

**3500 Hawthorne Road
Transportation Impact Study**



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INTRODUCTION

1.0 INTRODUCTION

1.1 STUDY PURPOSE

2520333 Ontario Inc. is preparing a development application for a proposed commercial development in the Hunt Club Park Community of Ottawa, Ontario. As part of the approvals process a Transportation Impact Study (TIS) is required to support the application.

This TIS has been prepared to assess the potential transportation implications of the proposed commercial development and to determine whether transportation improvements are required to support it.

1.2 PROPOSED DEVELOPMENT

Figure 1 illustrates the location of the subject development.

The proposed commercial development is located at 3500 Hawthorne Road in the City of Ottawa. The site is bound by existing residential to the north and west, Hunt Club Road to the south, and Hawthorne Road to the east.

The proposed development includes a gas station with convenience store (120m²) and a fast food restaurant with drive-through (130m²). Transportation access to the site will be facilitated through a proposed right-in / right-out access to Hawthorne Road and a proposed right-out access to Hunt Club Road.

Figure 2 depicts the proposed site plan.

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Figure 1 Site Location

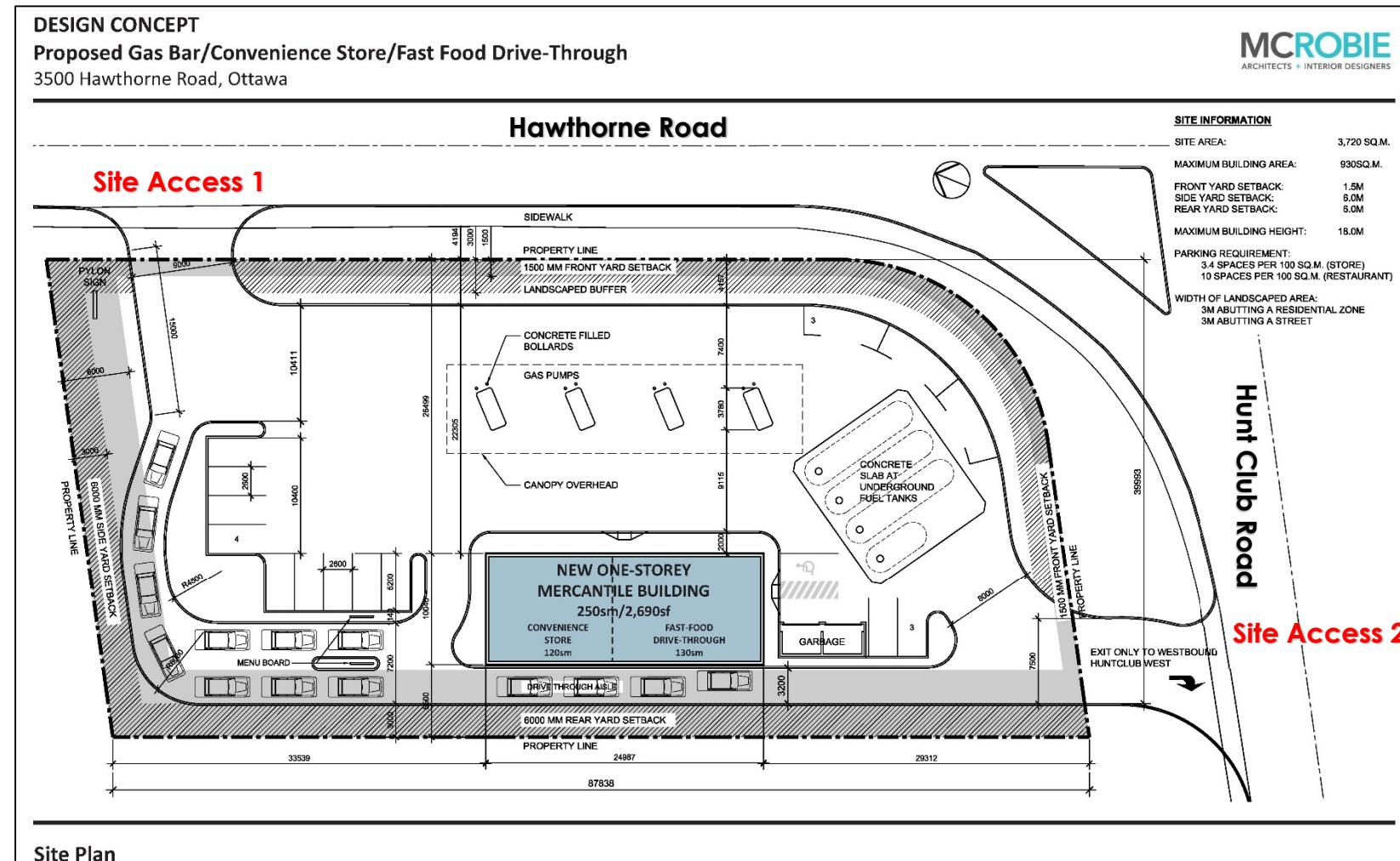


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Figure 2 Proposed Site Plan



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1.3 SCOPE OF THE ASSESSMENT

This TIS has been carried out in accordance with the City of Ottawa's 2006 *Transportation Impact Assessment (TIA) Guidelines* and is based on a pre-consultation meeting with City of Ottawa staff. The scope of the transportation assessment, which was discussed with City staff, includes the following:

- Study area intersections include:
 - Hunt Club Road at Hawthorne Road;
 - Hawthorne Road at Site Access 1 (right-in / right-out); and
 - Hunt Club at Site Access 2 (right-out only).
- Study horizons include:
 - 2017 existing conditions;
 - 2018 future background conditions;
 - 2018 total future conditions (site build-out); and
 - 2023 total future conditions (5 years beyond build-out).
- Analysis time periods include the weekday AM and PM peak hours

The methodology used in the TIS includes:

- The net increase in site traffic from the proposed development will be estimated;
- A background traffic growth rate of 2% per annum will be used;
- Future background traffic volumes will be combined with the net increase in site traffic volumes to determine total future traffic volumes;
- Intersection analyses will be performed to determine the operating characteristics of the study area intersections under each study horizon; and
- Where operational deficiencies are identified mitigation measures will be examined.

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EXISTING TRANSPORTATION ENVIRONMENT

2.0 EXISTING TRANSPORTATION ENVIRONMENT

2.1 ROADS AND TRAFFIC CONTROL

The roadways under consideration in the study area are described below:

Hunt Club Road

Within the vicinity of the subject site Hunt Club Road is a four-lane divided arterial road with a posted speed limit of 80 km/h. West of Hawthorne Road, asphalt sidewalks are provided along both sides of the road and east of Hawthorne Road a concrete sidewalk is provided along the north side of the road.

Hawthorne Road

Within the vicinity of the subject site, Hawthorne Road is a four-lane divided arterial road with a posted speed limit of 70 km/h. North of the site, a two-way left turn lane facilitate access to individual industrial/commercial properties. There currently exists a concrete sidewalk across the frontage of the subject site on the west side of Hawthorne Road. The intersection with Hunt Club Road is signalized.

The road classifications noted above are referenced from Map 6 of the City of Ottawa's 2013 *Transportation Master Plan*.

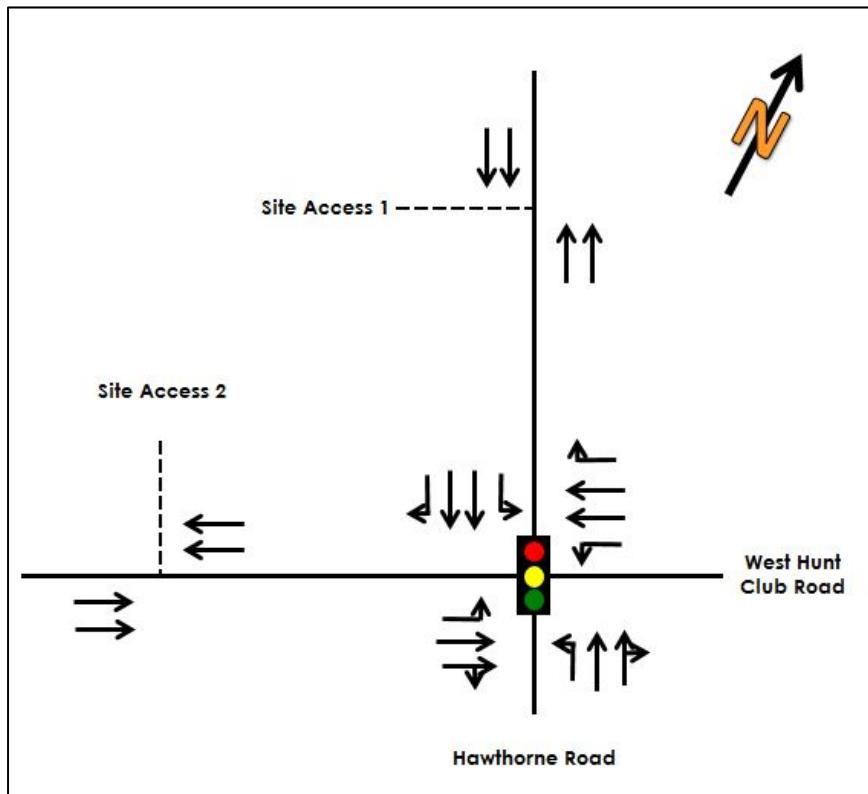
Figure 3 illustrates the existing intersection control and lane configuration for the study area intersections.

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EXISTING TRANSPORTATION ENVIRONMENT

Figure 3 2017 Existing Intersection Control and Lane Configuration



2.2 TRANSIT

Transit service is currently provided in the immediate vicinity of the proposed development via route 98. Route 98 is a regular route that runs between Hawthorne and Lebreton Station. During the peak hours in the peak directions, the route continues to Tunney's Pasture Station. Transit stops are located along Hunt Club Road approximately 100m east of Hawthorne Road.

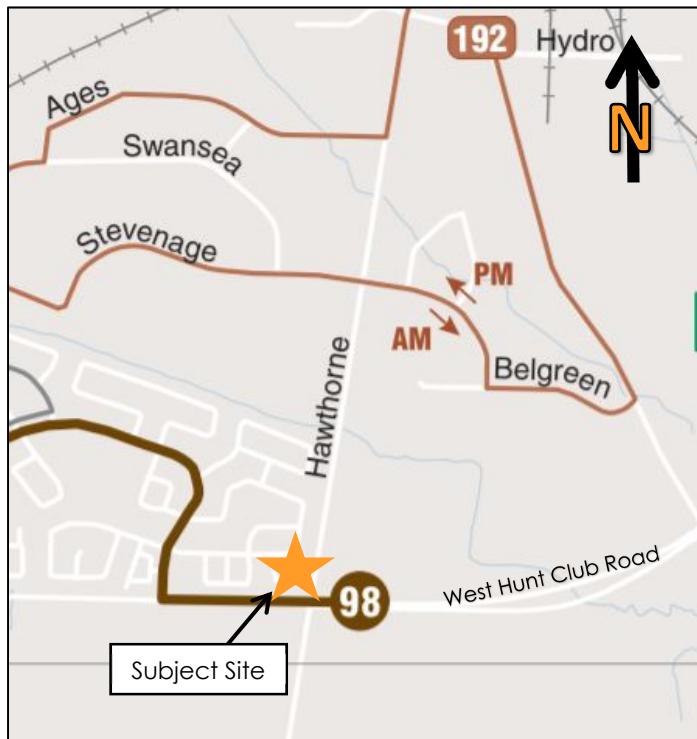
Figure 4 illustrates the study area transit route.

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EXISTING TRANSPORTATION ENVIRONMENT

Figure 4 Study Area Transit



(Source: OC Transpo System Map, Accessed February 17th, 2017)

2.3 WALKING AND CYCLING

Within the vicinity of the subject site, there are sidewalks along portions of Hunt Club Road and Hawthorne Road. Hawthorne Road has bicycle lanes along both sides of the road to facilitate cyclists. There is also a multi-use pathway that runs from Hawthorne Road, north of the subject site, into the community to the west.

It should be noted that as part of the City's ultimate cycling network, Hunt Club Road is scheduled to be a spine route west of Hawthorne Road.

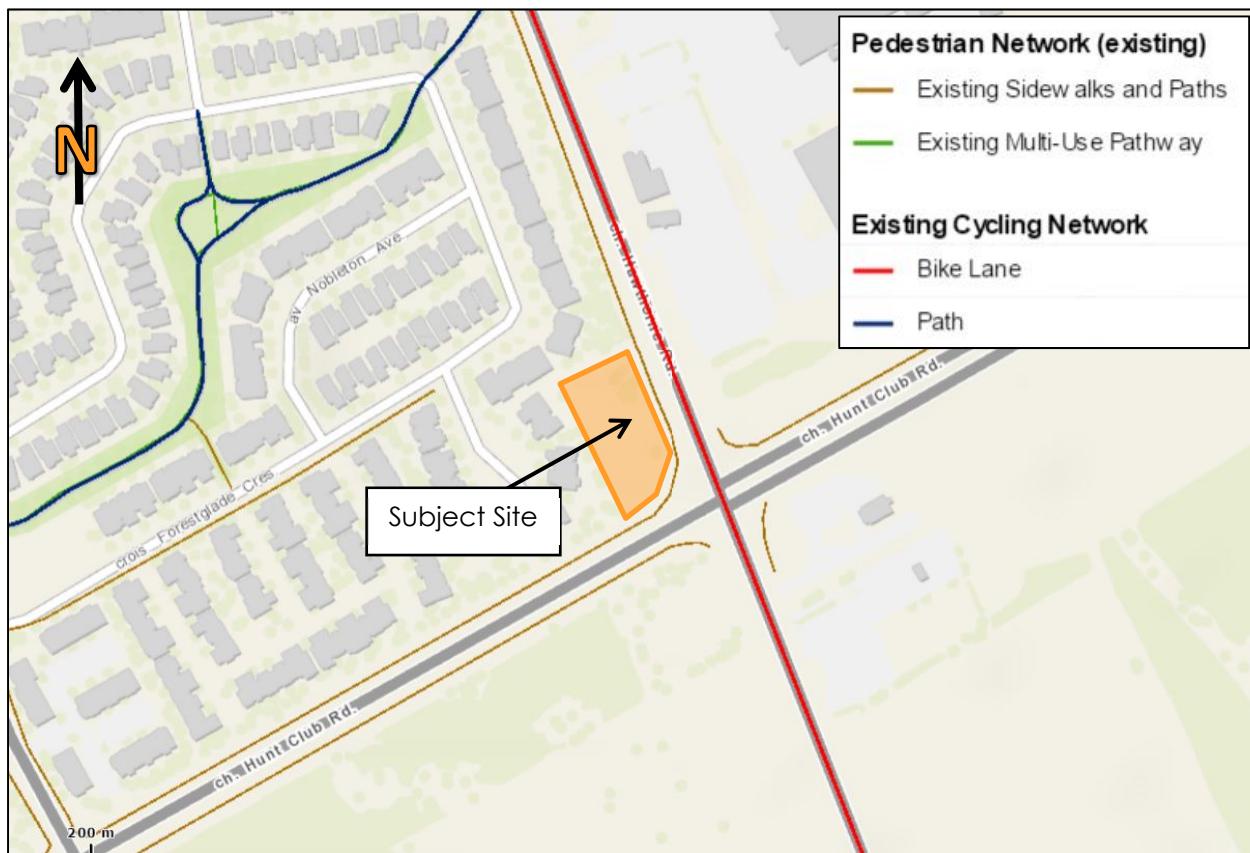
Figure 5 illustrates the existing pedestrian and cycling facilities.

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EXISTING TRANSPORTATION ENVIRONMENT

Figure 5 Existing Pedestrian and Cycling Facilities



2.4 TRAFFIC VOLUMES

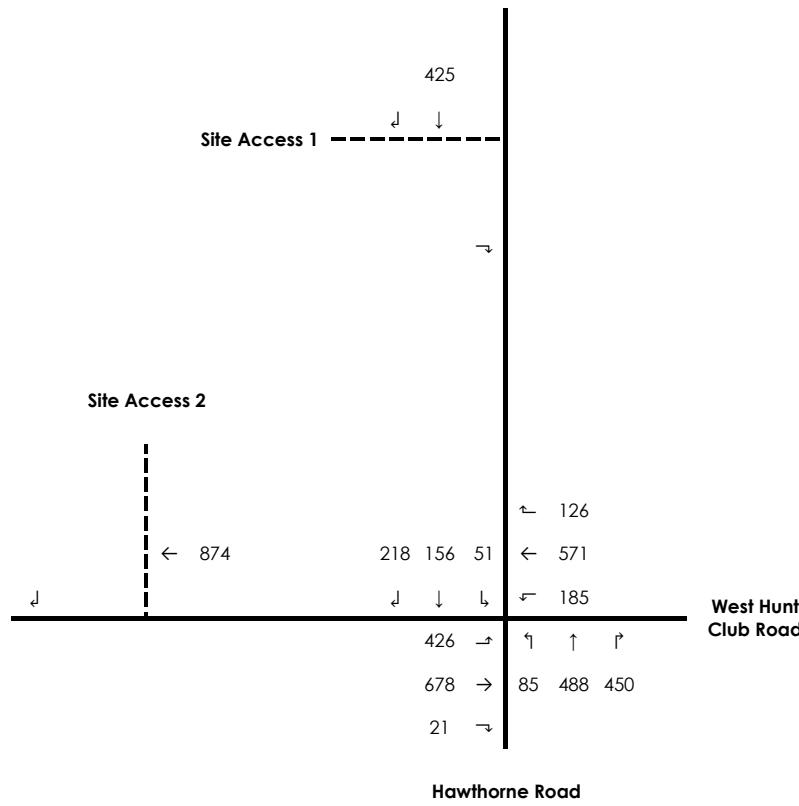
Intersection turning movement counts were provided by the City of Ottawa at the Hunt Club Road at Hawthorne Road intersection (2015).

As the intersection counts were collected prior to 2017, the data required adjustments to reflect the current existing condition. Using a 2% annual growth rate, the 2015 volumes were increased to represent 2017 conditions.

