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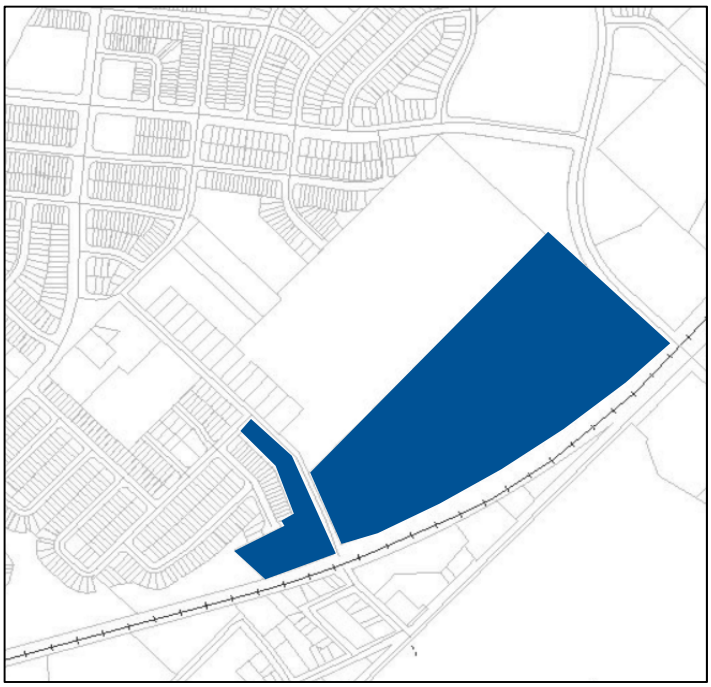
Cityview Ridge
Guelph, Ontario
Traffic Impact Study



Prepared for:
Carson Reid

September 2014

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Project Summary

Project Name: ..... **Cityview Ridge**
Guelph, Ontario
Traffic Impact Study

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Report Date: ..... **September 2014**
Project Number: **140210**

Executive Summary

Content

This report summarizes the traffic impact study for a proposed residential subdivision located generally north of the Canadian National Rail line between Starwood Drive and Cityview Drive in the City of Guelph on a vacant parcel of land. The report documents the additional traffic that is estimated to occur as a result of the development and assesses the impact of the traffic on the surrounding road network. The findings, conclusions, and recommendations of this study are summarized below and outlined in more detail in the body of the report.

Summary and Conclusions

The main conclusions of this study are as follows:

- **Proposed Development:** The subject site is located generally north of the Canadian National Rail line between Starwood Drive and Cityview Drive in the City of Guelph on a vacant parcel of land. The lands are planned to be developed as a residential subdivision with approximately 261 new residential units. The build-out of the subject site is anticipated to occur with an estimated completion date of year 2019.

- **Existing Traffic Conditions:** The study area is generally defined as the Grange Road corridor from Cityview Drive to Starwood Drive and the Starwood Drive corridor from Grange Road to Watson Parkway. The intersections in the study area are currently operating with satisfactory levels of service during the AM and PM peak hours. No improvements are required to address the operation of the intersections in the study area.

- **Background Traffic:** The background traffic volumes in the vicinity of the subject site have been assessed for a five-year horizon following the full build-out and occupancy of the subject site, assumed to be the year 2019. The background traffic volumes are estimated to consist of generalized traffic growth and traffic related to the potential future development of four surrounding residential developments, the future UGDSB Stockford Road school site and a commercial development at the Starwood Drive intersection with Watson Parkway.

- **Background Traffic Conditions:** The Cityview Drive intersection with Grange Road is estimated to operate at LOS E on the side street approach. All other study area intersections are anticipated to continue to operate with satisfactory levels of service during the AM and PM peak hours. However, under background traffic conditions, left turn traffic meet MTO warrants at some locations and the need to extend some left-turn storage lanes at the signalized intersections of Starwood Drive with Grange Road and Watson Parkway increases from existing conditions.

- **Development Generated Traffic:** The planned development of the 261 residential unit subdivision is estimated to generate approximately 161 new vehicle trips during the AM peak hour and approximately 206 new vehicle trips during the PM peak hour. The additional traffic estimated to be generated by the subject site will not have a significant impact on the operations of the study area intersections over background traffic conditions and will result in volumes well within the guidelines for the respective local and collector roadway classifications.

- **Total Traffic Conditions:** With the build-out of the subject site, the level of service at the study area intersections is anticipated to be similar to the background traffic conditions. The intersections,

where side street delays begin to increase may result in traffic diverting towards other local connections to the collector road network.

- **Traffic Control Requirements:** With exception to the Starwood Drive intersection with Watson Parkway, the existing form of traffic control at the study area intersection is considered to be acceptable. With the development of the Grangehill Commercial Development at 115 Watson Parkway North the OTM signal warrant criteria is satisfied the Starwood Drive intersection with Watson Parkway. The need for signalization is not solely due to the subject site.

- **Auxiliary Turn Lane Requirements:** Under the background traffic conditions, a southbound left-turn lane is warranted at the Grange Road intersection with Cityview Drive. Additionally, an eastbound and a westbound left-turn lane is warranted at the Starwood Drive intersection with Keating Street/Fleming Road. The requirement for left turn lanes are primarily due to background traffic.

- **Alternative Connection Scenarios:** With an additional connection to Starwood Drive thru the 55-57 Cityview lands, the operational conditions at the study area intersection will not improve at the Keating/Fleming intersection which is the only intersection affected. A new connection to Starwood Drive would reduce traffic on the Keating/Fleming approach to Starwood Drive and would not resolve any capacity issues.

RECOMMENDATIONS

Based on the findings of this study, the following is recommended:

- For a complete road network that is capable of accommodating all modes of transport, sidewalk facilities should be developed on both sides of all roadways internal to the subject site.

- Under the forecast background traffic volumes, the operational conditions on the side street approaches of Cityview Drive to Grange Road and Keating Street/Fleming Road to Starwood Drive will begin to deteriorate. The City of Guelph should monitor the operations of these intersections in the future to ensure adequate traffic control is provided as background and site traffic may divert from these intersection to avoid delays resulting in acceptable operations.

- The City of Guelph should monitor the operation of the Starwood Drive intersection with Grange Road and Watson Parkway to ensure that the intersections queuing requirements are satisfied by the available storage lane lengths. Should the future queuing conditions deteriorate, consideration should be given to extending the available storage lane lengths.

- The City of Guelph should review the existing right-of-ways of Grange Road at Cityview Drive and Starwood Drive at Keating Street/Fleming Road to determine the feasibility of providing auxiliary left-turn lanes on the mainline approaches.

An additional connection to Starwood Drive is not recommended for the following reasons:

- As a minor collector roadway future traffic levels on Keating/Fleming will be well within what is expected for this road function. Peak volumes will be approximately 4 vehicles per minute which is not excessive for a residential street.

- The new connection will affect a local street within the 55-57 Plan exceeding the recommended volumes for this type of street.

- Environmental and property issues occur with either new connection scenarios.
- The new connection does not resolve any capacity issues as indicated by the analysis below.

Based on the findings of this study, no other roadway or traffic control improvements are required or recommended to accommodate both background traffic and the development of the subject site.

Contents

Appendices

Figures

Tables

1.0 Introduction

1.1 Overview

Paradigm Transportation Solutions Limited was retained by Carson Reid Homes Limited to undertake a traffic impact study for the proposed residential subdivision located generally north of the Canadian National Rail line between Starwood Drive and Cityview Drive in the City of Guelph on a vacant parcel of land.

The purpose of the study is to determine the impact of the development on the surrounding road network. The scope of the study includes documenting the current traffic and site conditions in the vicinity of the development, assessing additional traffic that will be generated by the development, analyses of the impact of the traffic up to full occupancy and recommendations on the remedial measures necessary (if any) to accommodate the site generated traffic in a satisfactory manner.

1.2 Study Area

The approximate location of the subject site is illustrated in **Figure 1.1**. The community surrounding the subject site is comprised mostly of low density residential homes with a small mix of commercial shops and higher density residential units located at the Starwood Drive and Grange Road intersection.

The following existing intersections have been analyzed in this report to examine the impacts of additional traffic due to the development of the subject site:

1) Starwood Drive and Grange Road (Signalized);

2) Starwood Drive and Lee Street (Unsignalized);

3) Starwood Drive and Keating Street/Fleming Road (Unsignalized);

4) Starwood Drive and Watson Parkway (Unsignalized)

5) Cityview Drive and Grange Road (Unsignalized); and

6) Cityview Drive and Lee Street (Unsignalized).

North

NTS
Image Source: maps.guelph.ca

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Figure 1.1
Location of Subject Site

2.0 Existing Conditions

This section provides an overview of the existing conditions of the roadways within the study area. The roadways include Grange Road, Cityview Drive, Starwood Drive, and Keating Street/Fleming Road. **Figure 2.1** illustrates the existing lane configurations at the intersections within the study area as well as the traffic control provisions.

2.1 Transit Service

The area is currently serviced by a single Guelph Transit (GT) route. **Figure 2.2** illustrates the current GT route and bus stops in the vicinity of the subject site. Route 14 – Grange provides transit service seven days a week along both Grange Road and Starwood Drive with peak headways of 15 minutes and off-peak headways of 30 minutes.

2.2 Traffic Volumes

The traffic volumes used to establish the existing traffic horizon have been derived from turning movement counts conducted by Paradigm staff during November 2011, March 2012, and April, March and October 2013 at the study area intersections. Based on the recent turning movement counts volume-balancing was completed to ensure a more consistent flow of traffic between adjacent intersections in the study area.

For the purposes of this report it is assumed that Starwood Drive and Cityview Drive run east/west. The existing traffic volumes are illustrated in **Figure 2.3A** and **Figure 2.3B**.

Figure 2.1
Existing Lane Configuration and Traffic Control

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Image Source: maps.guelph.ca

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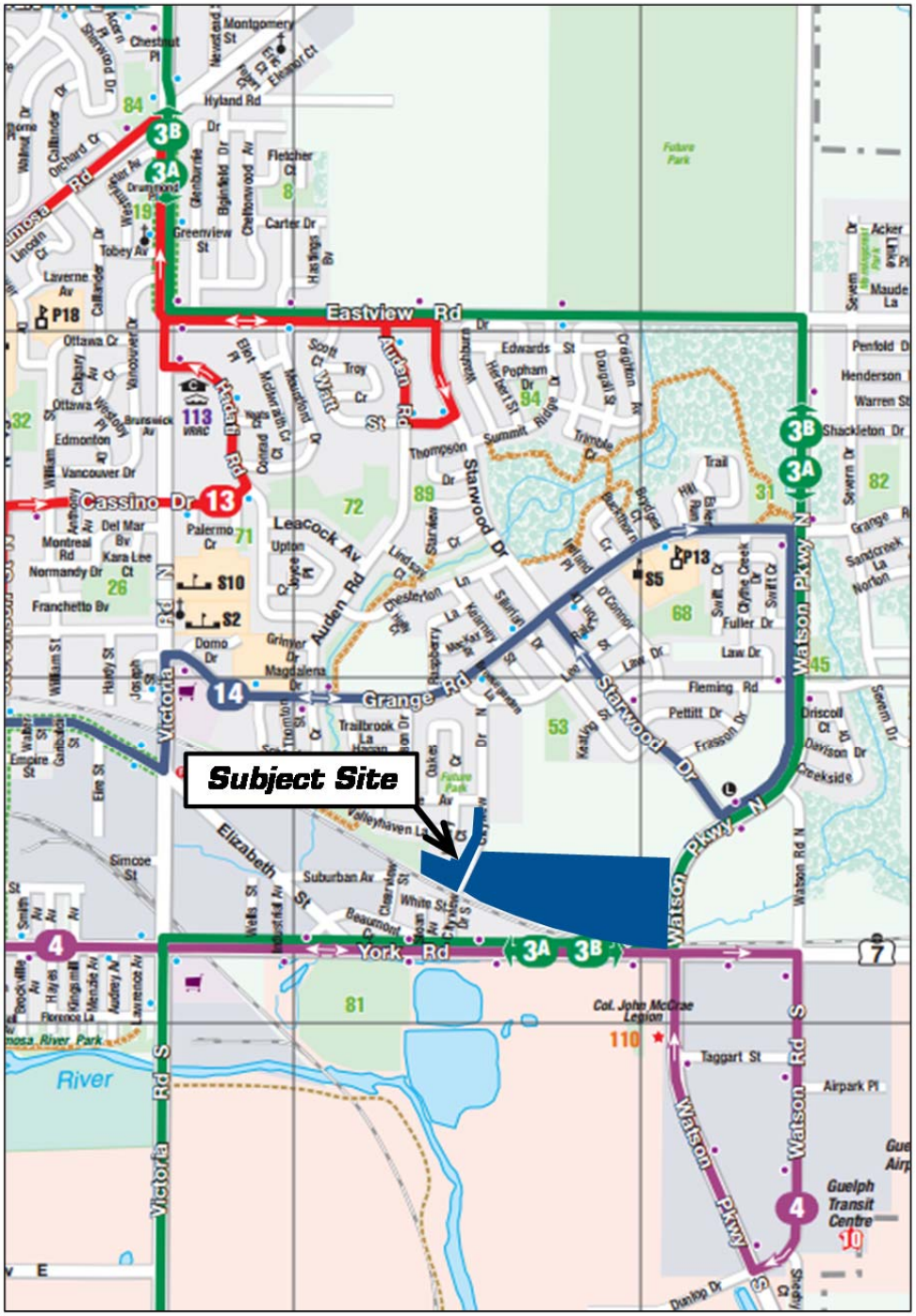

NTS
Image Source: http://guelph.ca/living/getting-around/bus/

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Figure 2.2
Existing Guelph Transit Routes

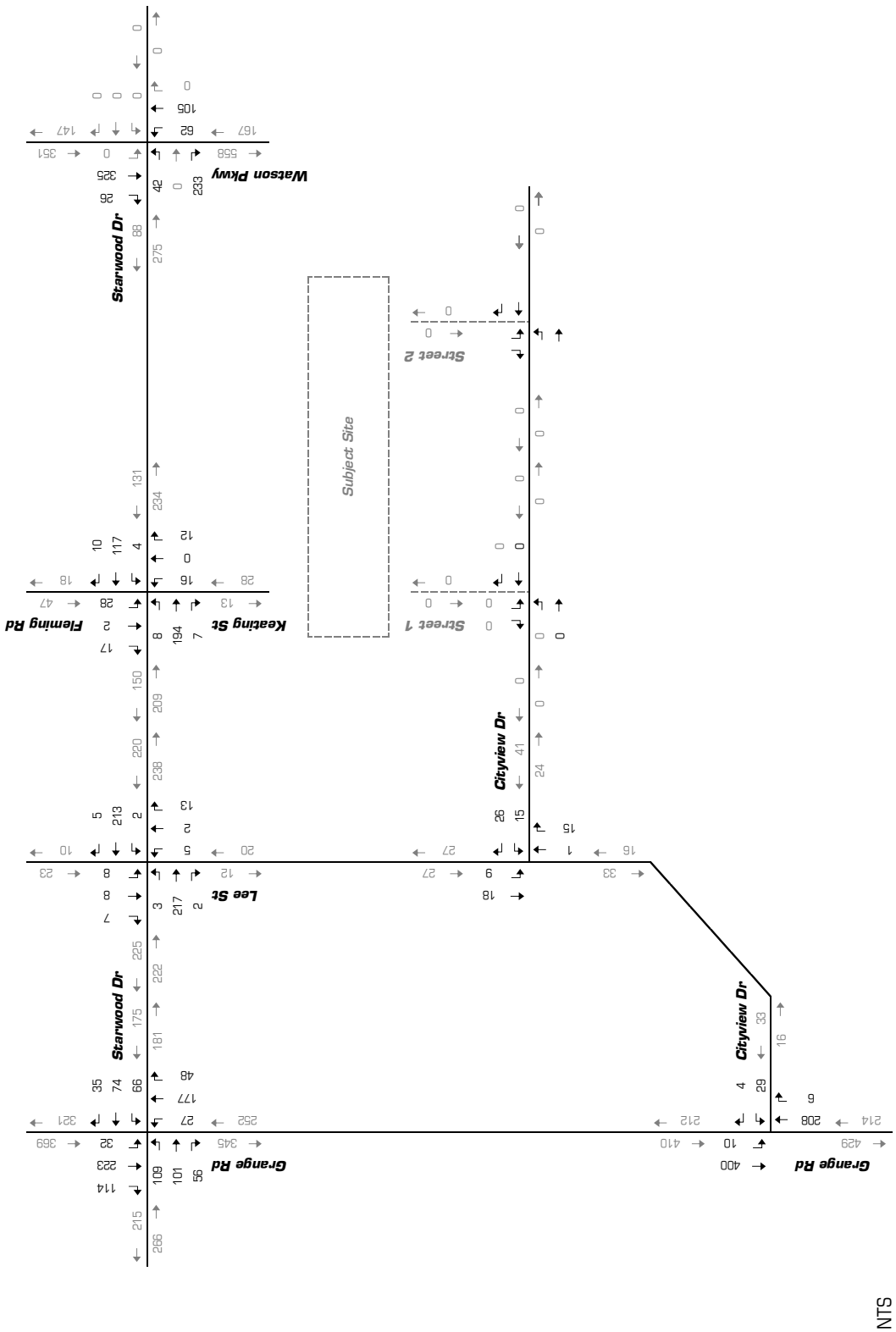

Figure 2.3A
Existing Traffic - AM Peak hour

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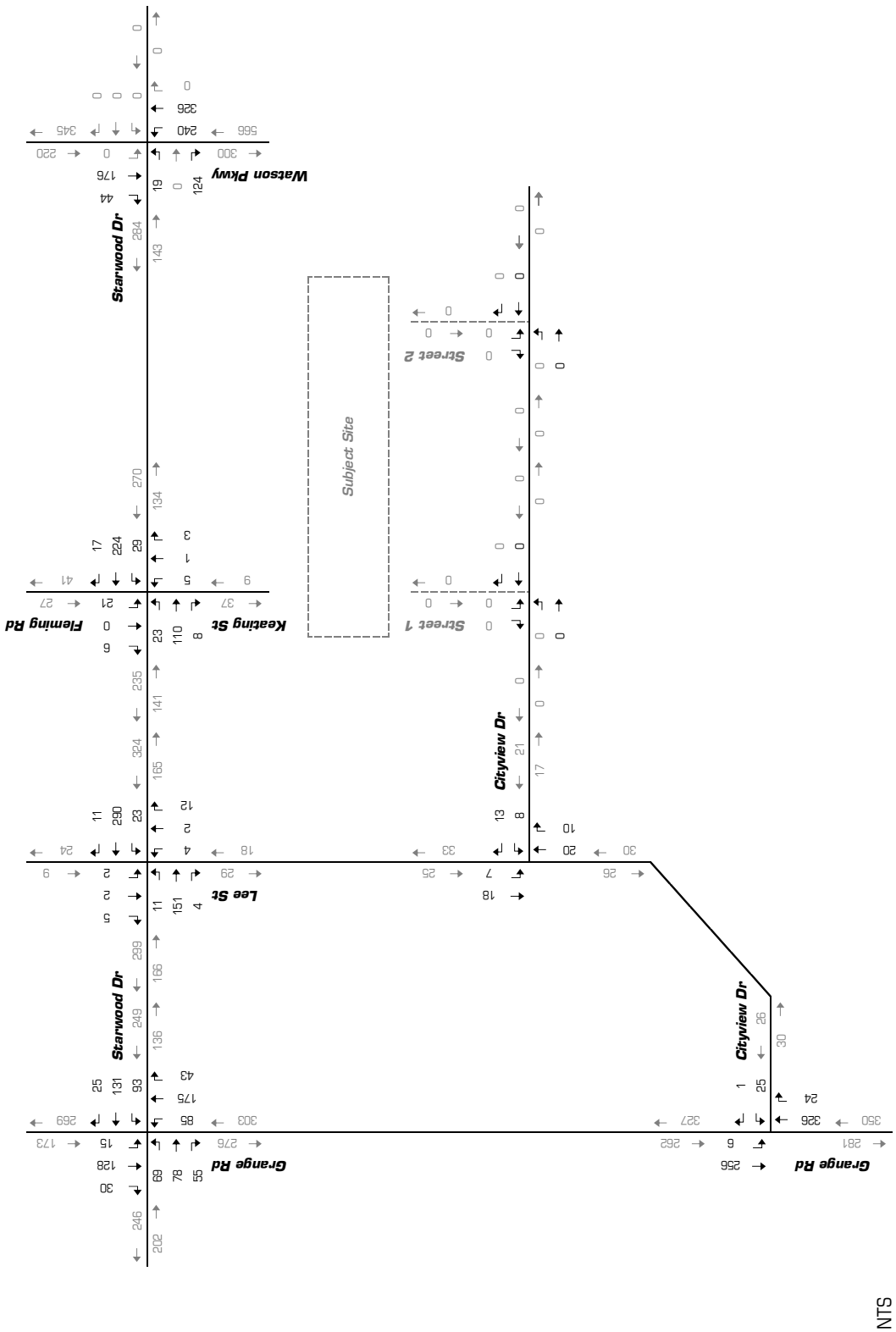

Figure 2.3B
Existing Traffic – PM Peak Hour

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2.3 Traffic Operations

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

The highest possible rating is LOS A, under which the average total delay is equal or less than 10 seconds per vehicle. When the average delay exceeds 80 seconds at signalized intersections, the movement is classified as LOS F and remedial measures are usually implemented, if they are feasible.

The operations of the intersections in the study area were evaluated using the existing lane geometry and signal timing data collected by Paradigm in the field. The intersection analysis considered three separate measures of performance:

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

The level of service conditions on the existing road network have been assessed using Synchro 7.0 with HCM 2000 procedures. Movements are considered critical under the following conditions:

- Level of service on individual movements exceeds LOS "E";
- Volume to capacity ratios for overall intersection operations, through movements or shared/turning movements increased to 0.85 or greater;
- Volume to capacity ratios for exclusive movements increased to 0.90 or above; or
- Queue lengths for individual movements that are estimated to exceed the available storage.

Level of service analysis was conducted on the existing traffic volumes for the study area. The existing intersection operations are summarized in **Table 2.1A** and **Table 2.1B** and the following is noted:

AM Peak Hour

- The signalized intersection of Starwood Drive with Grange Road is operating with satisfactory levels of service on all approaches. Overall, the intersection is operating with delays in the LOS B range with a v/c ratio of 0.37. The 95th percentile queue lengths estimated to be fully contained by the existing available storage lane lengths.
- The unsignalized intersections in the study area are operating with satisfactory levels of service on all approaches.
- No movements are considered critical.

