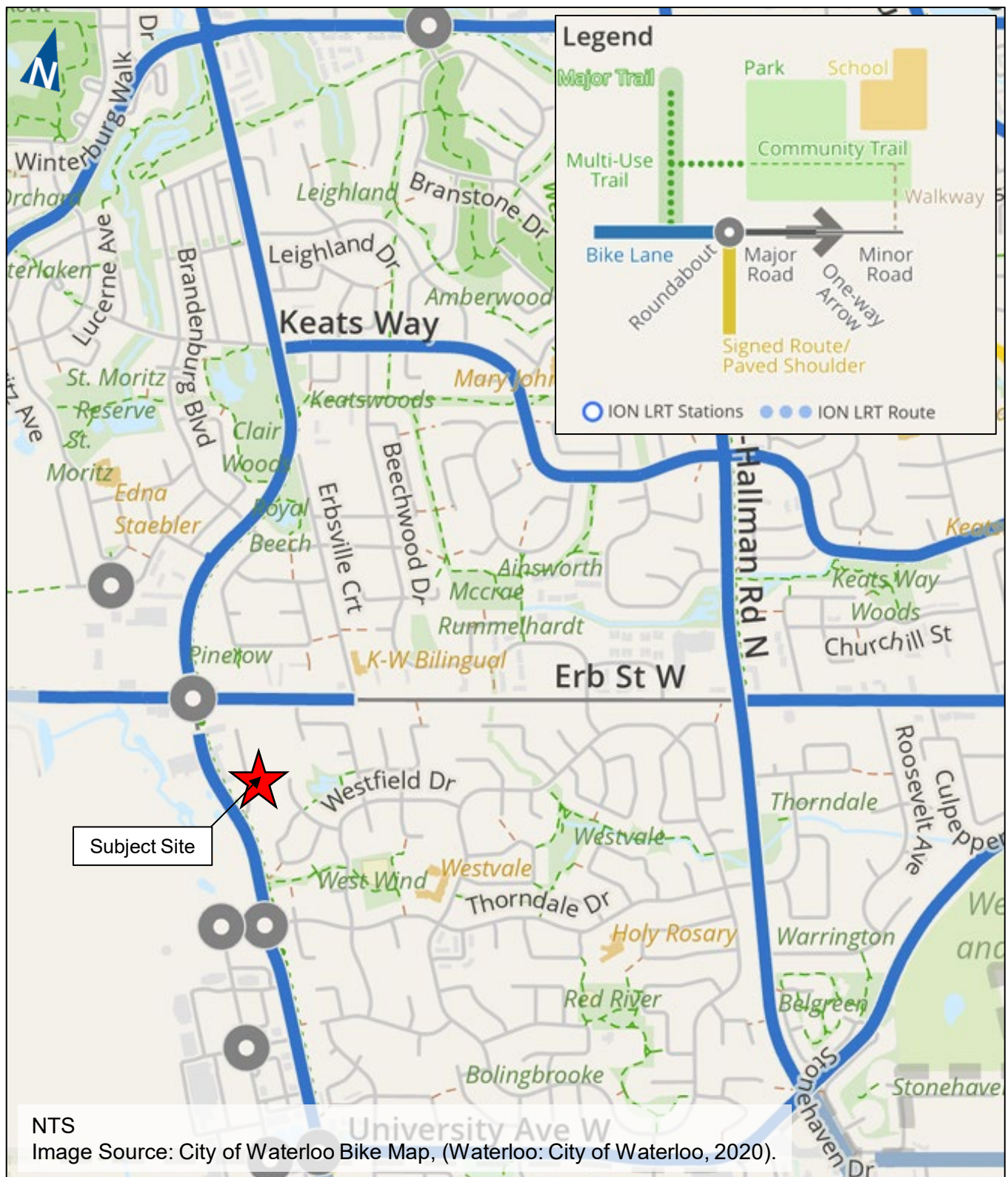


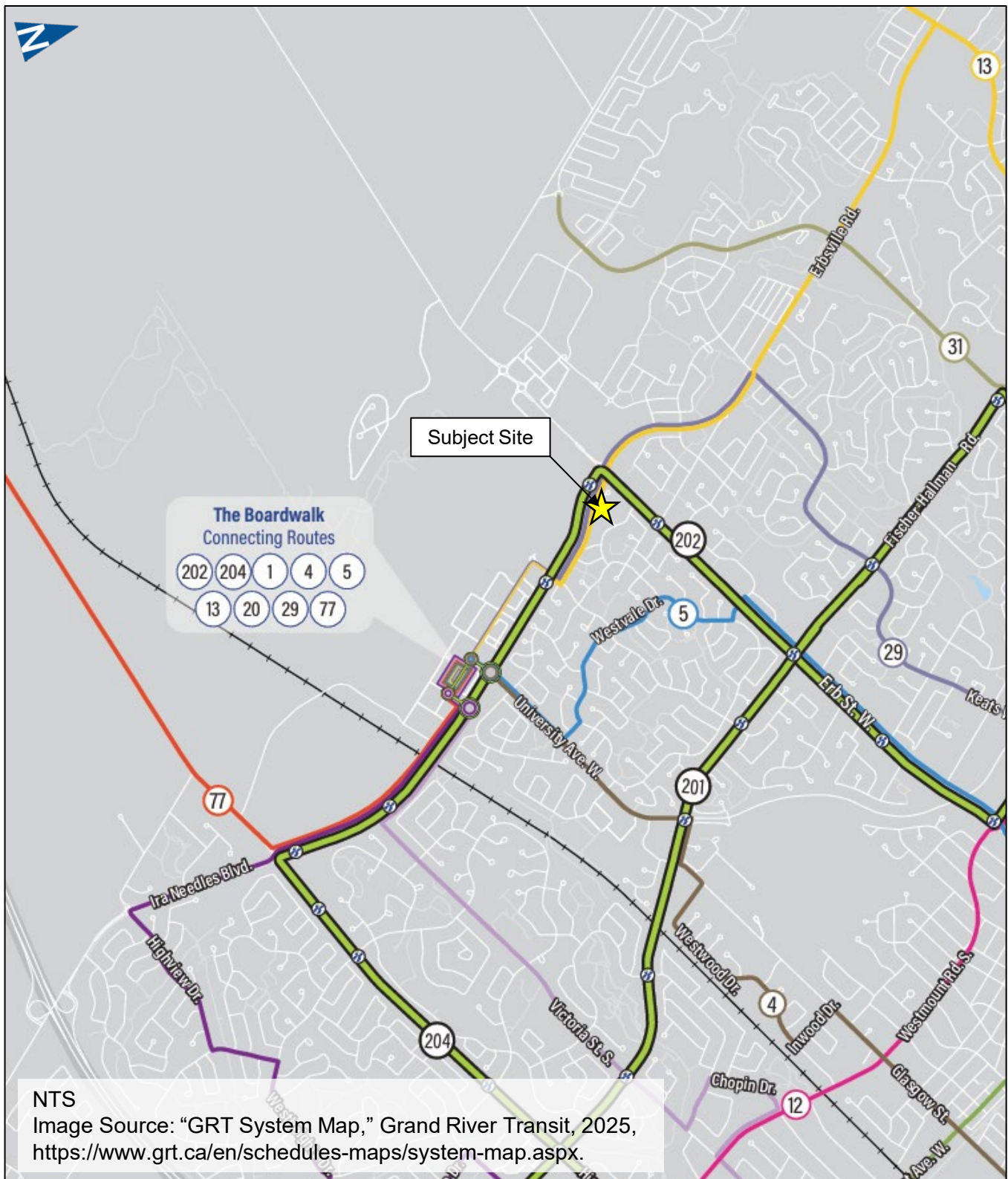












Appendix A: Pre-Study Consultation Notes



From: Ainsley Rego <Ainsley.Rego@waterloo.ca>
Sent: May 6, 2025 8:14 AM
To: Andrew Orr; Tanikia Kinear
Cc: Erica Bayley
Subject: RE: 250261 (36 Westhill Drive, Waterloo) TIS

Good morning Andrew,

Thank you for providing the terms of reference for the 36 Westhill Drive TIS. The below scope of work is acceptable to the City.

Please let me know if you have any questions or concerns.