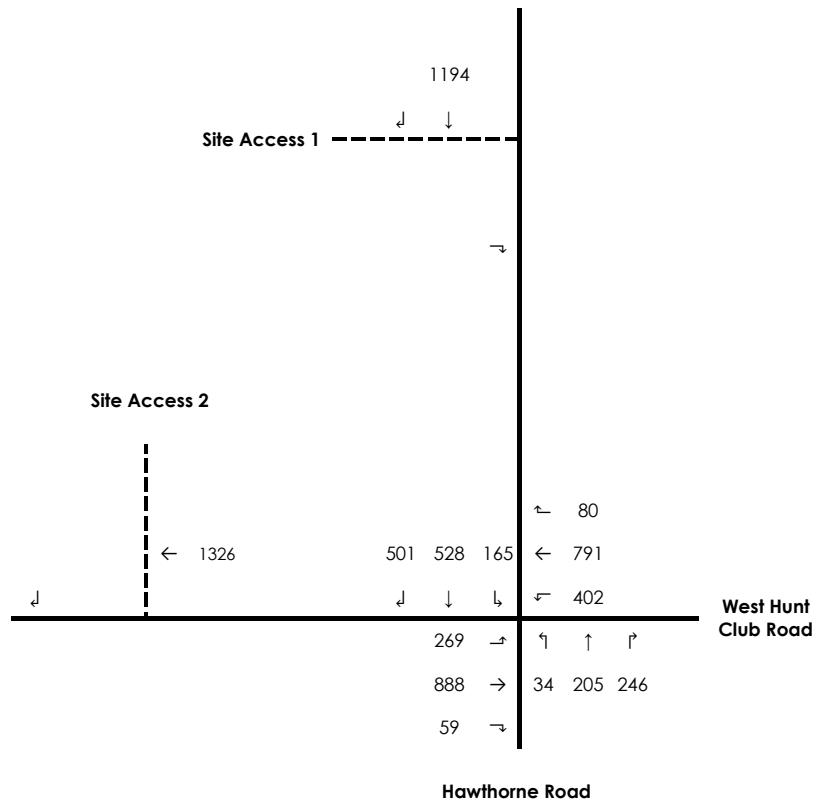
Figure 6 illustrates 2017 existing AM and PM peak hour traffic volumes at the study area intersections.

Appendix A contains the traffic data and is provided for reference.

AM Peak Hour



PM Peak Hour



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FUTURE TRANSPORTATION ENVIRONMENT

3.0 FUTURE TRANSPORTATION ENVIRONMENT

3.1 FUTURE NETWORK UPGRADES

No transportation improvements have been noted in the City of Ottawa's 2013 *Transportation Master Plan* (TMP) in the vicinity of the proposed site.

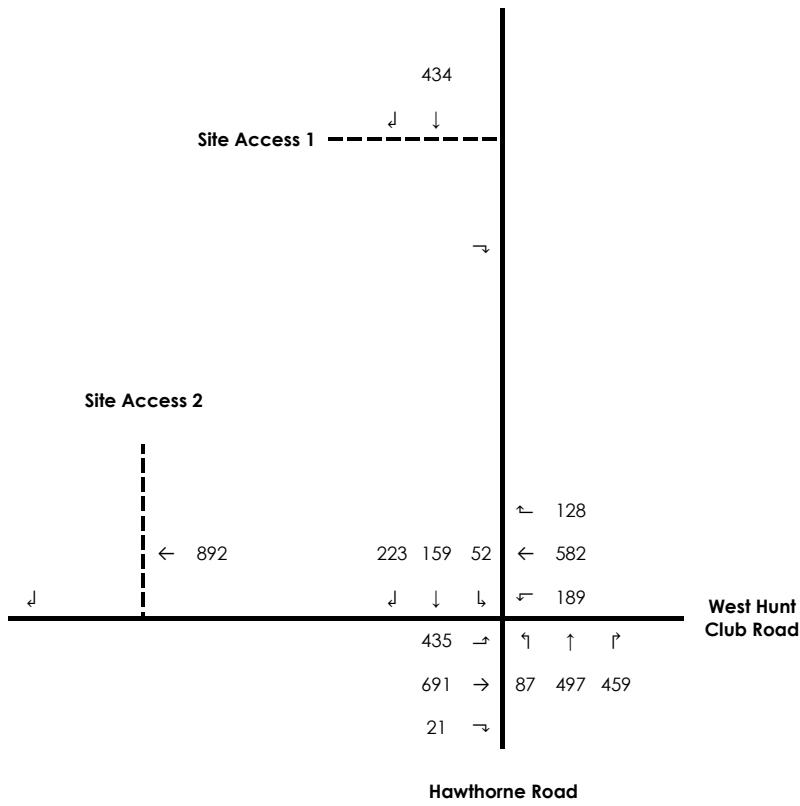
3.2 2018 FUTURE BACKGROUND CONDITIONS

Future background conditions are assessed to differentiate between the transportation improvements that may be required to address background traffic growth and those that may be required to accommodate traffic generated by the subject development. Any improvements identified to address future background conditions are not the responsibility of the developer.

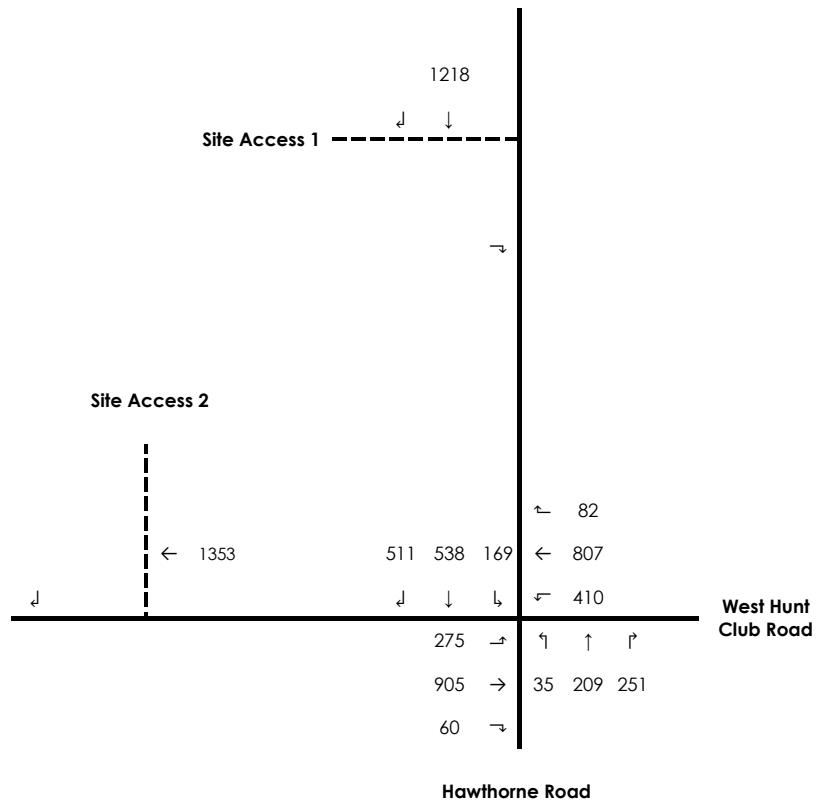
A nominal 2% annual growth rate was applied to the Hunt Club Road at Hawthorne Road traffic volumes to increase them to the 2018 horizon.

Figure 7 illustrates 2018 future background traffic volumes at the study area intersections.

AM Peak Hour



PM Peak Hour



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FUTURE TRANSPORTATION ENVIRONMENT

3.3 SITE TRAFFIC GENERATION

3.3.1 Land Use and Trip Generation Rates

The Institute of Transportation Engineers (ITE) Trip Generation Manual (9th Edition) was used to estimate traffic generated by the subject site. The ITE land use codes 945 – Gas Station with Convenience Market and 934 – Fast-Food Restaurant with Drive-Through Window were thought to be most representative of the proposed land uses.

Table 1 summarizes the anticipated site trips.

Table 1 Trips Generated by the Proposed Commercial Development

ITE LAND USE		MORNING PEAK HOUR			AFTERNOON PEAK HOUR		
		In	Out	Total	In	Out	Total
ITE Trip Generation Rates							
945 – Gas Station with Convenience Market	Gross Floor Area (1000's ft ²)	1.3	41.89	41.07	82.13	48.74	48.74
934 – Fast-Food Restaurant with Drive-Through Window	Gross Floor Area (1000's ft ²)	1.4	23.16	22.26	45.42	16.98	15.67
Trips Generated							
945 – Gas Station with Convenience Market	Trip Gen	54	53	107	63	63	126
934 – Fast-Food Restaurant with Drive-Through Window	Trip Gen	32	31	63	24	22	46
Pass-By and Internal Capture							
945 – Gas Station with Convenience Market	Auto Trips	54	53	107	63	63	126
	Pass-By	80%	43	43	86	51	51
	Internal Capture	0%	0	0	0	0	0
	Net New Auto Trips	11	10	21	12	12	24
934 – Fast-Food Restaurant with Drive-Through Window	Auto Trips	32	31	63	24	22	46
	Pass-By	50%	16	16	32	12	11
	Internal Capture	50%	16	16	32	12	11
	Net New Auto Trips	0	0	0	0	0	0
Net New Auto Trips							
Total Development	Auto Trips	86	84	170	87	85	172
	Pass-By Trips	59	59	118	63	62	125
	Internal Capture Trips	16	15	31	12	11	23
	Net New Auto Trips	11	10	21	12	12	24

3.3.2 Pass-By and Internal Capture

Pass-by trips are considered intermediate stops between an origin and a destination. They are site trips that are drawn from existing traffic volumes on the road network that are “passing-by” the site. While the overall total number of trips generated by a given development remains the same, the pass-by site trips are deducted from existing / background volumes and added to the site access locations to reflect this.

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FUTURE TRANSPORTATION ENVIRONMENT

Based on a combination of technical sources and professional judgement, it was assumed that the gas station and convenience store will have a pass-by rate of 80% while the fast food restaurant will have a pass-by rate of 50%.

Figure 8 illustrates the pass-by trips the proposed development is anticipated to generate.

When predicting site trips that are associated with different land use types on the same site, the interaction between those land use types must be accounted for to reflect the synergy between uses. Internal capture trips – also referred to as “shared-use” trips - are trips which are shared between two or more uses on the same site. A portion of the generated trips for each individual land use, therefore, are drawn from the adjacent land uses on the same site and primarily by the “anchor” land use. Internal capture adjustments were made to account for vehicles that visit more than one use within the subject commercial development. Since these trips are contained within the subject site, accounting for each trip separately on the roadway network would result in “double-counting”. For this reason, land uses that may have associated shared-use trips between one another ultimately have their net new trips adjusted.

Within the proposed commercial development, the trips that are subject to internal capture adjustments are the trips generated from the fast food restaurant. No adjustments were made to the gas station as this land use is considered to be the site anchor. An assumed internal capture rate of 50% was assumed for the fast food restaurant.

Following the application of the pass-by and internal capture adjustments, the commercial development is expected to generate approximately 21 and 24 net new auto trips (two-way) during the AM and PM peak hours, respectively.

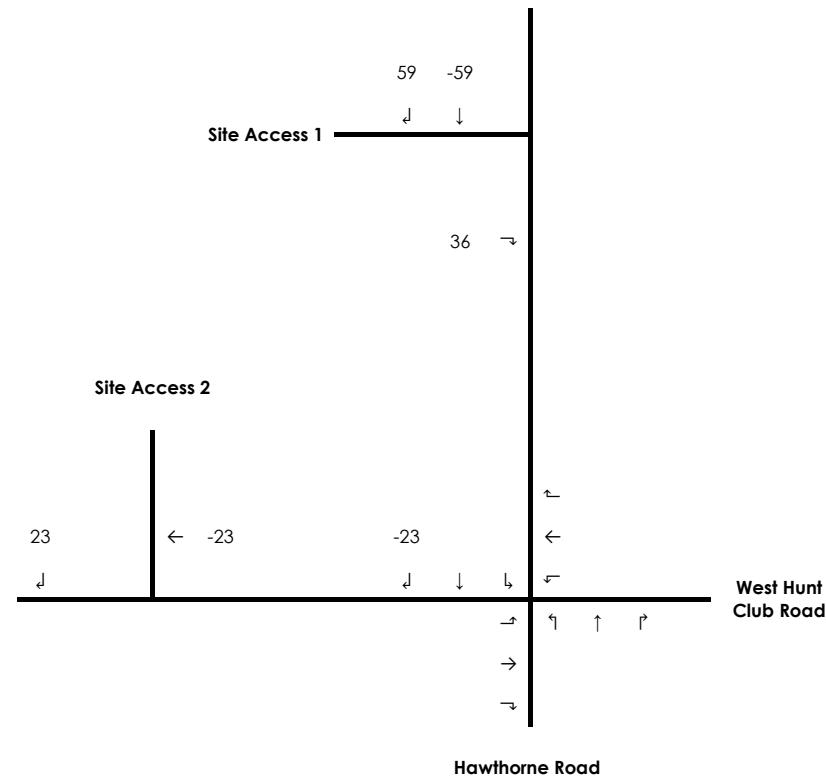
Figure 9 illustrates the net new site trips the proposed commercial development is anticipated to generate.

3.3.3 Traffic Distribution and Assignment

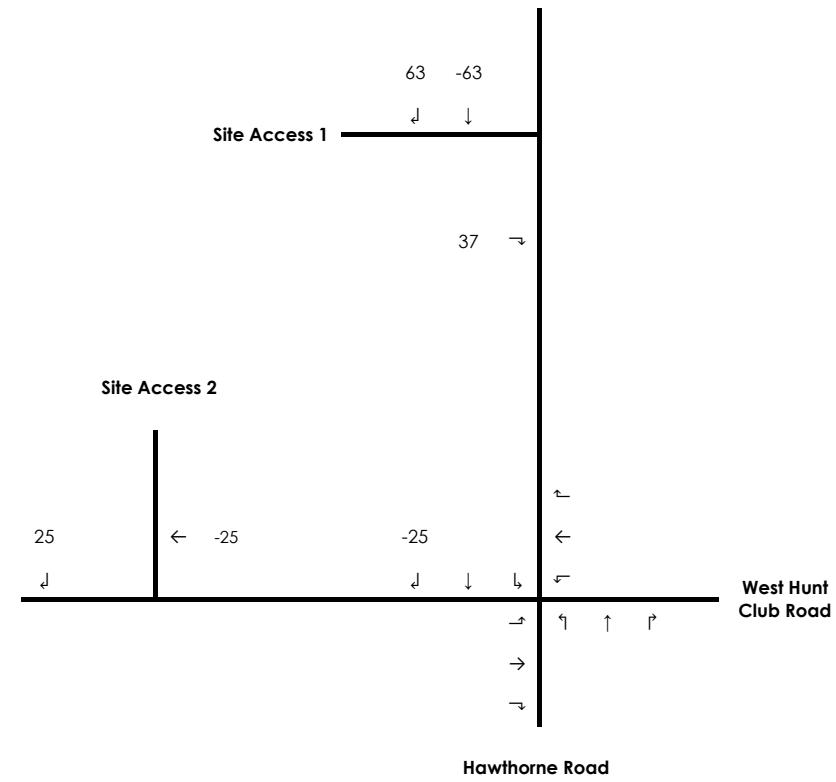
The distribution of traffic to / from the study area was determined through examination of the current traffic patterns at the Hunt Club Road at Hawthorne Road intersection.

Figure 10 illustrates the total site traffic volumes the proposed commercial development is anticipated to generate.