PM Peak Hour

- The signalized intersection of Starwood Drive with Grange Road is operating with satisfactory levels of service on all approaches. Overall, the intersection is operating with delays in the LOS B range with a v/c ratio of 0.23. The 95th percentile queue lengths estimated to be fully contained by the existing available storage lane lengths.
- The unsignalized intersections are operating with satisfactory levels of service on all approaches.
- No movements are considered critical.

Detailed Synchro 7.0 output is provided in **Appendix A**.

Table 2.1A: Existing Traffic Operational Conditions – AM Peak Hour

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach															
				EB - LEFT	EB - THROUGH	EB - RIGHT	EB APPROACH	WB - LEFT	WB - THROUGH	WB - RIGHT	WB APPROACH	NB - LEFT	NB - THROUGH	NB - RIGHT	NB APPROACH	SB - LEFT	SB - THROUGH	SB - RIGHT	SB APPROACH	OVERALL
AM Peak Hour	Starwood Drive & Grange Road	TCS	LOS	C	C	B	C	C	C	B	C	A	A	>	A	A	A	>	A	B
			Delay	23.3	21.5	20.0	21.9	21.9	21.0	19.9	21.1	4.2	5.0	>	4.9	4.1	5.7	>	5.6	12.1
			V/C	0.47	0.29	0.04		0.31	0.22	0.03		0.06	0.23	>		0.05	0.34	>		0.37
			Q 95th	20	18	6		13	14	5		6	30	>		7	45	>		
			Ex.	30	-	30		25	-	25		20	-	>		20	-	>		
			Avail	10	-	25		12	-	21		14	-	>		13	-	>		
	Starwood Drive & Lee Street	TWSC	LOS	<	A	>	A	<	A	>	A	<	B	>	B	<	B	>	B	
			Delay	<	0.1	>	0.1	<	0.1	>	0.1	<	11.6	>	11.6	<	13.2	>	13.2	
			V/C	<	0.00	>		<	0.00	>		<	0.05	>		<	0.06	>		
			Q 95th	<	0	>		<	0	>		<	1	>		<	2	>		
			Ex.	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail	<	-	>		<	-	>		<	-	>		<	-	>		
	Starwood Drive & Keating Street/Fleming Road	TWSC	LOS	<	A	>	A	<	A	>	A	<	B	>	B	<	B	>	B	
			Delay	<	0.3	>	0.3	<	0.3	>	0.3	<	11.1	>	11.1	<	11.2	>	11.2	
			V/C	<	0.01	>		<	0.00	>		<	0.05	>		<	0.08	>		
			Q 95th	<	0	>		<	0	>		<	1	>		<	2	>		
			Ex.	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail	<	-	>		<	-	>		<	-	>		<	-	>		
	Starwood Drive & Watson Parkway	TWSC	LOS	B		A	A					A	A		A		A	A	A	
			Delay	11.8		8.5						8.5	0.0		3.2		0.0	0.0	0.0	
			V/C	0.31		0.06						0.06	0.03				0.14	0.09		
			Q 95th	10.5		2						2	0				0	0		
			Ex.	-		30						30	-				-	-		
			Avail	-		28						28	-				-	-		
	Cityview Drive & Grange Road	TWSC	LOS					C		>	C		A	>	A	<	A		A	
			Delay					16.1		>	16.1		0.0	>	0.0	<	0.3		0.3	
			V/C					0.11		>			0.16	>		<	0.01			
			Q 95th					3		>			0	>		<	0			
			Ex.					-		>			-	>		<	-			
			Avail					-		>			-	>		<	-			
	Cityview Drive & Lee Street	TWSC	LOS					A		>	A		A	>	A	<	A		A	
			Delay					8.8		>	8.8		0.0	>	0.0	<	2.5		2.5	
			V/C					0.05		>			0.01	>		<	0.01			
			Q 95th					1		>			0	>		<	0			
			Ex.					-		>			-	>		<	-			
			Avail					-		>			-	>		<	-			

MOE - Measure of Effectiveness
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
LOS - Level of Service
V/C - Volume to Capacity Ratio
> - Shared Right-Turn Lane
< - Shared Left-Turn Lane
Q - Queue Length
95th - 95th Percentile Queue Length (m)
Ex. - Existing Storage (m)
Avail. - Available Storage (m)

TABLE 2.1B: EXISTING TRAFFIC OPERATIONAL CONDITIONS – PM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				EB - LEFT	EB - THROUGH	EB - RIGHT	EB APPROACH	WB - LEFT	WB - THROUGH	WB - RIGHT	WB APPROACH	NB - LEFT	NB - THROUGH	NB - RIGHT	NB APPROACH	SB - LEFT	SB - THROUGH	SB - RIGHT	SB APPROACH	OVERALL
PM Peak Hour	Starwood Drive & Grange Road	TCS	LOS	C	C	C	C	C	C	C	C	A	A	>	A	A	A	>	A	B
			Delay	22.3	21.6	20.6	21.6	22.9	22.5	20.5	22.5	4.1	4.4	>	4.3	3.7	4.1	>	4.1	12.9
			V/C	0.28	0.21	0.04		0.36	0.35	0.02		0.11	0.18	>		0.02	0.13	>		0.23
			Q 95th	13	14	6		17	21	4		14	28	>		4	20	>		
			Ex.	30	-	30		25	-	25		20	-	>		20	-	>		
			Avail	17	-	24		9	-	21		6	-	>		16	-	>		
	Starwood Drive & Lee Street	TWSC	LOS	<	A	>	A	<	A	>	A	<	B	>	B	<	B	>	B	
			Delay	<	0.6	>	0.6	<	0.7	>	0.7	<	10.8	>	10.8	<	11.8	>	11.8	
			V/C	<	0.01	>		<	0.02	>		<	0.03	>		<	0.02	>		
			Q 95th	<	0	>		<	0	>		<	1	>		<	0	>		
			Ex.	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail	<	-	>		<	-	>		<	-	>		<	-	>		
	Starwood Drive & Keating Street/Fleming Road	TWSC	LOS	<	A	>	A	<	A	>	A	<	B	>	B	<	B	>	B	
			Delay	<	1.4	>	1.4	<	1.0	>	1.0	<	11.5	>	11.5	<	12.4	>	12.4	
			V/C	<	0.02	>		<	0.02	>		<	0.02	>		<	0.06	>		
			Q 95th	<	1	>		<	1	>		<	0	>		<	1	>		
			Ex.	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail	<	-	>		<	-	>		<	-	>		<	-	>		
	Starwood Drive & Watson Parkway	TWSC	LOS	B		A	A					A	A		A		A	A	A	
			Delay	11.3		8.3						8.3	0.0		3.5		0.0	0.0	0.0	
			V/C	0.15		0.19						0.19	0.10				0.07	0.06		
			Q 95th	4.1		6						6	0				0	0		
			Ex.	-		30						30	-				-	-		
			Avail	-		24						24	-				-	-		
	Cityview Drive & Grange Road	TWSC	LOS					B		>	B		A	>	A	<	A		A	
			Delay					15.0		>	15.0		0.0	>	0.0	<	0.2		0.2	
			V/C					0.08		>			0.25	>		<	0.01			
			Q 95th					2		>			0	>		<	0			
			Ex.					-		>			-	>		<	-			
			Avail					-		>			-	>		<	-			
	Cityview Drive & Lee Street	TWSC	LOS					A		>	A		A	>	A	<	A		A	
			Delay					8.8		>	8.8		0.0	>	0.0	<	2.1		2.1	
			V/C					0.02		>			0.02	>		<	0.00			
			Q 95th					1		>			0	>		<	0			
			Ex.					-		>			-	>		<	-			
			Avail					-		>			-	>		<	-			

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Q - Queue Length
95th - 95th Percentile Queue Length (m)
Ex. - Existing Storage (m)
Avail. - Available Storage (m)

3.0 Development Concept

3.1 Development Description

The proposed plan of subdivision is located generally north of the Canadian National Rail line between Starwood Drive and Cityview Drive in the City of Guelph. The subject site is also comprised of some lands on the west side of Cityview Drive and at the terminus of Henry Court. These lands are expected to have direct access to the respective fronting roadways. The draft plan of subdivision is anticipated to consist of approximately 261 new residential units with the following breakdown:

- 101 Single Family units,
- 40 Semi-Detached units,
- 66 Street townhouse units, and
- 54 apartment units, and

Vehicular access to the subdivision is proposed to be provided by the extension of Keating Street southerly through the 55 Cityview lands. A second connection to the lands known as 55 Cityview will also be formed. In addition to completing the road network to the north, two new roadway connections to Cityview Drive will be constructed. The first connection, Street 1 is located approximately 180 metres south of Cedarvale Avenue. The second connection, Street 4, is located approximately 295 metres south of Cedarvale Avenue. There is a significant vertical alignment change along Cityview Drive south of Cedarvale Avenue. It is expected that with the development of the subject site and the lands to the north at 55 Cityview Drive, that the vertical curvature will be adjusted in order to maintain acceptable sightlines.

It is expected that all future roadways internal to the subdivision will be designed and built as local residential roadways with daily volumes of less than 1,000 vehicles[1] where the primary function is land access.

The preliminary site concept plan and the proposed internal traffic control layout are illustrated in **Figure 3.1**. The build-out of the subject site is anticipated to occur in one or two phases with an estimated completion date of Year 2019. For a complete road network that is capable of accommodating all modes of travel, it is recommended that sidewalk facilities be developed on both sides of all roadways internal to the subject site.

3.2 Trip Generation Estimates

The trips estimated to be generated by the subject site for the AM peak hour and PM peak hour were developed using the Institute of Transportation Engineers (ITE) Trip Generation Manual[2]. The average trip rates for the proposed residential subdivision were derived from land use code (LUC) 210 (Single Family Detached) and LUC 230 (Residential Condominium/Townhouse. LUC 210 has been used to estimate the new vehicular trips for the single family, semi-detached and future units noted in **Section 3.1**. LUC 230 has been used to estimate the new vehicular trips for the townhouse and apartment units noted in

[1] *Geometric Design Guide for Canadian Road – Table 1.3.4.2*

[2] *Trip Generation Eighth Edition, Institute of Transportation Engineers, Washington D.C., 2008*

Section 3.1.

Table 3.1 indicates that the subject site is estimated to have a total trip generation of approximately 178 vehicle trips during the AM peak hour and approximately 227 vehicle trips during the PM peak hour.

TABLE 3.1: ESTIMATED TRIP GENERATION

Land Use Code	Description	Units of Measure	Number of Units	AM Peak Hour			PM Peak Hour		
				In	Out	Total	In	Out	Total
210	Single Family Detached	Units	141	29	79	108	90	53	143
230	Residential Condominium/Townhouse	Units	120	9	44	53	42	21	63
Total Generation				38	123	161	132	74	206

The estimated trip generation was assigned to the road network based on the observed local trip patterns documented in the existing traffic volumes (**Figure 2.3**) and is constant with other traffic studies recently completed by Paradigm in the immediate area. The estimated trip distribution based on these patterns is outlined in **Table 3.2** and is described in terms of the peak direction of traffic (i.e., outbound during the AM peak hour and inbound in the PM peak hour). The AM and PM peak hour site generated traffic volumes are illustrated in **Figure 3.2A** and **Figure 3.2B**.

TABLE 3.2: ESTIMATED TRIP DISTRIBUTION

Origin/Destination	AM Peak Hour		PM Peak Hour	
	IN	OUT	IN	OUT
North via Grange Road	30%	25%	20%	30%
North via Watson Parkway	6%	3%	4%	2%
South via Grange Road	20%	35%	35%	30%
South via Watson Parkway	14%	17%	21%	13%
West via Starwood Drive	30%	20%	20%	25%
Total	100%	100%	100%	100%

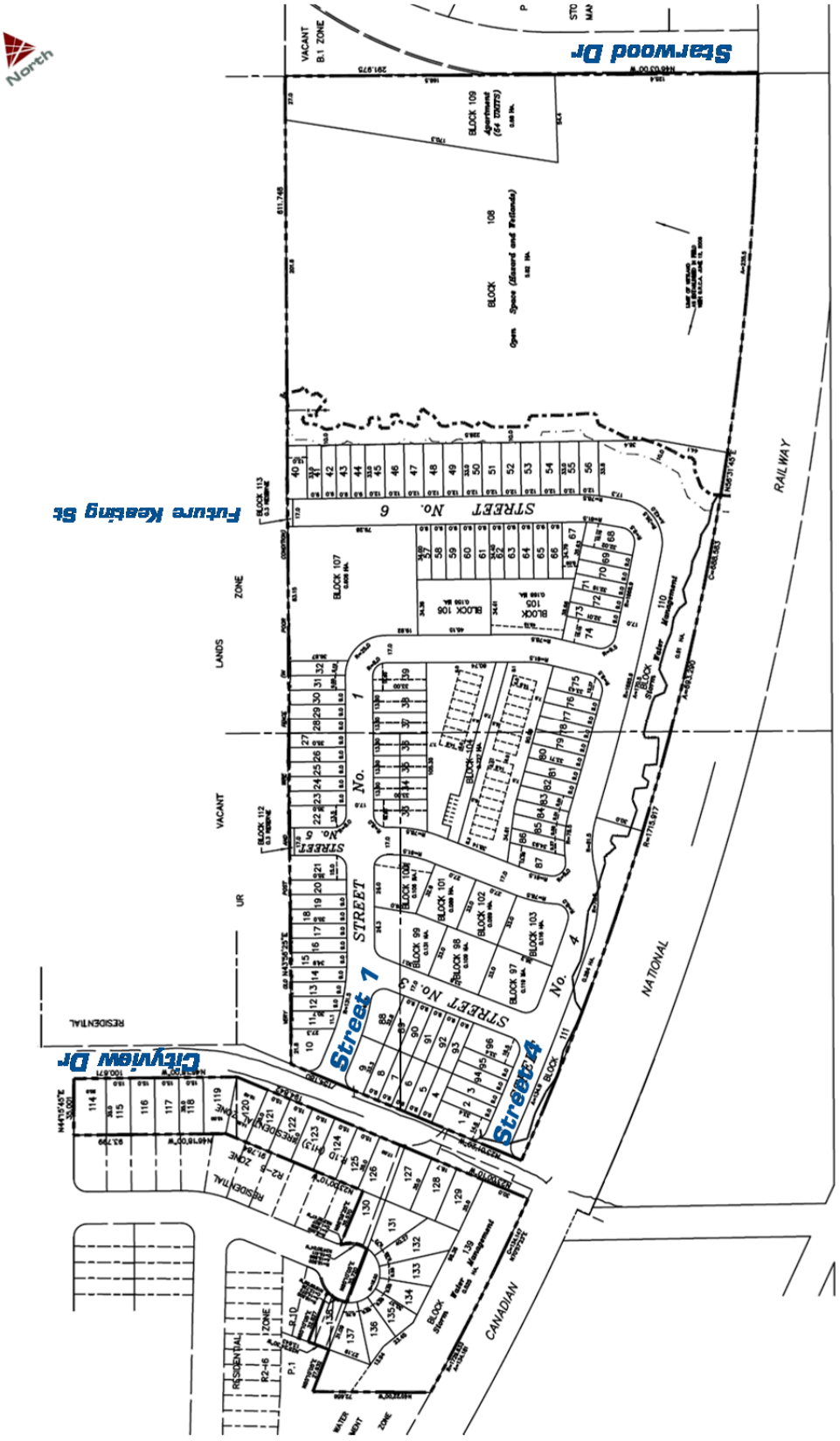

Figure 3.1
Preliminary Site Concept Plan

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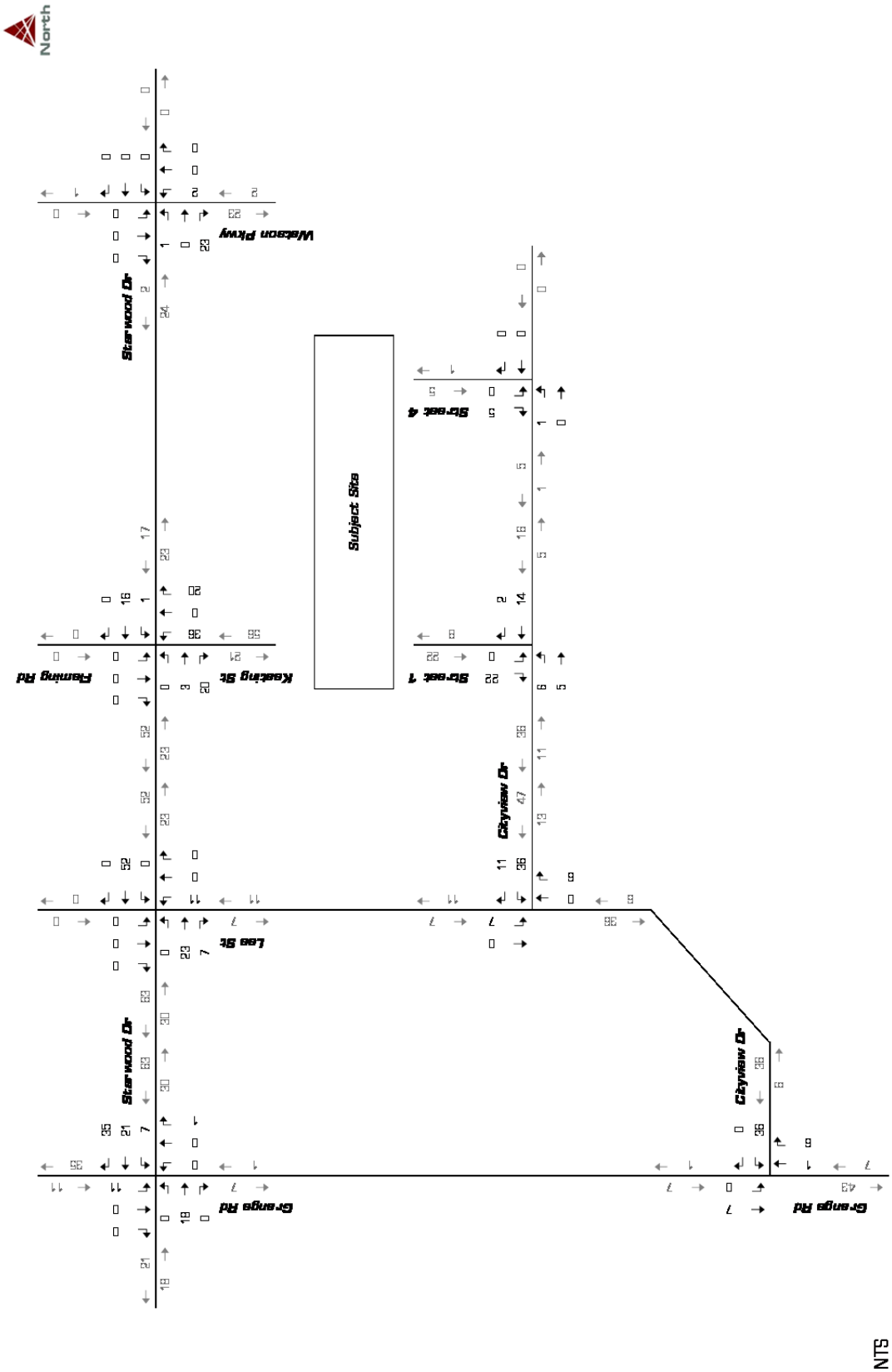

Figure 3.2A
Site Generated Traffic
– AM Peak Hour

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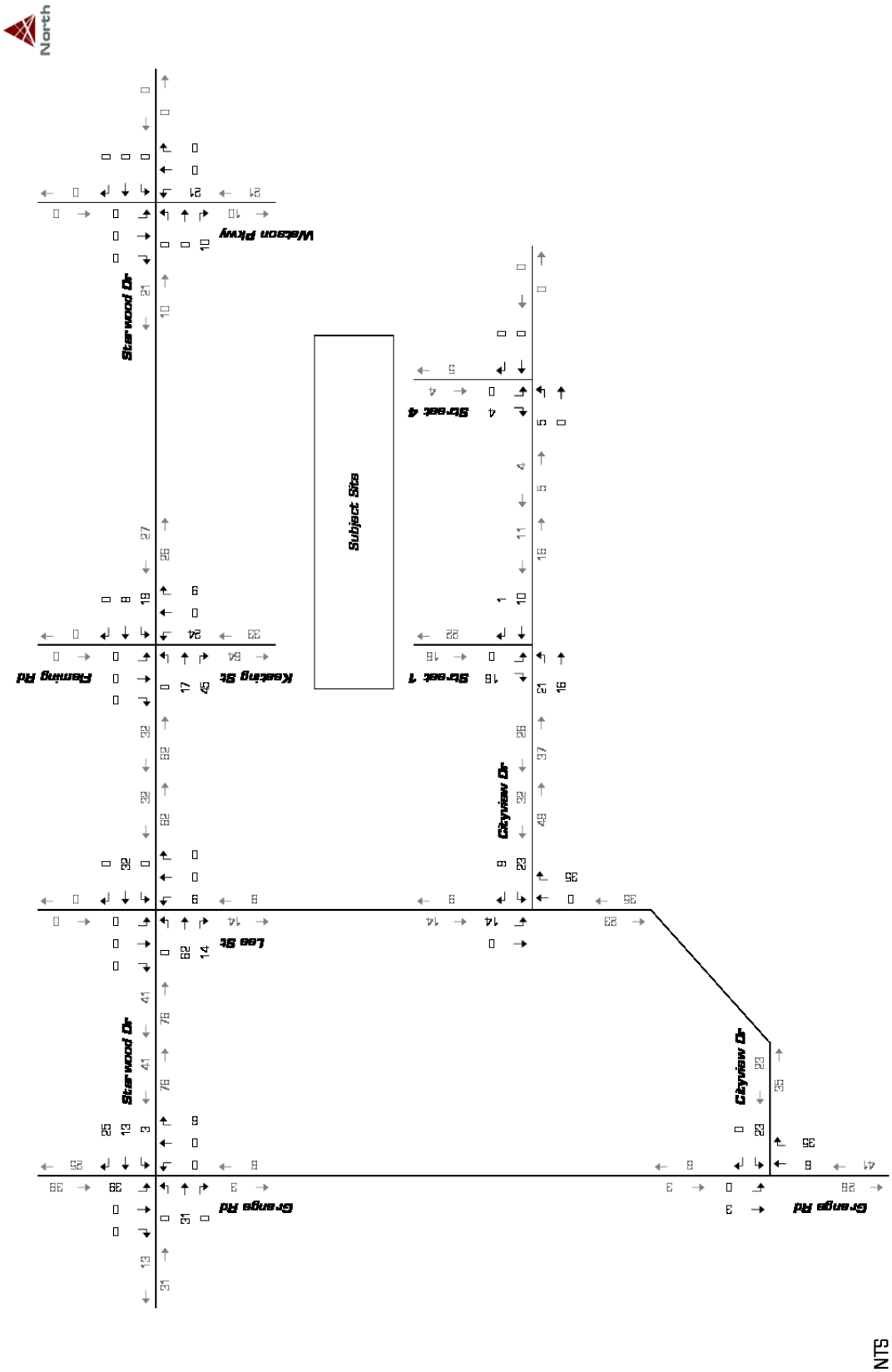

Figure 3.2B
Site Generated Traffic – PM Peak Hour

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4.0 Future Conditions

The assessment of the future traffic conditions contained in this section includes future background traffic and site traffic estimates. Level of service analysis for background traffic (pre-development) and background traffic with the build-out of the subject site (post-development) is undertaken in order to assess the traffic implications on the adjacent road network.