Best Regards,
Ainsley



Ainsley Rego, BES, RSP1 (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 Orr <aorr@ptsl.com>
Sent: May 1, 2025 5:51 PM
To: Ainsley Rego <Ainsley.Rego@waterloo.ca>; Tanikia Kinear <tkinear@regionofwaterloo.ca>
Cc: Erica Bayley <ebayley@ptsl.com>
Subject: [EXTERNAL] 250261 (36 Westhill Drive, Waterloo) TIS

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Hello Ainsley and Tanikia,

Paradigm Transportation Solutions Limited (Paradigm) has been retained to conduct this Transportation Impact Study (TIS) for a proposed residential development located at 36 Westhill Drive in Waterloo. The subject site is proposed to be developed into three six-storey buildings totalling 150 units. Vehicle access is proposed via two all-moves driveway connections to Westhill Drive (concept plan attached). If the Region is interested in this study, a PSC form will be prepared.

We'd like to prepare our report based on the following scope, subject to your comments:

PROPOSED TERMS OF REFERENCE

Study Area Intersections:

- Ira Needles Boulevard and Westhill Drive (RIRO and unsignalized); and
- Two proposed driveway connections to Westhill Drive (assumed unsignalized);

Analysis Periods:

- Weekday AM peak hour; and
- Weekday PM peak hour.

Existing Data:

- Existing 8-hour TMC data collected at Ira Needles Boulevard and Westhill Drive in January 2025.

Horizon Year:

- Five years from the date the study is commissioned (2030).

Analysis:

- Synchro 12, HCM 7 analysis.

Background Traffic: **Please confirm**

- Background traffic annual growth rate – 1.5%
- 41 Westhill Drive
- 414 Westhaven Street
- Any additional developments to include in background?

Future Road Improvements:

- **Please confirm –**

Trip Generation:

- ITE Trip Generation Data 11th Edition.

Trip Distribution:

- Existing Distribution; and
- 2022 Transportation Tomorrow Survey (TTS) data.

Best Regards,

Andrew Orr, M.A.Sc., EIT

Transportation Consultant, Associate
(He/Him)



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Appendix B: Traffic Data





Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

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

Count Name: Ira Needles Blvd & Westhill Drive
Site Code: 240745
Start Date: 01/28/2025
Page No: 1

Turning Movement Data

Start Time	Eastbound Approach Eastbound						West Hill Drive Westbound						Ira Needles Blvd Northbound						Ira Needles Blvd 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	0	0	0	0	0	0	0	0	0	0	0	0	77	5	0	0	82	0	107	0	0	0	107	189
7:15 AM	0	0	0	0	0	0	0	0	1	0	0	1	0	74	4	0	0	78	0	133	0	0	0	133	212
7:30 AM	0	0	0	0	0	0	0	0	3	0	0	3	0	102	7	0	0	109	0	140	0	0	0	140	252
7:45 AM	0	0	0	0	0	0	0	0	1	0	0	1	0	143	1	0	0	144	0	162	0	0	0	162	307
Hourly Total	0	0	0	0	0	0	0	0	5	0	0	5	0	396	17	0	0	413	0	542	0	0	0	542	960
8:00 AM	0	0	0	0	0	0	0	0	3	0	1	3	0	158	2	0	0	160	0	156	0	0	0	156	319
8:15 AM	0	0	0	0	0	0	0	0	5	0	0	5	0	167	3	0	0	170	0	180	0	0	0	180	355
8:30 AM	0	0	0	0	0	0	0	0	10	0	0	10	0	181	6	0	0	187	0	178	0	0	0	178	375
8:45 AM	0	0	0	0	0	0	0	0	1	0	1	1	0	198	2	0	0	200	0	205	0	0	0	205	406
Hourly Total	0	0	0	0	0	0	0	0	19	0	2	19	0	704	13	0	0	717	0	719	0	0	0	719	1455
9:00 AM	0	0	0	0	0	0	0	0	4	0	0	4	0	157	2	0	0	159	0	170	0	0	0	170	333
9:15 AM	0	0	0	0	0	0	0	0	2	0	0	2	0	150	3	0	0	153	0	167	0	0	0	167	322
9:30 AM	0	0	0	0	0	0	0	0	7	0	1	7	0	146	8	0	0	154	0	166	0	0	0	166	327
9:45 AM	0	0	0	0	0	0	0	0	2	0	1	2	0	138	5	0	0	143	0	182	0	0	0	182	327
Hourly Total	0	0	0	0	0	0	0	0	15	0	2	15	0	591	18	0	0	609	0	685	0	0	0	685	1309
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11:30 AM	0	0	0	0	2	0	0	0	2	0	2	2	0	222	8	0	0	230	0	174	1	0	0	175	407
11:45 AM	0	0	0	0	0	0	0	0	6	0	0	6	0	209	7	0	0	216	0	188	0	0	0	188	410
Hourly Total	0	0	0	0	2	0	0	0	8	0	2	8	0	431	15	0	0	446	0	362	1	0	0	363	817
12:00 PM	0	0	0	0	0	0	0	0	2	0	0	2	0	208	7	0	0	215	0	197	0	0	0	197	414
12:15 PM	0	0	1	0	0	1	0	0	4	0	0	4	0	192	6	0	0	198	0	205	0	0	0	205	408
12:30 PM	0	0	0	0	0	0	0	0	8	0	0	8	0	193	6	0	0	199	0	223	0	0	0	223	430
12:45 PM	0	0	0	0	0	0	0	0	6	0	3	6	0	212	5	0	0	217	0	218	0	0	0	218	441
Hourly Total	0	0	1	0	0	1	0	0	20	0	3	20	0	805	24	0	0	829	0	843	0	0	0	843	1693
1:00 PM	0	0	0	0	2	0	0	0	11	0	1	11	0	186	4	0	0	190	0	242	0	0	0	242	443
1:15 PM	0	0	0	0	1	0	0	0	1	0	1	1	0	183	6	0	0	189	0	233	0	0	0	233	423
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hourly Total	0	0	0	0	3	0	0	0	12	0	2	12	0	369	10	0	0	379	0	475	0	0	0	475	866
3:00 PM	0	0	0	0	4	0	0	0	5	0	3	5	0	239	8	0	0	247	0	223	0	0	0	223	475
3:15 PM	0	0	0	0	2	0	0	0	2	0	1	2	0	204	5	0	0	209	0	243	0	0	0	243	454
3:30 PM	0	0	1	0	0	1	0	0	10	0	2	10	0	267	5	0	0	272	0	236	0	0	0	236	519
3:45 PM	0	0	0	0	3	0	0	0	15	0	0	15	0	229	9	0	0	238	0	248	0	0	0	248	501
Hourly Total	0	0	1	0	9	1	0	0	32	0	6	32	0	939	27	0	0	966	0	950	0	0	0	950	1949
4:00 PM	0	0	0	0	1	0	0	0	9	0	2	9	0	273	5	0	0	278	0	265	0	0	0	265	552
4:15 PM	0	0	0	0	0	0	0	0	6	0	0	6	0	258	1	0	0	259	0	271	0	0	0	271	536

4:30 PM	0	0	0	0	0	0	0	0	8	0	1	8	0	243	5	0	0	248	0	283	0	0	0	283	539
4:45 PM	0	0	0	0	1	0	0	0	6	0	0	6	0	209	5	0	0	214	0	256	0	0	0	256	476
Hourly Total	0	0	0	0	2	0	0	0	29	0	3	29	0	983	16	0	0	999	0	1075	0	0	0	1075	2103
5:00 PM	0	0	0	0	0	0	0	0	6	0	0	6	0	233	1	0	0	234	0	253	0	0	0	253	493
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	222	6	0	0	228	0	239	0	0	0	239	467
5:30 PM	0	0	0	0	0	0	0	0	2	0	0	2	0	201	6	0	0	207	0	217	0	0	0	217	426
5:45 PM	0	0	0	0	0	0	0	0	4	0	0	4	0	198	1	0	0	199	0	202	0	0	0	202	405
Hourly Total	0	0	0	0	0	0	0	0	12	0	0	12	0	854	14	0	0	868	0	911	0	0	0	911	1791
Grand Total	0	0	2	0	16	2	0	0	152	0	20	152	0	6072	154	0	0	6226	0	6562	1	0	0	6563	12943
Approach %	0.0	0.0	100.0	0.0	-	-	0.0	0.0	100.0	0.0	-	-	0.0	97.5	2.5	0.0	-	-	0.0	100.0	0.0	0.0	-	-	-
Total %	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	1.2	0.0	-	1.2	0.0	46.9	1.2	0.0	-	48.1	0.0	50.7	0.0	0.0	-	50.7	-
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
Cars & Light Goods	0	0	2	0	-	2	0	0	144	0	-	144	0	5830	138	0	-	5968	0	6332	1	0	-	6333	12447
% Cars & Light Goods	-	-	100.0	-	-	100.0	-	-	94.7	-	-	94.7	-	96.0	89.6	-	-	95.9	-	96.5	100.0	-	-	96.5	96.2
Buses	0	0	0	0	-	0	0	0	1	0	-	1	0	121	1	0	-	122	0	119	0	0	-	119	242
% Buses	-	-	0.0	-	-	0.0	-	-	0.7	-	-	0.7	-	2.0	0.6	-	-	2.0	-	1.8	0.0	-	-	1.8	1.9
Single-Unit Trucks	0	0	0	0	-	0	0	0	7	0	-	7	0	109	15	0	-	124	0	103	0	0	-	103	234
% Single-Unit Trucks	-	-	0.0	-	-	0.0	-	-	4.6	-	-	4.6	-	1.8	9.7	-	-	2.0	-	1.6	0.0	-	-	1.6	1.8
Articulated Trucks	0	0	0	0	-	0	0	0	0	0	-	0	0	12	0	0	-	12	0	8	0	0	-	8	20
% Articulated Trucks	-	-	0.0	-	-	0.0	-	-	0.0	-	-	0.0	-	0.2	0.0	-	-	0.2	-	0.1	0.0	-	-	0.1	0.2
Bicycles on Road	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	-	-	0.0	-	0.0	0.0	-	-	0.0	-	0.0	0.0	-	-	0.0	0.0
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	0	-	-	-
% Bicycles on Crosswalk	-	-	-	-	0.0	-	-	-	-	-	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	16	-	-	-	-	-	19	-	-	-	-	-	0	-	-	-	-	0	-	-	-
% Pedestrians	-	-	-	-	100.0	-	-	-	-	-	95.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-