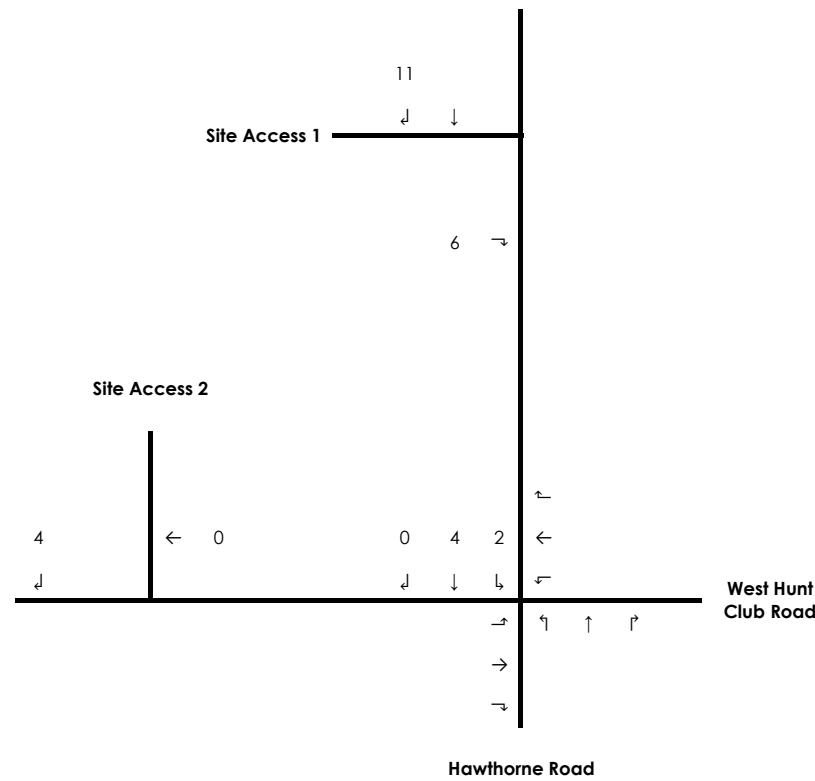
AM Peak Hour



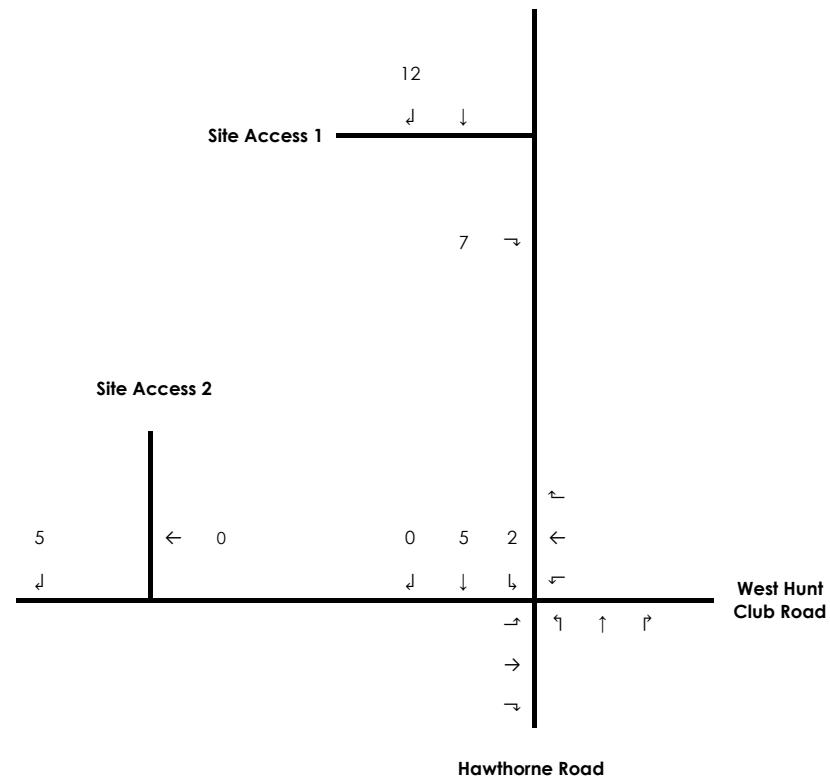
PM Peak Hour



AM Peak Hour



PM Peak Hour

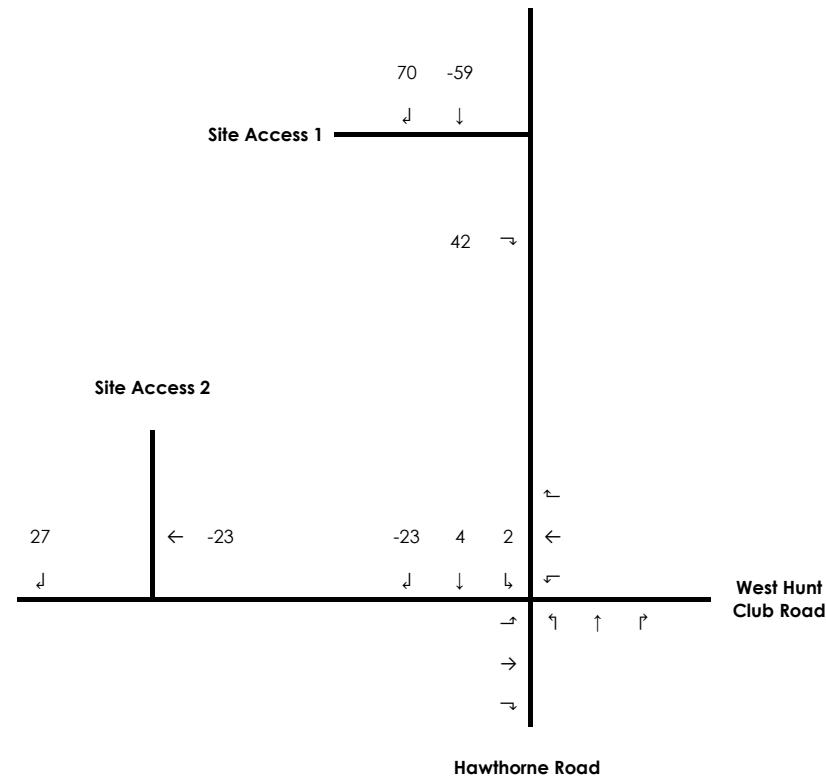


3500 Hawthorne Road

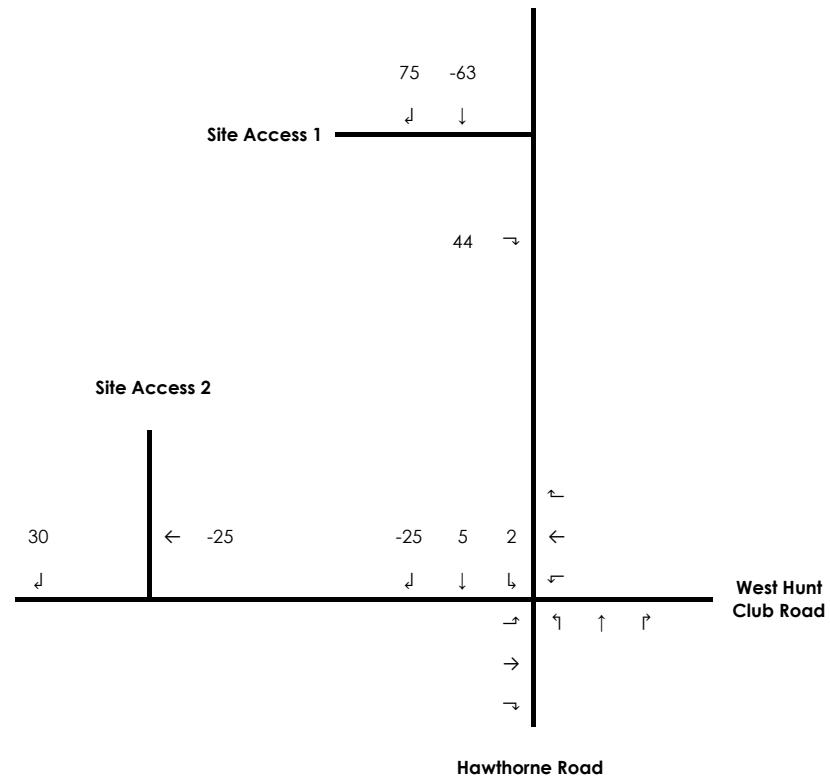
Figure 9

Net New Site Traffic Volumes

AM Peak Hour



PM Peak Hour



3500 Hawthorne Road

Figure 10

Total Site Traffic Volumes

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FUTURE TRANSPORTATION ENVIRONMENT

3.4 2018 TOTAL FUTURE CONDITIONS

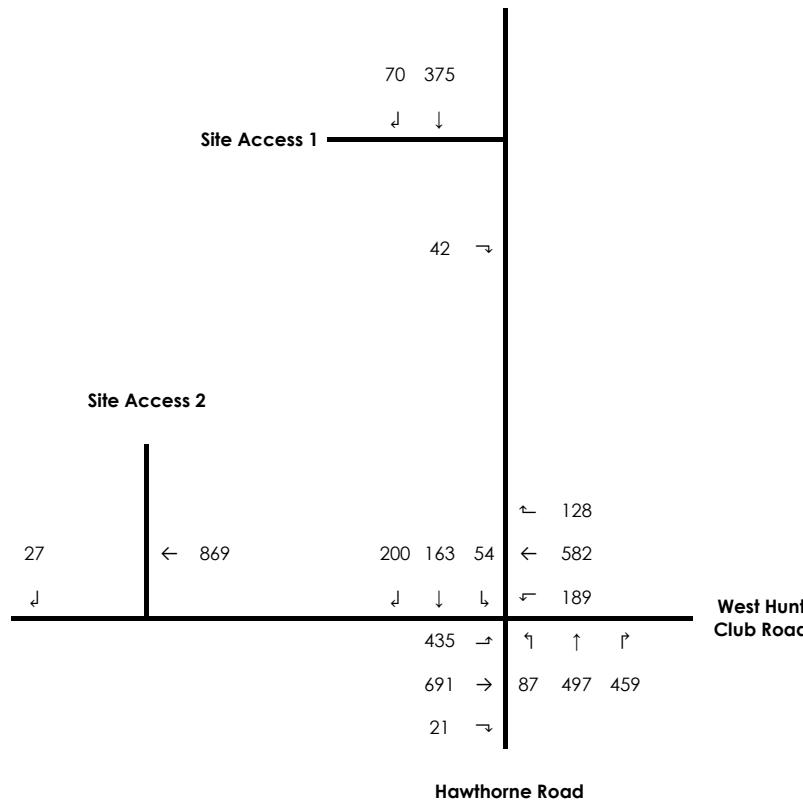
Total future conditions are examined to determine improvements that may be required as a direct result of the development of the site. It is anticipated that by 2018 the commercial development will be fully built and occupied.

The 2018 total future traffic volumes were derived by adding 3500 Hawthorne Road site generated trips to future background volumes anticipated for 2018.

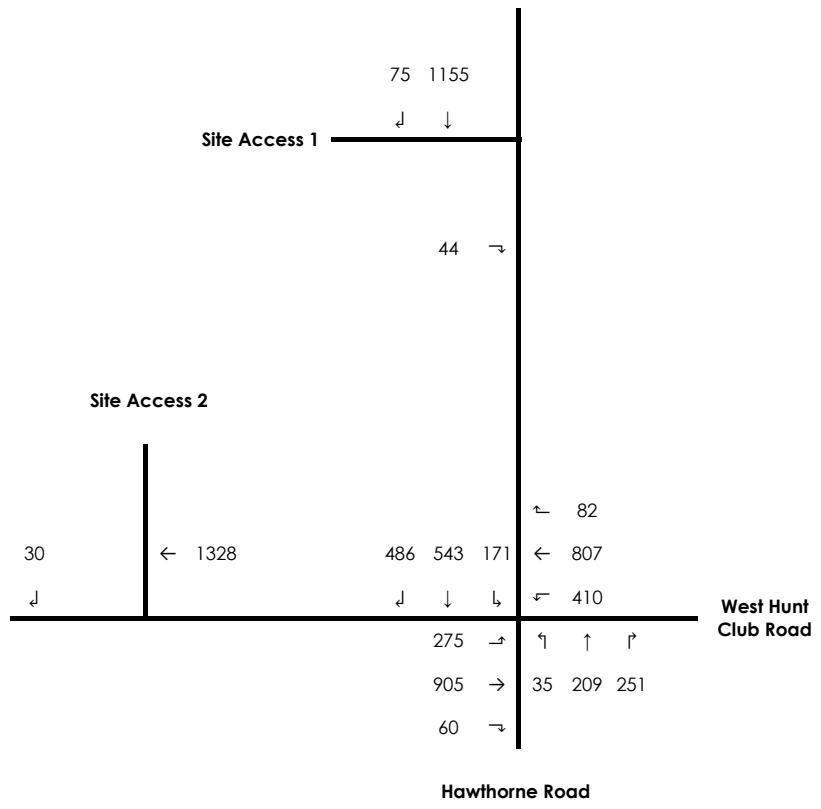
Figure 11 illustrates 2018 total future traffic volumes at the study area intersections during the AM and PM peaks.

An assessment of 2018 total future traffic conditions is outlined in **Section 4.3**.

AM Peak Hour



PM Peak Hour



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FUTURE TRANSPORTATION ENVIRONMENT

3.5 2023 ULTIMATE CONDITIONS

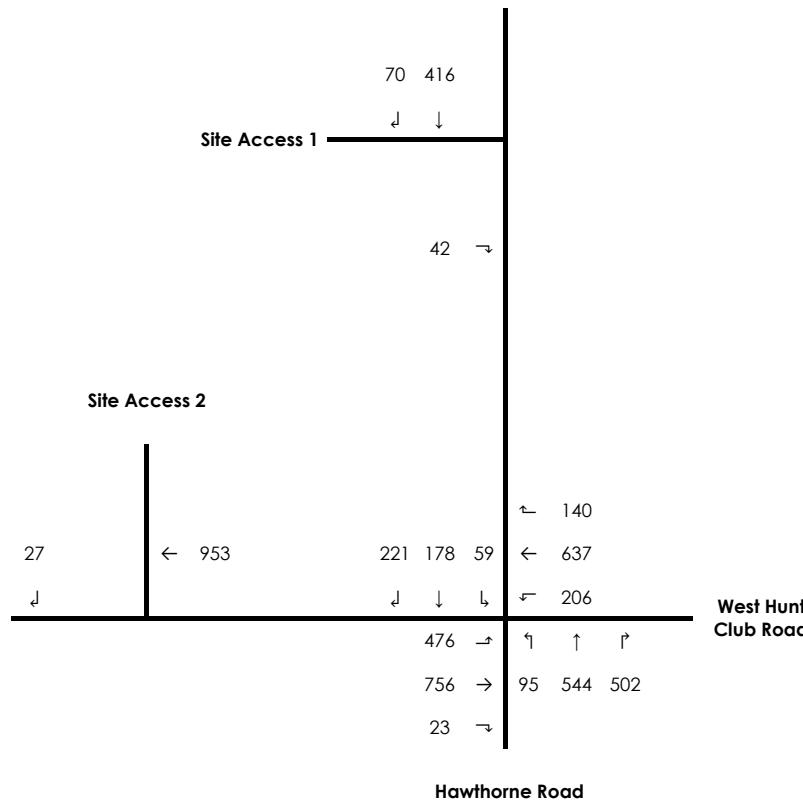
Ultimate conditions for the 2023 horizon were examined to determine if other improvements may be required due to additional growth in background traffic volumes 5 years beyond the expected build-out of the subject site.

A nominal 2% annual growth rate was applied to the Hunt Club Road at Hawthorne Road traffic volumes to represent 2023 future traffic volumes.

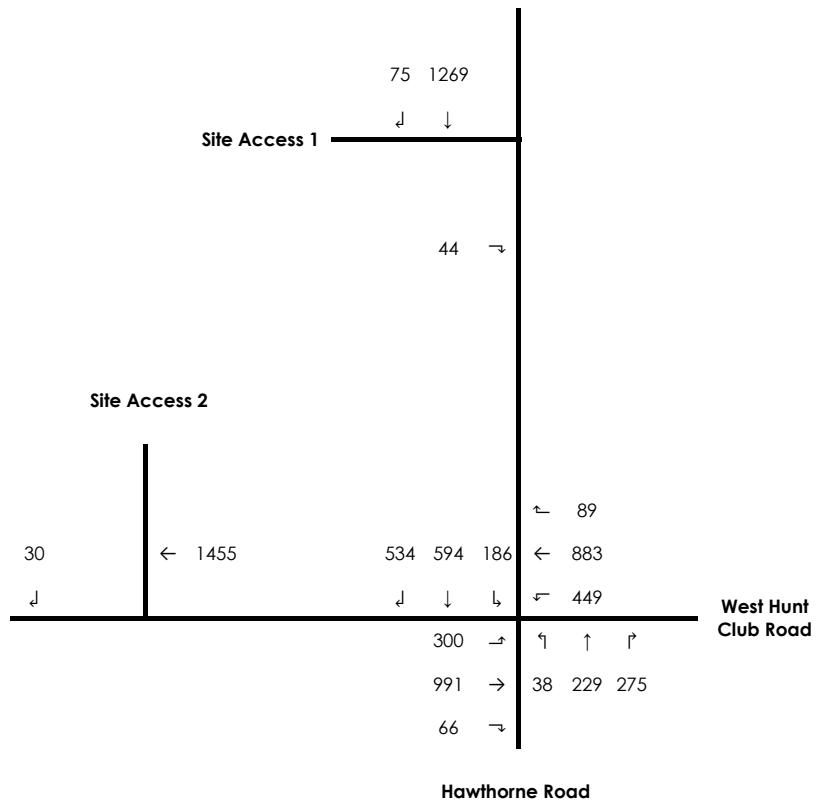
Figure 12 illustrates 2023 ultimate traffic volume at the study area intersections during the AM and PM peaks.

An assessment of 2023 ultimate traffic conditions is outlined in **Section 4.4**.

AM Peak Hour



PM Peak Hour



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4.0 TRANSPORTATION ASSESSMENT

An assessment of the study area intersections was undertaken for all horizons to determine the operational characteristics of these intersections. Intersection operations were facilitated by Synchro 9.1™ software package and analyzed using the following methodologies:

- Highway Capacity Manual 2010 edition (HCM 2010) for two-way stop controlled intersections; and
- Highway Capacity Manual 2000 edition (HCM 2000) for signalized intersections.

4.1 2017 EXISTING CONDITIONS

Figure 3 (Section 2.1) illustrates the 2017 existing intersection controls and lane configuration at the study area intersections.

Table 2 provides a summary of 2017 existing intersection operations.

The intersection of Hunt Club Road at Hawthorne Road currently operates at or above capacity during both peak hours. During the AM peak hour, the northbound through / right operates at or above capacity and during the PM peak hour, the eastbound through / right operates at or above capacity. This represents an existing deficiency in the capacity of the intersection which will occur in the analysis of future horizons as well.

Due to the existing deficiencies at the Hunt Club Road at Hawthorne Road intersection, the City should consider adding this intersection to the intersection improvement program to be reviewed in the near future.

Appendix B contains detailed intersection performance worksheets.

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TRANSPORTATION ASSESSMENT

Table 2 2017 Existing Intersection Operations

INTERSECTION	INTERSECTION CONTROL	APPROACH/MOVEMENT	AM PEAK HOUR			PM PEAK HOUR		
			LOS	v/c ¹	Q ²	LOS	v/c ¹	Q ²
Hunt Club Road at Hawthorne Road	Traffic Signals	EB	Left	E	0.99	#203.8	D	0.83
			Through / Right	B	0.64	120.4	F	1.25
		WB	Left	C	0.75	75.0	E	0.94
			Through	C	0.78	101.9	D	0.81
			Right	A	0.09	15.9	A	0.06
			Left	A	0.24	30.2	A	0.22
			Through / Right	F	1.21	#206.6	B	0.62
		NB	Left	A	0.37	19.8	C	0.72
			Through	A	0.24	31.4	C	0.72
			Right	A	0.16	22.3	A	0.36
		Overall Intersection		E	0.95	-	E	0.99

Notes:

1. v/c – represents the anticipated volume divided by the predicted capacity
2. 95th Percentile Queue (m)

4.2 2018 FUTURE BACKGROUND CONDITIONS

Future background conditions for the 2018 horizon were assessed to determine transportation improvements that may be required to address growth in traffic exclusive from improvements that may be required to accommodate traffic generated by the proposed development.

The background development assumptions and distributions outlined in **Section 3.2** were applied to existing traffic volumes to predict 2018 future background traffic volumes.

Table 3 summarizes the operational characteristics of the study area intersections under 2018 future background conditions.

The signal timing plan was optimized for the 2018 future background horizon. Using the optimized signal timing plan, the intersection is anticipated to operate with a few individual movements that are expected to operate at or above capacity, which is consistent with existing conditions.

Appendix B contains detailed intersection performance worksheets.

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Table 3 2018 Future Background Intersection Operations

INTERSECTION	INTERSECTION CONTROL	APPROACH/MOVEMENT	AM PEAK HOUR			PM PEAK HOUR		
			LOS	v/c ¹	Q ²	LOS	v/c ¹	Q ²
Hunt Club Road at Hawthorne Road	Traffic Signals	EB	Left	E	0.93	#209.7	D	0.89
			Through / Right	B	0.62	128.5	F	1.03
		WB	Left	C	0.77	#93.1	F	1.03
			Through	C	0.82	#136.3	C	0.72
			Right	A	0.08	11.2	A	0.06
			Left	A	0.21	31.4	A	0.29
			Through / Right	E	0.92	#192.6	A	0.58
		NB	Left	A	0.48	20.6	E	0.99
			Through	A	0.18	30.4	C	0.79
			Right	A	0.15	28.9	A	0.53
		Overall Intersection		D	0.88	-	F	1.05

Notes:

1. v/c – represents the anticipated volume divided by the predicted capacity
2. 95th Percentile Queue (m)

4.3 2018 TOTAL FUTURE CONDITIONS

Total future conditions are assessed to determine transportation improvements that may be required to accommodate traffic generated by the proposed development. The site trip generation, distribution, and assignment assumptions outlined in **Section 3.3** were applied to 2018 future background traffic volumes to predict 2018 total future traffic volumes.

Table 4 summarizes the operational characteristics of the study area intersections under 2018 total future conditions.

Consistent with the findings from the 2018 future background horizon, the intersection of Hunt Club Road at Hawthorne Road is expected to operate with several individual movements operating at or above capacity. As this is an existing deficiency, no improvements have been identified.

The two proposed site access intersections are anticipated to operate acceptably under 2018 total future conditions.

Figure 13 illustrates the intersection control and lane configuration for the 2018 total future horizon.

Appendix B contains detailed intersection performance worksheets.