4.1 Background Traffic Forecast

For analysis purposes, a five-year horizon following the anticipated build-out of the subject site has been assessed to determine the implications of the subject site on the area roadways. The likely future background traffic volumes in the vicinity of the subject site will consist of:

- Traffic generated by 7 adjacent residential developments, and
- Generalized background traffic growth.

A generalized growth rate of 1.5 percent per annum has been applied to the existing traffic volumes. This growth rate was identified and confirmed by City of Guelph Staff during the initial consultation process.

The seven adjacent sites anticipated to be developed are identified in the Development Priorities Plan (DPP) prepared annually by City of Guelph Planning, Building, Engineering, and Environment with the assistance of the Finance Department[3]. The developments include:

1. 55 Cityview Drive;
2. Upper Grand District School Board (UGDSB) Stockford Road School Site
3. Cityview & Grange
4. 312/316 Grange Phase 2
5. 300 Grange Road; and
6. Watson 503 South of Starwood; and
7. Grangehill Commercial Development at 115 Watson Parkway North

The location and approximate size of each of the above noted developments are illustrated in **Figure 4.1**. The Grangehill Commercial Development at 115 Watson Parkway North site is not included in this figure. The timing of build-out of these developments is anticipated to occur well beyond the year 2020 but they are however included in the five-year horizon to remain conservative.

The peak hour vehicle trips for the sites noted above were estimated using the Institute of Transportation Engineers (ITE) Trip Generation Manual[4] and are outlined in **Table 4.1**. The estimated peak hour vehicle trips were distributed to the surrounding road network using the trip distribution previously assumed in the "The Eastview Community Transportation Study." The distribution is documented in **Table 4.2**. The site

[3] *Development Priorities Plan 2012, City of Guelph*

[4] *Trip Generation Eighth Edition, Institute of Transportation Engineers, Washington D.C., 2008*

traffic related to the Grangehill Commercial Development was taken from a previously completed traffic impact study[5].

The traffic forecasts for the surrounding sites that are planned to be developed are provided in **Appendix F**. The five-year background traffic reasonably expected to occur with the development of the adjacent sites and the nominal increases in existing traffic are illustrated in **Figure 4.2A** and **Figure 4.2B**.

TABLE 4.1: ESTIMATED TRIP GENERATION FOR SURROUNDING SITES

Development	Land Use Code	Description	Units of Measure	Units	AM Peak Hour				PM Peak Hour			
					Rate	In	Out	Total	Rate	In	Out	Total
55 Cityview	210	Single Family Detached	Units	142	0.75	27	80	107	1.01	90	53	143
	230	Residential Condominium/Townhouse	Units	162	0.44	12	59	71	0.52	56	28	84
UGDSB School Site	520	Elementary School	Students	501	0.45	124	101	225	0.15	37	38	75
Cityview & Grange	210	Single Family Detached	Units	73	0.75	14	41	55	1.01	46	27	73
300 Grange	210	Single Family Detached	Units	14	0.75	3	8	11	1.01	9	5	14
	230	Residential Condominium/Townhouse	Units	78	0.44	6	28	34	0.52	27	13	40
Watson 530 South of Starwood	230	Residential Condominium/Townhouse	Units	131	0.44	10	48	58	0.52	46	22	68
Grangehill Commercial Development Traffic Study						187	121	308		502	534	1,036
Total Generation						383	486	869		813	720	1,533

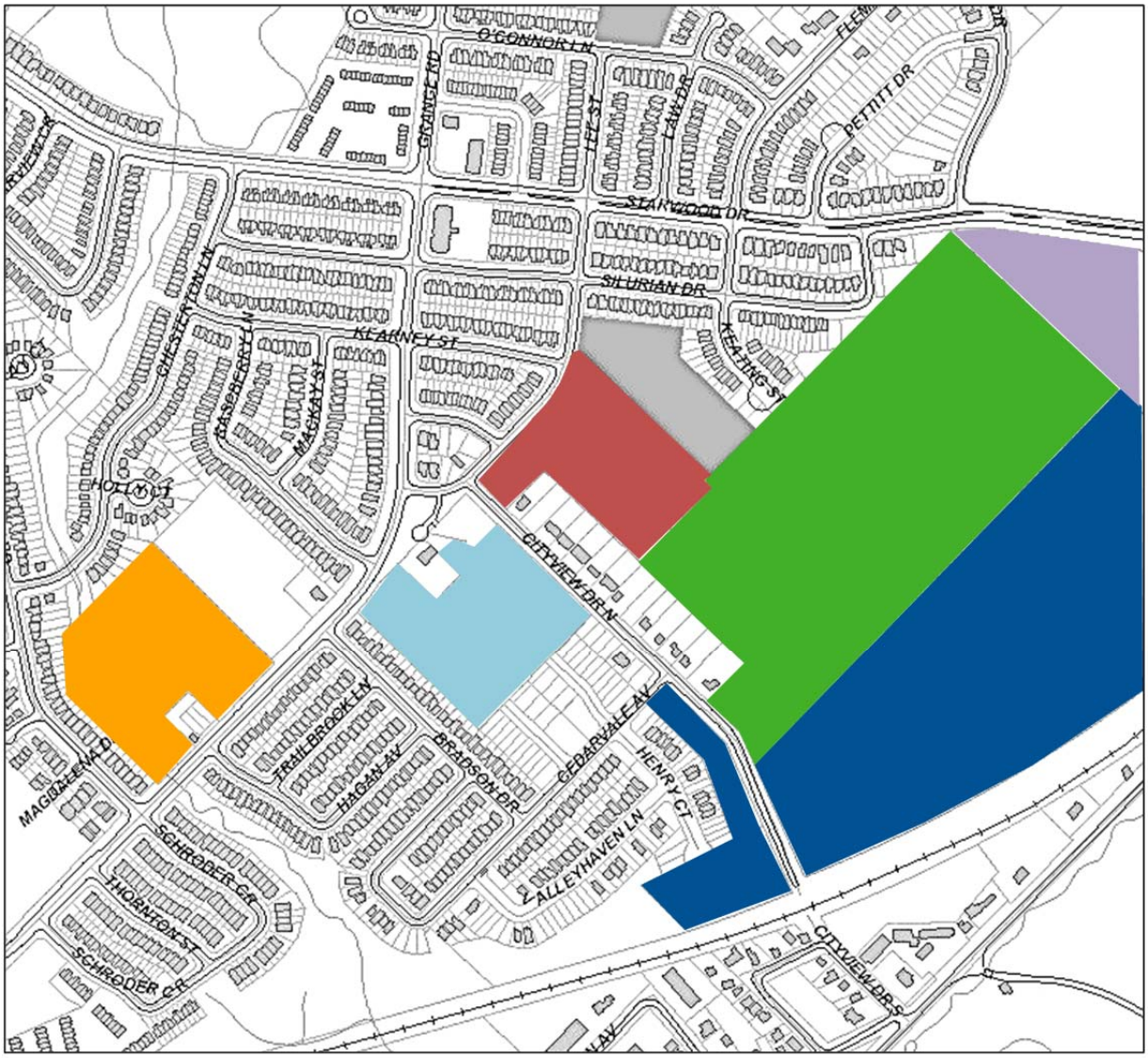
TABLE 4.2: ESTIMATED TRIP DISTRIBUTION

Trip Organ/Destination	Percentage
To/From the North	
via Victoria Road	4%
To/From the South	
via Watson Road	17%
To/From the East	
via York Road	10%
via Eramosa Road	5%
To/From West	
via Woodlawn Road	15%
via Speedvale Avenue	15%
via Grange Road	6%
via York Road	13%
via College Avenue	5%
via Stone Road	10%
Total	100%

It is noted that some traffic to/from the commercial development may originate from the residential development, thus the potential for double counting of trips may occur within this report. Given this scenario, the volumes illustrated are expected to resemble very conservative estimates under total traffic volumes.

[5] *Guelph Grangehill Commercial Development Traffic Study, 2000, iTRANS Consulting Inc.*

North



NTS Image Source: maps.guelph.ca

55 & 57 Cityview Drive
Traffic Impact Study

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Figure 4.1
Local Area Development Priorities

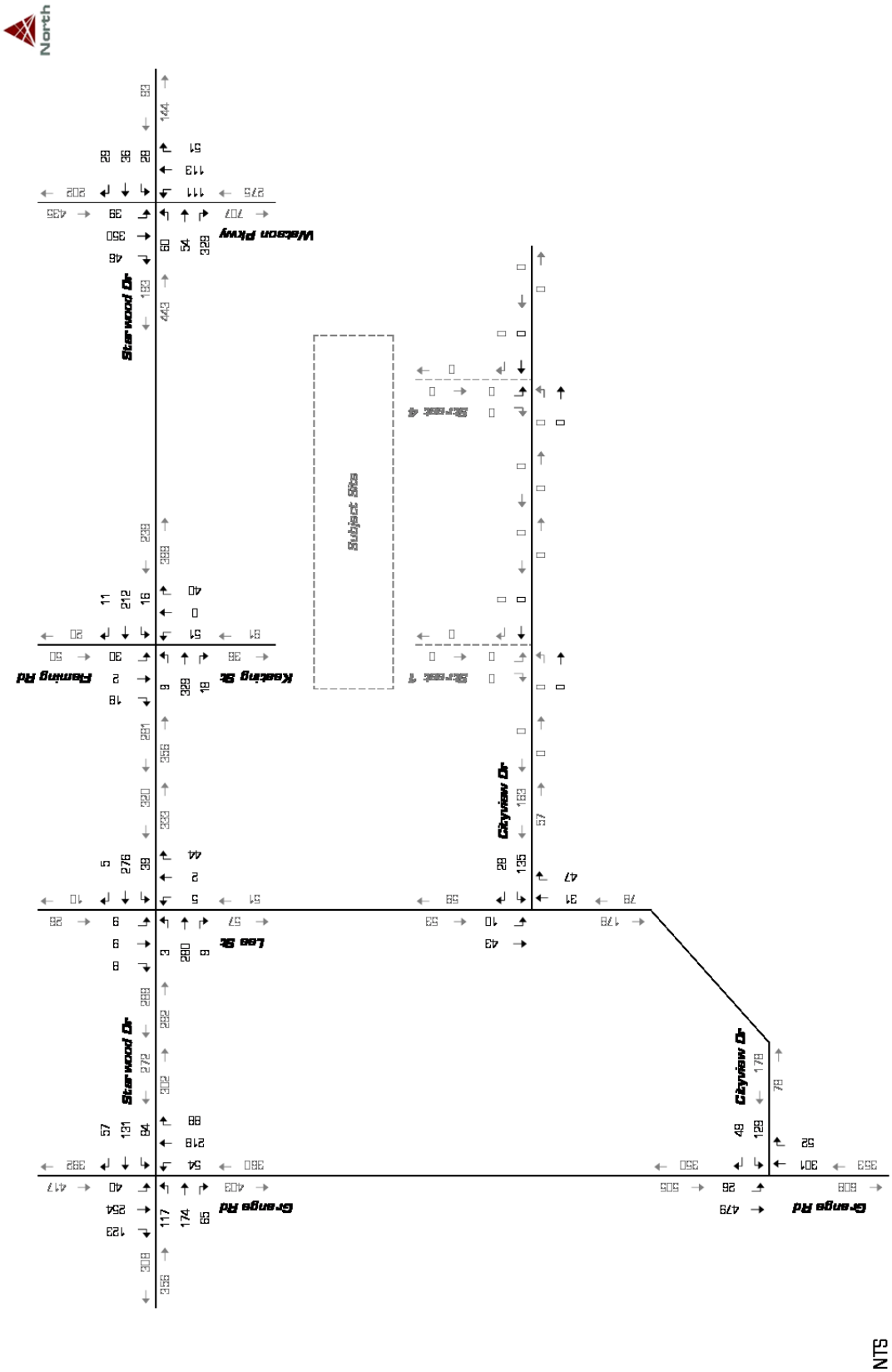

Figure 4.2A
Five-Year Background Traffic – AM Peak Hour

Cityview Ridge
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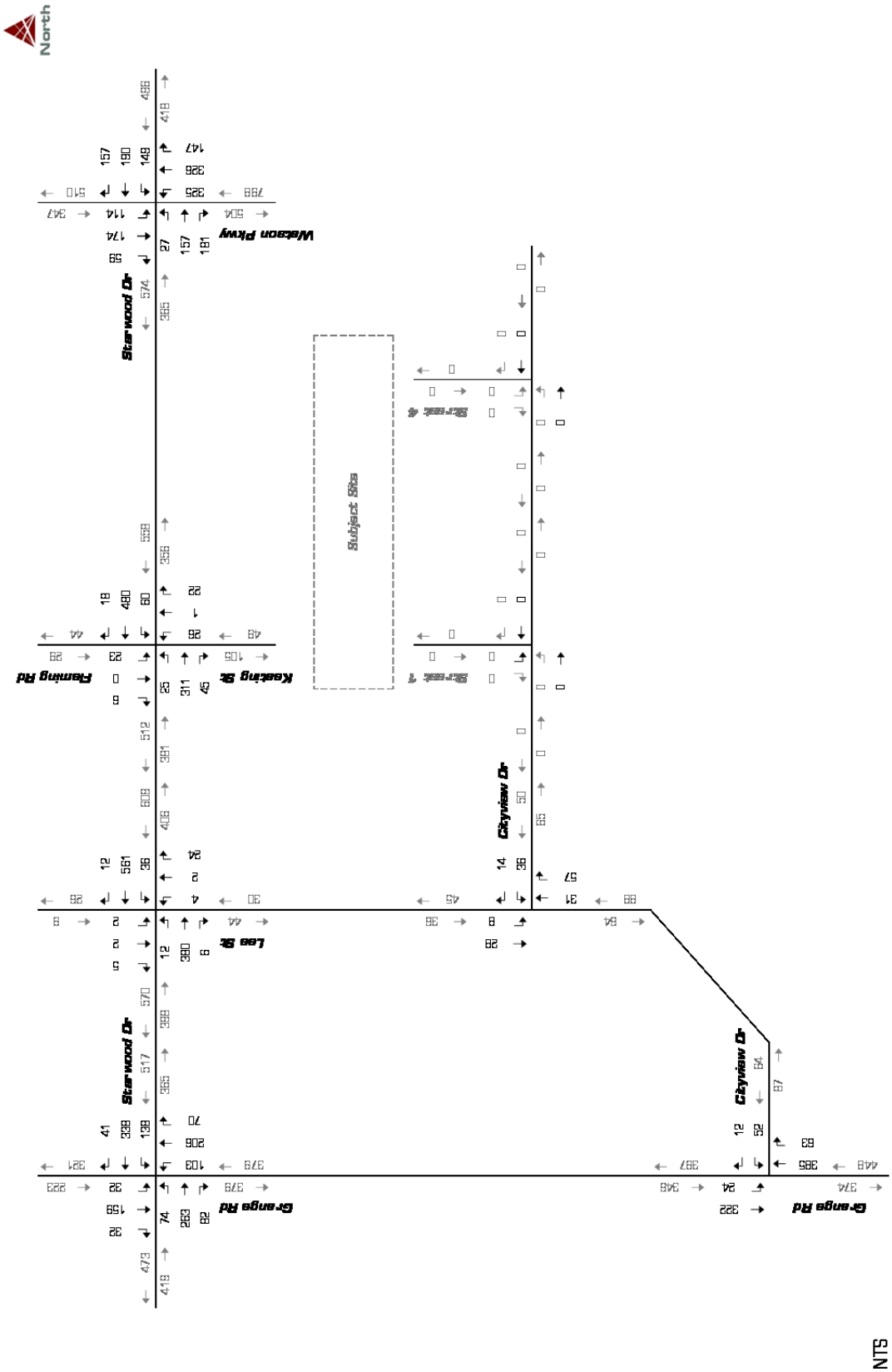

Figure 4.2B
Five-Year Background Traffic – PM Peak Hour

Cityview Ridge
Traffic Impact Study

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4.2 Future Improvements

The future development of 115 Watson Parkway is expected to construct the fourth leg to the existing T-intersection of Starwood Drive and Watson Parkway. To support the development of some 27,000 square feet of typical commercial land uses and an 117,497 square foot food store, the intersection is anticipated to operate with traffic control signals and auxiliary turn lanes on all approaches. The Ontario Traffic Manual (OTM Book 12) signal warrant[6] for the of Starwood Drive and Watson Parkway intersection can be found attached in **Appendix D**. The forecast traffic volumes satisfy the warrant criteria for future signalization. For analysis purposes, the auxiliary turn lanes are assumed to have 30 metres of storage.

4.3 Background Traffic Operations

The operations of the intersections were evaluated using the same analytical approach that was used for the existing traffic operations along with the forecasted future background traffic volumes (**Figure 4.2**) and the geometric and traffic control improvements outlined in **Section 4.2**. Signal timings have been optimized in an effort to ensure that a reasonable level of service is maintained within the study area. The resulting level of service conditions for the five-Year background traffic horizon is summarized in **Table 4.3A** and **Table 4.3B** and the following is noted:

AM Peak Hour

- The signalized intersections of Starwood Drive with Grange Road and Watson Parking are anticipated to operate with satisfactory levels of service on all approaches. Overall, the intersections will experience delays in the LOS B range with a v/c ratio of 0.50.
- The side street approach of Cityview Drive to Grange Road is estimated to experience delays in the LOS F range. It is recommended that the City of Guelph monitor the operation of this intersection in the future to confirm the extent of future delays. The potential need for improvements to the existing form of two-way stop control is discussed in **Section 5.1**. Should this approach actually experience high levels of delay in the future, traffic from the surrounding area can filter towards other access points along Grange Road via Bradson Drive, Hagan Avenue, Breesegarden Lane, or Kearney Street.
- All other intersections in the study area are anticipated to operate with satisfactory levels of service on all approaches.

PM Peak Hour

- The signalized intersections of Starwood Drive with Grange Road and Watson Parking are anticipated to operate with satisfactory levels of service on all approaches. Overall, the intersections will experience delays in the LOS B range with a v/c ratio of 0.80.
- Several left-turn movements are projected to have queue lengths greater than the available storage based on the 95th percentile queue estimates. The current pavement widths along Starwood Drive and Watson Parkway can support additional storage with minor modifications to the existing pavement markings.
- The unsignalized intersections are anticipated to operate with satisfactory levels of service on all approaches.

[6] *Ontario Traffic Manual Book 12, Ministry of Transportation of Ontario, July 2001.*

Detailed Synchro 7.0 output is provided in **Appendix B**.

TABLE 4.3A: BACKGROUND TRAFFIC OPERATIONAL CONDITIONS – AM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach															
				EB - LEFT	EB - THROUGH	EB - RIGHT	EB APPROACH	WB - LEFT	WB - THROUGH	WB - RIGHT	WB APPROACH	NB - LEFT	NB - THROUGH	NB - RIGHT	NB APPROACH	SB - LEFT	SB - THROUGH	SB - RIGHT	SB APPROACH	OVERALL
AM Peak Hour	Starwood Drive & Grange Road	TCS	LOS	C	C	B	C	C	B	B	B	A	A	>	A	A	A	>	A	B
			Delay	21.6	20.7	18.2	20.6	21.3	20.0	18.2	20.0	5.7	6.7	>	6.6	5.2	7.4	>	7.2	12.9
			V/C	0.47	0.42	0.05		0.42	0.33	0.04		0.14	0.33	>		0.08	0.40	>		0.42
			Q 95th	21	28	6		17	22	6		11	41	>		8	53	>		
			Ex.	30	-	30		25	-	25		20	-	>		20	-	>		
			Avail	9	-	24		9	-	20		9	-	>		12	-	>		
	Starwood Drive & Lee Street	TWSC	LOS	<	A	>	A	<	A	>	A	<	B	>	B	<	C	>	C	
			Delay	<	0.1	>	0.1	<	1.4	>	1.4	<	12.4	>	12.4	<	18.2	>	18.2	
			V/C	<	0.00	>		<	0.04	>		<	0.12	>		<	0.11	>		
			Q 95th	<	0	>		<	1	>		<	3	>		<	3	>		
			Ex.	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail	<	-	>		<	-	>		<	-	>		<	-	>		
	Starwood Drive & Keating Street/Fleming Road	TWSC	LOS	<	A	>	A	<	A	>	A	<	C	>	C	<	C	>	C	
			Delay	<	0.3	>	0.3	<	0.5	>	0.5	<	17.8	>	17.8	<	17.3	>	17.3	
			V/C	<	0.01	>		<	0.01	>		<	0.26	>		<	0.16	>		
			Q 95th	<	0	>		<	0	>		<	8	>		<	4	>		
			Ex.	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail	<	-	>		<	-	>		<	-	>		<	-	>		
	Starwood Drive & Watson Parkway	TCS	LOS	C	C	>	C	C	B	>	B	A	A	>	A	A	A	>	A	B
			Delay	20.4	21.4	>	21.3	20.9	19.6	>	20.0	4.9	3.7	>	4.2	3.7	4.1	>	4.1	11.4
			V/C	0.23	0.39	>		0.24	0.13	>		0.22	0.08	>		0.05	0.19	>		0.26
			Q 95th	13	22	>		8	10	>		17	8	>		6	19	>		
			Ex.	30	-	>		30	-	>		30	-	>		30	-	>		
			Avail	18	-	>		22	-	>		13	-	>		24	-	>		
	Cityview Drive & Grange Road	TWSC	LOS					F		>	F		A	>	A	<	A		A	
			Delay					56.0		>	56.0		0.0	>	0.0	<	0.8		0.8	
			V/C					0.81		>			0.26	>		<	0.03			
			Q 95th					51		>			0	>		<	1			
			Ex.					-		>			-	>		<	-			
			Avail					-		>			-	>		<	-			
	Cityview Drive & Lee Street	TWSC	LOS					B		>	B		A	>	A	<	A		A	
			Delay					10.7		>	10.7		0.0	>	0.0	<	1.5		1.5	
			V/C					0.24		>			0.06	>		<	0.01			
			Q 95th					7		>			0	>		<	0			
			Ex.					-		>			-	>		<	-			
			Avail					-		>			-	>		<	-			