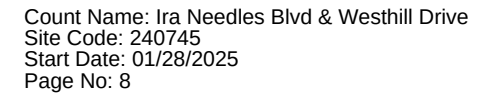
Turning Movement Data Plot

Start Time	Eastbound Approach						West Hill Drive						Ira Needles Blvd						Ira Needles Blvd						Int. Total
	Eastbound						Westbound						Northbound						Southbound						
	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	
8:15 AM	0	0	0	0	0	0	0	0	5	0	0	5	0	167	3	0	0	170	0	180	0	0	0	180	355
8:30 AM	0	0	0	0	0	0	0	0	10	0	0	10	0	181	6	0	0	187	0	178	0	0	0	178	375
8:45 AM	0	0	0	0	0	0	0	0	1	0	1	1	0	198	2	0	0	200	0	205	0	0	0	205	406
9:00 AM	0	0	0	0	0	0	0	0	4	0	0	4	0	157	2	0	0	159	0	170	0	0	0	170	333
Total	0	0	0	0	0	0	0	0	20	0	1	20	0	703	13	0	0	716	0	733	0	0	0	733	1469
Approach %	0.0	0.0	0.0	0.0	-	-	0.0	0.0	100.0	0.0	-	-	0.0	98.2	1.8	0.0	-	-	0.0	100.0	0.0	0.0	-	-	-
Total %	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	1.4	0.0	-	1.4	0.0	47.9	0.9	0.0	-	48.7	0.0	49.9	0.0	0.0	-	49.9	-
PHF	0.000	0.000	0.000	0.000	-	0.000	0.000	0.000	0.500	0.000	-	0.500	0.000	0.888	0.542	0.000	-	0.895	0.000	0.894	0.000	0.000	-	0.894	0.905
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
Cars & Light Goods	0	0	0	0	-	0	0	0	18	0	-	18	0	666	12	0	-	678	0	696	0	0	-	696	1392
% Cars & Light Goods	-	-	-	-	-	-	-	-	90.0	-	-	90.0	-	94.7	92.3	-	-	94.7	-	95.0	-	-	-	95.0	94.8
Buses	0	0	0	0	-	0	0	0	0	0	-	0	0	18	0	0	-	18	0	25	0	0	-	25	43
% Buses	-	-	-	-	-	-	-	-	0.0	-	-	0.0	-	2.6	0.0	-	-	2.5	-	3.4	-	-	-	3.4	2.9
Single-Unit Trucks	0	0	0	0	-	0	0	0	2	0	-	2	0	16	1	0	-	17	0	10	0	0	-	10	29
% Single-Unit Trucks	-	-	-	-	-	-	-	-	10.0	-	-	10.0	-	2.3	7.7	-	-	2.4	-	1.4	-	-	-	1.4	2.0
Articulated Trucks	0	0	0	0	-	0	0	0	0	0	-	0	0	3	0	0	-	3	0	2	0	0	-	2	5
% Articulated Trucks	-	-	-	-	-	-	-	-	0.0	-	-	0.0	-	0.4	0.0	-	-	0.4	-	0.3	-	-	-	0.3	0.3
Bicycles on Road	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	0.0	-	-	0.0	-	0.0	-	-	-	0.0	0.0
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	0	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Turning Movement Peak Hour Data Plot (8:15 AM)

Start Time	Eastbound Approach						West Hill Drive						Ira Needles Blvd						Int. Total						
	Eastbound						Westbound						Northbound							Southbound					
	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
12:30 PM	0	0	0	0	0	0	0	0	8	0	0	8	0	193	6	0	0	199	0	223	0	0	0	223	430
12:45 PM	0	0	0	0	0	0	0	0	6	0	3	6	0	212	5	0	0	217	0	218	0	0	0	218	441
1:00 PM	0	0	0	0	2	0	0	0	11	0	1	11	0	186	4	0	0	190	0	242	0	0	0	242	443
1:15 PM	0	0	0	0	1	0	0	0	1	0	1	1	0	183	6	0	0	189	0	233	0	0	0	233	423
Total	0	0	0	0	3	0	0	0	26	0	5	26	0	774	21	0	0	795	0	916	0	0	0	916	1737
Approach %	0.0	0.0	0.0	0.0	-	-	0.0	0.0	100.0	0.0	-	-	0.0	97.4	2.6	0.0	-	-	0.0	100.0	0.0	0.0	-	-	-
Total %	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	1.5	0.0	-	1.5	0.0	44.6	1.2	0.0	-	45.8	0.0	52.7	0.0	0.0	-	52.7	-
PHF	0.000	0.000	0.000	0.000	-	0.000	0.000	0.000	0.591	0.000	-	0.591	0.000	0.913	0.875	0.000	-	0.916	0.000	0.946	0.000	0.000	-	0.946	0.980
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
Cars & Light Goods	0	0	0	0	-	0	0	0	25	0	-	25	0	749	20	0	-	769	0	882	0	0	-	882	1676
% Cars & Light Goods	-	-	-	-	-	-	-	-	96.2	-	-	96.2	-	96.8	95.2	-	-	96.7	-	96.3	-	-	-	96.3	96.5
Buses	0	0	0	0	-	0	0	0	1	0	-	1	0	12	0	0	-	12	0	11	0	0	-	11	24
% Buses	-	-	-	-	-	-	-	-	3.8	-	-	3.8	-	1.6	0.0	-	-	1.5	-	1.2	-	-	-	1.2	1.4
Single-Unit Trucks	0	0	0	0	-	0	0	0	0	0	-	0	0	13	1	0	-	14	0	21	0	0	-	21	35
% Single-Unit Trucks	-	-	-	-	-	-	-	-	0.0	-	-	0.0	-	1.7	4.8	-	-	1.8	-	2.3	-	-	-	2.3	2.0
Articulated Trucks	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	2	0	0	-	2	2
% Articulated Trucks	-	-	-	-	-	-	-	-	0.0	-	-	0.0	-	0.0	0.0	-	-	0.0	-	0.2	-	-	-	0.2	0.1
Bicycles on Road	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	0.0	-	-	0.0	-	0.0	-	-	-	0.0	0.0
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	0	-	-	-
% Bicycles on Crosswalk	-	-	-	-	0.0	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	3	-	-	-	-	5	-	-	-	-	-	-	0	-	-	-	-	0	-	-	-
% Pedestrians	-	-	-	-	100.0	-	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Turning Movement Peak Hour Data Plot (12:30 PM)