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Table 4 2018 Total Future Intersection Operations

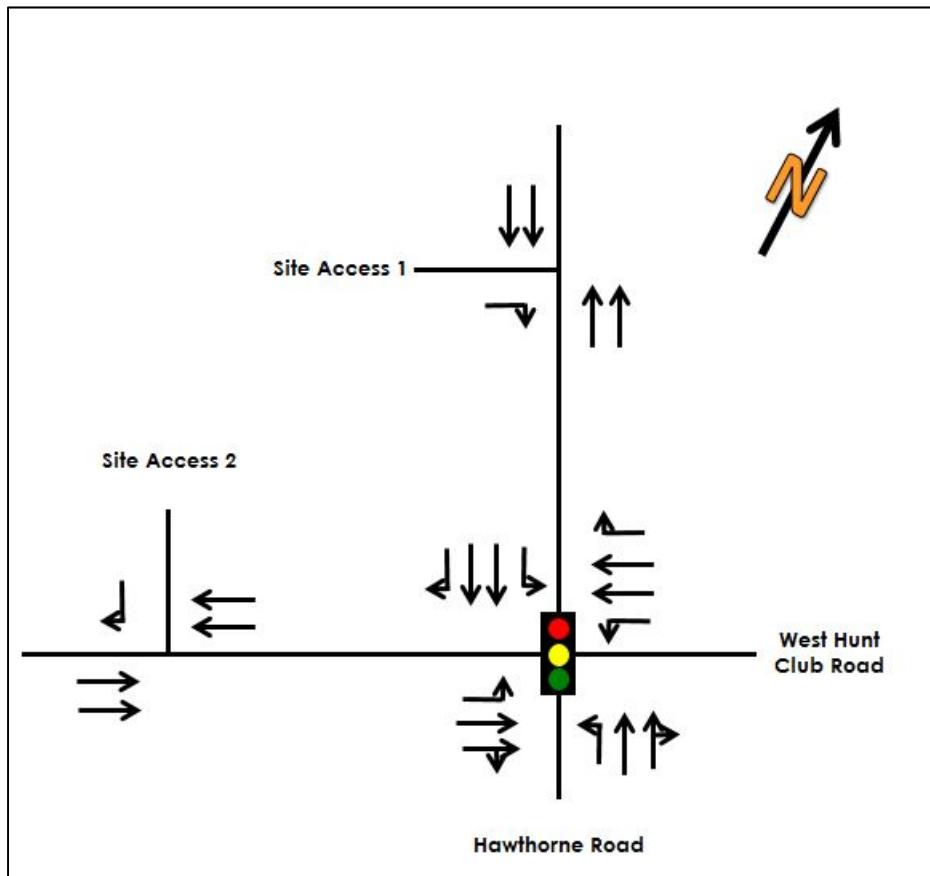
INTERSECTION	INTERSECTION CONTROL	APPROACH/MOVEMENT	AM PEAK HOUR			PM PEAK HOUR					
			LOS	v/c ¹	Q ²	LOS	v/c ¹	Q ²			
Hunt Club Road at Hawthorne Road	Traffic Signals	EB	Left	E	0.93	#209.7	D	0.89			
			Through / Right	B	0.62	128.5	F	1.04			
		WB	Left	C	0.77	#93.1	F	1.03			
			Through	C	0.82	#136.3	C	0.73			
		NB	Right	A	0.08	11.2	A	0.06			
			Left	A	0.22	31.4	A	0.29			
		SB	Through / Right	E	0.92	#192.6	A	0.58			
			Left	A	0.50	21.2	E	0.99			
			Through	A	0.18	31.0	C	0.80			
			Right	A	0.13	27.0	A	0.44			
<i>Overall Intersection</i>			D	0.88	-	F	1.05	-			
INTERSECTION	INTERSECTION CONTROL	APPROACH / MOVEMENT		AM PEAK HOUR			PM Peak Hour				
		LOS	Delay (s)	Q ²	LOS	Delay (s)	Q ²				
Hawthorne Road at Site Access 1	Two-Way Stop Control (Right-In / Right-Out)	EB	Right	A	9.9	1.0	B	14.2			
		<i>Overall Intersection</i>		A	0.3	-	A	0.3			
Hunt Club Road at Site Access 2	Two-Way Stop Control (Right-Out Only)	SB	Right	B	11.6	1.0	B	14.7			
		<i>Overall Intersection</i>		A	0.2	-	A	0.2			
Notes:											
1. v/c – represents the anticipated volume divided by the predicted capacity											
2. 95 th Percentile Queue (m)											

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Figure 13 2018 Total Future Intersection Geometry and Lane Configuration



4.4 2023 ULTIMATE CONDITIONS

Ultimate future conditions for the 2023 horizon were examined to determine if other improvements may be required due to growth in background traffic volumes 5 years beyond the anticipated build-out horizon of the site.

Table 5 summarizes the operational characteristics of the study area intersections under 2023 ultimate conditions.

Consistent with the findings from earlier horizons, the intersection of Hunt Club Road at Hawthorne Road is expected to operate with several individual movements operating at or above capacity. As this is an existing deficiency, no improvements have been identified.

Also consistent with the findings from the 2018 total future horizon, the two proposed site access intersections are anticipated to operate acceptably under 2023 ultimate conditions.

Appendix B contains detailed intersection operation summaries.

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TRANSPORTATION ASSESSMENT

Table 5 2023 Ultimate Intersection Operations

INTERSECTION	INTERSECTION CONTROL	APPROACH/MOVEMENT	AM PEAK HOUR			PM PEAK HOUR					
			LOS	v/c ¹	Q ²	LOS	v/c ¹	Q ²			
Hunt Club Road at Hawthorne Road	Traffic Signals	EB	Left	E	0.98	#237.9	E	0.96			
			Through / Right	B	0.68	143.7	F	1.09			
		WB	Left	D	0.82	#105.8	F	1.22			
			Through	E	0.95	#155.7	D	0.81			
		NB	Right	A	0.09	15.3	A	0.06			
			Left	A	0.23	33.7	A	0.35			
		SB	Through / Right	E	0.99	#223.5	B	0.65			
			Left	A	0.56	#23.4	E	1.13			
			Through	A	0.19	33.6	D	0.85			
			Right	A	0.15	28.9	B	0.67			
<i>Overall Intersection</i>			E	0.96	-		F	1.18			
INTERSECTION	INTERSECTION CONTROL	APPROACH / MOVEMENT		AM PEAK HOUR			PM Peak Hour				
		LOS	Delay (s)	Q ²	LOS	Delay (s)	Q ²				
Hawthorne Road at Site Access 1	Two-Way Stop Control (Right-In / Right-Out)	EB	Right	A	10.0	1.0	C	15.2			
		<i>Overall Intersection</i>		A	0.2	-	A	0.3			
Hunt Club Road at Site Access 2	Two-Way Stop Control (Right-Out Only)	SB	Right	B	12.1	1.0	C	15.7			
		<i>Overall Intersection</i>		A	0.1	-	A	0.2			
Notes:											
1. v/c – represents the anticipated volume divided by the predicted capacity											
2. 95 th Percentile Queue (m)											

3500 HAWTHORNE ROAD TRANSPORTATION IMPACT STUDY

MARCH 2017

Geometric Modifications

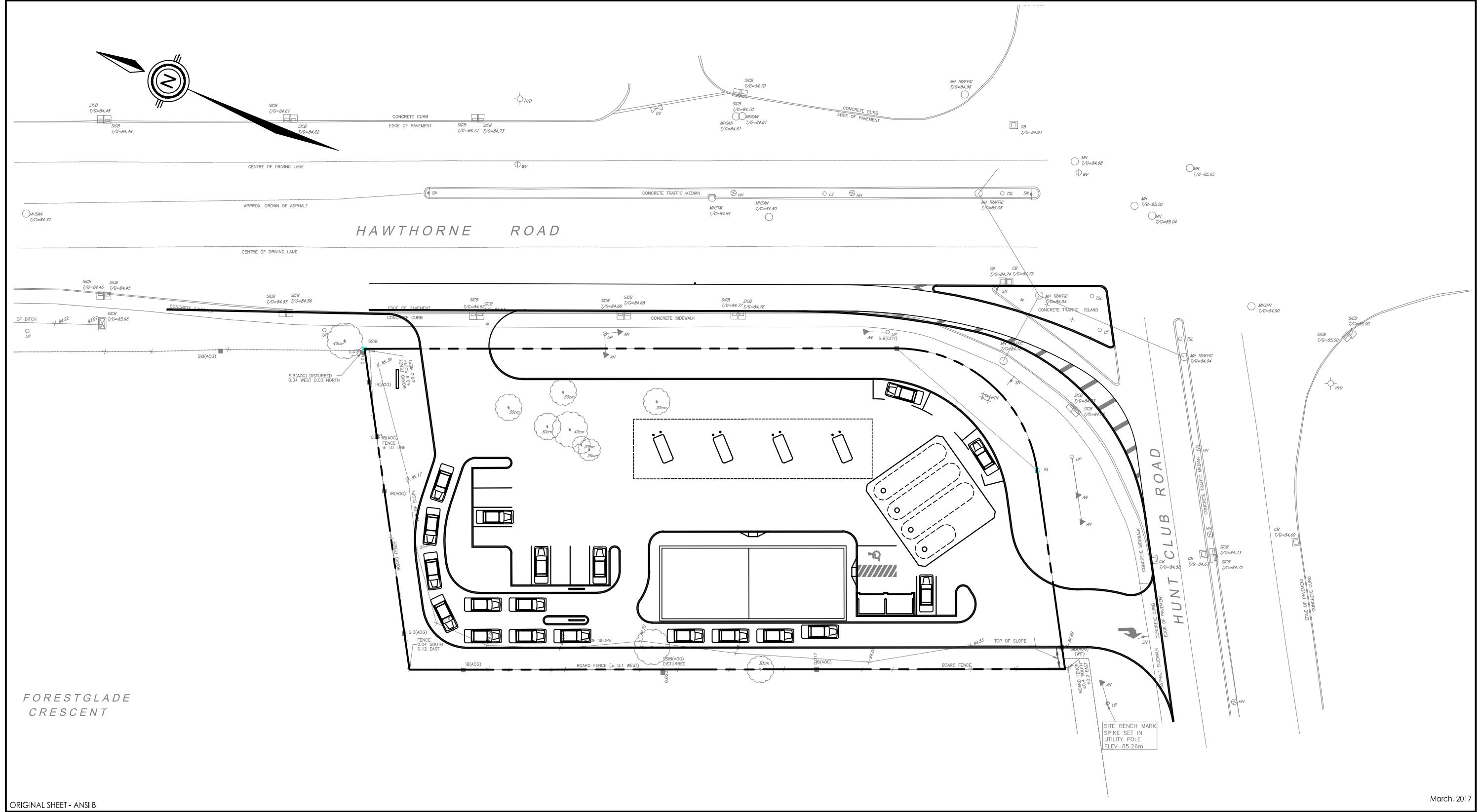
5.0 GEOMETRIC MODIFICATIONS

The proposed Site Access 2 is located within the acceleration / merge lane of the southbound right turn channel from the Hunt Club Road at Hawthorne Road intersection. Motorists exiting the subject development via Site Access 2 will encounter motorists in the southbound right turn channel. It is desirable to create as much distance separation between the two movements as possible to help mitigate any potential conflicts.

The configuration as is, which includes a generous acceleration / merge lane, is not typical of a smart channel design. It is recommended to reconstruct the southbound right turn channel at the Hunt Club Road at Hawthorne Road intersection to a more typical 'smart channel' configuration which is consistent with the other 3 quadrants of the intersections. This will achieve additional distance separation between the southbound right turn channel and the proposed Site Access 2.

Figure 14 below illustrates a concept that includes a more typical smart channel design, thus eliminating the need for the acceleration / merge lane. While this figure is for illustrative purposes, it should be noted that a turning template for a WB-20 transport truck was used to ensure the smart channel can accommodate large trucks.

It is also recommended to extend the centre median along Hawthorne Road beyond the proposed right-in / right-out access (Site Access 1). This will ensure that this site access operates as a right-in / right-out only, prohibiting the left out and left in movements. The exact length of the median extension will be determined at detailed design.



3500 HAWTHORNE ROAD TRANSPORTATION IMPACT STUDY

MARCH 2017

SUMMARY AND CONCLUSIONS

6.0 SUMMARY AND CONCLUSIONS

Proposed Development

- The proposed commercial development is located at 3500 Hawthorne Road in the City of Ottawa's. The site is bound by existing residential to the north and west, Hunt Club Road to the south, and Hawthorne Road to the east.
- The proposed development includes a gas station with convenience store (120m^2) and a fast food restaurant with drive-through (130m^2).
- Transportation access to the site will be facilitated through a proposed right-in / right-out access to Hawthorne Road and a proposed right-out access to Hunt Club Road.
- The proposed commercial development is anticipated to generate 21 and 24 net new auto trips (two-way) during the AM and PM peak hours, respectively.

2017 Existing Conditions

- Notwithstanding the recent reconstruction of the intersections due to the Hunt Club interchange Highway 417, the intersection of Hunt Club Road at Hawthorne Road currently operates at or above capacity during both peak hours. This represents an existing deficiency in the capacity of the intersection which will occur in the analysis of future horizons as well.
- Due to the existing deficiencies at the Hunt Club Road at Hawthorne Road intersection, the City should consider adding this intersection to the intersection improvement program to be reviewed in the near future.

2018 Future Background Conditions

- Consistent with the findings from the 2017 existing horizon, the intersection of Hunt Club Road at Hawthorne Road is anticipated to operate with several individual movements operating at or above capacity.

2018 Total Future Conditions

- Consistent with the findings from the 2018 future background horizon, the intersection of Hunt Club Road at Hawthorne Road is expected to operate with several individual movements operating at or above capacity. As this is an existing deficiency, no improvements have been identified.
- The two site access intersections are anticipated to operate acceptably under 2018 total future conditions.

3500 HAWTHORNE ROAD TRANSPORTATION IMPACT STUDY

MARCH 2017

SUMMARY AND CONCLUSIONS

2023 Ultimate Conditions

- Consistent with the findings from the 2018 total future horizon, the intersection of Hunt Club Road at Hawthorne Road is expected to operate with several individual movements operating at or above capacity. As this is an existing / background deficiency, no improvements have been identified.
- Also consistent with the findings from the 2018 total future horizon, the two site access intersections are anticipated to operate acceptably under 2023 ultimate conditions.

Geometric Modifications

- The proposed Site Access 2 is located within the acceleration / merge lane of the southbound right turn channel from the Hunt Club Road at Hawthorne Road intersection. Motorists exiting the subject development via Site Access 2 will encounter motorists in the southbound right turn channel. It is desirable to create as much distance separation between the two movements as possible to help mitigate any potential conflicts.
- The configuration as is, which includes a generous acceleration / merge lane, is not typical of a smart channel design. It is recommended to reconstruct the southbound right turn channel at the Hunt Club Road at Hawthorne Road intersection to a more typical 'smart channel' configuration which is consistent with the other 3 quadrants of the intersections. This will achieve additional distance separation between the southbound right turn channel and the proposed Site Access 2.
- It is also recommended to extend the centre median along Hawthorne Road beyond the proposed right-in / right-out access (Site Access 1). This will ensure that this site access operates as a right-in / right-out only, prohibiting the left out and left in movements. The exact length of the median extension will be determined at detailed design.

Based on the transportation evaluation and improvements recommended in this study, the proposed commercial development located at 3500 Hawthorne Road should be permitted to proceed.

STANTEC CONSULTING LTD.

(Original signed and stamped)