MOE - Measure of Effectiveness
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
LOS - Level of Service
V/C - Volume to Capacity Ratio
> - Shared Right-Turn Lane
< - Shared Left-Turn Lane
Q - Queue Length
95th - 95th Percentile Queue Length (m)
Ex. - Existing Storage (m)
Avail. - Available Storage (m)

TABLE 4.3B: BACKGROUND TRAFFIC OPERATIONAL CONDITIONS – PM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				EB - LEFT	EB - THROUGH	EB - RIGHT	EB APPROACH	WB - LEFT	WB - THROUGH	WB - RIGHT	WB APPROACH	NB - LEFT	NB - THROUGH	NB - RIGHT	NB APPROACH	SB - LEFT	SB - THROUGH	SB - RIGHT	SB APPROACH	OVERALL
PM Peak Hour	Starwood Drive & Grange Road	TCS	LOS	B	B	B	B	C	C	B	C	A	A	>	A	A	A	>	A	B
			Delay	18.9	19.1	16.0	18.4	21.4	21.2	15.8	20.8	7.1	7.8	>	7.6	6.4	7.1	>	7.0	14.9
			V/C	0.38	0.49	0.05		0.55	0.61	0.03		0.16	0.27	>		0.06	0.18	>		0.39
			Q 95th	16	40	7		27	52	5		17	35	>		7	25	>		
			Ex.	30	-	30		25	-	25		20	-	>		20	-	>		
			Avail	14	-	23		-2	-	20		3	-	>		13	-	>		
	Starwood Drive & Lee Street	TWSC	LOS	<	A	>	A	<	A	>	A	<	B	>	B	<	C	>	C	
			Delay	<	0.4	>	0.4	<	0.9	>	0.9	<	14.2	>	14.2	<	19.1	>	19.1	
			V/C	<	0.01	>		<	0.03	>		<	0.08	>		<	0.04	>		
			Q 95th	<	0	>		<	1	>		<	2	>		<	1	>		
			Ex.	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail	<	-	>		<	-	>		<	-	>		<	-	>		
	Starwood Drive & Keating Street/Fleming Road	TWSC	LOS	<	A	>	A	<	A	>	A	<	C	>	C	<	D	>	D	
			Delay	<	0.8	>	0.8	<	1.5	>	1.5	<	21.2	>	21.2	<	26.0	>	26.0	
			V/C	<	0.03	>		<	0.05	>		<	0.19	>		<	0.15	>		
			Q 95th	<	1	>		<	1	>		<	6	>		<	4	>		
			Ex.	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail	<	-	>		<	-	>		<	-	>		<	-	>		
	Starwood Drive & Watson Parkway	TCS	LOS	C	D	>	C	C	B	>	C	B	B	>	B	C	B	>	C	B
			Delay	24.2	35.9	>	35.0	25.3	19.9	>	21.5	14.0	10.8	>	12.1	23.8	18.6	>	20.3	20.0
			V/C	0.12	0.75	>		0.63	0.50	>		0.59	0.26	>		0.40	0.18	>		0.62
			Q 95th	10	76	>		30	61	>		52	27	>		32	20	>		
			Ex.	30	-	>		30	-	>		30	-	>		30	-	>		
			Avail	20	-	>		0	-	>		-22	-	>		-2	-	>		
	Cityview Drive & Grange Road	TWSC	LOS					C		>	C		A	>	A	<	A		A	
			Delay					20.4		>	20.4		0.0	>	0.0	<	0.9		0.9	
			V/C					0.25		>			0.31	>		<	0.03			
			Q 95th					8		>			0	>		<	1			
			Ex.					-		>			-	>		<	-			
			Avail					-		>			-	>		<	-			
	Cityview Drive & Lee Street	TWSC	LOS					A		>	A		A	>	A	<	A		A	
			Delay					9.3		>	9.3		0.0	>	0.0	<	1.7		1.7	
			V/C					0.06		>			0.05	>		<	0.01			
			Q 95th					2		>			0	>		<	0			
			Ex.					-		>			-	>		<	-			
			Avail					-		>			-	>		<	-			

MOE - Measure of Effectiveness
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
LOS - Level of Service
V/C - Volume to Capacity Ratio
> - Shared Right-Turn Lane
< - Shared Left-Turn Lane
Q - Queue Length
95th - 95th Percentile Queue Length (m)
Ex. - Existing Storage (m)
Avail. - Available Storage (m)

4.4 Total Traffic Forecast

The future total traffic is the combination of the future background traffic (**Figure 4.2A** and **Figure 4.2B**) and the site generated traffic (**Figure 3.2A** and **Figure 3.2B**) and represents the traffic volumes anticipated to occur following the build-out of the subject site. The total traffic forecast volumes for the opening date horizon are illustrated in **Figure 4.3A** and **Figure 4.3B**).

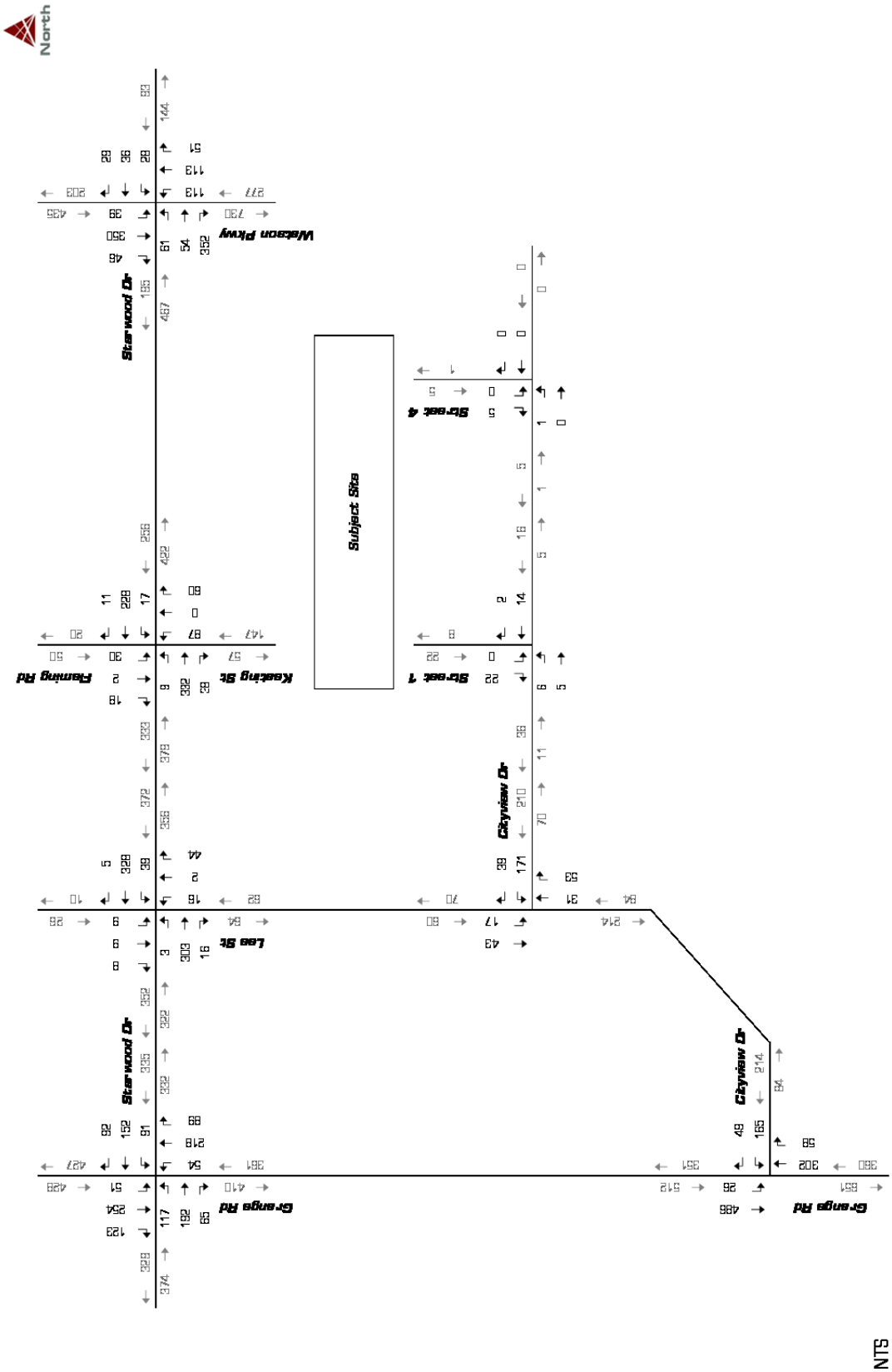

Figure 4.3A
Five-Year Total Traffic – AM Peak Hour

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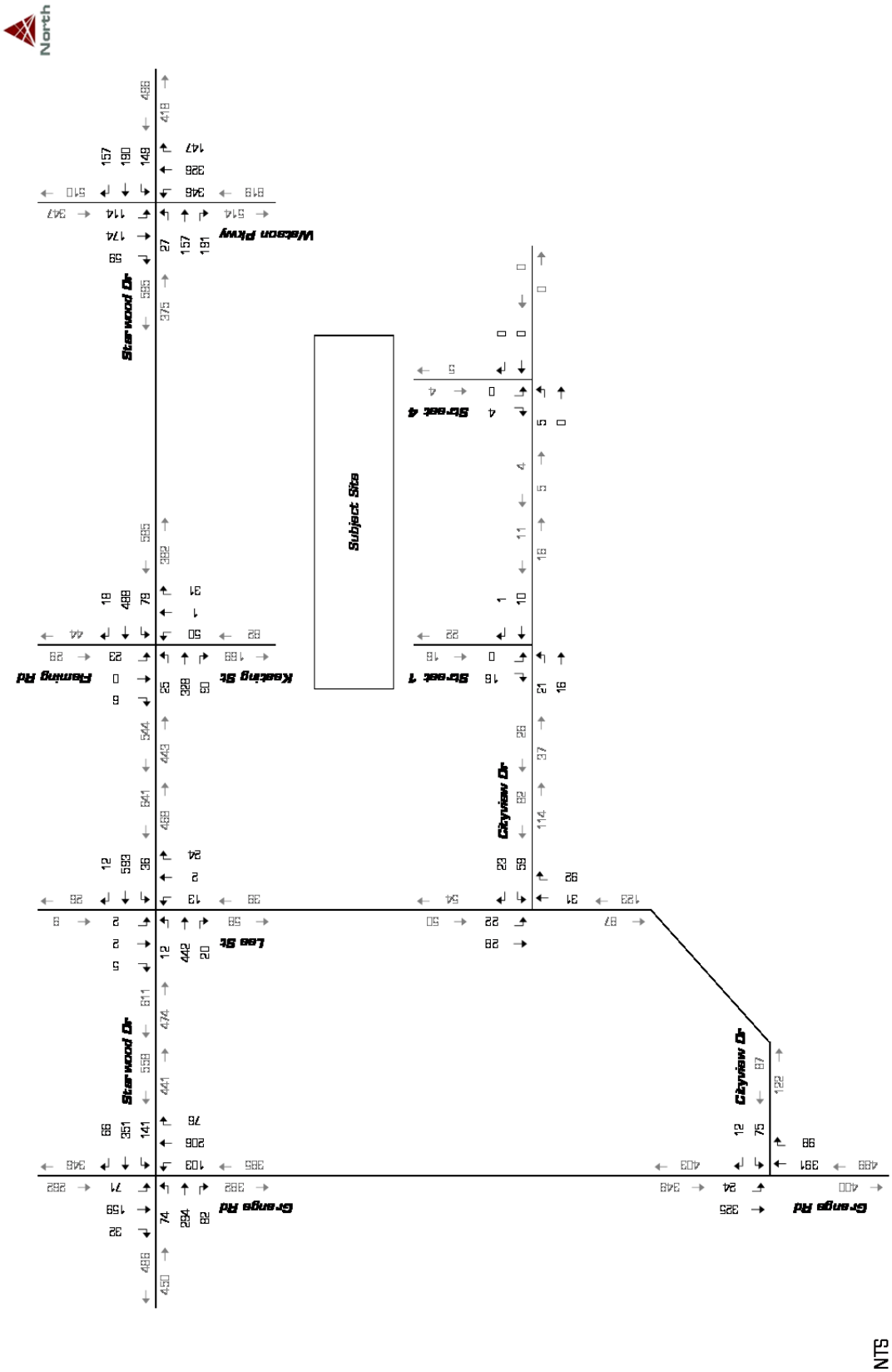

Figure 4.3B
Five-Year Total Traffic – PM Peak Hour

Cityview Ridge
Traffic Impact Study

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4.5 Future Total Traffic Operations

The operations of the intersections were evaluated using the same analytical approach that was used for the five-Year background traffic operations along with the forecasted future total traffic volumes (**Figure 4.3**). Signal timings have been optimized in an effort to ensure that a reasonable level of service is maintained within the study area. The resulting level of service conditions for the five-Year total traffic horizon is summarized in **Table 4.4A** and **Table 4.4B** and the following is noted:

AM Peak Hour

- The signalized intersections of Starwood Drive with Grange Road and Watson Parking are anticipated to operate with satisfactory levels of service on all approaches. Overall, the intersections will experience delays in the LOS B range with a v/c ratio of less than 0.50.
- The side street approach of Cityview Drive to Grange Road is anticipated to continue to experience delays similar to those estimated under the background traffic horizon. Side street delays are noted to be in the LOS F range with a v/c ratio of 1.02.
- All other intersections, including the new roadways connections to Cityview Drive, in the study area are anticipated to operate with satisfactory levels of service on all approaches.

PM Peak Hour

- The signalized intersections of Starwood Drive with Grange Road and Watson Parking are anticipated to operate with satisfactory levels of service on all approaches. Overall, the intersections will experience delays in the LOS B to C range with v/c ratios of less than 0.80.
- Several left-turn movements are projected to have queue lengths greater than the available storage based on the 95th percentile queue lengths. The current pavement widths along Starwood Drive and Watson Parkway can support additional storage with minor modifications to the existing pavement markings.
- The unsignalized intersections are anticipated to operate with satisfactory levels of service on all approaches.

Detailed Synchro 7.0 output is provided in **Appendix C**.

TABLE 4.4A: TOTAL TRAFFIC OPERATIONAL CONDITIONS – AM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				EB - LEFT	EB - THROUGH	EB - RIGHT	EB APPROACH	WB - LEFT	WB - THROUGH	WB - RIGHT	WB APPROACH	NB - LEFT	NB - THROUGH	NB - RIGHT	NB APPROACH	SB - LEFT	SB - THROUGH	SB - RIGHT	SB APPROACH	OVERALL
AM Peak Hour	Starwood Drive & Grange Road	TCS	LOS	C	C	B	C	C	C	B	B	A	A	>	A	A	A	>	A	B
			Delay	21.7	20.8	18.0	20.6	21.8	20.2	18.1	20.0	5.9	6.9	>	6.8	5.5	7.6	>	7.3	13.4
			V/C	0.49	0.46	0.05		0.47	0.38	0.07		0.14	0.33	>		0.11	0.41	>		0.43
			Q 95th	22	30	6		18	25	7		11	42	>		10	53	>		
			Ex.	30	-	30		25	-	25		20	-	>		20	-	>		
			Avail	8	-	24		7	-	18		9	-	>		10	-	>		
	Starwood Drive & Lee Street	TWSC	LOS	<	A	>	A	<	A	>	A	<	C	>	C	<	C	>	C	
			Delay	<	0.1	>	0.1	<	1.3	>	1.3	<	16.0	>	16.0	<	20.8	>	20.8	
			V/C	<	0.00	>		<	0.04	>		<	0.20	>		<	0.13	>		
			Q 95th	<	0	>		<	1	>		<	6	>		<	4	>		
			Ex.	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail	<	-	>		<	-	>		<	-	>		<	-	>		
	Starwood Drive & Keating Street/Fleming Road	TWSC	LOS	<	A	>	A	<	A	>	A	<	C	>	C	<	C	>	C	
			Delay	<	0.3	>	0.3	<	0.7	>	0.7	<	19.6	>	19.6	<	16.5	>	16.5	
			V/C	<	0.01	>		<	0.02	>		<	0.40	>		<	0.15	>		
			Q 95th	<	0	>		<	0	>		<	15	>		<	4	>		
			Ex.	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail	<	-	>		<	-	>		<	-	>		<	-	>		
	Starwood Drive & Watson Parkway	TCS	LOS	C	C	>	C	C	B	>	B	A	A	>	A	A	A	>	A	B
			Delay	20.1	21.6	>	21.4	20.7	19.4	>	19.8	5.1	3.8	>	4.3	3.8	4.3	>	4.2	11.7
			V/C	0.23	0.44	>		0.24	0.12	>		0.22	0.08	>		0.05	0.19	>		0.28
			Q 95th	13	25	>		8	10	>		17	8	>		6	19	>		
			Ex.	30	-	>		30	-	>		30	-	>		30	-	>		
			Avail	17	-	>		22	-	>		13	-	>		24	-	>		
	Cityview Drive & Grange Road	TWSC	LOS					F		>	F		A	>	A	<	A		A	
			Delay					103.4		>	103.4		0.0	>	0.0	<	0.8		0.8	
			V/C					1.02		>			0.26	>		<	0.03			
			Q 95th					83		>			0	>		<	1			
			Ex.					-		>			-	>		<	-			
			Avail					-		>			-	>		<	-			
	Cityview Drive & Lee Street	TWSC	LOS					B		>	B		A	>	A	<	A		A	
			Delay					11.5		>	11.5		0.0	>	0.0	<	2.2		2.2	
			V/C					0.31		>			0.06	>		<	0.01			
			Q 95th					11		>			0	>		<	0			
			Ex.					-		>			-	>		<	-			
			Avail					-		>			-	>		<	-			
	Cityview Drive & Street 1	TWSC	LOS	<	A		A		A	A	A					A		>	A	
			Delay	<	4.0		4.0		0.0	>	0.0					8.4		>	0.0	
			V/C	<	0.00				0.01	>						0.0		>		
			Q 95th	<	0				0	>						0.5		>		
			Ex.	<	-				-	>						-		>		
			Avail	<	-				-	>						-		>		
	Cityview Drive & Street 4	TWSC	LOS	<	A		A		A	A	A					A		>	A	
			Delay	<	7.2		7.2		0.0	>	0.0					8.3		>	0.0	
			V/C	<	0.00				0.00	>						0.0		>		
			Q 95th	<	0				0	>						0.1		>		
			Ex.	<	-				-	>						-		>		
			Avail	<	-				-	>						-		>		

MOE - Measure of Effectiveness
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
LOS - Level of Service
V/C - Volume to Capacity Ratio
> - Shared Right-Turn Lane
< - Shared Left-Turn Lane
Q - Queue Length
95th - 95th Percentile Queue Length (m)
Ex. - Existing Storage (m)
Avail. - Available Storage (m)

TABLE 4.4B: TOTAL TRAFFIC OPERATIONAL CONDITIONS – PM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach															
				EB - LEFT	EB - THROUGH	EB - RIGHT	EB APPROACH	WB - LEFT	WB - THROUGH	WB - RIGHT	WB APPROACH	NB - LEFT	NB - THROUGH	NB - RIGHT	NB APPROACH	SB - LEFT	SB - THROUGH	SB - RIGHT	SB APPROACH	OVERALL
PM Peak Hour	Starwood Drive & Grange Road	TCS	LOS	B	B	B	B	C	C	B	C	A	A	>	A	A	A	>	A	B
			Delay	18.8	19.5	15.7	18.7	23.6	21.2	15.7	21.2	7.2	8.0	>	7.8	7.0	7.2	>	7.2	15.2
			V/C	0.39	0.54	0.05		0.61	0.63	0.04		0.16	0.28	>		0.13	0.19	>		0.40
			Q 95th	16	45	7		29	54	6		17	36	>		13	25	>		
			Ex.	30	-	30		25	-	25		20	-	>		20	-	>		
			Avail	14	-	23		-4	-	19		3	-	>		8	-	>		
	Starwood Drive & Lee Street	TWSC	LOS	<	A	>	A	<	A	>	A	<	C	>	C	<	C	>	C	
			Delay	<	0.4	>	0.4	<	0.9	>	0.9	<	21.3	>	21.3	<	21.6	>	21.6	
			V/C	<	0.01	>		<	0.04	>		<	0.16	>		<	0.04	>		
			Q 95th	<	0	>		<	1	>		<	4	>		<	1	>		
			Ex.	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail	<	-	>		<	-	>		<	-	>		<	-	>		
	Starwood Drive & Keating Street/Fleming Road	TWSC	LOS	<	A	>	A	<	A	>	A	<	D	>	D	<	D	>	D	
			Delay	<	0.8	>	0.8	<	2.0	>	2.0	<	31.9	>	31.9	<	31.1	>	31.1	
			V/C	<	0.03	>		<	0.08	>		<	0.40	>		<	0.18	>		
			Q 95th	<	1	>		<	2	>		<	15	>		<	5	>		
			Ex.	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail	<	-	>		<	-	>		<	-	>		<	-	>		
	Starwood Drive & Watson Parkway	TCS	LOS	C	D	>	C	C	B	>	C	B	B	>	B	C	C	>	C	C
			Delay	23.7	35.3	>	34.5	25.1	19.4	>	21.1	15.1	11.1	>	12.8	26.2	20.1	>	22.1	20.4
			V/C	0.12	0.75	>		0.63	0.49	>		0.62	0.26	>		0.43	0.20	>		0.64
			Q 95th	10	74	>		29	59	>		58	28	>		33	21	>		
			Ex.	30	-	>		30	-	>		30	-	>		30	-	>		
			Avail	20	-	>		1	-	>		-28	-	>		-3	-	>		
	Cityview Drive & Grange Road	TWSC	LOS					C		>	C		A	>	A	<	A		A	
			Delay					24.3		>	24.3		0.0	>	0.0	<	0.9		0.9	
			V/C					0.36		>			0.34	>		<	0.03			
			Q 95th					13		>			0	>		<	1			
			Ex.					-		>			-	>		<	-			
			Avail					-		>			-	>		<	-			
	Cityview Drive & Lee Street	TWSC	LOS					A		>	A		A	>	A	<	A		A	
			Delay					9.7		>	9.7		0.0	>	0.0	<	3.4		3.4	
			V/C					0.10		>			0.08	>		<	0.02			
			Q 95th					3		>			0	>		<	0			
			Ex.					-		>			-	>		<	-			
			Avail					-		>			-	>		<	-			
	Cityview Drive & Street 1	TWSC	LOS	<	A		A		A	A	A					A		>	A	
			Delay	<	4.2		4.2		0.0	>	0.0					8.4		>	0.0	
			V/C	<	0.01				0.01	>						0.0		>		
			Q 95th	<	0				0	>						0.4		>		
			Ex.	<	-				-	>						-		>		
			Avail	<	-				-	>						-		>		
	Cityview Drive & Street 4	TWSC	LOS	<	A		A		A	A	A					A		>	A	
			Delay	<	7.2		7.2		0.0	>	0.0					8.3		>	0.0	
			V/C	<	0.00				0.00	>						0.0		>		
			Q 95th	<	0				0	>						0.1		>		
			Ex.	<	-				-	>						-		>		
			Avail	<	-				-	>						-		>		

MOE - Measure of Effectiveness
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
LOS - Level of Service
V/C - Volume to Capacity Ratio
> - Shared Right-Turn Lane
< - Shared Left-Turn Lane
Q - Queue Length
95th - 95th Percentile Queue Length (m)
Ex. - Existing Storage (m)
Avail. - Available Storage (m)

5.0 Need for Improvements

The level of service conditions outlined in **Section 4.0** indicate that the study area intersections are anticipated to operate with satisfactory level of service conditions based on the future v/c ratios, with the possible exception to the Cityview Drive intersection with Grange Road. At this location, the side street delays are estimated to have v/c ratio greater than 1.00 during the AM peak hour. This section discusses the need for improvements to the existing form of traffic control at the two unsignalized intersections in the study area and assesses the site's overall impact.