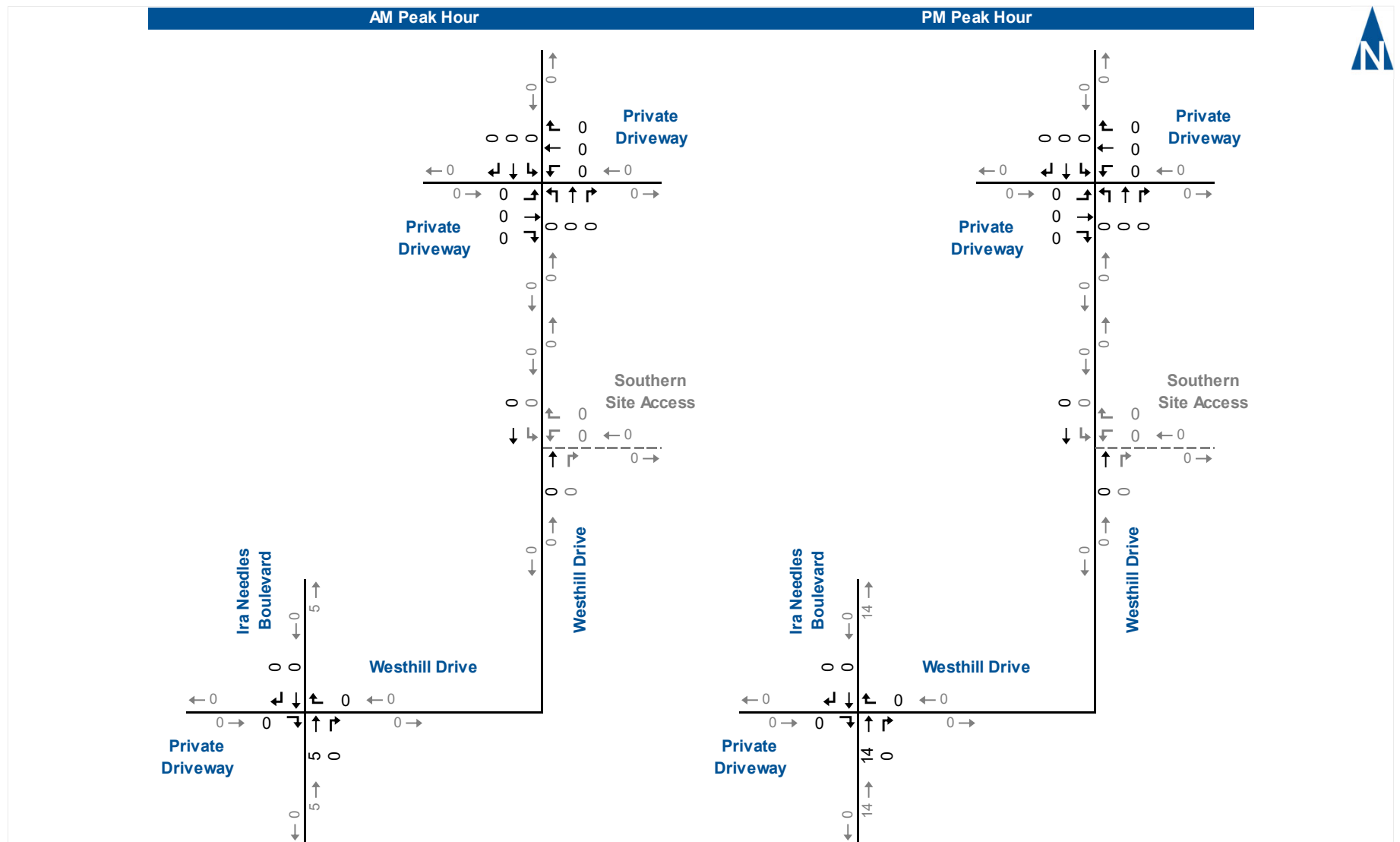


Start Time	Eastbound Approach Eastbound						West Hill Drive Westbound						Ira Needles Blvd Northbound						Ira Needles Blvd Southbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
3:45 PM	0	0	0	0	3	0	0	0	15	0	0	15	0	229	9	0	0	238	0	248	0	0	0	248	501
4:00 PM	0	0	0	0	1	0	0	0	9	0	2	9	0	273	5	0	0	278	0	265	0	0	0	265	552
4:15 PM	0	0	0	0	0	0	0	0	6	0	0	6	0	258	1	0	0	259	0	271	0	0	0	271	536
4:30 PM	0	0	0	0	0	0	0	0	8	0	1	8	0	243	5	0	0	248	0	283	0	0	0	283	539
Total	0	0	0	0	4	0	0	0	38	0	3	38	0	1003	20	0	0	1023	0	1067	0	0	0	1067	2128
Approach %	0.0	0.0	0.0	0.0	-	-	0.0	0.0	100.0	0.0	-	-	0.0	98.0	2.0	0.0	-	-	0.0	100.0	0.0	0.0	-	-	-
Total %	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	1.8	0.0	-	1.8	0.0	47.1	0.9	0.0	-	48.1	0.0	50.1	0.0	0.0	-	50.1	-
PHF	0.000	0.000	0.000	0.000	-	0.000	0.000	0.000	0.633	0.000	-	0.633	0.000	0.918	0.556	0.000	-	0.920	0.000	0.943	0.000	0.000	-	0.943	0.964
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
Cars & Light Goods	0	0	0	0	-	0	0	0	37	0	-	37	0	973	20	0	-	993	0	1043	0	0	-	1043	2073
% Cars & Light Goods	-	-	-	-	-	-	-	-	97.4	-	-	97.4	-	97.0	100.0	-	-	97.1	-	97.8	-	-	-	97.8	97.4
Buses	0	0	0	0	-	0	0	0	0	0	-	0	0	17	0	0	-	17	0	12	0	0	-	12	29
% Buses	-	-	-	-	-	-	-	-	0.0	-	-	0.0	-	1.7	0.0	-	-	1.7	-	1.1	-	-	-	1.1	1.4
Single-Unit Trucks	0	0	0	0	-	0	0	0	1	0	-	1	0	11	0	0	-	11	0	12	0	0	-	12	24
% Single-Unit Trucks	-	-	-	-	-	-	-	-	2.6	-	-	2.6	-	1.1	0.0	-	-	1.1	-	1.1	-	-	-	1.1	1.1
Articulated Trucks	0	0	0	0	-	0	0	0	0	0	-	0	0	2	0	0	-	2	0	0	0	0	-	0	2
% Articulated Trucks	-	-	-	-	-	-	-	-	0.0	-	-	0.0	-	0.2	0.0	-	-	0.2	-	0.0	-	-	-	0.0	0.1
Bicycles on Road	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	0.0	-	-	0.0	-	0.0	-	-	-	0.0	0.0
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	0	-	-	-
% Bicycles on Crosswalk	-	-	-	-	0.0	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	4	-	-	-	-	-	3	-	-	-	-	-	0	-	-	-	-	0	-	-	-
% Pedestrians	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Turning Movement Peak Hour Data Plot (3:45 PM)

Appendix C: Background Development Traffic





Appendix D: Existing Traffic Operations



												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations								 			 	
Traffic Volume (vph)	0	0	0	0	0	20	0	703	13	0	733	0
Future Volume (vph)	0	0	0	0	0	20	0	703	13	0	733	0
Ideal Flow (vphpl)	1000	1000	1750	1000	1000	1750	1000	1775	1775	1000	1775	1775
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Ped Bike Factor												
Frt	0.865						0.997					
Flt Protected												
Satd. Flow (prot)	0	0	1731	0	0	1361	0	3165	0	0	3176	0
Flt Permitted												
Satd. Flow (perm)	0	0	1731	0	0	1361	0	3165	0	0	3176	0
Link Speed (k/h)	40				40				60			
Link Distance (m)	63.3				61.6				185.2			
Travel Time (s)	5.7				5.5				11.1			
Confl. Peds. (#/hr)									1	1		
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%	0%	0%	0%	0%	10%	0%	5%	8%	0%	5%	0%
Adj. Flow (vph)	0	0	0	0	0	20	0	703	13	0	733	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	0	20	0	716	0	0	733	0
Sign Control	Stop				Stop				Free			
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization	31.2%						ICU Level of Service A					
Analysis Period (min)	15											

Intersection												
Int Delay, s/veh	0.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations			↗			↗		↕			↕	
Traffic Vol, veh/h	0	0	0	0	0	20	0	703	13	0	733	0
Future Vol, veh/h	0	0	0	0	0	20	0	703	13	0	733	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	1	1	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	-	-	0	-	-	-	-	-	-
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	0	0	0	0	10	0	5	8	0	5	0
Mvmt Flow	0	0	0	0	0	20	0	703	13	0	733	0
Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	-	-	367	-	-	359	-	0	0	-	-	0
Stage 1	-	-	-	-	-	-	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-	-	-	-	-	-	-
Critical Hdwy	-	-	6.9	-	-	7.1	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-	-	-	-	-	-	-
Follow-up Hdwy	-	-	3.3	-	-	3.4	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	636	0	0	615	0	-	-	0	-	-
Stage 1	0	0	-	0	0	-	0	-	-	0	-	-
Stage 2	0	0	-	0	0	-	0	-	-	0	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	636	-	-	614	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-	-	-	-	-	-	-
Approach	EB		WB		NB		SB					
HCM Ctrl Dly, s/v	0		11.06		0		0					
HCM LOS	A		B									
Minor Lane/Major Mvmt	NBT		NBR EBLn1WBLn1		SBT SBR							
Capacity (veh/h)	-	-	-	614	-	-						
HCM Lane V/C Ratio	-	-	-	0.033	-	-						
HCM Ctrl Dly (s/v)	-	-	0	11.1	-	-						
HCM Lane LOS	-	-	A	B	-	-						
HCM 95th %tile Q(veh)	-	-	-	0.1	-	-						