Robert Vastag, RPP
Project Manager, Senior Transportation Planner

Lauren O'Grady, P.Eng.
Transportation Engineer



3500 HAWTHORNE ROAD TRANSPORTATION IMPACT STUDY

Appendix A TRAFFIC DATA
MARCH 2017

Appendix A TRAFFIC DATA



Transportation Services - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

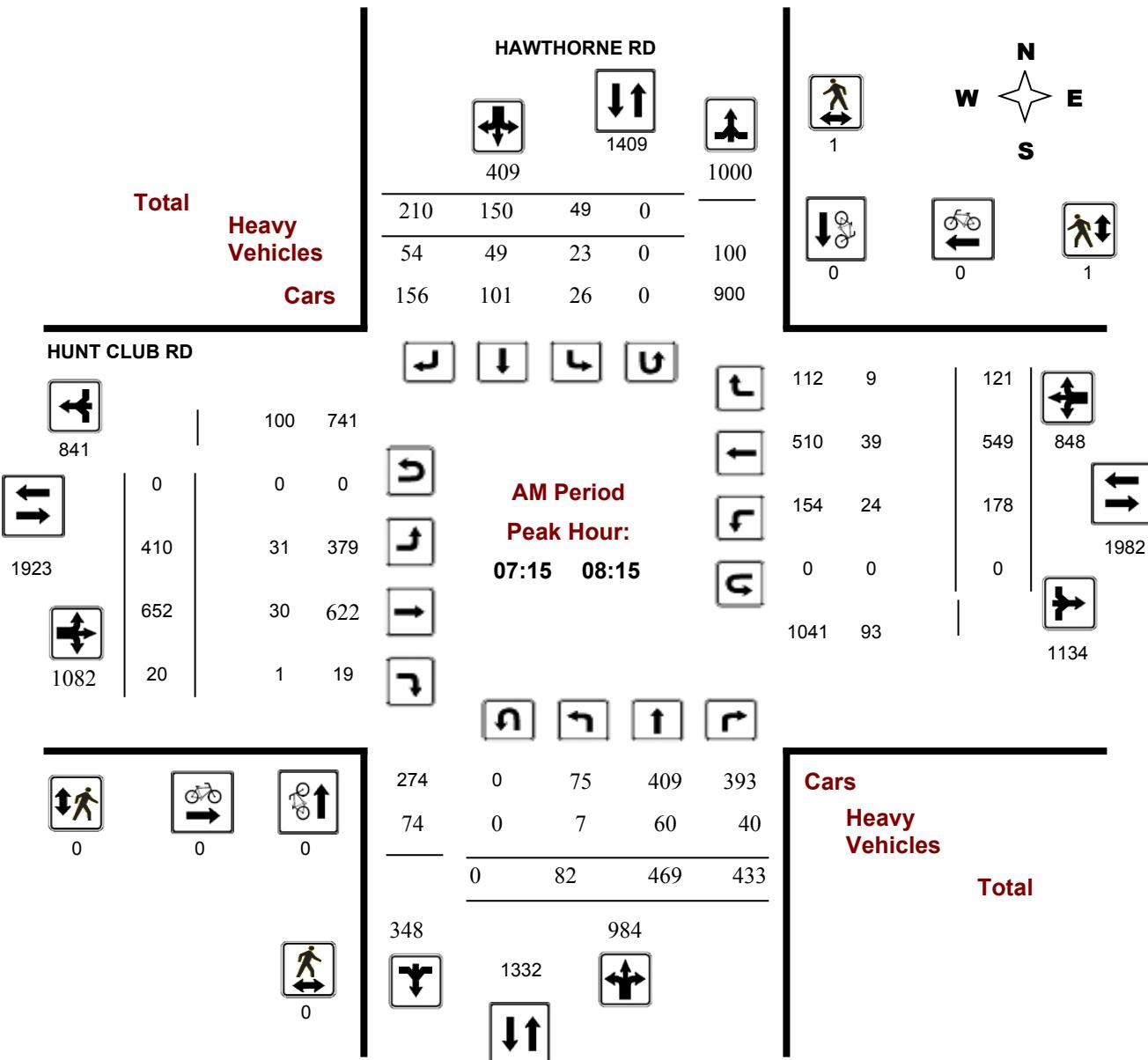
HAWTHORNE RD @ HUNT CLUB RD

Survey Date: Thursday, September 17, 2015

Start Time: 07:00

WO No: 35400

Device: Miovision





Transportation Services - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

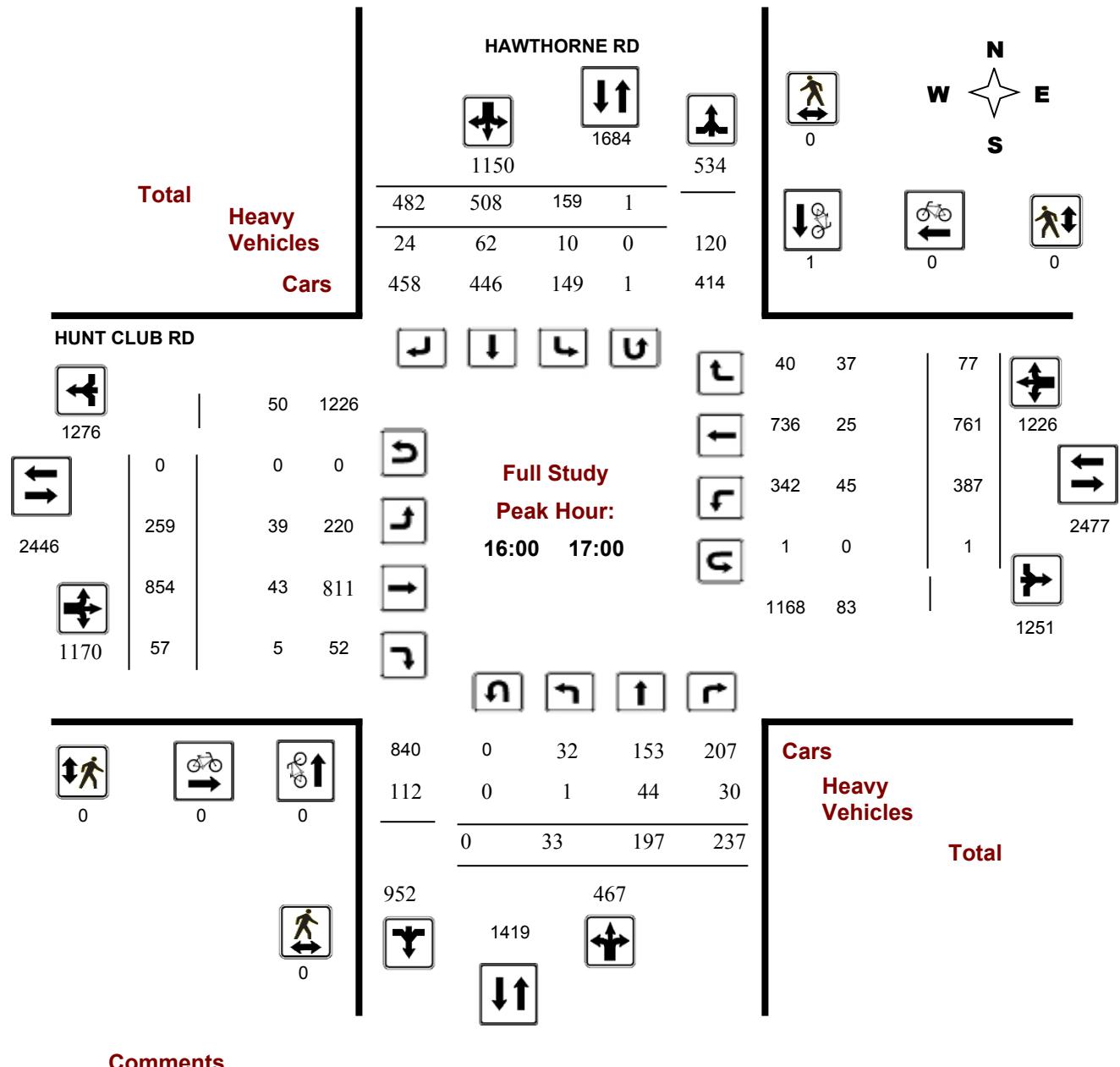
HAWTHORNE RD @ HUNT CLUB RD

Survey Date: Thursday, September 17, 2015

Start Time: 07:00

WO No: 35400

Device: Miovision





Transportation Services - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

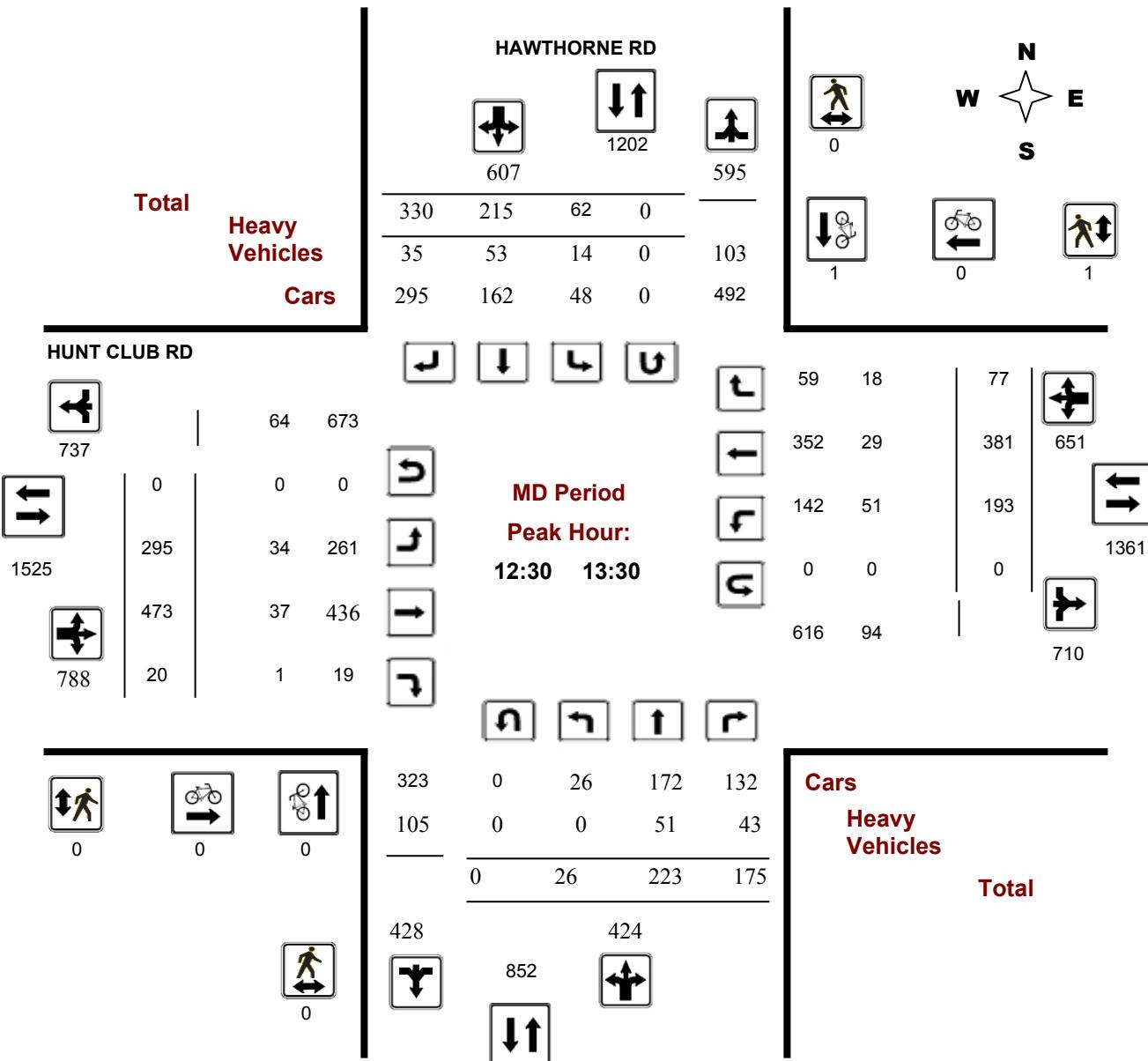
HAWTHORNE RD @ HUNT CLUB RD

Survey Date: Thursday, September 17, 2015

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Device: Miovision



Turning Movement Count - Full Study Peak Hour Diagram

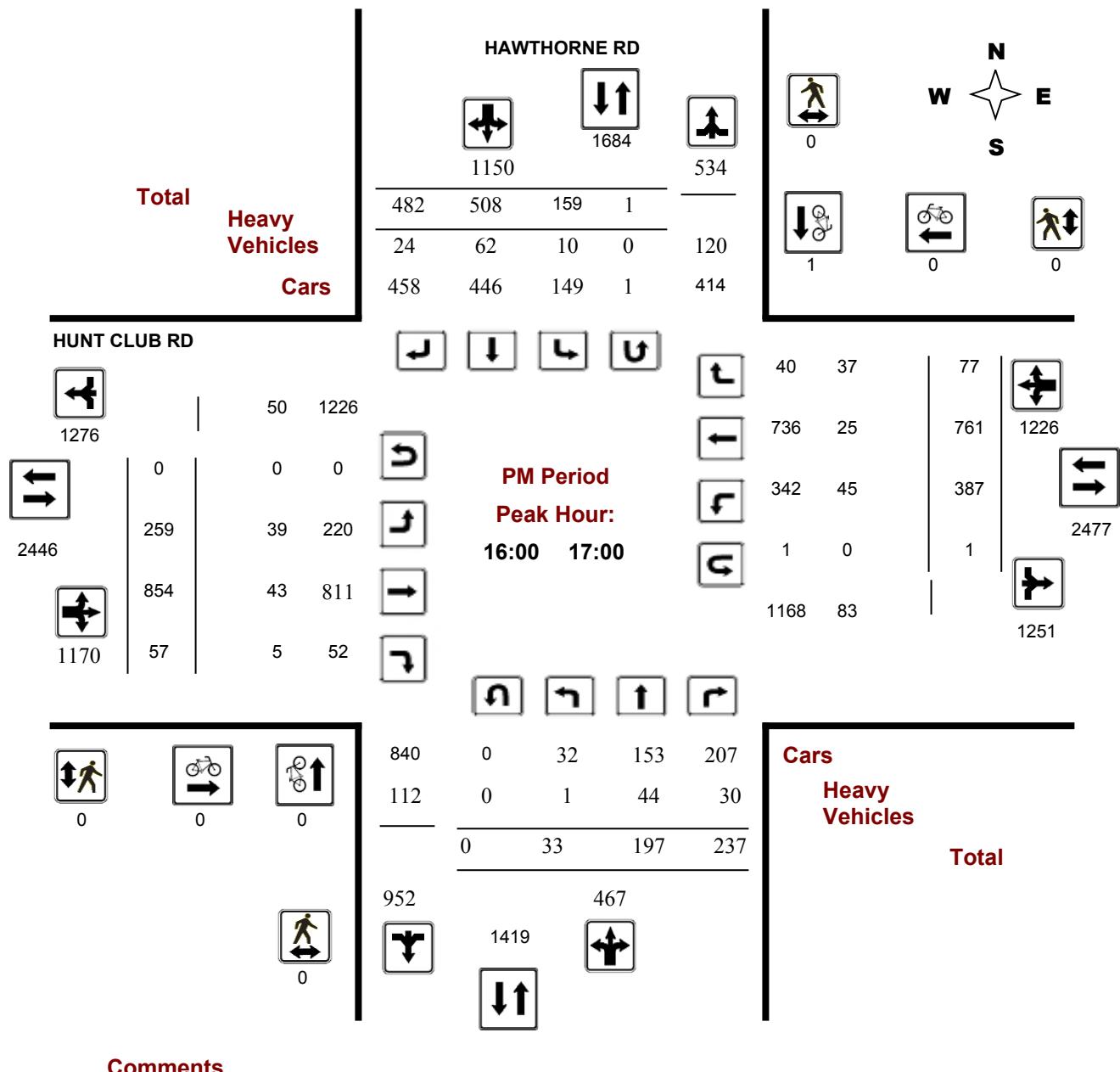
HAWTHORNE RD @ HUNT CLUB RD

Survey Date: Thursday, September 17, 2015

Start Time: 07:00

WO No: 35400

Device: Miovision





Transportation Services - Traffic Services

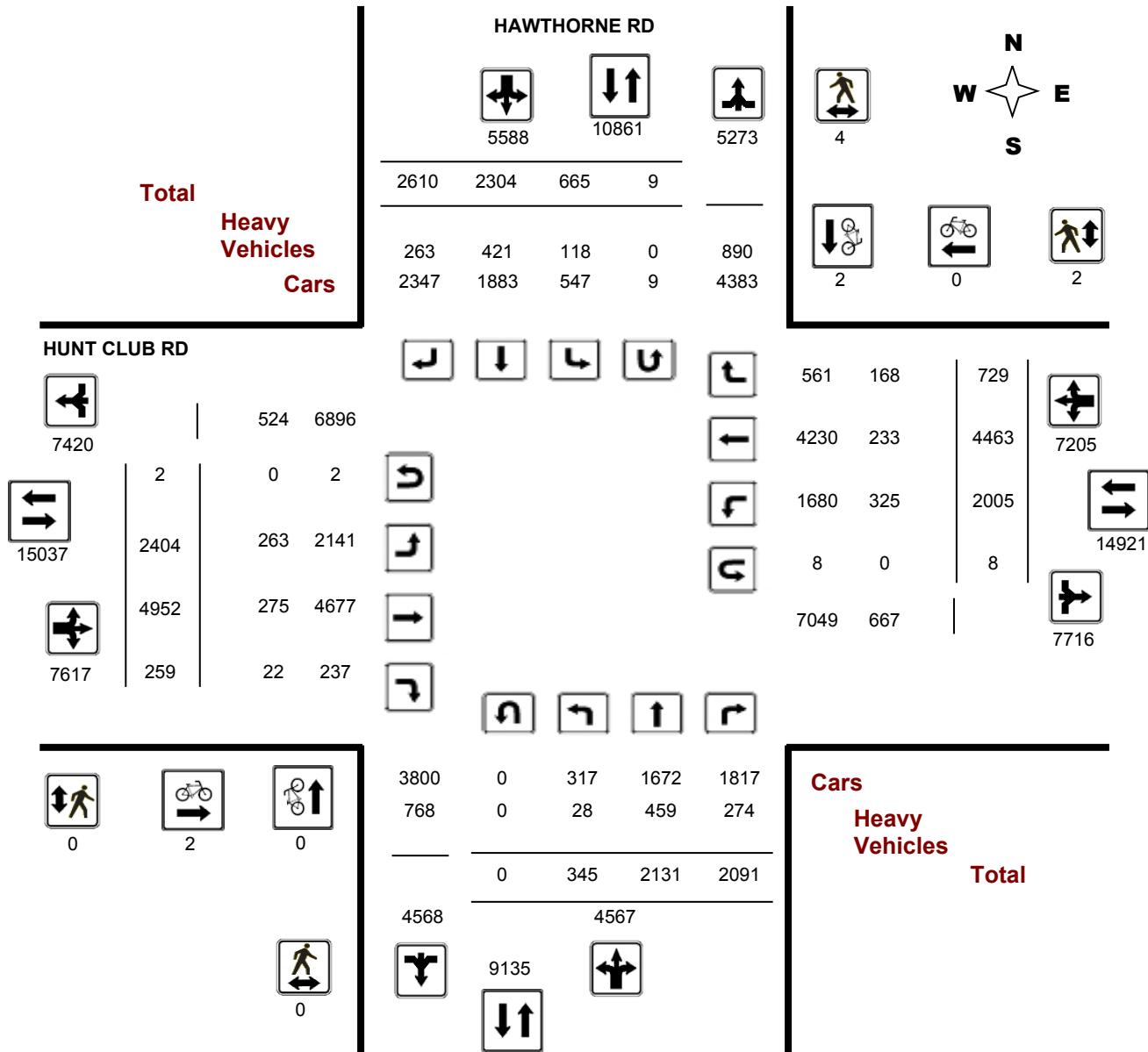
Turning Movement Count - Full Study Diagram

HAWTHORNE RD @ HUNT CLUB RD

Survey Date: Thursday, September 17, 2015

WO#: 35400

Device: Miovision



Comments



Transportation Services - Traffic Services

Work Order

35400

Turning Movement Count - Full Study Summary Report

HAWTHORNE RD @ HUNT CLUB RD

Survey Date: Thursday, September 17, 2015

Total Observed U-Turns

AADT Factor

Northbound:	0	Southbound:	9	
Eastbound:	2	Westbound:	8	1.00

Full Study

HAWTHORNE RD

HUNT CLUB RD

Period	Northbound			Southbound			SB TOT	STR TOT	Eastbound			Westbound			WB TOT	STR TOT	Grand Total		
	LT	ST	RT	LT	ST	RT			LT	ST	RT	EB TOT	LT	ST	RT				
07:00 08:00	67	437	406	910	45	139	218	402	1312	398	594	23	1015	204	592	157	953	1968	3280
08:00 09:00	89	477	407	973	49	151	198	398	1371	398	646	33	1077	144	516	106	766	1843	3214
09:00 10:00	32	222	223	477	62	195	230	487	964	274	479	18	771	153	448	88	689	1460	2424
11:30 12:30	36	204	142	382	59	205	329	593	975	285	440	23	748	192	403	87	682	1430	2405
12:30 13:30	26	223	175	424	62	215	330	607	1031	295	473	20	788	193	381	77	651	1439	2470
15:00 16:00	23	185	245	453	132	452	383	967	1420	273	704	47	1024	368	666	72	1106	2130	3550
16:00 17:00	33	197	237	467	159	508	482	1149	1616	259	854	57	1170	387	761	77	1225	2395	4011
17:00 18:00	39	186	256	481	97	439	440	976	1457	222	762	38	1022	364	696	65	1125	2147	3604
Sub Total	345	2131	2091	4567	665	2304	2610	5579	10146	2404	4952	259	7615	2005	4463	729	7197	14812	24958
U Turns				0				9	9			2				8	10	19	
Total	345	2131	2091	4567	665	2304	2610	5588	10155	2404	4952	259	7617	2005	4463	729	7205	14822	24977
EQ 12Hr	480	2962	2906	6348	924	3203	3628	7767	14115	3342	6883	360	10588	2787	6204	1013	10015	20603	34718

Note: These values are calculated by multiplying the totals by the appropriate expansion factor.