5.1 Traffic Control Provisions

The unsignalized intersections of Starwood Drive with Lee Street, Keating Street/Fleming Road, and Watson Parkway along with the Grange Road intersection with Cityview Drive have been assessed using the OTM signal warrant guidelines to determine if the need for improvements to the existing form of two-way stop control is required. The signal warrant analysis is summarized in **Table 5.1** and can be found attached in **Appendix D**. Based on the warrant analysis, the criteria necessary to warrant the installation of a traffic control signal is satisfied only for the Starwood Drive intersection with Watson Parkway.

The forecast traffic volumes at the Grange Road intersection with Cityview Drive suggests that the side street approach of Cityview Drive will have v/c ratios greater than 1.00 and there may be future operational concerns. It is recommended that the City of Guelph monitor the future operation of this intersection to confirm the level of service and extent of delays. It should be noted, if high levels of side street delay occur in the future, traffic may divert by filtering through the Grange Hill East community.

Table 5.1: OTM Signal Warrant Analysis Summary

Intersection	Horizon Year	OTM Warrant				Warranted
		1A	1B	2A	2B	
Starwood Drive & Lee Street	Existing	35%	10%	32%	10%	No
	Background	60%	17%	56%	10%	No
	Total	68%	20%	63%	17%	No
Starwood Drive & Keating Street/Fleming Road	Existing	30%	16%	26%	24%	No
	Background	61%	32%	53%	44%	No
	Total	68%	45%	58%	64%	No
Starwood Drive & Watson Parkway	Existing	72%	58%	54%	31%	No
	Background	136%	291%	77%	254%	Yes
	Total	138%	298%	78%	255%	Yes
Grange Road & Cityview Drive	Existing	45%	9%	43%	18%	No
	Background	66%	24%	57%	60%	No
	Total	70%	44%	59%	80%	No

5.2 Auxiliary Turn Lane Requirements

The requirement for auxiliary left-turn lanes on Grange Road at Cityview Drive and Keating Street/Fleming Road were assessed based on the Ministry of Transportation of Ontario left-turn lane warrants[7]. Left-turn lane warrants and storage lane lengths for unsignalized intersections are based on turning, advancing and opposing design hour volumes. Where a left-turn lane is warranted the minimum storage length that should be provided is 15 metres, which typically provides adequate storage for the queuing of two vehicles. The speed limit on the study area roadways is 50 kilometres per hour, therefore the left-turn lane warrants were examined under a design speed of 70 kilometres per hour, as generally design speeds are taken at 20 kilometres per hour over the posted speed limit. The left-turn lane warrant nomographs are summarized in **Table 5.2** and can be found attached in **Appendix E**.

TABLE 5.2: AUXILIARY TURN LANE REQUIREMENTS

Intersection	Direction	Horizon Year		
		Existing	Background	Total
Starwood Drive & Keating Street/Fleming Drive	Eastbound	No	Yes - 15 m	Yes - 15 m
	Westbound	No	Yes - 15 m	Yes - 25 m
Grange Road & Cityview Drive	Southbound	No	Yes - 15 m	Yes - 15 m

According to the left-turn lane warrant procedures, under the background traffic estimates, a southbound left-turn lane with 15 metres of storage is warranted at the Grange Road intersection with Cityview Drive and an eastbound left-turn lane with 15 metres of storage is warranted at the intersection of Starwood Drive with Keating Street/Fleming Road. No additional storage is warranted following the build-out of the subject site at these two intersections. Under the background traffic volumes, a westbound left-turn lane with 15 metres of storage is warranted at the Starwood Drive intersection with Keating Street/Fleming Road with an additional 10 metres (25 metres) required with build-out of the development.

It is recommended that the City of Guelph review the existing right-of-ways of Grange Road and Starwood Drive to determine the feasibility of providing auxiliary turn lanes at Cityview Drive and Keating Street/Fleming Road. These left turn lanes are attributed to all developments considered in the report not solely due to the subject site.

5.3 Signalized Intersection Storage Lane Lengths

The signalized intersection of Starwood Drive with Grange Road and Watson Parkway are anticipated to operate with acceptable levels of service during the AM and PM peak hours. However, several movements are expected to experience queues greater than the available storage based on the 95th percentile queue length estimates.

The ultimate storage lengths required for the signalized intersections within the study area are summarized in **Table 5.3**. Based on the 95th percentile queue length estimates, additional storage is recommend for the westbound left-turn movement at the Starwood Drive intersection with Grange Road and additional storage is recommended for the northbound and southbound left-turn movements at the Starwood Drive intersection Watson Parkway intersection. The existing cross section of both Starwood Drive and Watson

[7] *Geometric Design Manual for Ontario Highways, Ministry of Transportation of Ontario, Queen's Printer for Ontario, 1986*

Parkway appear to be adequate enough to accommodate the additional storage lane lengths with little to no modifications to existing curb lines. The additional storage can be achieved through modifications to the existing pavement lane markings.

TABLE 5.3: RECOMMENDED STORAGE LANE LENGTHS

Intersection	Movement	Existing Storage	95th Percentile Queue Length		Recommended Storage
			AM Peak Hour	PM Peak Hour	
Starwood Drive & Grange Road	Eastbound Left-Turn	30	22	16	30
	Eastbound Right-Turn	30	6	7	30
	Westbound - Left-Turn	25	19	29	30
	Westbound - Right Turn	25	7	6	25
	Northbound Left-Thru	20	11	17	20
	Southbound Left-Turn	20	10	36	20
Starwood Drive & Watson Parkway	Eastbound Left-Turn	30	13	10	30
	Westbound - Left-Turn	30	8	29	30
	Northbound Left-Thru	30	17	58	60
	Southbound Left-Turn	30	6	33	35

5.4 Site Traffic Intensification

The additional vehicular traffic estimated to occur with build-out of the subject site is illustrated in **Figure 3.2A** and **Figure 3.2B**. Using the PM peak hour as an example (the highest period of traffic activity from the site) the largest increase in traffic, in terms of additional vehicles per hour, is expected to be on Cityview Drive east of Lee Street with an increase of approximately 80 vehicles per hour. The second largest increase in traffic is expected to occur on Keating Street south of Starwood Drive where 52 vehicles per hour are estimated to occur in the southbound direction.

The additional traffic estimated to be generated by the build-out of the subject site will not have a significant impact on the operations of the study area intersections. Higher side street delays will occur on the local roadway approaches to the collector roadways of Grange Road. The future traffic volumes are noted to be within the guidelines for the respective local and collector roadway classifications as indicated by TAC.

6.0 Additional Access Scenarios

The City of Guelph has requested a review of two alternative additional access points following build-out of the lands located north of the subject site (55 Cityview). The first scenario could see a right-in/right-out connection to Starwood Drive west of Frasson Drive. The second scenario could see the development of a fourth leg to the Frasson Drive intersection.

6.1 Alternative Traffic Forecast

The site traffic estimated for the subject sit has been reassigned to the road network with the creation of the potential new access point. The estimated site traffic volumes for Scenario One is illustrated in **Figure 6.1A** and **Figure 6.1B**. The estimated site traffic volumes for Scenario Two are illustrated in **Figure 6.2A** and **Figure 6.2B**. The forecast total traffic volumes for Scenario One and Scenario Two are illustrated in **Figure 6.3A**, **Figure 6.3B**, **Figure 6.4A** and **Figure 6.4B** respectively.

It is noted from the figures that the traffic volumes on Keating/Fleming only will drop as a result of the new connection.

Table 6.1: Comparison of Future Volumes on Keating/Fleming With and Without Additional Access

Horizon	Period	Scenario 1			Scenario 2		
		Without	With	Change	Without	With	Change
Future	AM Peak	204	132	72	204	78	126
	PM Peak	251	160	91	251	87	164
	Daily	2510	1600	910	2510	870	1640

It is noted that without the new connection volumes on Keating/Fleming will be 2500 vpd which is in keeping with its minor collector function. Given that minor collectors typically serve 3000 or more per day, the traffic environment will be acceptable for the roadway.

If the additional access is provided the new connection will need to accommodate 1640 vpd. Within the 55-57 Cityview Plan this road is a local roadway. The Transportation Association of Canada indicates that local residential roadways should not accommodate more than 1000 vehicles per day.

A road connection such as Scenario One cannot be accommodated within the 55-57 Plan. As such additional property will need to be acquired. Scenario Two is also difficult to implement in the 55-57 Plan given the environmental constraints and the configuration of the property. As well some additional property will be required.

In summary, we do not recommend the additional connection for the following reasons:

1. As a minor collector roadway future traffic levels on Keating/Fleming will be well within what is expected for this road function. Peak volumes will be approximately 4 vehicles per minute which is not excessive for a residential street.

2. The new connection will affect a local street within the 55-57 Plan exceeding the recommended volumes for this type of street.

3. Environmental and property issues occur with either new connection scenarios.

4. The new connection does not resolve any capacity issues as indicated by the analysis below.

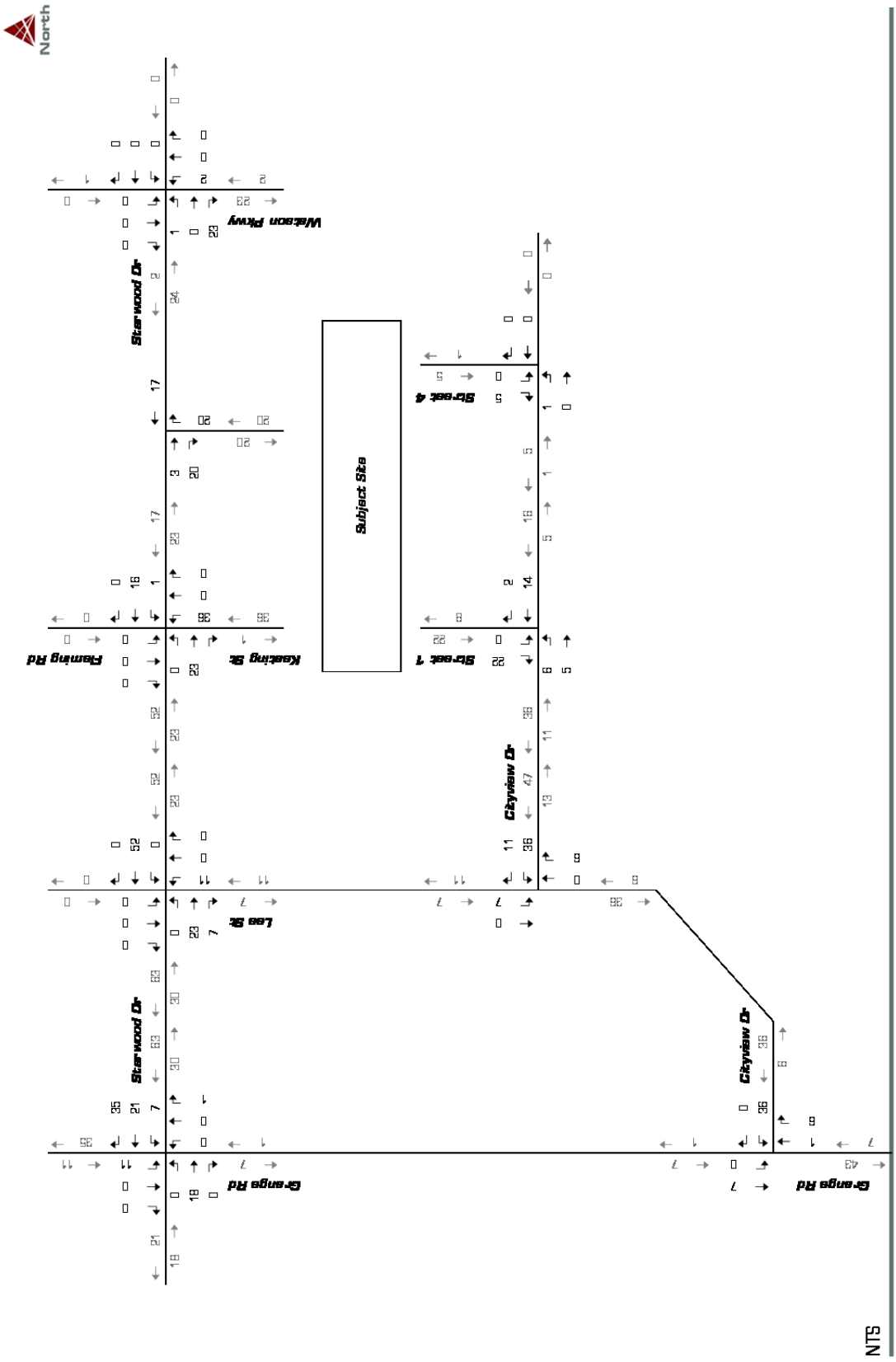

Figure 6.1A
Scenario One Site Generated Traffic
– AM Peak Hour

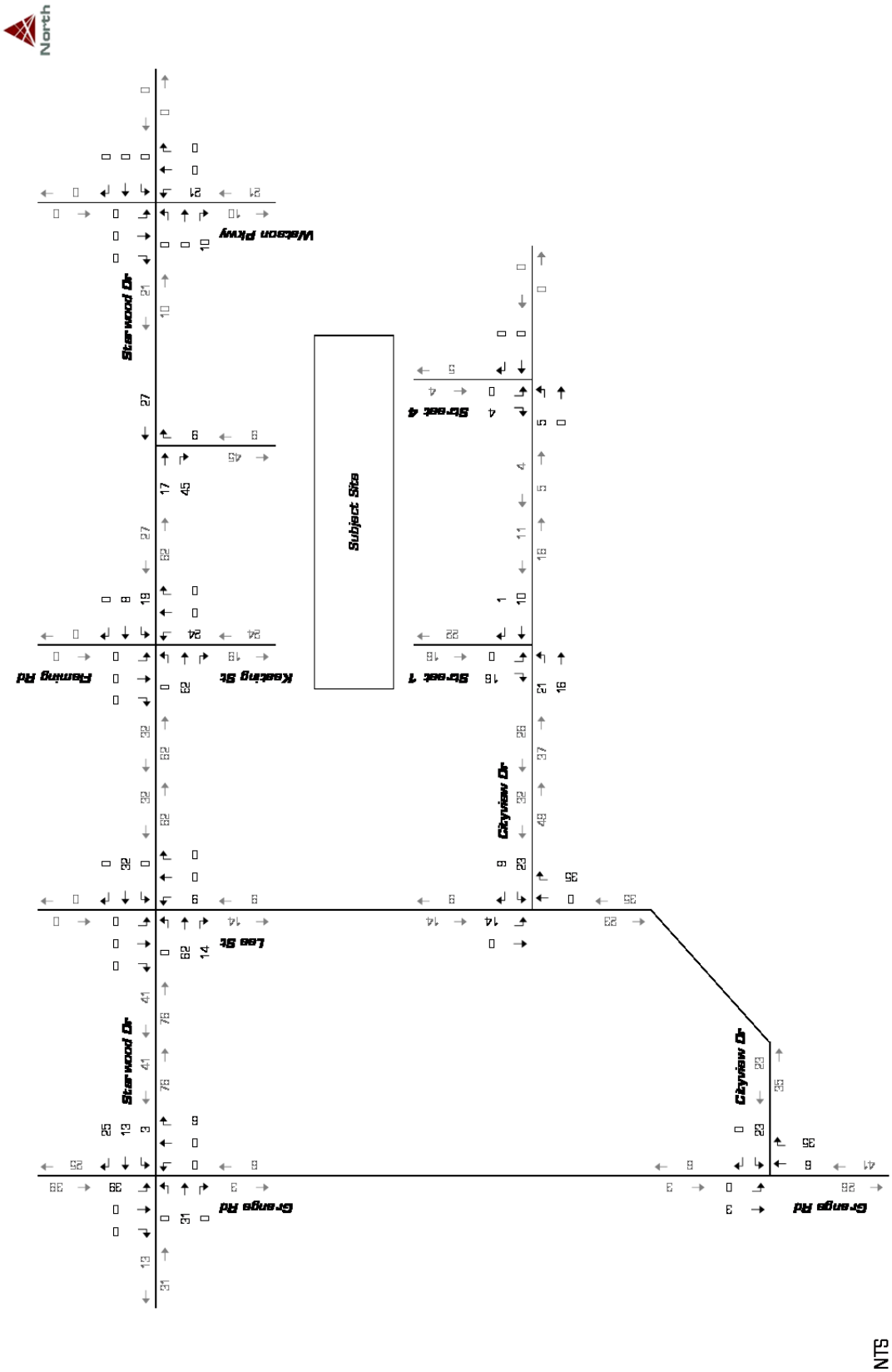

Figure 6.1B
Scenario One Site Generated Traffic – PM Peak Hour

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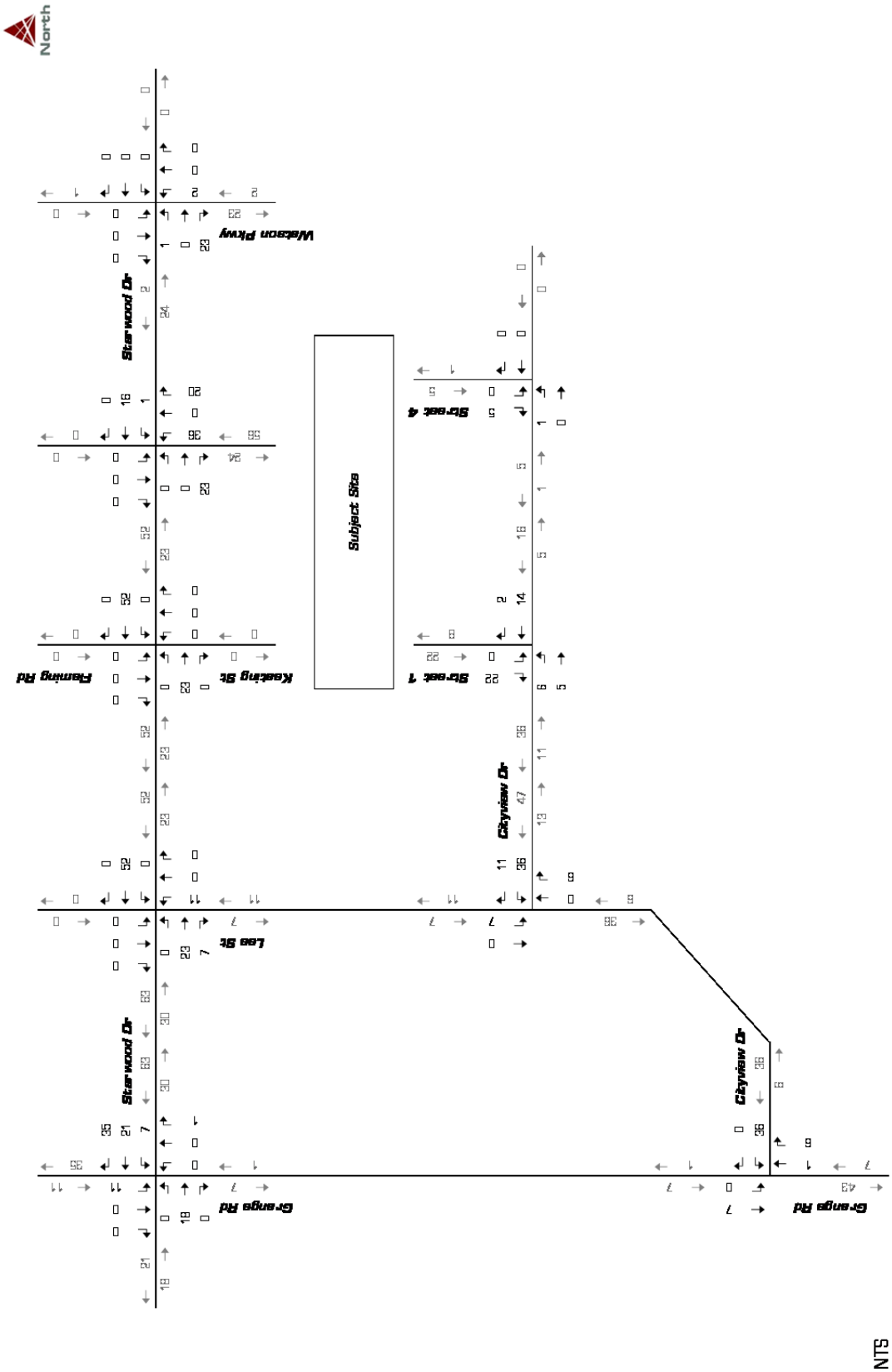