Lanes, Volumes, Timings
2: Westhill Drive & Private Driveway

36 Westhill Drive, Waterloo TIS
Base Year AM

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	1	0	13	0	0	19
Future Volume (vph)	1	0	13	0	0	19
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						
Flt Protected	0.950					
Satd. Flow (prot)	1626	0	1511	0	0	1470
Flt Permitted	0.950					
Satd. Flow (perm)	1626	0	1511	0	0	1470
Link Speed (k/h)	40		40			40
Link Distance (m)	56.0		41.0			99.0
Travel Time (s)	5.0		3.7			8.9
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	2%	8%	2%	2%	11%
Adj. Flow (vph)	1	0	13	0	0	19
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1	0	13	0	0	19
Sign Control	Stop		Free			Free
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	13.3%			ICU Level of Service A		
Analysis Period (min)	15					

Intersection						
Int Delay, s/veh	0.3					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	1	0	13	0	0	19
Future Vol, veh/h	1	0	13	0	0	19
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, %	2	2	8	2	2	11
Mvmt Flow	1	0	13	0	0	19

Major/Minor	Minor1	Major1	Major2
Conflicting Flow All	32	13	0
Stage 1	13	-	-
Stage 2	19	-	-
Critical Hdwy	6.42	6.22	-
Critical Hdwy Stg 1	5.42	-	-
Critical Hdwy Stg 2	5.42	-	-
Follow-up Hdwy	3.518	3.318	-
Pot Cap-1 Maneuver	982	1067	-
Stage 1	1010	-	-
Stage 2	1004	-	-
Platoon blocked, %		-	-
Mov Cap-1 Maneuver	982	1067	-
Mov Cap-2 Maneuver	982	-	-
Stage 1	1010	-	-
Stage 2	1004	-	-

Approach	WB	NB	SB
HCM Ctrl Dly, s/v	8.67	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	982	1606
HCM Lane V/C Ratio	-	-	0.001	-
HCM Ctrl Dly (s/v)	-	-	8.7	0
HCM Lane LOS	-	-	A	A
HCM 95th %tile Q(veh)	-	-	0	0

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	0	0	38	0	1003	20	0	1067	0
Future Volume (vph)	0	0	0	0	0	38	0	1003	20	0	1067	0
Ideal Flow (vphpl)	1000	1000	1750	1000	1000	1750	1000	1775	1775	1000	1775	1775
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Ped Bike Factor												
Frt	0.865						0.997					
Flt Protected												
Satd. Flow (prot)	0	0	1731	0	0	1453	0	3230	0	0	3270	0
Flt Permitted												
Satd. Flow (perm)	0	0	1731	0	0	1453	0	3230	0	0	3270	0
Link Speed (k/h)	40				40				60			
Link Distance (m)	63.3				61.6				185.2			
Travel Time (s)	5.7				5.5				11.1			
Confl. Peds. (#/hr)							4	3			3	4
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%	0%	0%	0%	0%	3%	0%	3%	0%	0%	2%	0%
Adj. Flow (vph)	0	0	0	0	0	38	0	1003	20	0	1067	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	0	38	0	1023	0	0	1067	0
Sign Control	Stop				Stop				Free			
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization	40.4%						ICU Level of Service A					
Analysis Period (min)	15											

Intersection												
Int Delay, s/veh	0.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations			↗			↗		↕			↕	
Traffic Vol, veh/h	0	0	0	0	0	38	0	1003	20	0	1067	0
Future Vol, veh/h	0	0	0	0	0	38	0	1003	20	0	1067	0
Conflicting Peds, #/hr	0	0	0	0	0	0	4	0	3	3	0	4
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	-	-	0	-	-	-	-	-	-
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	0	0	0	0	3	0	3	0	0	2	0
Mvmt Flow	0	0	0	0	0	38	0	1003	20	0	1067	0
Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	-	-	538	-	-	515	-	0	0	-	-	0
Stage 1	-	-	-	-	-	-	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-	-	-	-	-	-	-
Critical Hdwy	-	-	6.9	-	-	6.96	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-	-	-	-	-	-	-
Follow-up Hdwy	-	-	3.3	-	-	3.33	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	493	0	0	502	0	-	-	0	-	-
Stage 1	0	0	-	0	0	-	0	-	-	0	-	-
Stage 2	0	0	-	0	0	-	0	-	-	0	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	491	-	-	501	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-	-	-	-	-	-	-
Approach	EB		WB		NB		SB					
HCM Ctrl Dly, s/v	0		12.77		0		0					
HCM LOS	A		B									
Minor Lane/Major Mvmt	NBT		NBR EBLn1WBLn1		SBT SBR							
Capacity (veh/h)	-	-	-	501	-	-						
HCM Lane V/C Ratio	-	-	-	0.076	-	-						
HCM Ctrl Dly (s/v)	-	-	0	12.8	-	-						
HCM Lane LOS	-	-	A	B	-	-						
HCM 95th %tile Q(veh)	-	-	-	0.2	-	-						

Lanes, Volumes, Timings
2: Westhill Drive & Private Driveway

36 Westhill Drive, Waterloo TIS
Base Year PM

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	0	0	19	1	0	38
Future Volume (vph)	0	0	19	1	0	38
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	0.993					
Flt Protected						
Satd. Flow (prot)	1711	0	1619	0	0	1584
Flt Permitted						
Satd. Flow (perm)	1711	0	1619	0	0	1584
Link Speed (k/h)	40		40			40
Link Distance (m)	56.0		41.0			99.0
Travel Time (s)	5.0		3.7			8.9
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	2%	0%	2%	2%	3%
Adj. Flow (vph)	0	0	19	1	0	38
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	0	20	0	0	38
Sign Control	Stop		Free			Free
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	6.7%			ICU Level of Service A		
Analysis Period (min)	15					

Intersection						
Int Delay, s/veh	0					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	0	19	1	0	38
Future Vol, veh/h	0	0	19	1	0	38
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, %	2	2	0	2	2	3
Mvmt Flow	0	0	19	1	0	38

Major/Minor	Minor1	Major1	Major2
Conflicting Flow All	58	20	0
Stage 1	20	-	-
Stage 2	38	-	-
Critical Hdwy	6.42	6.22	-
Critical Hdwy Stg 1	5.42	-	-
Critical Hdwy Stg 2	5.42	-	-
Follow-up Hdwy	3.518	3.318	-
Pot Cap-1 Maneuver	950	1058	-
Stage 1	1003	-	-
Stage 2	984	-	-
Platoon blocked, %		-	-
Mov Cap-1 Maneuver	950	1058	-
Mov Cap-2 Maneuver	950	-	-
Stage 1	1003	-	-
Stage 2	984	-	-

Approach	WB	NB	SB
HCM Ctrl Dly, s/v	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	-	1596
HCM Lane V/C Ratio	-	-	-	-
HCM Ctrl Dly (s/v)	-	-	0	0
HCM Lane LOS	-	-	A	A
HCM 95th %tile Q(veh)	-	-	-	0

Appendix E: Background Traffic Operations



												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations								 			 	
Traffic Volume (vph)	0	0	0	0	0	32	0	762	17	0	797	0
Future Volume (vph)	0	0	0	0	0	32	0	762	17	0	797	0
Ideal Flow (vphpl)	1000	1000	1750	1000	1000	1750	1000	1775	1775	1000	1775	1775
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Ped Bike Factor												
Frt	0.865						0.997					
Flt Protected												
Satd. Flow (prot)	0	0	1731	0	0	1361	0	3165	0	0	3176	0
Flt Permitted												
Satd. Flow (perm)	0	0	1731	0	0	1361	0	3165	0	0	3176	0
Link Speed (k/h)	40				40				60			
Link Distance (m)	63.3				61.6				185.2			
Travel Time (s)	5.7				5.5				11.1			
Confl. Peds. (#/hr)									1	1		
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%	0%	0%	0%	0%	10%	0%	5%	8%	0%	5%	0%
Adj. Flow (vph)	0	0	0	0	0	32	0	762	17	0	797	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	0	32	0	779	0	0	797	0
Sign Control	Stop				Stop				Free			
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization	33.1%						ICU Level of Service A					
Analysis Period (min)	15											