1.39

Note: These volumes are calculated by multiplying the Equivalent 12 hr. totals by the AADT factor.

1.00

Comments:

Note: U-Turns provided for approach totals. Refer to 'U-Turn' Report for specific breakdown.

Avg 12Hr

480	2962	2906	6348	924	3203	3628	7767	14115	3342	6883	360	10588	2787	6204	1013	10015	20603	34718
-----	------	------	-------------	-----	------	------	-------------	-------	------	------	-----	--------------	------	------	------	--------------	-------	--------------

Avg 24Hr

628	3880	3808	8316	1211	4195	4753	10175	18491	4377	9017	472	13870	3651	8127	1327	13120	26990	45481
-----	------	------	-------------	------	------	------	--------------	--------------	------	------	-----	--------------	------	------	------	--------------	--------------	--------------

Note:

These volumes are calculated by multiplying the Average Daily 12 hr. totals by 12 to 24 expansion factor.

1.31

Turning Movement Count - 15 Minute Summary Report

HAWTHORNE RD @ HUNT CLUB RD

Survey Date: Thursday, September 17, 2015

Total Observed U-Turns

 Northbound: 0 Southbound: 9
 Eastbound: 2 Westbound: 8

HAWTHORNE RD
HUNT CLUB RD

Time Period	Northbound			Southbound			Eastbound			Westbound			W TOT	STR TOT	Grand Total					
	LT	ST	RT	N TOT	LT	ST	RT	S TOT	STR TOT	LT	ST	RT	E TOT							
07:00	07:15	7	76	83	166	7	27	61	95	261	74	117	8	199	60	173	57	290	489	750
07:15	07:30	22	111	106	239	15	46	43	104	343	122	154	5	281	48	160	45	253	534	877
07:30	07:45	16	121	101	238	9	30	57	96	334	100	163	5	268	44	111	21	176	444	778
07:45	08:00	22	129	116	267	14	36	57	107	374	102	160	5	267	52	148	34	234	501	875
08:00	08:15	22	108	110	240	11	38	53	102	342	86	175	5	266	34	130	21	185	451	793
08:15	08:30	27	119	112	258	9	25	48	82	340	108	175	15	298	48	124	35	207	505	845
08:30	08:45	19	136	89	244	12	40	32	84	328	113	171	9	293	33	107	19	160	453	781
08:45	09:00	21	114	96	231	17	48	65	130	361	91	125	4	220	29	155	31	215	435	796
09:00	09:15	8	61	65	134	16	57	63	136	270	84	120	7	211	35	126	24	185	396	666
09:15	09:30	14	52	62	128	12	49	59	120	248	67	106	5	178	35	114	26	175	353	601
09:30	09:45	4	54	58	116	17	37	46	101	217	53	127	2	182	44	110	16	170	352	569
09:45	10:00	6	55	38	99	17	52	62	131	230	70	126	4	200	39	98	22	159	359	589
11:30	11:45	8	54	43	105	16	53	77	146	251	66	112	4	182	48	100	24	172	354	605
11:45	12:00	8	49	44	101	12	43	87	142	243	69	121	5	195	50	117	19	186	381	624
12:00	12:15	10	44	33	87	17	57	82	157	244	60	107	7	174	51	102	24	178	352	596
12:15	12:30	10	57	22	89	14	52	83	149	238	90	100	7	197	43	84	20	147	344	582
12:30	12:45	7	54	54	115	15	61	80	156	271	70	120	1	191	57	100	22	179	370	641
12:45	13:00	8	66	43	117	17	55	97	169	286	72	108	7	187	48	94	23	165	352	638
13:00	13:15	5	53	42	100	15	55	76	146	246	74	120	8	202	49	82	17	148	350	596
13:15	13:30	6	50	36	92	15	44	77	136	228	79	125	4	208	39	105	15	159	367	595
15:00	15:15	5	53	63	121	27	125	93	246	367	68	119	18	205	86	139	15	241	446	813
15:15	15:30	7	43	67	117	24	85	89	199	316	69	211	3	283	69	152	18	239	522	838
15:30	15:45	6	45	62	113	41	131	102	275	388	64	170	12	246	111	172	16	299	545	933
15:45	16:00	5	44	53	102	40	111	99	250	352	72	204	14	290	102	203	23	328	618	970
16:00	16:15	8	42	59	109	39	129	120	289	398	67	207	12	286	102	188	22	313	599	997
16:15	16:30	7	51	54	112	41	136	131	308	420	51	227	7	285	71	179	17	267	552	972
16:30	16:45	5	50	63	118	48	139	138	325	443	76	202	20	298	118	183	28	329	627	1070
16:45	17:00	13	54	61	128	31	104	93	228	356	65	218	18	301	96	211	10	317	618	974
17:00	17:15	12	74	62	148	44	144	124	314	462	53	172	10	235	96	175	13	284	519	981
17:15	17:30	4	41	78	123	18	110	122	250	373	54	221	10	286	97	173	14	287	573	946
17:30	17:45	9	23	61	93	19	116	101	237	330	52	177	15	244	88	201	17	307	551	881
17:45	18:00	14	48	55	117	16	69	93	178	295	63	192	3	259	83	147	21	251	510	805

TOTAL: 345 2131 2091 4567 665 2304 2610 5588 10155 2404 4952 259 7617 2005 4463 729 7205 14822 24977

Note: U-Turns are included in Totals.

Comment:



Transportation Services - Traffic Services

Turning Movement Count - Cyclist Volume Report

Work Order
35400

HAWTHORNE RD @ HUNT CLUB RD

Count Date: Thursday, September 17, 2015

Start Time: 07:00

Time Period	HAWTHORNE RD			HUNT CLUB RD			Grand Total
	Northbound	Southbound	Street Total	Eastbound	Westbound	Street Total	
07:00 08:00	0	0	0	0	0	0	0
08:00 09:00	0	0	0	0	0	0	0
09:00 10:00	0	0	0	0	0	0	0
11:30 12:30	0	0	0	0	0	0	0
12:30 13:30	0	1	1	0	0	0	1
15:00 16:00	0	0	0	2	0	2	2
16:00 17:00	0	1	1	0	0	0	1
17:00 18:00	0	0	0	0	0	0	0
Total	0	2	2	2	0	2	4

Comment:

Note: These volumes consists of bicycles only (no mopeds or motorcycles) and ARE NOT included in the Turning Movement Count Summary.



Transportation Services - Traffic Services

W.O.
35400

Turning Movement Count - Heavy Vehicle Report

HAWTHORNE RD @ HUNT CLUB RD

Survey Date: Thursday, September 17, 2015

HAWTHORNE RD							HUNT CLUB RD													
Time Period	Northbound			Southbound			S TOT	STR TOT	Eastbound			Westbound			W TOT	STR TOT	Grand Total			
	LT	ST	RT	N TOT	LT	ST	RT		LT	ST	RT	E TOT	LT	ST	RT					
07:00	08:00	6	52	47	105	22	50	55	127	232	27	25	1	53	26	38	8	72	125	357
08:00	09:00	9	73	34	116	22	50	39	111	227	40	38	4	82	31	40	18	89	171	398
09:00	10:00	4	46	34	84	24	70	45	139	223	34	35	2	71	46	30	14	90	161	384
11:30	12:30	5	68	38	111	9	53	32	94	205	29	36	2	67	49	30	25	104	171	376
12:30	13:30	0	51	43	94	14	53	35	102	196	34	37	1	72	51	29	18	98	170	366
15:00	16:00	3	67	34	104	12	58	19	89	193	32	33	7	72	50	28	21	99	171	364
16:00	17:00	1	44	30	75	10	62	24	96	171	39	43	5	87	45	25	37	107	194	365
17:00	18:00	0	58	14	72	5	25	14	44	116	28	28	0	56	27	13	27	67	123	239
Sub Total		28	459	274	761	118	421	263	802	1563	263	275	22	560	325	233	168	726	1286	2849
U-Turns (Heavy Vehicles)				0				0	0				0			0	0	0	0	
Total		28	459	274	0	118	421	263	802	1563	263	275	22	560	325	233	168	726	1286	2849

Heavy Vehicles include Buses, Single-Unit Trucks and Articulated Trucks. Further, they ARE included in the Turning Movement Count Summary.



Transportation Services - Traffic Services

Work Order

35400

Turning Movement Count - Pedestrian Volume Report

HAWTHORNE RD @ HUNT CLUB RD

Count Date: Thursday, September 17, 2015

Start Time: 07:00

Time Period	NB Approach (E or W Crossing)	SB Approach (E or W Crossing)	Total	EB Approach (N or S Crossing)	WB Approach (N or S Crossing)	Total	Grand Total
07:00 07:15	0	0	0	0	0	0	0
07:15 07:30	0	1	1	0	1	1	2
07:30 07:45	0	0	0	0	0	0	0
07:45 08:00	0	0	0	0	0	0	0
07:00 08:00	0	1	1	0	1	1	2
08:00 08:15	0	0	0	0	0	0	0
08:15 08:30	0	0	0	0	0	0	0
08:30 08:45	0	0	0	0	0	0	0
08:45 09:00	0	0	0	0	0	0	0
08:00 09:00	0	0	0	0	0	0	0
09:00 09:15	0	0	0	0	0	0	0
09:15 09:30	0	0	0	0	0	0	0
09:30 09:45	0	0	0	0	0	0	0
09:45 10:00	0	0	0	0	0	0	0
09:00 10:00	0	0	0	0	0	0	0
11:30 11:45	0	0	0	0	0	0	0
11:45 12:00	0	1	1	0	0	0	1
12:00 12:15	0	1	1	0	0	0	1
12:15 12:30	0	0	0	0	0	0	0
11:30 12:30	0	2	2	0	0	0	2
12:30 12:45	0	0	0	0	0	0	0
12:45 13:00	0	0	0	0	0	0	0
13:00 13:15	0	0	0	0	0	0	0
13:15 13:30	0	0	0	0	1	1	1
12:30 13:30	0	0	0	0	1	1	1
15:00 15:15	0	0	0	0	0	0	0
15:15 15:30	0	0	0	0	0	0	0
15:30 15:45	0	0	0	0	0	0	0
15:45 16:00	0	1	1	0	0	0	1
15:00 16:00	0	1	1	0	0	0	1
16:00 16:15	0	0	0	0	0	0	0
16:15 16:30	0	0	0	0	0	0	0
16:30 16:45	0	0	0	0	0	0	0
16:45 17:00	0	0	0	0	0	0	0
16:00 17:00	0	0	0	0	0	0	0
17:00 17:15	0	0	0	0	0	0	0
17:15 17:30	0	0	0	0	0	0	0
17:30 17:45	0	0	0	0	0	0	0
17:45 18:00	0	0	0	0	0	0	0
17:00 18:00	0	0	0	0	0	0	0
Total	0	4	4	0	2	2	6

Comment:

Turning Movement Count - 15 Min U-Turn Total Report

HAWTHORNE RD @ HUNT CLUB RD

Survey Date: Thursday, September 17, 2015

Time Period		Northbound U-Turn Total	Southbound U-Turn Total	Eastbound U-Turn Total	Westbound U-Turn Total	Total
07:00	07:15	0	0	0	0	0
07:15	07:30	0	0	0	0	0
07:30	07:45	0	0	0	0	0
07:45	08:00	0	0	0	0	0
08:00	08:15	0	0	0	0	0
08:15	08:30	0	0	0	0	0
08:30	08:45	0	0	0	1	1
08:45	09:00	0	0	0	0	0
09:00	09:15	0	0	0	0	0
09:15	09:30	0	0	0	0	0
09:30	09:45	0	1	0	0	1
09:45	10:00	0	0	0	0	0
11:30	11:45	0	0	0	0	0
11:45	12:00	0	0	0	0	0
12:00	12:15	0	1	0	1	2
12:15	12:30	0	0	0	0	0
12:30	12:45	0	0	0	0	0
12:45	13:00	0	0	0	0	0
13:00	13:15	0	0	0	0	0
13:15	13:30	0	0	0	0	0
15:00	15:15	0	1	0	1	2
15:15	15:30	0	1	0	0	1
15:30	15:45	0	1	0	0	1
15:45	16:00	0	0	0	0	0
16:00	16:15	0	1	0	1	2
16:15	16:30	0	0	0	0	0
16:30	16:45	0	0	0	0	0
16:45	17:00	0	0	0	0	0
17:00	17:15	0	2	0	0	2
17:15	17:30	0	0	1	3	4
17:30	17:45	0	1	0	1	2
17:45	18:00	0	0	1	0	1
Total		0	9	2	8	19

Traffic Signal Timing

City of Ottawa, Transportation Services Department

Traffic Operations Unit

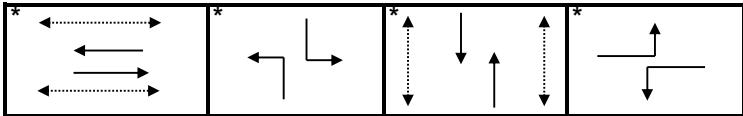
Intersection:	Main: Hunt Club	Side: Hawthorne
Controller:	ATC-3	TSD: 6024
Author:	Jon Pach	Date: 16-Feb-17

Existing Timing Plans[†]

Plan	Ped Minimum Time							
	AM Peak 1	Off Peak 2	PM Peak 3	Night 4	Weekend 5	Walk	DW	A+R
Cycle	FREE	FREE	FREE	FREE	FREE			
Offset	X	X	X	X	X			
EB Thru	max 41.4	max 36.4	max 36.4	max 31.4	max 36.4	7	19	4.6+1.8
WB Thru	max 41.4	max 36.4	max 36.4	max 31.4	max 36.4	7	19	4.6+1.8
NB Left	max 21.3	max 21.3	max 21.3	max 16.3	max 16.3	-	-	4.2+2.1
SB Left	max 21.3	max 21.3	max 21.3	max 16.3	max 16.3	-	-	4.2+2.1
NB Thru	max 36.3	max 26.3	max 31.3	max 26.3	max 26.3	7	19	4.2+2.1
SB Thru	max 36.3	max 26.3	max 31.3	max 26.3	max 26.3	7	19	4.2+2.1
EB Left (fp)	max 41.4	max 41.4	max 41.4	max 31.4	max 31.4	-	-	4.6+1.8
WB Left (fp)	max 41.4	max 41.4	max 41.4	max 31.4	max 31.4	-	-	4.6+1.8

Phasing Sequence[‡]

Plan: ALL



- Note:**
- 1) The minimum green time for NB and SB Thru is 10s for all plans
 - 2) The minimum green time for NB, SB, EB and WB Left is 5s for all plans
 - 3) There is a minimum recall for EB and WB Thru of 26s green time
 - 4) If the pedestrian phase is actuated for NB and/or SB Thru, the minimum split will be 32.3s to allow for the Walk and FDW time

Schedule

Weekday		Weekend	
Time	Plan	Time	Plan
0:10	4	0:10	4
6:00	1	8:30	5
9:30	2	19:00	2
15:00	3	20:00	4
19:00	2		
22:00	4		

Notes

[†]: Time for each direction includes amber and all red intervals

[‡]: Start of first phase should be used as reference point for offset

Asterisk (*) Indicates actuated phase

(fp): Fully Protected Left Turn

◀→ Pedestrian signal

Cost is \$56.50 (\$50 + HST)

3500 HAWTHORNE ROAD TRANSPORTATION IMPACT STUDY

Appendix B INTERSECTION PERFORMANCE WORKSHEETS
MARCH 2017

Appendix B INTERSECTION PERFORMANCE WORKSHEETS

3500 HAWTHORNE ROAD TRANSPORTATION IMPACT STUDY

Appendix B INTERSECTION PERFORMANCE WORKSHEETS
MARCH 2017

B.1 2017 EXISTING CONDITIONS

Queues
1: Hunt Club Road & Hawthorne Road

3500 Hawthorne Road
2017 Existing AM

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	463	760	201	621	137	92	1019	55	170	237
v/c Ratio	0.98	0.64	0.74	0.78	0.30	0.25	1.18	0.34	0.25	0.48
Control Delay	83.2	38.7	67.3	53.1	8.0	31.8	128.1	35.4	44.3	9.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	83.2	38.7	67.3	53.1	8.0	31.8	128.1	35.4	44.3	9.0
Queue Length 50th (m)	116.5	84.8	48.7	78.2	0.0	15.8	~147.0	9.3	18.6	0.0
Queue Length 95th (m)	#203.8	120.4	75.0	101.9	15.9	30.2	#206.6	19.8	31.4	22.3
Internal Link Dist (m)		143.8		205.0			64.2		107.5	
Turn Bay Length (m)	100.0		60.0		100.0	50.0		100.0		80.0
Base Capacity (vph)	472	1196	472	945	521	414	866	255	810	542
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.98	0.64	0.43	0.66	0.26	0.22	1.18	0.22	0.21	0.44

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

1: Hunt Club Road & Hawthorne Road

3500 Hawthorne Road

2017 Existing AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑		↑	↑↑	↑	↑	↑↑		↑	↑↑	↑
Traffic Volume (vph)	426	678	21	185	571	126	85	488	450	51	156	218
Future Volume (vph)	426	678	21	185	571	126	85	488	450	51	156	218
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.4	6.4		6.4	6.4	6.4	6.3	6.3		6.3	6.3	6.3
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	0.95		1.00	0.95	1.00
Fr _t	1.00	1.00		1.00	1.00	0.85	1.00	0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1695	3375		1695	3390	1517	1695	3146		1695	3390	1517
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.57	1.00		0.15	1.00	1.00
Satd. Flow (perm)	1695	3375		1695	3390	1517	1017	3146		267	3390	1517
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	463	737	23	201	621	137	92	530	489	55	170	237
RTOR Reduction (vph)	0	1	0	0	0	105	0	114	0	0	0	187
Lane Group Flow (vph)	463	759	0	201	621	32	92	905	0	55	170	50
Turn Type	Prot	NA		Prot	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases						6	4			8		8
Actuated Green, G (s)	35.2	44.7		20.3	29.8	29.8	40.6	30.2		33.6	26.7	26.7
Effective Green, g (s)	35.2	44.7		20.3	29.8	29.8	40.6	30.2		33.6	26.7	26.7
Actuated g/C Ratio	0.28	0.35		0.16	0.23	0.23	0.32	0.24		0.26	0.21	0.21
Clearance Time (s)	6.4	6.4		6.4	6.4	6.4	6.3	6.3		6.3	6.3	6.3
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	467	1183		269	792	354	379	745		147	709	317
v/s Ratio Prot	c0.27	0.22		0.12	c0.18		0.02	c0.29		c0.02	0.05	
v/s Ratio Perm						0.02	0.06			0.08		0.03
v/c Ratio	0.99	0.64		0.75	0.78	0.09	0.24	1.21		0.37	0.24	0.16
Uniform Delay, d1	46.0	34.7		51.2	45.8	38.2	31.4	48.6		37.8	42.0	41.2
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	39.3	1.2		10.8	5.1	0.1	0.3	108.5		1.6	0.2	0.2
Delay (s)	85.3	35.9		61.9	50.9	38.4	31.7	157.2		39.4	42.1	41.4
Level of Service	F	D		E	D	D	C	F		D	D	D
Approach Delay (s)		54.6			51.4			146.8			41.4	
Approach LOS		D			D			F			D	
Intersection Summary												
HCM 2000 Control Delay		79.4								E		
HCM 2000 Volume to Capacity ratio		0.95										
Actuated Cycle Length (s)		127.5								G		
Intersection Capacity Utilization		101.4%										
Analysis Period (min)		15										
c Critical Lane Group												