Figure 6.2A
Scenario Two Site Generated Traffic – AM Peak Hour

Cityview Ridge Traffic Impact Study

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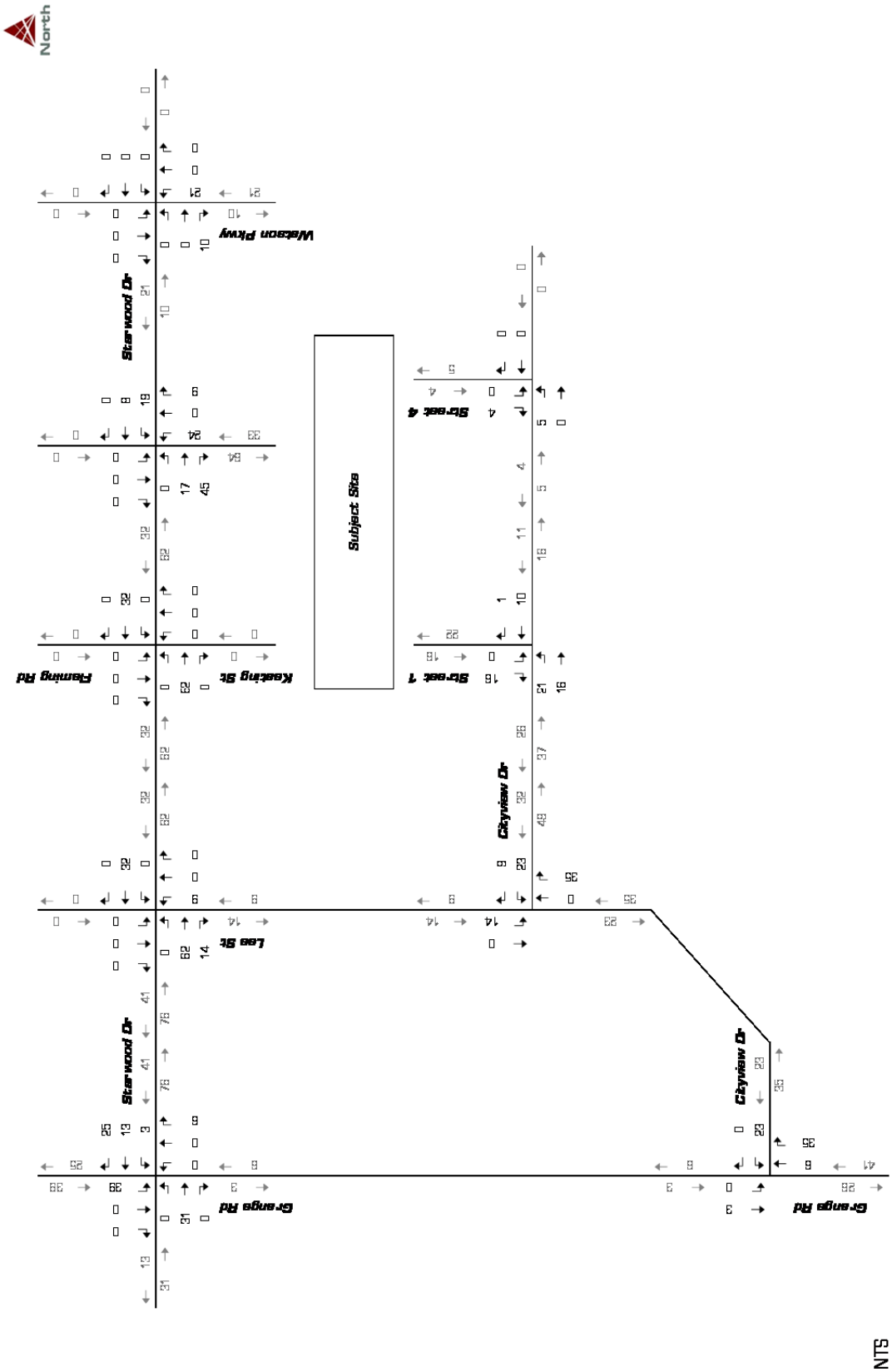

Figure 6.2B
Scenario Two Site Generated Traffic – PM Peak Hour

Cityview Ridge Traffic Impact Study

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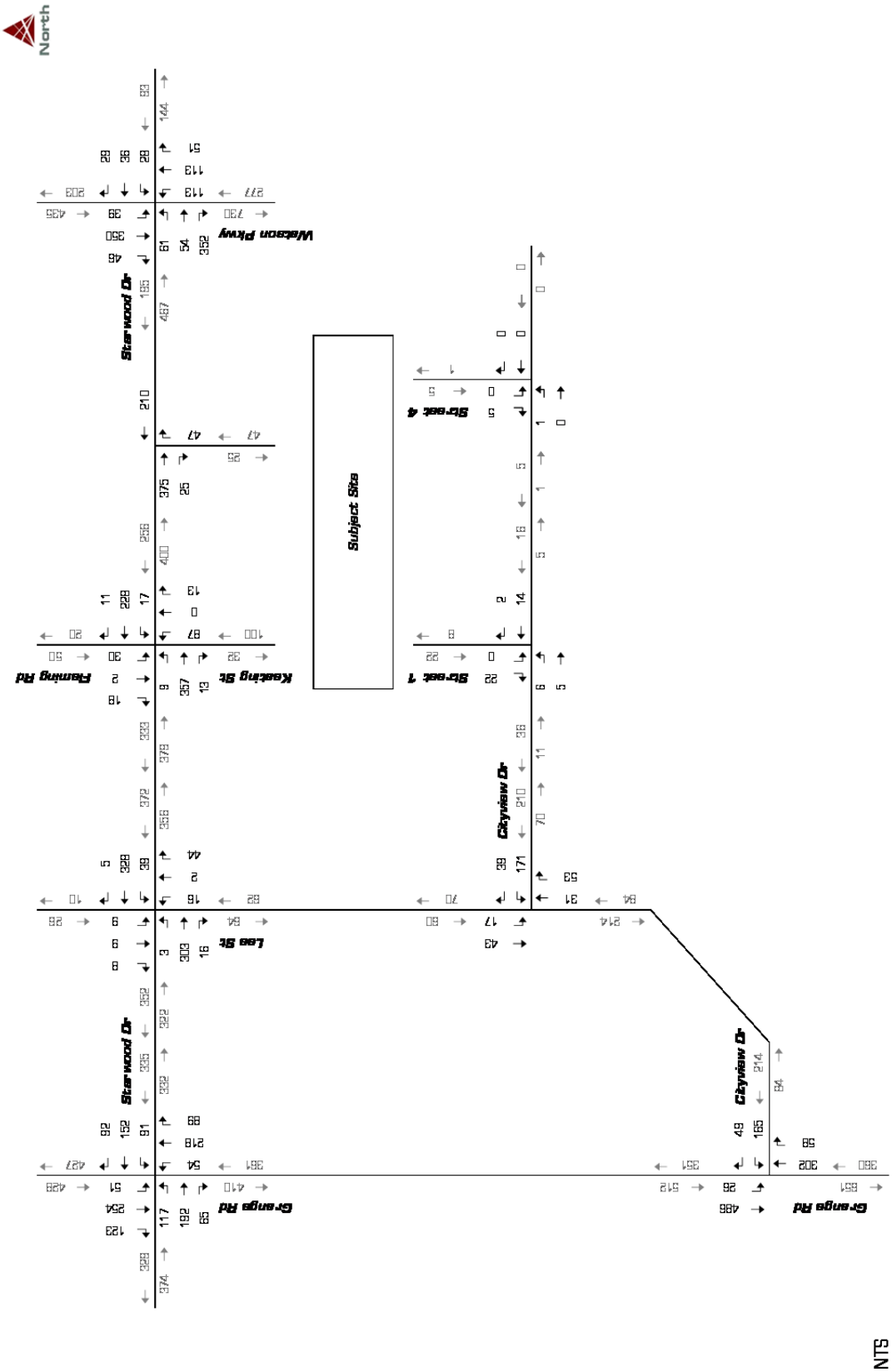

Figure 6.3A
Scenario One Total Traffic – AM Peak Hour

Cityview Ridge Traffic Impact Study

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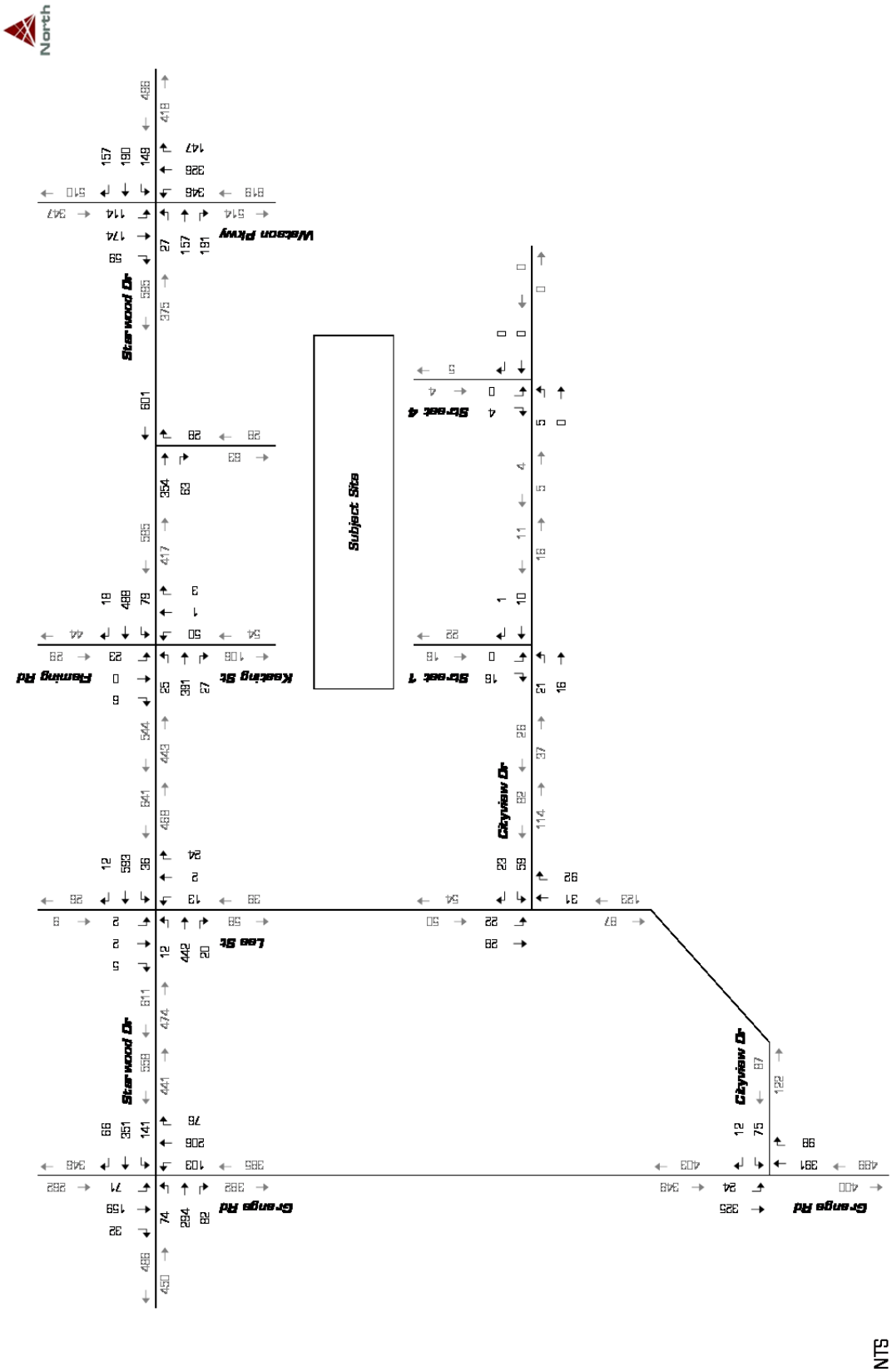

Figure 6.3B
Scenario One Total Traffic – PM Peak Hour

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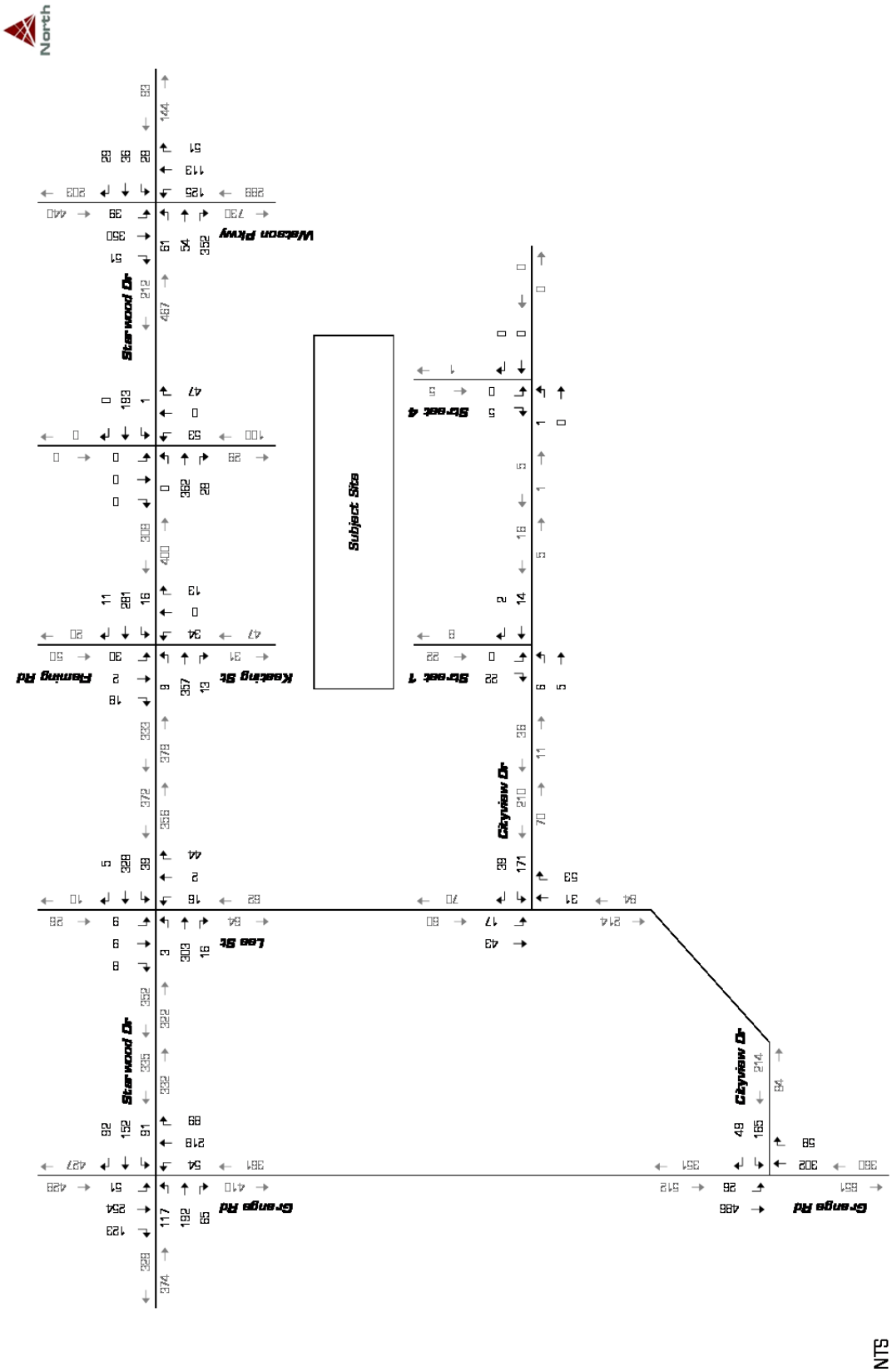

Figure 6.4A
Scenario Two Total Traffic
– AM Peak Hour

Cityview Ridge
Traffic Impact Study

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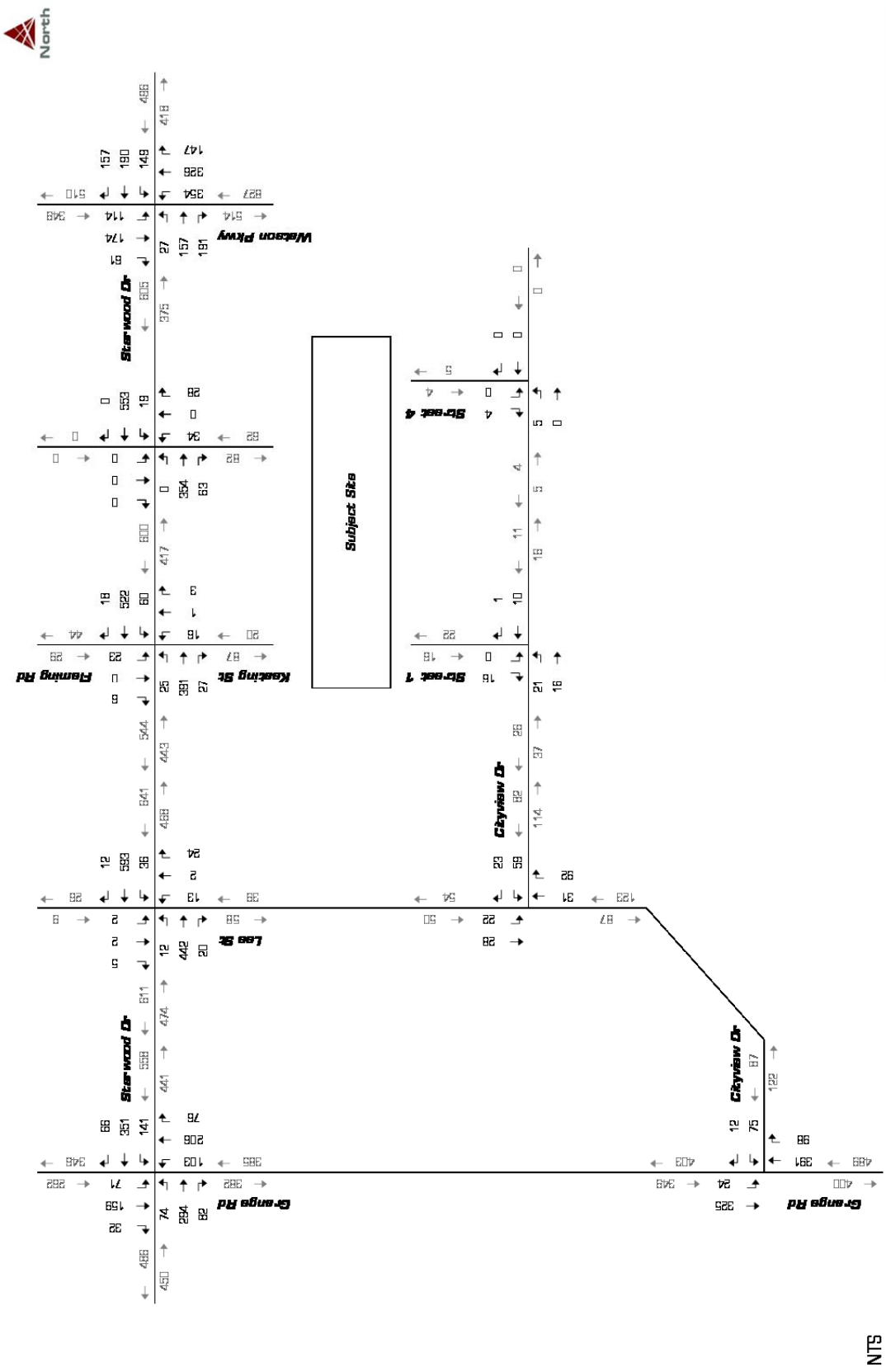

Figure 6.4B
Scenario Two Total Traffic – PM Peak Hour

Cityview Ridge Traffic Impact Study

Paradigm
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6.2 Alternative Access Scenario One Traffic Operations

The operations of the intersections at Keating/Fleming and the new connection on Starwood as these intersections are the only location affected. The resulting level of service conditions for the five-year total traffic horizon is summarized in **Table 6.1** and the following is noted:

- With a new right-in/right-out connection to Starwood Drive the side street approach of Keating Street to Starwood Drive will experience delays in the LOS E range during the PM Peak hour which is worse than without the new connection. This is considered to result because of the increased through traffic created on Starwood Drive. However the v/c ratio is estimated to be lower than 0.50 and would not suggest that this approach is at capacity. Beyond the new connection to Starwood Drive, intersection operational conditions are anticipated to be similar to those documented in **Section 4.5**.

- No movements are considered to be overly critical.

Detailed Synchro 7.0 output is provided in **Appendix G**.

TABLE 6.1: SCENARIO ONE TRAFFIC OPERATIONAL CONDITIONS

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				EB - LEFT	EB - THROUGH	EB - RIGHT	EB APPROACH	WB - LEFT	WB - THROUGH	WB - RIGHT	WB APPROACH	NB - LEFT	NB - THROUGH	NB - RIGHT	NB APPROACH	SB - LEFT	SB - THROUGH	SB - RIGHT	SB APPROACH	OVERALL
AM Peak Hour	Starwood Drive & Keating Street/Fleming Road	TWSC	LOS	<	A	>	A	<	A	>	A	<	C	>	C	<	C	>	C	
			Delay	<	0.3	>	0.3	<	0.7	>	0.7	<	20.9	>	20.9	<	15.1	>	15.1	
			V/C	<	0.01	>		<	0.02	>		<	0.32	>		<	0.13	>		
			Q 95th	<	0	>		<	0	>		<	11	>		<	4	>		
			Ex.	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail	<	-	>		<	-	>		<	-	>		<	-	>		
	Starwood Drive & Watson Parkway	TCS	LOS	C	C	>	C	C	B	>	B	A	A	>	A	A	A	>	A	B
			Delay	20.1	21.6	>	21.4	20.7	19.4	>	19.8	5.1	3.8	>	4.3	3.8	4.3	>	4.2	11.7
			V/C	0.23	0.44	>		0.24	0.12	>		0.22	0.08	>		0.05	0.19	>		0.28
			Q 95th	13	25	>		8	10	>		17	8	>		6	19	>		
			Ex.	30	-	>		30	-	>		30	-	>		30	-	>		
			Avail	17	-	>		22	-	>		13	-	>		24	-	>		
	Starwood Drive & New Street Connection	TWSC	LOS		A	>	A		A		A			B	B					
			Delay		0.0	>	0.0		0.0		0.0			11.1	11.1					
			V/C		0.26	>			0.13					0.08						
			Q 95th		0	>			0					2						
			Ex.		-	>			-					-						
			Avail		-	>			-					-						
PM Peak Hour	Starwood Drive & Keating Street/Fleming Road	TWSC	LOS	<	A	>	A	<	A	>	A	<	**E**	>	**E**	<	D	>	D	
			Delay	<	0.8	>	0.8	<	2.0	>	2.0	<	**41.4**	>	**41.4**	<	29.9	>	29.9	
			V/C	<	0.03	>		<	0.08	>		<	**0.37**	>		<	0.18	>		
			Q 95th	<	1	>		<	2	>		<	**13**	>		<	5	>		
			Ex.	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail	<	-	>		<	-	>		<	-	>		<	-	>		
	Starwood Drive & Watson Parkway	TCS	LOS	C	D	>	C	C	B	>	C	B	B	>	B	C	C	>	C	C
			Delay	23.7	35.3	>	34.5	25.1	19.4	>	21.1	15.1	11.1	>	12.8	26.2	20.1	>	22.1	20.4
			V/C	0.12	0.75	>		0.63	0.49	>		0.62	0.26	>		0.43	0.20	>		0.64
			Q 95th	10	74	>		29	59	>		**58**	28	>		**33**	21	>		
			Ex.	30	-	>		30	-	>		**30**	-	>		**30**	-	>		
			Avail	20	-	>		1	-	>		**-28**	-	>		**-3**	-	>		
	Starwood Drive & New Street Connection	TWSC	LOS		A	>	A		A		A			B	B					
			Delay		0.0	>	0.0		0.0		0.0			10.9	10.9					
			V/C		0.26	>			0.38					0.05						
			Q 95th		0	>			0					1						
			Ex.		-	>			-					-						
			Avail		-	>			-					-						

MOE - Measure of Effectiveness
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
LOS - Level of Service
V/C - Volume to Capacity Ratio
> - Shared Right-Turn Lane
< - Shared Left-Turn Lane
Q - Queue Length
95th - 95th Percentile Queue Length (m)
Ex. - Existing Storage (m)
Avail. - Available Storage (m)

6.3 Alternative Access Scenario Two Traffic Operations

The operations of the intersections were evaluated using the same analytical approach that was used for the five-year total traffic operations along with the forecasted Scenario One total traffic volumes. The resulting level of service conditions for the five-year total traffic horizon is summarized in **Table 6.2** and the following is noted:

- With the development of the fourth leg to the Frasson Drive intersection, the intersection operational conditions along Starwood Drive and within the study area are anticipated to be similar to those documented in **Section 4.5**. There is therefore no change in the LOS for the Keating/Fleming Starwood Drive intersection with the roadway connection the side street approaches remain at LOS C and D in the AM and PM peak hour respectively.