Intersection												
Int Delay, s/veh	0.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	0	0	0	0	32	0	762	17	0	797	0
Future Vol, veh/h	0	0	0	0	0	32	0	762	17	0	797	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	1	1	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	-	-	0	-	-	-	-	-	-
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	0	0	0	0	10	0	5	8	0	5	0
Mvmt Flow	0	0	0	0	0	32	0	762	17	0	797	0
Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	-	-	399	-	-	391	-	0	0	-	-	0
Stage 1	-	-	-	-	-	-	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-	-	-	-	-	-	-
Critical Hdwy	-	-	6.9	-	-	7.1	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-	-	-	-	-	-	-
Follow-up Hdwy	-	-	3.3	-	-	3.4	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	607	0	0	586	0	-	-	0	-	-
Stage 1	0	0	-	0	0	-	0	-	-	0	-	-
Stage 2	0	0	-	0	0	-	0	-	-	0	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	-	-	607	-	-	586	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-	-	-	-	-	-	-
Approach	EB		WB		NB		SB					
HCM Ctrl Dly, s/v	0		11.5		0		0					
HCM LOS	A		B									
Minor Lane/Major Mvmt	NBT		NBR EBLn1WBLn1		SBT SBR							
Capacity (veh/h)	-		-		586		-		-			
HCM Lane V/C Ratio	-		-		0.055		-		-			
HCM Ctrl Dly (s/v)	-		0		11.5		-		-			
HCM Lane LOS	-		A		B		-		-			
HCM 95th %tile Q(veh)	-		-		0.2		-		-			

Lanes, Volumes, Timings
2: Westhill Drive & Private Driveway

36 Westhill Drive, Waterloo TIS
Background AM

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	10	1	0	0	3	14	0	0	21	0
Future Volume (vph)	0	0	10	1	0	0	3	14	0	0	21	0
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
Frt	0.865											
Flt Protected					0.950		0.991					
Satd. Flow (prot)	0	1300	0	0	1428	0	0	1420	0	0	1381	0
Flt Permitted					0.950		0.991					
Satd. Flow (perm)	0	1300	0	0	1428	0	0	1420	0	0	1381	0
Link Speed (k/h)	40											
Link Distance (m)	30.4				56.0				41.0			
Travel Time (s)	2.7				5.0				3.7			
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 (%)	2%	2%	2%	2%	2%	2%	2%	8%	2%	2%	11%	2%
Adj. Flow (vph)	0	0	10	1	0	0	3	14	0	0	21	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	10	0	0	1	0	0	17	0	0	21	0
Sign Control	Stop			Stop			Free			Free		
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization	14.1%				ICU Level of Service A							
Analysis Period (min)	15											

Intersection												
Int Delay, s/veh	2.3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	0	10	1	0	0	3	14	0	0	21	0
Future Vol, veh/h	0	0	10	1	0	0	3	14	0	0	21	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
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, %	2	2	2	2	2	2	2	8	2	2	11	2
Mvmt Flow	0	0	10	1	0	0	3	14	0	0	21	0
Major/Minor	Minor2		Minor1			Major1			Major2			
Conflicting Flow All	41	41	21	41	41	14	21	0	0	14	0	0
Stage 1	21	21	-	20	20	-	-	-	-	-	-	-
Stage 2	20	20	-	21	21	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	963	851	1056	963	851	1066	1595	-	-	1604	-	-
Stage 1	998	878	-	999	879	-	-	-	-	-	-	-
Stage 2	999	879	-	998	878	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	961	849	1056	952	849	1066	1595	-	-	1604	-	-
Mov Cap-2 Maneuver	961	849	-	952	849	-	-	-	-	-	-	-
Stage 1	998	878	-	997	877	-	-	-	-	-	-	-
Stage 2	997	877	-	988	878	-	-	-	-	-	-	-
Approach	EB		WB			NB			SB			
HCM Ctrl Dly, s/v	8.44		8.79			1.28			0			
HCM LOS	A		A									
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR				
Capacity (veh/h)	318	-	-	1056	952	1604	-	-				
HCM Lane V/C Ratio	0.002	-	-	0.009	0.001	-	-	-				
HCM Ctrl Dly (s/v)	7.3	0	-	8.4	8.8	0	-	-				
HCM Lane LOS	A	A	-	A	A	A	-	-				
HCM 95th %tile Q(veh)	0	-	-	0	0	0	-	-				

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	0	0	49	0	1095	36	0	1161	0
Future Volume (vph)	0	0	0	0	0	49	0	1095	36	0	1161	0
Ideal Flow (vphpl)	1000	1000	1750	1000	1000	1750	1000	1775	1775	1000	1775	1775
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Ped Bike Factor												
Frt	0.865						0.995					
Flt Protected												
Satd. Flow (prot)	0	0	1731	0	0	1453	0	3225	0	0	3270	0
Flt Permitted												
Satd. Flow (perm)	0	0	1731	0	0	1453	0	3225	0	0	3270	0
Link Speed (k/h)	40				40				60			
Link Distance (m)	63.3				61.6				185.2			
Travel Time (s)	5.7				5.5				11.1			
Confl. Peds. (#/hr)							4	3			3	4
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%	0%	0%	0%	0%	3%	0%	3%	0%	0%	2%	0%
Adj. Flow (vph)	0	0	0	0	0	49	0	1095	36	0	1161	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	0	49	0	1131	0	0	1161	0
Sign Control	Stop			Stop				Free			Free	
Intersection Summary												
Area Type:	Other											
Control Type: Unsignalized												
Intersection Capacity Utilization 43.6%												
ICU Level of Service A												
Analysis Period (min) 15												

Intersection												
Int Delay, s/veh	0.3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations			↗			↗		↕			↕	
Traffic Vol, veh/h	0	0	0	0	0	49	0	1095	36	0	1161	0
Future Vol, veh/h	0	0	0	0	0	49	0	1095	36	0	1161	0
Conflicting Peds, #/hr	0	0	0	0	0	0	4	0	3	3	0	4
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	-	-	0	-	-	-	-	-	-
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	0	0	0	0	3	0	3	0	0	2	0
Mvmt Flow	0	0	0	0	0	49	0	1095	36	0	1161	0
Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	-	-	585	-	-	569	-	0	0	-	-	0
Stage 1	-	-	-	-	-	-	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-	-	-	-	-	-	-
Critical Hdwy	-	-	6.9	-	-	6.96	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-	-	-	-	-	-	-
Follow-up Hdwy	-	-	3.3	-	-	3.33	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	460	0	0	463	0	-	-	0	-	-
Stage 1	0	0	-	0	0	-	0	-	-	0	-	-
Stage 2	0	0	-	0	0	-	0	-	-	0	-	-
Platoon blocked, %							-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	458	-	-	462	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-	-	-	-	-	-	-
Approach	EB		WB		NB		SB					
HCM Ctrl Dly, s/v	0		13.72		0		0					
HCM LOS	A		B									
Minor Lane/Major Mvmt	NBT		NBR EBLn1WBLn1		SBT SBR							
Capacity (veh/h)	-	-	-	462	-	-						
HCM Lane V/C Ratio	-	-	-	0.106	-	-						
HCM Ctrl Dly (s/v)	-	-	0	13.7	-	-						
HCM Lane LOS	-	-	A	B	-	-						
HCM 95th %tile Q(veh)	-	-	-	0.4	-	-						

Lanes, Volumes, Timings
2: Westhill Drive & Private Driveway

36 Westhill Drive, Waterloo TIS
Background PM

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	8	0	0	0	14	21	1	0	41	0
Future Volume (vph)	0	0	8	0	0	0	14	21	1	0	41	0
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
Frt	0.865						0.996					
Flt Protected							0.981					
Satd. Flow (prot)	0	1300	0	0	1503	0	0	1485	0	0	1488	0
Flt Permitted							0.981					
Satd. Flow (perm)	0	1300	0	0	1503	0	0	1485	0	0	1488	0
Link Speed (k/h)	40			40			40			40		
Link Distance (m)	30.4			56.0			41.0			99.0		
Travel Time (s)	2.7			5.0			3.7			8.9		
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 (%)	2%	2%	2%	2%	2%	2%	2%	0%	2%	2%	3%	2%
Adj. Flow (vph)	0	0	8	0	0	0	14	21	1	0	41	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	8	0	0	0	0	0	36	0	0	41	0
Sign Control	Stop			Stop			Free			Free		
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization	19.0%						ICU Level of Service A					
Analysis Period (min)	15											