Queues
1: Hunt Club Road & Hawthorne Road

3500 Hawthorne Road
2017 Existing PM

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	292	1029	437	860	87	37	490	179	574	545
v/c Ratio	0.81	1.22	0.91	0.80	0.15	0.19	0.78	0.72	0.71	0.70
Control Delay	63.1	149.2	68.0	46.0	2.1	31.8	37.7	49.1	48.7	8.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	63.1	149.2	68.0	46.0	2.1	31.8	37.7	49.1	48.7	8.9
Queue Length 50th (m)	68.2	~165.5	102.9	101.3	0.0	6.2	35.4	33.0	70.5	0.0
Queue Length 95th (m)	97.8	#222.7	#175.9	#172.4	3.6	14.0	54.1	#52.6	92.6	33.0
Internal Link Dist (m)		143.8		205.0			64.2		107.5	
Turn Bay Length (m)	100.0		60.0		100.0	50.0		100.0		80.0
Base Capacity (vph)	494	843	494	1081	574	301	836	265	812	778
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.59	1.22	0.88	0.80	0.15	0.12	0.59	0.68	0.71	0.70

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

1: Hunt Club Road & Hawthorne Road

3500 Hawthorne Road

2017 Existing PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑		↑	↑↑	↑	↑	↑↑		↑	↑↑	↑
Traffic Volume (vph)	269	888	59	402	791	80	34	205	246	165	528	501
Future Volume (vph)	269	888	59	402	791	80	34	205	246	165	528	501
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.4	6.4		6.4	6.4	6.4	6.3	6.3		6.3	6.3	6.3
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	0.95		1.00	0.95	1.00
Fr _t	1.00	0.99		1.00	1.00	0.85	1.00	0.92		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1695	3359		1695	3390	1517	1695	3113		1695	3390	1517
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.35	1.00		0.17	1.00	1.00
Satd. Flow (perm)	1695	3359		1695	3390	1517	623	3113		297	3390	1517
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	292	965	64	437	860	87	37	223	267	179	574	545
RTOR Reduction (vph)	0	4	0	0	0	60	0	173	0	0	0	417
Lane Group Flow (vph)	292	1025	0	437	860	27	37	317	0	179	574	128
Turn Type	Prot	NA		Prot	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases						6	4			8		8
Actuated Green, G (s)	25.7	30.2		34.0	38.5	38.5	25.1	20.3		40.1	29.0	29.0
Effective Green, g (s)	25.7	30.2		34.0	38.5	38.5	25.1	20.3		40.1	29.0	29.0
Actuated g/C Ratio	0.21	0.24		0.28	0.31	0.31	0.20	0.16		0.32	0.24	0.24
Clearance Time (s)	6.4	6.4		6.4	6.4	6.4	6.3	6.3		6.3	6.3	6.3
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	353	822		467	1057	473	168	512		249	796	356
v/s Ratio Prot	0.17	c0.31		c0.26	c0.25		0.01	0.10		c0.08	c0.17	
v/s Ratio Perm						0.02	0.04			0.15		0.08
v/c Ratio	0.83	1.25		0.94	0.81	0.06	0.22	0.62		0.72	0.72	0.36
Uniform Delay, d1	46.7	46.6		43.6	39.1	29.7	40.1	48.0		33.0	43.5	39.4
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	14.6	121.4		26.2	4.9	0.1	0.7	2.2		9.5	3.2	0.6
Delay (s)	61.4	168.0		69.8	44.0	29.8	40.8	50.2		42.5	46.7	40.1
Level of Service	E	F		E	D	C	D	D		D	D	D
Approach Delay (s)		144.4			51.3			49.5			43.3	
Approach LOS		F			D			D			D	
Intersection Summary												
HCM 2000 Control Delay		76.0								E		
HCM 2000 Volume to Capacity ratio		0.99										
Actuated Cycle Length (s)		123.4								25.4		
Intersection Capacity Utilization		96.5%								F		
Analysis Period (min)		15										
c Critical Lane Group												

3500 HAWTHORNE ROAD TRANSPORTATION IMPACT STUDY

Appendix B INTERSECTION PERFORMANCE WORKSHEETS
MARCH 2017

B.2 2018 FUTURE BACKGROUND CONDITIONS

Queues
1: Hunt Club Road & Hawthorne Road

3500 Hawthorne Road

2018 FBG AM



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	435	712	189	582	128	87	956	52	159	223
v/c Ratio	0.92	0.61	0.77	0.82	0.28	0.22	0.92	0.41	0.19	0.41
Control Delay	80.4	40.2	78.3	62.6	3.5	30.1	55.7	38.6	39.1	7.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	80.4	40.2	78.3	62.6	3.5	30.1	55.7	38.6	39.1	7.1
Queue Length 50th (m)	115.9	86.9	51.1	83.3	0.0	15.8	115.7	9.2	17.7	0.0
Queue Length 95th (m)	#209.7	128.5	#93.1	#136.3	11.2	31.4	#192.6	20.6	30.4	28.9
Internal Link Dist (m)		143.8		205.0			64.2		107.5	
Turn Bay Length (m)	100.0		60.0		100.0	50.0		100.0		80.0
Base Capacity (vph)	532	1196	309	724	461	397	1115	126	1015	610
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.82	0.60	0.61	0.80	0.28	0.22	0.86	0.41	0.16	0.37

Intersection Summary

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

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

1: Hunt Club Road & Hawthorne Road

3500 Hawthorne Road

2018 FBG AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑		↑	↑↑	↑	↑	↑↑		↑	↑↑	↑
Traffic Volume (vph)	435	691	21	189	582	128	87	497	459	52	159	223
Future Volume (vph)	435	691	21	189	582	128	87	497	459	52	159	223
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.4	6.4		6.4	6.4	6.4	6.3	6.3		6.3	6.3	6.3
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	0.95		1.00	0.95	1.00
Fr _t	1.00	1.00		1.00	1.00	0.85	1.00	0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1695	3375		1695	3390	1517	1695	3146		1695	3390	1517
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.59	1.00		0.11	1.00	1.00
Satd. Flow (perm)	1695	3375		1695	3390	1517	1053	3146		205	3390	1517
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	435	691	21	189	582	128	87	497	459	52	159	223
RTOR Reduction (vph)	0	1	0	0	0	101	0	119	0	0	0	164
Lane Group Flow (vph)	435	711	0	189	582	27	87	837	0	52	159	59
Turn Type	Prot	NA		Prot	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases						6	4			8		8
Actuated Green, G (s)	36.9	45.4		19.2	27.7	27.7	46.4	38.5		39.2	34.9	34.9
Effective Green, g (s)	36.9	45.4		19.2	27.7	27.7	46.4	38.5		39.2	34.9	34.9
Actuated g/C Ratio	0.28	0.34		0.14	0.21	0.21	0.35	0.29		0.30	0.26	0.26
Clearance Time (s)	6.4	6.4		6.4	6.4	6.4	6.3	6.3		6.3	6.3	6.3
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	470	1153		245	707	316	406	912		108	890	398
v/s Ratio Prot	c0.26	0.21		0.11	c0.17		0.01	c0.27		c0.02	0.05	
v/s Ratio Perm						0.02	0.06			0.13		0.04
v/c Ratio	0.93	0.62		0.77	0.82	0.08	0.21	0.92		0.48	0.18	0.15
Uniform Delay, d1	46.6	36.4		54.7	50.2	42.3	29.7	45.6		36.9	37.9	37.5
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	33.3	1.0		15.3	8.2	0.1	0.3	16.9		3.4	0.1	0.2
Delay (s)	79.9	37.4		69.9	58.4	42.5	29.9	62.5		40.3	38.0	37.7
Level of Service	E	D		E	E	D	C	E		D	D	D
Approach Delay (s)		53.5			58.6			59.8			38.1	
Approach LOS		D			E			E			D	
Intersection Summary												
HCM 2000 Control Delay		54.8									D	
HCM 2000 Volume to Capacity ratio		0.88										
Actuated Cycle Length (s)		132.8									25.4	
Intersection Capacity Utilization		102.5%									G	
Analysis Period (min)		60										
c Critical Lane Group												

Queues
1: Hunt Club Road & Hawthorne Road

3500 Hawthorne Road

2018 FBG PM



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	299	1049	446	877	89	38	500	184	585	555
v/c Ratio	0.88	1.02	1.03	0.72	0.14	0.27	0.70	1.01	0.79	0.78
Control Delay	76.2	77.6	96.8	40.8	1.8	37.5	33.9	108.7	56.0	15.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	76.2	77.6	96.8	40.8	1.8	37.5	33.9	108.7	56.0	15.5
Queue Length 50th (m)	74.3	~155.4	~126.2	107.9	0.0	7.0	36.9	37.0	75.4	14.2
Queue Length 95th (m)	#118.3	#197.4	#190.2	133.0	3.5	15.4	55.8	#73.7	96.5	60.5
Internal Link Dist (m)		143.8		205.0			64.2		107.5	
Turn Bay Length (m)	100.0		60.0		100.0	50.0		100.0		80.0
Base Capacity (vph)	377	1027	435	1223	632	143	798	183	777	724
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.79	1.02	1.03	0.72	0.14	0.27	0.63	1.01	0.75	0.77

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

1: Hunt Club Road & Hawthorne Road

3500 Hawthorne Road

2018 FBG PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑		↑	↑↑	↑	↑	↑↑		↑	↑↑	↑
Traffic Volume (vph)	275	905	60	410	807	82	35	209	251	169	538	511
Future Volume (vph)	275	905	60	410	807	82	35	209	251	169	538	511
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.4	6.4		6.4	6.4	6.4	6.3	6.3		6.3	6.3	6.3
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	0.95		1.00	0.95	1.00
Fr _t	1.00	0.99		1.00	1.00	0.85	1.00	0.92		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1695	3359		1695	3390	1517	1695	3113		1695	3390	1517
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.25	1.00		0.20	1.00	1.00
Satd. Flow (perm)	1695	3359		1695	3390	1517	439	3113		355	3390	1517
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	299	984	65	446	877	89	38	227	273	184	585	555
RTOR Reduction (vph)	0	3	0	0	0	57	0	169	0	0	0	382
Lane Group Flow (vph)	299	1046	0	446	877	32	38	331	0	184	585	173
Turn Type	Prot	NA		Prot	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases						6	4			8		8
Actuated Green, G (s)	25.7	39.0		32.9	46.2	46.2	27.6	23.7		36.4	28.1	28.1
Effective Green, g (s)	25.7	39.0		32.9	46.2	46.2	27.6	23.7		36.4	28.1	28.1
Actuated g/C Ratio	0.20	0.30		0.25	0.36	0.36	0.21	0.18		0.28	0.22	0.22
Clearance Time (s)	6.4	6.4		6.4	6.4	6.4	6.3	6.3		6.3	6.3	6.3
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	336	1013		431	1211	542	131	570		185	736	329
v/s Ratio Prot	0.18	c0.31		c0.26	0.26		0.01	0.11		c0.06	c0.17	
v/s Ratio Perm						0.02	0.05			c0.22		0.11
v/c Ratio	0.89	1.03		1.03	0.72	0.06	0.29	0.58		0.99	0.79	0.53
Uniform Delay, d1	50.4	45.2		48.2	36.0	27.3	41.3	48.3		43.1	47.9	44.7
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	23.7	36.8		52.6	2.2	0.0	1.2	1.5		64.3	5.9	1.5
Delay (s)	74.1	82.0		100.8	38.2	27.3	42.6	49.8		107.3	53.8	46.2
Level of Service	E	F		F	D	C	D	D		F	D	D
Approach Delay (s)		80.2			57.3			49.3			58.1	
Approach LOS		F			E			D			E	
Intersection Summary												
HCM 2000 Control Delay		63.3									E	
HCM 2000 Volume to Capacity ratio		1.05										
Actuated Cycle Length (s)		129.3									25.4	
Intersection Capacity Utilization		98.1%									F	
Analysis Period (min)		15										
c Critical Lane Group												

3500 HAWTHORNE ROAD TRANSPORTATION IMPACT STUDY

Appendix B INTERSECTION PERFORMANCE WORKSHEETS
MARCH 2017

B.3 2018 TOTAL FUTURE CONDITIONS

Queues
1: Hunt Club Road & Hawthorne Road

3500 Hawthorne Road

2018 Total AM

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	435	712	189	582	128	87	956	54	163	200
v/c Ratio	0.92	0.61	0.77	0.82	0.28	0.22	0.92	0.43	0.19	0.38
Control Delay	80.4	40.2	78.3	62.6	3.5	30.2	55.7	39.3	39.1	7.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	80.4	40.2	78.3	62.6	3.5	30.2	55.7	39.3	39.1	7.2
Queue Length 50th (m)	115.9	86.9	51.1	83.3	0.0	15.8	115.7	9.6	18.2	0.0
Queue Length 95th (m)	#209.7	128.5	#93.1	#136.3	11.2	31.4	#192.6	21.2	31.0	27.0
Internal Link Dist (m)		29.2		205.0			64.2		75.2	
Turn Bay Length (m)	100.0		60.0		100.0	50.0		100.0		80.0
Base Capacity (vph)	532	1196	309	724	461	395	1115	126	1015	594
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.82	0.60	0.61	0.80	0.28	0.22	0.86	0.43	0.16	0.34

Intersection Summary

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

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

1: Hunt Club Road & Hawthorne Road

3500 Hawthorne Road

2018 Total AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑		↑	↑↑	↑	↑	↑↑		↑	↑↑	↑
Traffic Volume (vph)	435	691	21	189	582	128	87	497	459	54	163	200
Future Volume (vph)	435	691	21	189	582	128	87	497	459	54	163	200
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.4	6.4		6.4	6.4	6.4	6.3	6.3		6.3	6.3	6.3
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	0.95		1.00	0.95	1.00
Fr _t	1.00	1.00		1.00	1.00	0.85	1.00	0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1695	3375		1695	3390	1517	1695	3146		1695	3390	1517
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.59	1.00		0.11	1.00	1.00
Satd. Flow (perm)	1695	3375		1695	3390	1517	1049	3146		205	3390	1517
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	435	691	21	189	582	128	87	497	459	54	163	200
RTOR Reduction (vph)	0	1	0	0	0	101	0	119	0	0	0	147
Lane Group Flow (vph)	435	711	0	189	582	27	87	837	0	54	163	53
Turn Type	Prot	NA		Prot	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases						6	4			8		8
Actuated Green, G (s)	36.9	45.4		19.2	27.7	27.7	46.4	38.5		39.2	34.9	34.9
Effective Green, g (s)	36.9	45.4		19.2	27.7	27.7	46.4	38.5		39.2	34.9	34.9
Actuated g/C Ratio	0.28	0.34		0.14	0.21	0.21	0.35	0.29		0.30	0.26	0.26
Clearance Time (s)	6.4	6.4		6.4	6.4	6.4	6.3	6.3		6.3	6.3	6.3
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	470	1153		245	707	316	404	912		108	890	398
v/s Ratio Prot	c0.26	0.21		0.11	c0.17		0.01	c0.27		c0.02	0.05	
v/s Ratio Perm						0.02	0.06			0.13		0.03
v/c Ratio	0.93	0.62		0.77	0.82	0.08	0.22	0.92		0.50	0.18	0.13
Uniform Delay, d1	46.6	36.4		54.7	50.2	42.3	29.7	45.6		36.9	37.9	37.4
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	33.3	1.0		15.3	8.2	0.1	0.3	16.9		3.7	0.1	0.2
Delay (s)	79.9	37.4		69.9	58.4	42.5	29.9	62.5		40.6	38.0	37.5
Level of Service	E	D		E	E	D	C	E		D	D	D
Approach Delay (s)		53.5			58.6			59.8			38.1	
Approach LOS		D			E			E			D	

Intersection Summary

HCM 2000 Control Delay	54.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	132.8	Sum of lost time (s)	25.4
Intersection Capacity Utilization	102.5%	ICU Level of Service	G
Analysis Period (min)	60		

c Critical Lane Group

Intersection

Int Delay, s/veh 0.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↑		↑↑		↑↑
Traffic Vol, veh/h	0	42	0	1060	375	70
Future Vol, veh/h	0	42	0	1060	375	70
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	2	2	2	2
Mvmt Flow	0	42	0	1060	375	70

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	-	223	- 0
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	-	6.94	-
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	-	3.32	-
Pot Cap-1 Maneuver	0	780	0
Stage 1	0	-	0
Stage 2	0	-	0
Platoon blocked, %		-	-
Mov Cap-1 Maneuver	-	780	-
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	9.9	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	780	-	-
HCM Lane V/C Ratio	-	0.054	-	-
HCM Control Delay (s)	-	9.9	-	-
HCM Lane LOS	-	A	-	-
HCM 95th %tile Q(veh)	-	0.2	-	-

Intersection

Int Delay, s/veh 0.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑		↑↑		↑
Traffic Vol, veh/h	0	1147		869	0	0
Future Vol, veh/h	0	1147		869	0	0
Conflicting Peds, #/hr	0	0		0	0	0
Sign Control	Free	Free		Free	Free	Stop
RT Channelized	-	None		-	None	-
Storage Length	-	-		-	-	0
Veh in Median Storage, #	-	0		0	-	0
Grade, %	-	0		0	-	-
Peak Hour Factor	100	100		100	100	100
Heavy Vehicles, %	2	2		2	2	2
Mvmt Flow	0	1147		869	0	27

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	- 0	- 0	- 435
Stage 1	- -	- -	- -
Stage 2	- -	- -	- -
Critical Hdwy	- -	- -	6.94
Critical Hdwy Stg 1	- -	- -	- -
Critical Hdwy Stg 2	- -	- -	- -
Follow-up Hdwy	- -	- -	3.32
Pot Cap-1 Maneuver	0 -	- 0	0 569
Stage 1	0 -	- 0	0 -
Stage 2	0 -	- 0	0 -
Platoon blocked, %	- -	- -	- -
Mov Cap-1 Maneuver	- -	- -	569
Mov Cap-2 Maneuver	- -	- -	- -
Stage 1	- -	- -	- -
Stage 2	- -	- -	- -