- No movements are considered to be overly critical.

Detailed Synchro 7.0 output is provided in **Appendix H**.

TABLE 6.2: SCENARIO TWO TRAFFIC OPERATIONAL CONDITIONS

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach															
				EB - LEFT	EB - THROUGH	EB - RIGHT	EB APPROACH	WB - LEFT	WB - THROUGH	WB - RIGHT	WB APPROACH	NB - LEFT	NB - THROUGH	NB - RIGHT	NB APPROACH	SB - LEFT	SB - THROUGH	SB - RIGHT	SB APPROACH	OVERALL
AM Peak Hour	Starwood Drive & Keating Street/Fleming Road	TWSC	LOS	<	A	>	A	<	A	>	A	<	C	>	C	<	C	>	C	
			Delay	<	0.3	>	0.3	<	0.6	>	0.6	<	17.5	>	17.5	<	16.2	>	16.2	
			V/C	<	0.01	>		<	0.02	>		<	0.15	>		<	0.14	>		
			Q 95th	<	0	>		<	0	>		<	4	>		<	4	>		
			Ex.	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail	<	-	>		<	-	>		<	-	>		<	-	>		
	Starwood Drive & Watson Parkway	TCS	LOS	C	C	>	C	C	B	>	B	A	A	>	A	A	A	>	A	B
			Delay	20.1	21.6	>	21.4	20.7	19.4	>	19.8	5.3	3.8	>	4.4	3.8	4.3	>	4.2	11.6
			V/C	0.23	0.44	>		0.24	0.12	>		0.25	0.08	>		0.05	0.19	>		0.29
			Q 95th	13	25	>		8	10	>		19	8	>		6	19	>		
			Ex.	30	-	>		30	-	>		30	-	>		30	-	>		
			Avail	17	-	>		22	-	>		11	-	>		24	-	>		
	Starwood Drive & Frasson Drive	TWSC	LOS	<	A	>	A	<	A	>	A	<	B	>	B	<	A	>	A	
			Delay	<	0.0	>	0.0	<	0.1	>	0.1	<	14.4	>	14.4	<	0.0	>	0.0	
			V/C	<	0.00	>		<	0.00	>		<	0.22	>		<	0.00	>		
			Q 95th	<	0	>		<	0	>		<	7	>		<	0	>		
			Ex.	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail	<	-	>		<	-	>		<	-	>		<	-	>		
PM Peak Hour	Starwood Drive & Keating Street/Fleming Road	TWSC	LOS	<	A	>	A	<	A	>	A	<	D	>	D	<	D	>	D	
			Delay	<	0.8	>	0.8	<	1.5	>	1.5	<	28.9	>	28.9	<	29.4	>	29.4	
			V/C	<	0.03	>		<	0.06	>		<	0.13	>		<	0.18	>		
			Q 95th	<	1	>		<	2	>		<	3	>		<	5	>		
			Ex.	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail	<	-	>		<	-	>		<	-	>		<	-	>		
	Starwood Drive & Watson Parkway	TCS	LOS	C	D	>	C	C	B	>	C	B	B	>	B	C	C	>	C	C
			Delay	23.7	35.3	>	34.5	25.1	19.4	>	21.1	15.4	11.1	>	12.9	26.3	20.2	>	22.2	20.4
			V/C	0.12	0.75	>		0.63	0.49	>		0.63	0.26	>		0.43	0.20	>		0.65
			Q 95th	10	74	>		29	59	>		**59**	28	>		**33**	21	>		
			Ex.	30	-	>		30	-	>		**30**	-	>		**30**	-	>		
			Avail	20	-	>		1	-	>		**-29**	-	>		**-3**	-	>		
	Starwood Drive & Frasson Drive	TWSC	LOS	<	A	>	A	<	A	>	A	<	C	>	C	<	A	>	A	
			Delay	<	0.0	>	0.0	<	0.5	>	0.5	<	21.2	>	21.2	<	0.0	>	0.0	
			V/C	<	0.00	>		<	0.02	>		<	0.23	>		<	0.00	>		
			Q 95th	<	0	>		<	0	>		<	7	>		<	0	>		
			Ex.	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail	<	-	>		<	-	>		<	-	>		<	-	>		

MOE - Measure of Effectiveness
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
LOS - Level of Service
V/C - Volume to Capacity Ratio
> - Shared Right-Turn Lane
< - Shared Left-Turn Lane
Q - Queue Length
95th - 95th Percentile Queue Length (m)
Ex. - Existing Storage (m)
Avail. - Available Storage (m)

7.0 Conclusions and Recommendations

7.1 Conclusions

The main conclusions of this study are as follows:

- **Proposed Development:** The subject site is located generally north of the Canadian National Rail line between Starwood Drive and Cityview Drive in the City of Guelph on a vacant parcel of land. The lands are planned to be developed as a residential subdivision with approximately 261 new residential units. The build-out of the subject site is anticipated to occur in one-two phases with an estimated completion date of year 2019.

- **Existing Traffic Conditions:** The study area is generally defined as the Grange Road corridor from Cityview Drive to Starwood Drive and the Starwood Drive corridor from Grange Road to Watson Parkway. The intersections in the study area are currently operating with satisfactory levels of service during the AM and PM peak hours. No improvements are required to improve the operation of the intersections in the study area.

- **Background Traffic:** The background traffic volumes in the vicinity of the subject site have been assessed for a five-year horizon following the full build-out and occupancy of the subject site, assumed to be the year 2019. The background traffic volumes are estimated to consist of generalized traffic growth and traffic related to the potential future development of four surrounding residential developments, the future UGDSB Stockford Road school site and a commercial development at the Starwood Drive intersection with Watson Parkway.

- **Background Traffic Conditions:** The Cityview Drive intersection with Grange Road is estimated to operate at LOS E on the side street approach. All other study area intersections are anticipated to continue to operate with satisfactory levels of service during the AM and PM peak hours. However, under background traffic conditions, left turn traffic meet MTO warrants at some locations and the need to extend some left-turn storage lanes at the signalized intersections of Starwood Drive with Grange Road and Watson Parkway increases from existing conditions.

- **Development Generated Traffic:** The planned development of the 261 residential unit subdivision is estimated to generate approximately 161 new vehicle trips during the AM peak hour and approximately 206 new vehicle trips during the PM peak hour. The additional traffic estimated to be generated by the subject site will not have a significant impact on the operations of the study area intersections and will result in volumes well within the guidelines for the respective local and collector roadway classifications.

- **Total Traffic Conditions:** With the build-out of the subject site, the level of service at the study area intersections is anticipated to be similar to the background traffic conditions. The intersections, where side street delays begin to increase may result in traffic diverting towards other local connections to the collector road network.

- **Traffic Control Requirements:** With exception to the Starwood Drive intersection with Watson Parkway, the existing form of traffic control at the study area intersection is considered to be acceptable. With the development of the Grangehill Commercial Development at 115 Watson Parkway North the OTM signal warrant criteria is satisfied for improvements to the existing form of traffic control.

- **Auxiliary Turn Lane Requirements:** Under the background traffic conditions, a southbound left-turn lane is warranted at the Grange Road intersection with Cityview Drive. Additionally, an eastbound and a westbound left-turn lane is warranted at the Starwood Drive intersection with Keating Street/Fleming Road. The requirement for left turn lanes are primarily due to background traffic.

- **Alternative Connection Scenarios:** With an additional connection to Starwood Drive thru the 55-57 Cityview lands, the operational conditions at the study area intersection will not improve at the Keating/Fleming intersection which is the only intersection affected. A new connection to Starwood Drive would reduce traffic on the Keating/Fleming approach to Starwood Drive and would not resolve any capacity issues.

7.2 Recommendations

Based on the findings of this study, the following is recommended:

- For a complete road network that is capable of accommodating all modes of transport, sidewalk facilities should be developed on both sides of all roadways internal to the subject site.

- Under the forecast traffic volumes, the operational conditions on the side street approaches of Cityview Drive to Grange Road and Keating Street/Fleming Road to Starwood Drive will begin to deteriorate. The City of Guelph should monitor the operations of these intersections in the future to ensure adequate traffic control is provided as background and site traffic may divert from these intersection to avoid delays resulting in acceptable operations.

- The City of Guelph should monitor the operation of the Starwood Drive intersections with Grange Road and Watson Parkway to ensure that the intersections queuing requirements are satisfied by the available storage lane lengths. Should the future queuing conditions deteriorate, consideration should be given to extending the available storage lane lengths.

- The City of Guelph should review the existing right-of-ways of Grange Road at Cityview Drive and Starwood Drive at Keating Street/Fleming Road to determine the feasibility of providing auxiliary left-turn lanes on the mainline approaches.

An additional connection to Starwood Drive is not recommended for the following reasons:

- As a minor collector roadway future traffic levels on Keating/Fleming will be well within what is expected for this road function. Peak volumes will be approximately 4 vehicles per minute which is not excessive for a residential street.

- The new connection will affect a local street within the 55-57 Plan exceeding the recommended volumes for this type of street.

- Environmental and property issues occur with either new connection scenarios.

- The new connection does not resolve any capacity issues as indicated by the analysis below.

Based on the findings of this study, no other roadway or traffic control improvements are required or recommended to accommodate both background traffic and the development of the subject site.

Appendix A

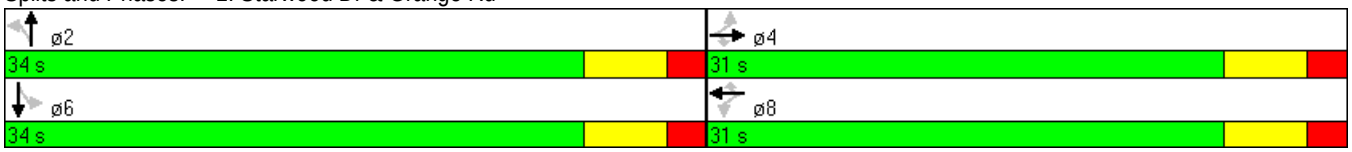
Existing Traffic Operations

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Volume (vph)	109	101	56	66	74	35	27	177	32	223
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	
Protected Phases		4			8			2		6
Permitted Phases	4		4	8		8	2		6	
Detector Phase	4	4	4	8	8	8	2	2	6	6
Switch Phase										
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	31.0	31.0	31.0	31.0	31.0	31.0	34.0	34.0	34.0	34.0
Total Split (s)	31.0	31.0	31.0	31.0	31.0	31.0	34.0	34.0	34.0	34.0
Total Split (%)	47.7%	47.7%	47.7%	47.7%	47.7%	47.7%	52.3%	52.3%	52.3%	52.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag										
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	None	None	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	16.3	16.3	16.3	16.3	16.3	16.3	44.7	44.7	44.7	44.7
Actuated g/C Ratio	0.25	0.25	0.25	0.25	0.25	0.25	0.69	0.69	0.69	0.69
v/c Ratio	0.41	0.25	0.16	0.27	0.19	0.10	0.06	0.22	0.05	0.34
Control Delay	22.8	19.1	5.2	20.0	18.2	5.6	7.4	6.5	7.2	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	22.8	19.1	5.2	20.0	18.2	5.6	7.4	6.5	7.2	7.1
LOS	C	B	A	B	B	A	A	A	A	A
Approach Delay		17.7			16.3			6.6		7.1
Approach LOS		B			B			A		A

Intersection Summary

Cycle Length: 65
Actuated Cycle Length: 65
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 65
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.41
Intersection Signal Delay: 11.2 Intersection LOS: B
Intersection Capacity Utilization 56.7% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 1: Starwood Dr & Grange Rd



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	130	120	67	79	88	42	32	268	38	401
v/c Ratio	0.41	0.25	0.16	0.27	0.19	0.10	0.06	0.22	0.05	0.34
Control Delay	22.8	19.1	5.2	20.0	18.2	5.6	7.4	6.5	7.2	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	22.8	19.1	5.2	20.0	18.2	5.6	7.4	6.5	7.2	7.1
Queue Length 50th (m)	14.5	12.8	0.0	8.5	9.2	0.0	1.2	10.0	1.4	15.6
Queue Length 95th (m)	19.7	17.1	5.5	13.0	13.5	4.5	6.1	30.0	6.7	45.3
Internal Link Dist (m)		193.7			181.2			338.3		108.7
Turn Bay Length (m)	30.0		30.0	25.0		25.0	20.0		20.0	
Base Capacity (vph)	527	789	659	484	759	662	568	1200	742	1195
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	0.25	0.15	0.10	0.16	0.12	0.06	0.06	0.22	0.05	0.34

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	109	101	56	66	74	35	27	177	48	32	223	114
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.96	1.00	1.00	0.95	1.00	0.98		1.00	0.97	
Flpb, ped/bikes	0.97	1.00	1.00	0.98	1.00	1.00	0.97	1.00		0.95	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97		1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1723	1900	1492	1629	1827	1535	1576	1730		1721	1712	
Flt Permitted	0.70	1.00	1.00	0.68	1.00	1.00	0.50	1.00		0.59	1.00	
Satd. Flow (perm)	1269	1900	1492	1166	1827	1535	824	1730		1077	1712	
Peak-hour factor, PHF	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Adj. Flow (vph)	130	120	67	79	88	42	32	211	57	38	265	136
RTOR Reduction (vph)	0	0	52	0	0	33	0	10	0	0	18	0
Lane Group Flow (vph)	130	120	15	79	88	9	32	258	0	38	383	0
Confl. Peds. (#/hr)	23		15	15		23	48		58	58		48
Heavy Vehicles (%)	2%	0%	4%	9%	4%	0%	11%	5%	2%	0%	2%	4%
Turn Type	Perm		Perm	Perm		Perm	Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)	12.3	12.3	12.3	12.3	12.3	12.3	40.7	40.7		40.7	40.7	
Effective Green, g (s)	14.3	14.3	14.3	14.3	14.3	14.3	42.7	42.7		42.7	42.7	
Actuated g/C Ratio	0.22	0.22	0.22	0.22	0.22	0.22	0.66	0.66		0.66	0.66	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	279	418	328	257	402	338	541	1136		708	1125	
v/s Ratio Prot		0.06			0.05			0.15			c0.22	
v/s Ratio Perm	c0.10		0.01	0.07		0.01	0.04			0.04		
v/c Ratio	0.47	0.29	0.04	0.31	0.22	0.03	0.06	0.23		0.05	0.34	
Uniform Delay, d1	22.0	21.1	20.0	21.2	20.8	19.9	4.0	4.5		4.0	4.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.2	0.4	0.1	0.7	0.3	0.0	0.2	0.5		0.1	0.8	
Delay (s)	23.3	21.5	20.0	21.9	21.0	19.9	4.2	5.0		4.1	5.7	
Level of Service	C	C	C	C	C	B	A	A		A	A	
Approach Delay (s)		21.9			21.1			4.9			5.6	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM Average Control Delay	12.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	56.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	3	217	2	2	213	5	5	2	13	8	8	7
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Hourly flow rate (vph)	4	282	3	3	277	6	6	3	17	10	10	9
Pedestrians		8			14			3			3	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		1			1			0			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		205										
pX, platoon unblocked												
vC, conflicting volume	286			287			601	585	300	611	583	291
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	286			287			601	585	300	611	583	291
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			98	99	98	97	98	99
cM capacity (veh/h)	1284			1283			395	421	734	389	422	746

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	288	286	26	30
Volume Left	4	3	6	10
Volume Right	3	6	17	9
cSH	1284	1283	570	470
Volume to Capacity	0.00	0.00	0.05	0.06
Queue Length 95th (m)	0.1	0.0	1.1	1.6
Control Delay (s)	0.1	0.1	11.6	13.2
Lane LOS	A	A	B	B
Approach Delay (s)	0.1	0.1	11.6	13.2
Approach LOS			B	B

Intersection Summary				
Average Delay	1.2			
Intersection Capacity Utilization	27.2%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	8	194	7	4	117	10	16	0	12	28	2	17
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	9	211	8	4	127	11	17	0	13	30	2	18
Pedestrians		7						8			5	
Lane Width (m)		3.6						3.6			3.6	
Walking Speed (m/s)		1.2						1.2			1.2	
Percent Blockage		1						1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		377										
pX, platoon unblocked												
vC, conflicting volume	143			226			408	392	223	391	390	145
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	143			226			408	392	223	391	390	145
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.3
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	99			100			97	100	98	94	100	98
cM capacity (veh/h)	1446			1345			529	536	816	551	537	871

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	227	142	30	51
Volume Left	9	4	17	30
Volume Right	8	11	13	18
cSH	1446	1345	623	635
Volume to Capacity	0.01	0.00	0.05	0.08
Queue Length 95th (m)	0.1	0.1	1.2	2.1
Control Delay (s)	0.3	0.3	11.1	11.2
Lane LOS	A	A	B	B
Approach Delay (s)	0.3	0.3	11.1	11.2
Approach LOS			B	B

Intersection Summary				
Average Delay	2.3			
Intersection Capacity Utilization	26.4%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	42	233	62	105	325	26
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	46	253	67	114	353	28
Pedestrians					1	
Lane Width (m)					3.6	
Walking Speed (m/s)					1.2	
Percent Blockage					0	
Right turn flare (veh)		4				
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	560	191	382			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	560	191	382			
tC, single (s)	6.8	6.9	4.4			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.3			
p0 queue free %	89	69	94			
cM capacity (veh/h)	434	822	1098			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	299	67	57	57	236	146
Volume Left	46	67	0	0	0	0
Volume Right	253	0	0	0	0	28
cSH	970	1098	1700	1700	1700	1700
Volume to Capacity	0.31	0.06	0.03	0.03	0.14	0.09
Queue Length 95th (m)	10.5	1.6	0.0	0.0	0.0	0.0
Control Delay (s)	11.8	8.5	0.0	0.0	0.0	0.0
Lane LOS	B	A				
Approach Delay (s)	11.8	3.2			0.0	
Approach LOS	B					

Intersection Summary			
Average Delay	4.7		
Intersection Capacity Utilization	30.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	29	4	208	6	10	400
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.80	0.80	0.80	0.80	0.80	0.80
Hourly flow rate (vph)	36	5	260	8	12	500
Pedestrians	21					
Lane Width (m)	3.6					
Walking Speed (m/s)	1.2					
Percent Blockage	2					
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						362
pX, platoon unblocked						
vC, conflicting volume	810	285			288	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	810	285			288	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	89	99			99	
cM capacity (veh/h)	343	746			1263	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	41	268	512
Volume Left	36	0	12
Volume Right	5	8	0
cSH	367	1700	1263
Volume to Capacity	0.11	0.16	0.01
Queue Length 95th (m)	3.0	0.0	0.2
Control Delay (s)	16.1	0.0	0.3
Lane LOS	C		A
Approach Delay (s)	16.1	0.0	0.3
Approach LOS	C		

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	39.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	15	26	1	15	9	18
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83
Hourly flow rate (vph)	18	31	1	18	11	22
Pedestrians			1			
Lane Width (m)			3.6			
Walking Speed (m/s)			1.2			
Percent Blockage			0			
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	55	10			19	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	55	10			19	
tC, single (s)	6.6	6.2			4.2	
tC, 2 stage (s)						
tF (s)	3.7	3.3			2.3	
p0 queue free %	98	97			99	
cM capacity (veh/h)	903	1065			1540	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	49	19	33
Volume Left	18	0	11
Volume Right	31	18	0
cSH	999	1700	1540
Volume to Capacity	0.05	0.01	0.01
Queue Length 95th (m)	1.2	0.0	0.2
Control Delay (s)	8.8	0.0	2.5
Lane LOS	A		A
Approach Delay (s)	8.8	0.0	2.5
Approach LOS	A		

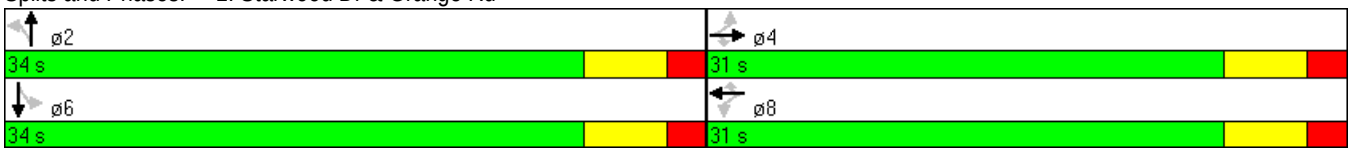
Intersection Summary			
Average Delay	5.1		
Intersection Capacity Utilization	18.1%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Volume (vph)	69	78	55	93	131	25	85	175	15	128
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	
Protected Phases		4			8			2		6
Permitted Phases	4		4	8		8	2		6	
Detector Phase	4	4	4	8	8	8	2	2	6	6
Switch Phase										
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	31.0	31.0	31.0	31.0	31.0	31.0	34.0	34.0	34.0	34.0
Total Split (s)	31.0	31.0	31.0	31.0	31.0	31.0	34.0	34.0	34.0	34.0
Total Split (%)	47.7%	47.7%	47.7%	47.7%	47.7%	47.7%	52.3%	52.3%	52.3%	52.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag										
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	None	None	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	15.5	15.5	15.5	15.5	15.5	15.5	45.5	45.5	45.5	45.5
Actuated g/C Ratio	0.24	0.24	0.24	0.24	0.24	0.24	0.70	0.70	0.70	0.70
v/c Ratio	0.25	0.19	0.14	0.32	0.31	0.06	0.10	0.18	0.02	0.13
Control Delay	20.2	18.9	5.4	21.5	20.7	6.6	6.9	5.9	7.0	5.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.2	18.9	5.4	21.5	20.7	6.6	6.9	5.9	7.0	5.6
LOS	C	B	A	C	C	A	A	A	A	A
Approach Delay		15.7			19.6			6.2		5.8
Approach LOS		B			B			A		A