Intersection												
Int Delay, s/veh	2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	0	0	8	0	0	0	14	21	1	0	41	0
Future Vol, veh/h	0	0	8	0	0	0	14	21	1	0	41	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
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, %	2	2	2	2	2	2	2	0	2	2	3	2
Mvmt Flow	0	0	8	0	0	0	14	21	1	0	41	0
Major/Minor	Minor2		Minor1			Major1			Major2			
Conflicting Flow All	90	91	41	91	91	22	41	0	0	22	0	0
Stage 1	41	41	-	50	50	-	-	-	-	-	-	-
Stage 2	49	50	-	41	41	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	895	799	1030	894	800	1056	1568	-	-	1593	-	-
Stage 1	974	861	-	964	854	-	-	-	-	-	-	-
Stage 2	964	853	-	974	861	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	887	792	1030	879	792	1056	1568	-	-	1593	-	-
Mov Cap-2 Maneuver	887	792	-	879	792	-	-	-	-	-	-	-
Stage 1	974	861	-	955	846	-	-	-	-	-	-	-
Stage 2	956	846	-	966	861	-	-	-	-	-	-	-
Approach	EB		WB			NB			SB			
HCM Ctrl Dly, s/v	8.52		0			2.85			0			
HCM LOS	A		A									
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR				
Capacity (veh/h)	694	-	-	1030	-	1593	-	-				
HCM Lane V/C Ratio	0.009	-	-	0.008	-	-	-	-				
HCM Ctrl Dly (s/v)	7.3	0	-	8.5	0	0	-	-				
HCM Lane LOS	A	A	-	A	A	A	-	-				
HCM 95th %tile Q(veh)	0	-	-	0	-	0	-	-				

Appendix F: Total Traffic Operations



												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	0	0	71	0	762	28	0	821	0
Future Volume (vph)	0	0	0	0	0	71	0	762	28	0	821	0
Ideal Flow (vphpl)	1000	1000	1750	1000	1000	1750	1000	1775	1775	1000	1775	1775
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Ped Bike Factor												
Frt	0.865						0.995					
Flt Protected												
Satd. Flow (prot)	0	0	1731	0	0	1361	0	3157	0	0	3176	0
Flt Permitted												
Satd. Flow (perm)	0	0	1731	0	0	1361	0	3157	0	0	3176	0
Link Speed (k/h)	40				40				60			
Link Distance (m)	63.3				61.6				185.2			
Travel Time (s)	5.7				5.5				11.1			
Confl. Peds. (#/hr)									1	1		
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%	0%	0%	0%	0%	10%	0%	5%	8%	0%	5%	0%
Adj. Flow (vph)	0	0	0	0	0	71	0	762	28	0	821	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	0	71	0	790	0	0	821	0
Sign Control	Stop		Stop				Free				Free	
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization	34.9%					ICU Level of Service A						
Analysis Period (min)	15											

Intersection												
Int Delay, s/veh	0.5											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations			↗			↗		↕			↕	
Traffic Vol, veh/h	0	0	0	0	0	71	0	762	28	0	821	0
Future Vol, veh/h	0	0	0	0	0	71	0	762	28	0	821	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	1	1	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	-	-	0	-	-	-	-	-	-
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	0	0	0	0	10	0	5	8	0	5	0
Mvmt Flow	0	0	0	0	0	71	0	762	28	0	821	0
Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	-	-	411	-	-	396	-	0	0	-	-	0
Stage 1	-	-	-	-	-	-	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-	-	-	-	-	-	-
Critical Hdwy	-	-	6.9	-	-	7.1	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-	-	-	-	-	-	-
Follow-up Hdwy	-	-	3.3	-	-	3.4	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	596	0	0	581	0	-	-	0	-	-
Stage 1	0	0	-	0	0	-	0	-	-	0	-	-
Stage 2	0	0	-	0	0	-	0	-	-	0	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	596	-	-	581	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-	-	-	-	-	-	-
Approach	EB		WB		NB		SB					
HCM Ctrl Dly, s/v	0		12.06		0		0					
HCM LOS	A		B									
Minor Lane/Major Mvmt	NBT		NBR EBLn1WBLn1		SBT		SBR					
Capacity (veh/h)	-	-	-	581	-	-	-	-	-	-	-	-
HCM Lane V/C Ratio	-	-	-	0.122	-	-	-	-	-	-	-	-
HCM Ctrl Dly (s/v)	-	-	0	12.1	-	-	-	-	-	-	-	-
HCM Lane LOS	-	-	A	B	-	-	-	-	-	-	-	-
HCM 95th %tile Q(veh)	-	-	-	0.4	-	-	-	-	-	-	-	-

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	10	21	0	0	3	14	5	0	21	0
Future Volume (vph)	0	0	10	21	0	0	3	14	5	0	21	0
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
Frt	0.865						0.969					
Flt Protected				0.950			0.993					
Satd. Flow (prot)	0	1300	0	0	1428	0	0	1394	0	0	1381	0
Flt Permitted				0.950			0.993					
Satd. Flow (perm)	0	1300	0	0	1428	0	0	1394	0	0	1381	0
Link Speed (k/h)	40			40			40			40		
Link Distance (m)	30.4			59.6			41.0			99.0		
Travel Time (s)	2.7			5.4			3.7			8.9		
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 (%)	2%	2%	2%	2%	2%	2%	2%	8%	2%	2%	11%	2%
Adj. Flow (vph)	0	0	10	21	0	0	3	14	5	0	21	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	10	0	0	21	0	0	22	0	0	21	0
Sign Control	Stop			Stop			Free			Free		
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization	19.3%			ICU Level of Service A								
Analysis Period (min)	15											

Intersection												
Int Delay, s/veh	4											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	0	10	21	0	0	3	14	5	0	21	0
Future Vol, veh/h	0	0	10	21	0	0	3	14	5	0	21	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
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, %	2	2	2	2	2	2	2	8	2	2	11	2
Mvmt Flow	0	0	10	21	0	0	3	14	5	0	21	0
Major/Minor	Minor2		Minor1			Major1			Major2			
Conflicting Flow All	41	46	21	44	44	17	21	0	0	19	0	0
Stage 1	21	21	-	23	23	-	-	-	-	-	-	-
Stage 2	20	25	-	21	21	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	963	846	1056	959	848	1063	1595	-	-	1597	-	-
Stage 1	998	878	-	996	876	-	-	-	-	-	-	-
Stage 2	999	874	-	998	878	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	961	844	1056	948	847	1063	1595	-	-	1597	-	-
Mov Cap-2 Maneuver	961	844	-	948	847	-	-	-	-	-	-	-
Stage 1	998	878	-	994	875	-	-	-	-	-	-	-
Stage 2	997	873	-	988	878	-	-	-	-	-	-	-
Approach	EB		WB			NB			SB			
HCM Ctrl Dly, s/v	8.44		8.88			0.99			0			
HCM LOS	A		A									
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR				
Capacity (veh/h)	233	-	-	1056	948	1597	-	-				
HCM Lane V/C Ratio	0.002	-	-	0.009	0.022	-	-	-				
HCM Ctrl Dly (s/v)	7.3	0	-	8.4	8.9	0	-	-				
HCM Lane LOS	A	A	-	A	A	A	-	-				
HCM 95th %tile Q(veh)	0	-	-	0	0.1	0	-	-				

Lanes, Volumes, Timings
3: Westhill Drive & Southern Site Access

36 Westhill Drive, Waterloo TIS
Total AM

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	19	0	22	6	0	52
Future Volume (vph)	19	0	22	6	0	52
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	0.971					
Flt Protected	0.950					
Satd. Flow (prot)	1626	0	1485	0	0	1483
Flt Permitted	0.950					
Satd. Flow (perm)	1626	0	1485	0	0	1483
Link Speed (k/h)	40		40			40
Link Distance (m)	54.9		61.6			41.0
Travel Time (s)	4.9		5.5			3.7
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	2%	8%	2%	2%	10%
Adj. Flow (vph)	19	0	22	6	0	52
Shared Lane Traffic (%)						
Lane Group Flow (vph)	19	0	28	0	0	52
Sign Control	Stop		Free			Free
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	13.3%			ICU Level of Service A		
Analysis Period (min)	15					