Approach	EB	WB	SB
HCM Control Delay, s	0	0	11.6
HCM LOS			B

Minor Lane/Major Mvmt	EBT	WBT	SBLn1
Capacity (veh/h)	- -	569	
HCM Lane V/C Ratio	- -	0.047	
HCM Control Delay (s)	- -	11.6	
HCM Lane LOS	- -	B	
HCM 95th %tile Q(veh)	- -	0.1	

Queues
1: Hunt Club Road & Hawthorne Road

3500 Hawthorne Road

2018 Total PM

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	299	1049	446	877	89	38	500	186	590	528
v/c Ratio	0.88	1.02	1.03	0.72	0.14	0.27	0.70	1.01	0.79	0.74
Control Delay	76.2	78.5	96.8	41.0	1.8	37.5	33.9	109.7	56.1	12.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	76.2	78.5	96.8	41.0	1.8	37.5	33.9	109.7	56.1	12.6
Queue Length 50th (m)	74.3	~155.8	~126.2	108.0	0.0	7.0	36.9	37.4	76.2	8.1
Queue Length 95th (m)	#118.3	#197.7	#190.2	133.1	3.5	15.4	55.8	#74.5	97.3	47.5
Internal Link Dist (m)		29.2		205.0			64.2		75.2	
Turn Bay Length (m)	100.0		60.0		100.0	50.0		100.0		80.0
Base Capacity (vph)	377	1024	435	1220	631	142	798	184	780	725
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.79	1.02	1.03	0.72	0.14	0.27	0.63	1.01	0.76	0.73

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

1: Hunt Club Road & Hawthorne Road

3500 Hawthorne Road

2018 Total PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑		↑	↑↑	↑	↑	↑↑		↑	↑↑	↑
Traffic Volume (vph)	275	905	60	410	807	82	35	209	251	171	543	486
Future Volume (vph)	275	905	60	410	807	82	35	209	251	171	543	486
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.4	6.4		6.4	6.4	6.4	6.3	6.3		6.3	6.3	6.3
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	0.95		1.00	0.95	1.00
Fr _t	1.00	0.99		1.00	1.00	0.85	1.00	0.92		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1695	3359		1695	3390	1517	1695	3113		1695	3390	1517
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.24	1.00		0.20	1.00	1.00
Satd. Flow (perm)	1695	3359		1695	3390	1517	434	3113		353	3390	1517
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	299	984	65	446	877	89	38	227	273	186	590	528
RTOR Reduction (vph)	0	3	0	0	0	57	0	169	0	0	0	382
Lane Group Flow (vph)	299	1046	0	446	877	32	38	331	0	186	590	146
Turn Type	Prot	NA		Prot	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases						6	4			8		8
Actuated Green, G (s)	25.7	38.9		32.9	46.1	46.1	27.6	23.7		36.6	28.2	28.2
Effective Green, g (s)	25.7	38.9		32.9	46.1	46.1	27.6	23.7		36.6	28.2	28.2
Actuated g/C Ratio	0.20	0.30		0.25	0.36	0.36	0.21	0.18		0.28	0.22	0.22
Clearance Time (s)	6.4	6.4		6.4	6.4	6.4	6.3	6.3		6.3	6.3	6.3
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	336	1010		431	1208	540	130	570		187	739	330
v/s Ratio Prot	0.18	c0.31		c0.26	0.26		0.01	0.11		c0.06	c0.17	
v/s Ratio Perm						0.02	0.05			c0.22		0.10
v/c Ratio	0.89	1.04		1.03	0.73	0.06	0.29	0.58		0.99	0.80	0.44
Uniform Delay, d1	50.4	45.2		48.2	36.1	27.3	41.3	48.3		43.0	47.9	43.7
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	23.7	37.8		52.6	2.2	0.0	1.3	1.5		63.9	6.0	0.9
Delay (s)	74.1	83.0		100.8	38.3	27.4	42.6	49.8		106.9	53.9	44.7
Level of Service	E	F		F	D	C	D	D		F	D	D
Approach Delay (s)		81.0			57.4			49.3			57.7	
Approach LOS		F			E			D			E	
Intersection Summary												
HCM 2000 Control Delay		63.4			HCM 2000 Level of Service				E			
HCM 2000 Volume to Capacity ratio		1.05										
Actuated Cycle Length (s)		129.3			Sum of lost time (s)				25.4			
Intersection Capacity Utilization		98.2%			ICU Level of Service				F			
Analysis Period (min)		15										
c Critical Lane Group												

Intersection

Int Delay, s/veh 0.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↑		↑↑		↑↑
Traffic Vol, veh/h	0	44	0	566	1155	75
Future Vol, veh/h	0	44	0	566	1155	75
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	2	2	2	2
Mvmt Flow	0	44	0	566	1155	75

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	-	615	- 0
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	-	6.94	-
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	-	3.32	-
Pot Cap-1 Maneuver	0	434	0
Stage 1	0	-	0
Stage 2	0	-	0
Platoon blocked, %		-	-
Mov Cap-1 Maneuver	-	434	-
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	14.2	0	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	434	-	-
HCM Lane V/C Ratio	-	0.101	-	-
HCM Control Delay (s)	-	14.2	-	-
HCM Lane LOS	-	B	-	-
HCM 95th %tile Q(veh)	-	0.3	-	-

Intersection

Int Delay, s/veh 0.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑		↑↑		↑
Traffic Vol, veh/h	0	1240		1328	0	0
Future Vol, veh/h	0	1240		1328	0	0
Conflicting Peds, #/hr	0	0		0	0	0
Sign Control	Free	Free		Free	Free	Stop
RT Channelized	-	None		-	None	-
Storage Length	-	-		-	-	0
Veh in Median Storage, #	-	0		0	-	0
Grade, %	-	0		0	-	-
Peak Hour Factor	100	100		100	100	100
Heavy Vehicles, %	2	2		2	2	2
Mvmt Flow	0	1240		1328	0	30

Major/Minor	Major1	Major2	Minor2	
Conflicting Flow All	-	0	-	664
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Critical Hdwy	-	-	-	6.94
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	-	-	-	3.32
Pot Cap-1 Maneuver	0	-	0	403
Stage 1	0	-	0	-
Stage 2	0	-	0	-
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	-	-	-	403
Mov Cap-2 Maneuver	-	-	-	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	14.7
HCM LOS			B

Minor Lane/Major Mvmt	EBT	WBT	SBLn1
Capacity (veh/h)	-	-	403
HCM Lane V/C Ratio	-	-	0.074
HCM Control Delay (s)	-	-	14.7
HCM Lane LOS	-	-	B
HCM 95th %tile Q(veh)	-	-	0.2

3500 HAWTHORNE ROAD TRANSPORTATION IMPACT STUDY

Appendix B INTERSECTION PERFORMANCE WORKSHEETS
MARCH 2017

B.4 2023 ULTIMATE CONDITIONS

Queues
1: Hunt Club Road & Hawthorne Road

3500 Hawthorne Road
2023 Ultimate AM

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	476	779	206	637	140	95	1046	59	178	221
v/c Ratio	0.97	0.68	0.81	0.94	0.32	0.24	0.98	0.49	0.20	0.39
Control Delay	103.0	43.3	85.4	87.1	4.8	30.7	80.9	43.4	39.6	6.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	103.0	43.3	85.4	87.1	4.8	30.7	80.9	43.4	39.6	6.9
Queue Length 50th (m)	131.1	99.5	55.4	93.0	0.0	17.3	~135.9	10.5	20.0	0.0
Queue Length 95th (m)	#237.9	143.7	#105.8	#155.7	15.3	33.7	#223.5	#23.4	33.6	28.9
Internal Link Dist (m)		29.2		205.0			64.2		75.2	
Turn Bay Length (m)	100.0		60.0		100.0	50.0		100.0		80.0
Base Capacity (vph)	504	1152	292	685	446	401	1065	120	961	588
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.94	0.68	0.71	0.93	0.31	0.24	0.98	0.49	0.19	0.38

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

1: Hunt Club Road & Hawthorne Road

3500 Hawthorne Road

2023 Ultimate AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑		↑	↑↑	↑	↑	↑↑		↑	↑↑	↑
Traffic Volume (vph)	476	756	23	206	637	140	95	544	502	59	178	221
Future Volume (vph)	476	756	23	206	637	140	95	544	502	59	178	221
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.4	6.4		6.4	6.4	6.4	6.3	6.3		6.3	6.3	6.3
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	0.95		1.00	0.95	1.00
Fr _t	1.00	1.00		1.00	1.00	0.85	1.00	0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1695	3375		1695	3390	1517	1695	3146		1695	3390	1517
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.59	1.00		0.11	1.00	1.00
Satd. Flow (perm)	1695	3375		1695	3390	1517	1044	3146		189	3390	1517
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	476	756	23	206	637	140	95	544	502	59	178	221
RTOR Reduction (vph)	0	1	0	0	0	112	0	119	0	0	0	161
Lane Group Flow (vph)	476	778	0	206	637	28	95	927	0	59	178	60
Turn Type	Prot	NA		Prot	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases						6	4			8		8
Actuated Green, G (s)	39.8	46.6		20.5	27.3	27.3	49.1	41.2		42.1	37.7	37.7
Effective Green, g (s)	39.8	46.6		20.5	27.3	27.3	49.1	41.2		42.1	37.7	37.7
Actuated g/C Ratio	0.29	0.34		0.15	0.20	0.20	0.36	0.30		0.30	0.27	0.27
Clearance Time (s)	6.4	6.4		6.4	6.4	6.4	6.3	6.3		6.3	6.3	6.3
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	488	1138		251	670	299	408	938		105	925	414
v/s Ratio Prot	c0.28	0.23		0.12	c0.19		0.01	c0.29		c0.02	0.05	
v/s Ratio Perm						0.02	0.07			0.15		0.04
v/c Ratio	0.98	0.68		0.82	0.95	0.09	0.23	0.99		0.56	0.19	0.15
Uniform Delay, d1	48.7	39.4		57.0	54.7	45.3	30.4	48.2		38.7	38.5	38.0
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	59.4	1.7		21.9	34.4	0.1	0.3	48.2		6.9	0.1	0.2
Delay (s)	108.1	41.1		78.9	89.1	45.4	30.7	96.5		45.5	38.6	38.2
Level of Service	F	D		E	F	D	C	F		D	D	D
Approach Delay (s)		66.5			80.8			91.0			39.3	
Approach LOS		E			F			F			D	

Intersection Summary

HCM 2000 Control Delay	74.2	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	138.1	Sum of lost time (s)	25.4
Intersection Capacity Utilization	107.7%	ICU Level of Service	G
Analysis Period (min)	60		

c Critical Lane Group

Intersection

Int Delay, s/veh 0.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↑		↑↑		↑↑
Traffic Vol, veh/h	0	42	0	1160	416	70
Future Vol, veh/h	0	42	0	1160	416	70
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	2	2	2	2
Mvmt Flow	0	42	0	1160	416	70

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	-	243	- 0
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	-	6.94	-
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	-	3.32	-
Pot Cap-1 Maneuver	0	758	0
Stage 1	0	-	0
Stage 2	0	-	0
Platoon blocked, %		-	-
Mov Cap-1 Maneuver	-	758	-
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10	0	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	758	-	-
HCM Lane V/C Ratio	-	0.055	-	-
HCM Control Delay (s)	-	10	-	-
HCM Lane LOS	-	B	-	-
HCM 95th %tile Q(veh)	-	0.2	-	-

Intersection

Int Delay, s/veh 0.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑		↑↑		↑
Traffic Vol, veh/h	0	1255		953	0	0
Future Vol, veh/h	0	1255		953	0	0
Conflicting Peds, #/hr	0	0		0	0	0
Sign Control	Free	Free		Free	Stop	Stop
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
Heavy Vehicles, %	2	2		2	2	2
Mvmt Flow	0	1255		953	0	27

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	- 0	- 0	- 477
Stage 1	- -	- -	- -
Stage 2	- -	- -	- -
Critical Hdwy	- -	- -	6.94
Critical Hdwy Stg 1	- -	- -	-
Critical Hdwy Stg 2	- -	- -	-
Follow-up Hdwy	- -	- -	3.32
Pot Cap-1 Maneuver	0 -	- 0	0 534
Stage 1	0 -	- 0	0 -
Stage 2	0 -	- 0	0 -
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	- -	- -	534
Mov Cap-2 Maneuver	- -	- -	-
Stage 1	- -	- -	- -
Stage 2	- -	- -	- -

Approach	EB	WB	SB
HCM Control Delay, s	0	0	12.1
HCM LOS			B

Minor Lane/Major Mvmt	EBT	WBT	SBLn1
Capacity (veh/h)	-	-	534
HCM Lane V/C Ratio	-	-	0.051
HCM Control Delay (s)	-	-	12.1
HCM Lane LOS	-	-	B
HCM 95th %tile Q(veh)	-	-	0.2

Queues
1: Hunt Club Road & Hawthorne Road

3500 Hawthorne Road
2023 Ultimate PM

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	326	1149	488	960	97	41	548	202	646	580
v/c Ratio	0.96	1.08	1.21	0.80	0.16	0.32	0.75	1.14	0.84	0.84
Control Delay	89.9	92.4	158.1	44.5	2.3	39.0	37.4	147.9	58.7	22.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	89.9	92.4	158.1	44.5	2.3	39.0	37.4	147.9	58.7	22.8
Queue Length 50th (m)	84.4	~177.5	~156.4	119.7	0.0	7.5	43.8	~42.7	84.8	32.7
Queue Length 95th (m)	#141.4	#220.0	#222.1	146.4	5.4	16.2	64.1	#91.9	#112.1	#97.7
Internal Link Dist (m)		29.2		205.0			64.2		75.2	
Turn Bay Length (m)	100.0		60.0		100.0	50.0		100.0		80.0
Base Capacity (vph)	348	1068	403	1197	621	130	795	177	783	698
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.94	1.08	1.21	0.80	0.16	0.32	0.69	1.14	0.83	0.83

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

1: Hunt Club Road & Hawthorne Road

3500 Hawthorne Road

2023 Ultimate PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑		↑	↑↑	↑	↑	↑↑		↑	↑↑	↑
Traffic Volume (vph)	300	991	66	449	883	89	38	229	275	186	594	534
Future Volume (vph)	300	991	66	449	883	89	38	229	275	186	594	534
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.4	6.4		6.4	6.4	6.4	6.3	6.3		6.3	6.3	6.3
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	0.95		1.00	0.95	1.00
Fr _t	1.00	0.99		1.00	1.00	0.85	1.00	0.92		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1695	3358		1695	3390	1517	1695	3113		1695	3390	1517
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.20	1.00		0.16	1.00	1.00
Satd. Flow (perm)	1695	3358		1695	3390	1517	359	3113		290	3390	1517
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	326	1077	72	488	960	97	41	249	299	202	646	580
RTOR Reduction (vph)	0	3	0	0	0	63	0	169	0	0	0	350
Lane Group Flow (vph)	326	1146	0	488	960	34	41	379	0	202	646	230
Turn Type	Prot	NA		Prot	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases						6	4			8		8
Actuated Green, G (s)	26.0	40.8		30.7	45.5	45.5	28.4	24.5		38.0	29.3	29.3
Effective Green, g (s)	26.0	40.8		30.7	45.5	45.5	28.4	24.5		38.0	29.3	29.3
Actuated g/C Ratio	0.20	0.31		0.24	0.35	0.35	0.22	0.19		0.29	0.23	0.23
Clearance Time (s)	6.4	6.4		6.4	6.4	6.4	6.3	6.3		6.3	6.3	6.3
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	338	1053		399	1185	530	118	586		178	763	341
v/s Ratio Prot	0.19	c0.34		c0.29	c0.28		0.01	0.12		c0.08	c0.19	
v/s Ratio Perm						0.02	0.07			c0.25		0.15
v/c Ratio	0.96	1.09		1.22	0.81	0.06	0.35	0.65		1.13	0.85	0.67
Uniform Delay, d1	51.6	44.6		49.7	38.4	28.1	41.4	48.8		41.7	48.2	46.0
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	39.2	54.8		120.9	4.3	0.1	1.8	2.5		108.3	8.6	5.2
Delay (s)	90.8	99.5		170.6	42.7	28.2	43.1	51.3		150.0	56.9	51.2
Level of Service	F	F		F	D	C	D	D		F	E	D
Approach Delay (s)		97.6			82.2			50.7			67.7	
Approach LOS		F			F			D			E	
Intersection Summary												
HCM 2000 Control Delay		78.9									E	
HCM 2000 Volume to Capacity ratio		1.18										
Actuated Cycle Length (s)		130.1									25.4	
Intersection Capacity Utilization		105.5%									G	
Analysis Period (min)		15										
c Critical Lane Group												

Intersection

Int Delay, s/veh 0.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↑		↑↑		↑↑
Traffic Vol, veh/h	0	44	0	618	1269	75
Future Vol, veh/h	0	44	0	618	1269	75
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	2	2	2	2
Mvmt Flow	0	44	0	618	1269	75

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	-	672	- 0
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	-	6.94	-
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	-	3.32	-
Pot Cap-1 Maneuver	0	398	0
Stage 1	0	-	0
Stage 2	0	-	0
Platoon blocked, %		-	-
Mov Cap-1 Maneuver	-	398	-
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	15.2	0	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	-	398	-	-
HCM Lane V/C Ratio	-	0.111	-	-
HCM Control Delay (s)	-	15.2	-	-
HCM Lane LOS	-	C	-	-
HCM 95th %tile Q(veh)	-	0.4	-	-

Intersection

Int Delay, s/veh 0.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑		↑↑		↑
Traffic Vol, veh/h	0	1357	1455	0	0	30
Future Vol, veh/h	0	1357	1455	0	0	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
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	2	2	2	2
Mvmt Flow	0	1357	1455	0	0	30

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	- 0	- 0	- 728
Stage 1	- -	- -	- -
Stage 2	- -	- -	- -
Critical Hdwy	- -	- -	6.94
Critical Hdwy Stg 1	- -	- -	-
Critical Hdwy Stg 2	- -	- -	-
Follow-up Hdwy	- -	- -	3.32
Pot Cap-1 Maneuver	0 -	- 0	0 366
Stage 1	0 -	- 0	0 -
Stage 2	0 -	- 0	0 -
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	- -	- -	366
Mov Cap-2 Maneuver	- -	- -	-
Stage 1	- -	- -	- -
Stage 2	- -	- -	- -

Approach	EB	WB	SB
HCM Control Delay, s	0	0	15.7
HCM LOS			C

Minor Lane/Major Mvmt	EBT	WBT	SBLn1
Capacity (veh/h)	-	-	366
HCM Lane V/C Ratio	-	-	0.082
HCM Control Delay (s)	-	-	15.7
HCM Lane LOS	-	-	C
HCM 95th %tile Q(veh)	-	-	0.3