Intersection						
Int Delay, s/veh	1.7					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	19	0	22	6	0	52
Future Vol, veh/h	19	0	22	6	0	52
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, %	2	2	8	2	2	10
Mvmt Flow	19	0	22	6	0	52
Major/Minor	Minor1	Major1		Major2		
Conflicting Flow All	77	25	0	0	28	0
Stage 1	25	-	-	-	-	-
Stage 2	52	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	926	1051	-	-	1585	-
Stage 1	998	-	-	-	-	-
Stage 2	970	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	926	1051	-	-	1585	-
Mov Cap-2 Maneuver	926	-	-	-	-	-
Stage 1	998	-	-	-	-	-
Stage 2	970	-	-	-	-	-
Approach	WB	NB		SB		
HCM Ctrl Dly, s/v	8.97	0		0		
HCM LOS	A					
Minor Lane/Major Mvmt	NBT	NBRWBLn1		SBL	SBT	
Capacity (veh/h)	-	-		926	1585	-
HCM Lane V/C Ratio	-	-		0.021	-	-
HCM Ctrl Dly (s/v)	-	-		9	0	-
HCM Lane LOS	-	-		A	A	-
HCM 95th %tile Q(veh)	-	-		0.1	0	-

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	0	0	70	0	1095	70	0	1193	0
Future Volume (vph)	0	0	0	0	0	70	0	1095	70	0	1193	0
Ideal Flow (vphpl)	1000	1000	1750	1000	1000	1750	1000	1775	1775	1000	1775	1775
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Ped Bike Factor												
Frt	0.865						0.991					
Flt Protected												
Satd. Flow (prot)	0	0	1731	0	0	1453	0	3214	0	0	3270	0
Flt Permitted												
Satd. Flow (perm)	0	0	1731	0	0	1453	0	3214	0	0	3270	0
Link Speed (k/h)	40				40				60			
Link Distance (m)	63.3				61.6				185.2			
Travel Time (s)	5.7				5.5				11.1			
Confl. Peds. (#/hr)							4	3			3	4
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%	0%	0%	0%	0%	3%	0%	3%	0%	0%	2%	0%
Adj. Flow (vph)	0	0	0	0	0	70	0	1095	70	0	1193	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	0	70	0	1165	0	0	1193	0
Sign Control	Stop			Stop				Free			Free	
Intersection Summary												
Area Type:	Other											
Control Type: Unsignalized												
Intersection Capacity Utilization 46.2%												
ICU Level of Service A												
Analysis Period (min) 15												

Intersection												
Int Delay, s/veh	0.4											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations			↗			↗		↕			↕	
Traffic Vol, veh/h	0	0	0	0	0	70	0	1095	70	0	1193	0
Future Vol, veh/h	0	0	0	0	0	70	0	1095	70	0	1193	0
Conflicting Peds, #/hr	0	0	0	0	0	0	4	0	3	3	0	4
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	-	-	0	-	-	-	-	-	-
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	0	0	0	0	3	0	3	0	0	2	0
Mvmt Flow	0	0	0	0	0	70	0	1095	70	0	1193	0
Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	-	-	601	-	-	586	-	0	0	-	-	0
Stage 1	-	-	-	-	-	-	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-	-	-	-	-	-	-
Critical Hdwy	-	-	6.9	-	-	6.96	-	-	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-	-	-	-	-	-	-
Follow-up Hdwy	-	-	3.3	-	-	3.33	-	-	-	-	-	-
Pot Cap-1 Maneuver	0	0	449	0	0	451	0	-	-	0	-	-
Stage 1	0	0	-	0	0	-	0	-	-	0	-	-
Stage 2	0	0	-	0	0	-	0	-	-	0	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	447	-	-	450	-	-	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-	-	-	-	-	-	-
Approach	EB		WB		NB		SB					
HCM Ctrl Dly, s/v	0		14.46		0		0					
HCM LOS	A		B									
Minor Lane/Major Mvmt	NBT		NBR EBLn1WBLn1		SBT		SBR					
Capacity (veh/h)	-	-	-	450	-	-	-	-	-	-	-	-
HCM Lane V/C Ratio	-	-	-	0.156	-	-	-	-	-	-	-	-
HCM Ctrl Dly (s/v)	-	-	0	14.5	-	-	-	-	-	-	-	-
HCM Lane LOS	-	-	A	B	-	-	-	-	-	-	-	-
HCM 95th %tile Q(veh)	-	-	-	0.5	-	-	-	-	-	-	-	-

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	8	11	0	0	14	21	18	0	41	0
Future Volume (vph)	0	0	8	11	0	0	14	21	18	0	41	0
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
Frt	0.865						0.954					
Flt Protected				0.950			0.987					
Satd. Flow (prot)	0	1300	0	0	1428	0	0	1426	0	0	1488	0
Flt Permitted				0.950			0.987					
Satd. Flow (perm)	0	1300	0	0	1428	0	0	1426	0	0	1488	0
Link Speed (k/h)	40			40			40			40		
Link Distance (m)	30.4			59.6			41.0			99.0		
Travel Time (s)	2.7			5.4			3.7			8.9		
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 (%)	2%	2%	2%	2%	2%	2%	2%	0%	2%	2%	3%	2%
Adj. Flow (vph)	0	0	8	11	0	0	14	21	18	0	41	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	8	0	0	11	0	0	53	0	0	41	0
Sign Control	Stop			Stop			Free			Free		
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization	24.4%			ICU Level of Service A								
Analysis Period (min)	15											

Intersection												
Int Delay, s/veh	2.4											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	0	8	11	0	0	14	21	18	0	41	0
Future Vol, veh/h	0	0	8	11	0	0	14	21	18	0	41	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
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, %	2	2	2	2	2	2	2	0	2	2	3	2
Mvmt Flow	0	0	8	11	0	0	14	21	18	0	41	0
Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	90	108	41	99	99	30	41	0	0	39	0	0
Stage 1	41	41	-	58	58	-	-	-	-	-	-	-
Stage 2	49	67	-	41	41	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	895	782	1030	883	791	1044	1568	-	-	1571	-	-
Stage 1	974	861	-	954	847	-	-	-	-	-	-	-
Stage 2	964	839	-	974	861	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	886	775	1030	868	784	1044	1568	-	-	1571	-	-
Mov Cap-2 Maneuver	886	775	-	868	784	-	-	-	-	-	-	-
Stage 1	974	861	-	945	839	-	-	-	-	-	-	-
Stage 2	955	831	-	966	861	-	-	-	-	-	-	-
Approach	EB		WB		NB		SB					
HCM Ctrl Dly, s/v	8.52		9.2		1.93		0					
HCM LOS	A		A									
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR					
Capacity (veh/h)	435	-	-	1030	868	1571	-	-				
HCM Lane V/C Ratio	0.009	-	-	0.008	0.013	-	-	-				
HCM Ctrl Dly (s/v)	7.3	0	-	8.5	9.2	0	-	-				
HCM Lane LOS	A	A	-	A	A	A	-	-				
HCM 95th %tile Q(veh)	0	-	-	0	0	0	-	-				

Lanes, Volumes, Timings
3: Westhill Drive & Southern Site Access

36 Westhill Drive, Waterloo TIS
Total PM

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	10	0	53	17	0	60
Future Volume (vph)	10	0	53	17	0	60
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	0.967					
Flt Protected	0.950					
Satd. Flow (prot)	1626	0	1570	0	0	1584
Flt Permitted	0.950					
Satd. Flow (perm)	1626	0	1570	0	0	1584
Link Speed (k/h)	40		40			40
Link Distance (m)	54.9		61.6			41.0
Travel Time (s)	4.9		5.5			3.7
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	2%	0%	2%	2%	3%
Adj. Flow (vph)	10	0	53	17	0	60
Shared Lane Traffic (%)						
Lane Group Flow (vph)	10	0	70	0	0	60
Sign Control	Stop		Free			Free
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	14.4%			ICU Level of Service A		
Analysis Period (min)	15					

Intersection						
Int Delay, s/veh	0.7					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	10	0	53	17	0	60
Future Vol, veh/h	10	0	53	17	0	60
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, %	2	2	0	2	2	3
Mvmt Flow	10	0	53	17	0	60
Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	122	62	0	0	70	0
Stage 1	62	-	-	-	-	-
Stage 2	60	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	874	1004	-	-	1531	-
Stage 1	961	-	-	-	-	-
Stage 2	963	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	874	1004	-	-	1531	-
Mov Cap-2 Maneuver	874	-	-	-	-	-
Stage 1	961	-	-	-	-	-
Stage 2	963	-	-	-	-	-
Approach	WB	NB	SB			
HCM Ctrl Dly, s/v	9.17	0	0			
HCM LOS	A					
Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT		
Capacity (veh/h)	-	-	874	1531	-	
HCM Lane V/C Ratio	-	-	0.011	-	-	
HCM Ctrl Dly (s/v)	-	-	9.2	0	-	
HCM Lane LOS	-	-	A	A	-	
HCM 95th %tile Q(veh)	-	-	0	0	-	