Intersection Summary

Cycle Length: 65
Actuated Cycle Length: 65
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 65
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.32
Intersection Signal Delay: 11.8 Intersection LOS: B
Intersection Capacity Utilization 61.7% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 1: Starwood Dr & Grange Rd



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	73	82	58	98	138	26	89	229	16	167
v/c Ratio	0.25	0.19	0.14	0.32	0.31	0.06	0.10	0.18	0.02	0.13
Control Delay	20.2	18.9	5.4	21.5	20.7	6.6	6.9	5.9	7.0	5.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.2	18.9	5.4	21.5	20.7	6.6	6.9	5.9	7.0	5.6
Queue Length 50th (m)	8.1	8.9	0.0	11.1	15.5	0.0	3.0	7.2	0.5	4.9
Queue Length 95th (m)	13.1	13.7	5.8	16.5	20.9	3.9	14.0	27.9	4.0	20.4
Internal Link Dist (m)		193.7			181.2			338.3		108.7
Turn Bay Length (m)	30.0		30.0	25.0		25.0	20.0		20.0	
Base Capacity (vph)	517	766	705	540	789	686	864	1262	818	1284
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.11	0.08	0.18	0.17	0.04	0.10	0.18	0.02	0.13

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	69	78	55	93	131	25	85	175	43	15	128	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97		1.00	0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1805	1845	1615	1752	1900	1615	1800	1789		1799	1822	
Flt Permitted	0.66	1.00	1.00	0.70	1.00	1.00	0.65	1.00		0.62	1.00	
Satd. Flow (perm)	1245	1845	1615	1298	1900	1615	1234	1789		1166	1822	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	73	82	58	98	138	26	89	184	45	16	135	32
RTOR Reduction (vph)	0	0	46	0	0	21	0	8	0	0	8	0
Lane Group Flow (vph)	73	82	12	98	138	5	89	221	0	16	159	0
Confl. Peds. (#/hr)							3		4	4		3
Heavy Vehicles (%)	0%	3%	0%	3%	0%	0%	0%	2%	5%	0%	1%	0%
Turn Type	Perm		Perm	Perm		Perm	Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)	11.5	11.5	11.5	11.5	11.5	11.5	41.5	41.5		41.5	41.5	
Effective Green, g (s)	13.5	13.5	13.5	13.5	13.5	13.5	43.5	43.5		43.5	43.5	
Actuated g/C Ratio	0.21	0.21	0.21	0.21	0.21	0.21	0.67	0.67		0.67	0.67	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	259	383	335	270	395	335	826	1197		780	1219	
v/s Ratio Prot		0.04			0.07			c0.12			0.09	
v/s Ratio Perm	0.06		0.01	c0.08		0.00	0.07			0.01		
v/c Ratio	0.28	0.21	0.04	0.36	0.35	0.02	0.11	0.18		0.02	0.13	
Uniform Delay, d1	21.7	21.4	20.6	22.1	22.0	20.5	3.8	4.1		3.6	3.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.6	0.3	0.0	0.8	0.5	0.0	0.3	0.3		0.0	0.2	
Delay (s)	22.3	21.6	20.6	22.9	22.5	20.5	4.1	4.4		3.7	4.1	
Level of Service	C	C	C	C	C	C	A	A		A	A	
Approach Delay (s)		21.6			22.5			4.3			4.1	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM Average Control Delay	12.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.23		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	61.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	11	151	4	23	290	11	4	2	12	2	2	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	12	161	4	24	309	12	4	2	13	2	2	5
Pedestrians		8			3			1			8	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		1			0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		205										
pX, platoon unblocked												
vC, conflicting volume	328			166			565	564	167	574	561	330
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	328			166			565	564	167	574	561	330
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			98			99	99	99	99	99	99
cM capacity (veh/h)	1234			1423			419	423	880	410	425	706

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	177	345	19	10
Volume Left	12	24	4	2
Volume Right	4	12	13	5
cSH	1234	1423	645	540
Volume to Capacity	0.01	0.02	0.03	0.02
Queue Length 95th (m)	0.2	0.4	0.7	0.4
Control Delay (s)	0.6	0.7	10.8	11.8
Lane LOS	A	A	B	B
Approach Delay (s)	0.6	0.7	10.8	11.8
Approach LOS			B	B

Intersection Summary				
Average Delay	1.2			
Intersection Capacity Utilization	35.0%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	23	110	8	29	224	17	5	1	3	21	0	6
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	25	118	9	31	241	18	5	1	3	23	0	6
Pedestrians					2			2				
Lane Width (m)					3.6			3.6				
Walking Speed (m/s)					1.2			1.2				
Percent Blockage					0			0				
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		377										
pX, platoon unblocked												
vC, conflicting volume	259			129			493	496	127	490	491	250
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	259			129			493	496	127	490	491	250
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.3
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	98			98			99	100	100	95	100	99
cM capacity (veh/h)	1317			1467			470	459	926	473	462	767

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	152	290	10	29
Volume Left	25	31	5	23
Volume Right	9	18	3	6
cSH	1317	1467	560	517
Volume to Capacity	0.02	0.02	0.02	0.06
Queue Length 95th (m)	0.5	0.5	0.4	1.4
Control Delay (s)	1.4	1.0	11.5	12.4
Lane LOS	A	A	B	B
Approach Delay (s)	1.4	1.0	11.5	12.4
Approach LOS			B	B

Intersection Summary				
Average Delay	2.0			
Intersection Capacity Utilization	28.0%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	19	124	240	326	176	44
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	20	133	258	351	189	47
Pedestrians					1	
Lane Width (m)					3.6	
Walking Speed (m/s)					1.2	
Percent Blockage					0	
Right turn flare (veh)		4				
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	905	118	237			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	905	118	237			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	91	85	81			
cM capacity (veh/h)	226	914	1342			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	154	258	175	175	126	110
Volume Left	20	258	0	0	0	0
Volume Right	133	0	0	0	0	47
cSH	1055	1342	1700	1700	1700	1700
Volume to Capacity	0.15	0.19	0.10	0.10	0.07	0.06
Queue Length 95th (m)	4.1	5.7	0.0	0.0	0.0	0.0
Control Delay (s)	11.3	8.3	0.0	0.0	0.0	0.0
Lane LOS	B	A				
Approach Delay (s)	11.3	3.5			0.0	
Approach LOS	B					

Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	32.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	25	1	326	24	6	256
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	30	1	388	29	7	305
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						362
pX, platoon unblocked						
vC, conflicting volume	721	402			417	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	721	402			417	
tC, single (s)	6.5	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.6	3.3			2.2	
p0 queue free %	92	100			99	
cM capacity (veh/h)	384	648			1153	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	31	417	312
Volume Left	30	0	7
Volume Right	1	29	0
cSH	390	1700	1153
Volume to Capacity	0.08	0.25	0.01
Queue Length 95th (m)	2.1	0.0	0.1
Control Delay (s)	15.0	0.0	0.2
Lane LOS	C		A
Approach Delay (s)	15.0	0.0	0.2
Approach LOS	C		

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	28.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	8	13	20	10	7	18
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	8	14	21	10	7	19
Pedestrians						1
Lane Width (m)						3.6
Walking Speed (m/s)						1.2
Percent Blockage						0
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	59	27			31	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	59	27			31	
tC, single (s)	6.4	6.5			4.2	
tC, 2 stage (s)						
tF (s)	3.5	3.6			2.3	
p0 queue free %	99	99			100	
cM capacity (veh/h)	948	970			1525	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	22	31	26
Volume Left	8	0	7
Volume Right	14	10	0
cSH	961	1700	1525
Volume to Capacity	0.02	0.02	0.00
Queue Length 95th (m)	0.6	0.0	0.1
Control Delay (s)	8.8	0.0	2.1
Lane LOS	A		A
Approach Delay (s)	8.8	0.0	2.1
Approach LOS	A		

Intersection Summary			
Average Delay	3.1		
Intersection Capacity Utilization	17.4%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix B

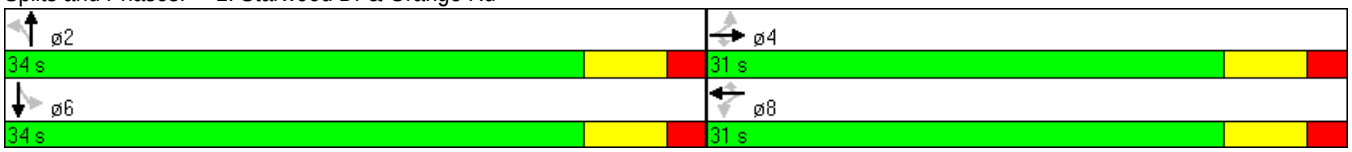
Background Traffic Operations

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Volume (vph)	117	174	65	84	131	57	54	218	40	254
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	
Protected Phases		4			8			2		6
Permitted Phases	4		4	8		8	2		6	
Detector Phase	4	4	4	8	8	8	2	2	6	6
Switch Phase										
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	31.0	31.0	31.0	31.0	31.0	31.0	34.0	34.0	34.0	34.0
Total Split (s)	31.0	31.0	31.0	31.0	31.0	31.0	34.0	34.0	34.0	34.0
Total Split (%)	47.7%	47.7%	47.7%	47.7%	47.7%	47.7%	52.3%	52.3%	52.3%	52.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag										
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	None	None	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	16.7	16.7	16.7	16.7	16.7	16.7	40.3	40.3	40.3	40.3
Actuated g/C Ratio	0.26	0.26	0.26	0.26	0.26	0.26	0.62	0.62	0.62	0.62
v/c Ratio	0.47	0.42	0.17	0.42	0.33	0.15	0.14	0.34	0.08	0.41
Control Delay	24.2	21.5	4.9	23.7	20.0	5.0	8.3	7.7	7.7	8.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.2	21.5	4.9	23.7	20.0	5.0	8.3	7.7	7.7	8.4
LOS	C	C	A	C	C	A	A	A	A	A
Approach Delay		19.4			18.0			7.8		8.3
Approach LOS		B			B			A		A

Intersection Summary

Cycle Length: 65
Actuated Cycle Length: 65
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 65
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.47
Intersection Signal Delay: 12.9 Intersection LOS: B
Intersection Capacity Utilization 68.4% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 1: Starwood Dr & Grange Rd



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	139	207	77	100	156	68	64	365	48	448
v/c Ratio	0.47	0.42	0.17	0.42	0.33	0.15	0.14	0.34	0.08	0.41
Control Delay	24.2	21.5	4.9	23.7	20.0	5.0	8.3	7.7	7.7	8.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.2	21.5	4.9	23.7	20.0	5.0	8.3	7.7	7.7	8.4
Queue Length 50th (m)	15.5	22.8	0.0	11.0	16.7	0.0	2.6	15.0	1.9	19.4
Queue Length 95th (m)	21.3	27.6	5.9	16.5	21.6	5.5	10.7	41.4	8.2	52.7
Internal Link Dist (m)		193.7			181.2			338.3		108.7
Turn Bay Length (m)	30.0		30.0	25.0		25.0	20.0		20.0	
Base Capacity (vph)	479	789	665	388	759	677	466	1071	581	1083
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	0.29	0.26	0.12	0.26	0.21	0.10	0.14	0.34	0.08	0.41

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	117	174	65	84	131	57	54	218	88	40	254	123
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.96	1.00	1.00	0.95	1.00	0.98		1.00	0.98	
Flpb, ped/bikes	0.98	1.00	1.00	0.99	1.00	1.00	0.97	1.00		0.96	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96		1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1728	1900	1492	1633	1827	1535	1581	1703		1735	1718	
Flt Permitted	0.64	1.00	1.00	0.54	1.00	1.00	0.45	1.00		0.51	1.00	
Satd. Flow (perm)	1155	1900	1492	933	1827	1535	751	1703		937	1718	
Peak-hour factor, PHF	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Adj. Flow (vph)	139	207	77	100	156	68	64	260	105	48	302	146
RTOR Reduction (vph)	0	0	57	0	0	51	0	16	0	0	19	0
Lane Group Flow (vph)	139	207	20	100	156	17	64	349	0	48	429	0
Confl. Peds. (#/hr)	23		15	15		23	48		58	58		48
Heavy Vehicles (%)	2%	0%	4%	9%	4%	0%	11%	5%	2%	0%	2%	4%
Turn Type	Perm		Perm	Perm		Perm	Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)	14.7	14.7	14.7	14.7	14.7	14.7	38.3	38.3		38.3	38.3	
Effective Green, g (s)	16.7	16.7	16.7	16.7	16.7	16.7	40.3	40.3		40.3	40.3	
Actuated g/C Ratio	0.26	0.26	0.26	0.26	0.26	0.26	0.62	0.62		0.62	0.62	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	297	488	383	240	469	394	466	1056		581	1065	
v/s Ratio Prot		0.11			0.09			0.21			c0.25	
v/s Ratio Perm	c0.12		0.01	0.11		0.01	0.09			0.05		
v/c Ratio	0.47	0.42	0.05	0.42	0.33	0.04	0.14	0.33		0.08	0.40	
Uniform Delay, d1	20.4	20.1	18.2	20.1	19.6	18.2	5.1	5.9		4.9	6.3	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.2	0.6	0.1	1.2	0.4	0.0	0.6	0.8		0.3	1.1	
Delay (s)	21.6	20.7	18.2	21.3	20.0	18.2	5.7	6.7		5.2	7.4	
Level of Service	C	C	B	C	C	B	A	A		A	A	
Approach Delay (s)		20.6			20.0			6.6			7.2	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM Average Control Delay	12.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	68.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	3	280	9	39	276	5	5	2	44	9	9	8
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Hourly flow rate (vph)	4	364	12	51	358	6	6	3	57	12	12	10
Pedestrians		8			14			3			3	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		1			1			0			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		205										
pX, platoon unblocked				0.95			0.95	0.95	0.95	0.95	0.95	
vC, conflicting volume	368			378			867	850	386	916	852	373
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	368			323			837	818	332	887	820	373
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			96			97	99	91	95	96	98
cM capacity (veh/h)	1199			1187			250	283	671	219	282	672

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	379	416	66	34
Volume Left	4	51	6	12
Volume Right	12	6	57	10
cSH	1199	1187	551	306
Volume to Capacity	0.00	0.04	0.12	0.11
Queue Length 95th (m)	0.1	1.1	3.3	2.9
Control Delay (s)	0.1	1.4	12.4	18.2
Lane LOS	A	A	B	C
Approach Delay (s)	0.1	1.4	12.4	18.2
Approach LOS			B	C

Intersection Summary				
Average Delay	2.3			
Intersection Capacity Utilization	50.2%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	9	329	18	16	212	11	51	0	40	30	2	18
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	10	358	20	17	230	12	55	0	43	33	2	20
Pedestrians		7						8			5	
Lane Width (m)		3.6						3.6			3.6	
Walking Speed (m/s)		1.2						1.2			1.2	
Percent Blockage		1						1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		377										
pX, platoon unblocked												
vC, conflicting volume	247			385			694	677	375	707	681	248
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	247			385			694	677	375	707	681	248
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.3
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	99			99			84	100	94	90	99	97
cM capacity (veh/h)	1325			1176			336	365	671	320	363	761

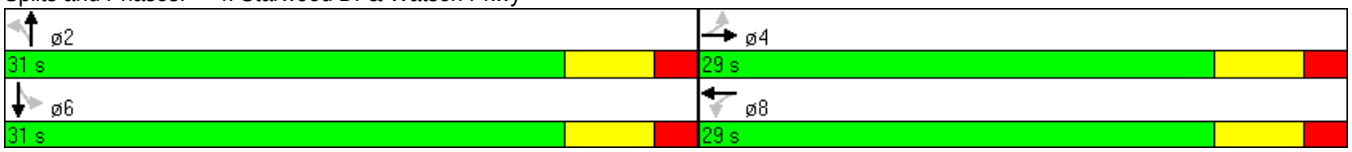
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	387	260	99	54
Volume Left	10	17	55	33
Volume Right	20	12	43	20
cSH	1325	1176	431	407
Volume to Capacity	0.01	0.01	0.23	0.13
Queue Length 95th (m)	0.2	0.4	7.0	3.7
Control Delay (s)	0.3	0.7	15.8	15.2
Lane LOS	A	A	C	C
Approach Delay (s)	0.3	0.7	15.8	15.2
Approach LOS			C	C

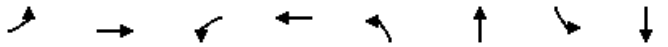
Intersection Summary				
Average Delay	3.3			
Intersection Capacity Utilization	33.8%	ICU Level of Service	A	
Analysis Period (min)	15			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	60	54	28	36	111	113	39	350
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Total Split (s)	29.0	29.0	29.0	29.0	31.0	31.0	31.0	31.0
Total Split (%)	48.3%	48.3%	48.3%	48.3%	51.7%	51.7%	51.7%	51.7%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	12.3	12.3	12.3	12.3	39.7	39.7	39.7	39.7
Actuated g/C Ratio	0.20	0.20	0.20	0.20	0.66	0.66	0.66	0.66
v/c Ratio	0.23	0.67	0.24	0.18	0.22	0.09	0.05	0.20
Control Delay	19.8	9.7	22.0	11.8	6.9	3.7	5.5	4.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.8	9.7	22.0	11.8	6.9	3.7	5.5	4.8
LOS	B	A	C	B	A	A	A	A
Approach Delay		11.1		14.8		5.0		4.9
Approach LOS		B		B		A		A

Intersection Summary	
Cycle Length: 60	
Actuated Cycle Length: 60	
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green	
Natural Cycle: 50	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.67	
Intersection Signal Delay: 7.8	Intersection LOS: A
Intersection Capacity Utilization 50.6%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 4: Starwood Dr & Watson Pkwy





Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	65	417	30	71	121	178	42	430
v/c Ratio	0.23	0.67	0.24	0.18	0.22	0.09	0.05	0.20
Control Delay	19.8	9.7	22.0	11.8	6.9	3.7	5.5	4.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.8	9.7	22.0	11.8	6.9	3.7	5.5	4.8
Queue Length 50th (m)	6.7	6.0	3.1	3.9	3.8	1.8	1.2	6.5
Queue Length 95th (m)	12.5	21.7	7.7	10.1	16.7	7.5	6.4	19.4
Internal Link Dist (m)		236.3		51.2		97.2		81.9
Turn Bay Length (m)	30.0		30.0		30.0		30.0	
Base Capacity (vph)	563	893	258	757	559	2059	805	2187
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.12	0.47	0.12	0.09	0.22	0.09	0.05	0.20

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	60	54	329	28	36	29	111	113	51	39	350	46
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.87		1.00	0.93		1.00	0.95		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1803	1641		1805	1772		1597	3081		1805	3286	
Flt Permitted	0.71	1.00		0.33	1.00		0.50	1.00		0.64	1.00	
Satd. Flow (perm)	1349	1641		618	1772		843	3081		1215	3286	
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)	65	59	358	30	39	32	121	123	55	42	380	50
RTOR Reduction (vph)	0	285	0	0	25	0	0	19	0	0	10	0
Lane Group Flow (vph)	65	132	0	30	46	0	121	159	0	42	420	0
Confl. Peds. (#/hr)	1											
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	13%	17%	0%	0%	7%	15%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	10.3	10.3		10.3	10.3		37.7	37.7		37.7	37.7	
Effective Green, g (s)	12.3	12.3		12.3	12.3		39.7	39.7		39.7	39.7	
Actuated g/C Ratio	0.21	0.21		0.21	0.21		0.66	0.66		0.66	0.66	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	277	336		127	363		558	2039		804	2174	
v/s Ratio Prot		c0.08			0.03			0.05			0.13	
v/s Ratio Perm	0.05			0.05			c0.14			0.03		
v/c Ratio	0.23	0.39		0.24	0.13		0.22	0.08		0.05	0.19	
Uniform Delay, d1	19.9	20.6		19.9	19.5		4.0	3.6		3.6	3.9	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.4	0.8		1.0	0.2		0.9	0.1		0.1	0.2	
Delay (s)	20.4	21.4		20.9	19.6		4.9	3.7		3.7	4.1	
Level of Service	C	C		C	B		A	A		A	A	
Approach Delay (s)		21.3			20.0			4.2			4.1	
Approach LOS		C			B			A			A	

Intersection Summary			
HCM Average Control Delay	11.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.26		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	50.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	129	49	301	52	26	479
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.80	0.80	0.80	0.80	0.80	0.80
Hourly flow rate (vph)	161	61	376	65	32	599
Pedestrians	21					
Lane Width (m)	3.6					
Walking Speed (m/s)	1.2					
Percent Blockage	2					
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						362
pX, platoon unblocked						
vC, conflicting volume	1094	430			462	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1094	430			462	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	29	90			97	
cM capacity (veh/h)	228	619			1090	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	222	441	631
Volume Left	161	0	32
Volume Right	61	65	0
cSH	276	1700	1090
Volume to Capacity	0.81	0.26	0.03
Queue Length 95th (m)	51.1	0.0	0.7
Control Delay (s)	56.0	0.0	0.8
Lane LOS	F		A
Approach Delay (s)	56.0	0.0	0.8
Approach LOS	F		

Intersection Summary			
Average Delay	10.0		
Intersection Capacity Utilization	63.2%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	135	28	31	47	10	43
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83
Hourly flow rate (vph)	163	34	37	57	12	52
Pedestrians			1			
Lane Width (m)			3.6			
Walking Speed (m/s)			1.2			
Percent Blockage			0			
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	143	66			94	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	143	66			94	
tC, single (s)	6.6	6.2			4.2	
tC, 2 stage (s)						
tF (s)	3.7	3.3			2.3	
p0 queue free %	80	97			99	
cM capacity (veh/h)	802	993			1445	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	196	94	64
Volume Left	163	0	12
Volume Right	34	57	0
cSH	829	1700	1445
Volume to Capacity	0.24	0.06	0.01
Queue Length 95th (m)	7.4	0.0	0.2
Control Delay (s)	10.7	0.0	1.5
Lane LOS	B		A
Approach Delay (s)	10.7	0.0	1.5
Approach LOS	B		

Intersection Summary			
Average Delay	6.2		
Intersection Capacity Utilization	25.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	0	0	0	0	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	0	0	0	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	0				0	0
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	0				0	0
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1636				1029	1091

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	0	0	0
Volume Left	0	0	0
Volume Right	0	0	0
cSH	1700	1700	1700
Volume to Capacity	0.00	0.00	0.00
Queue Length 95th (m)	0.0	0.0	0.0
Control Delay (s)	0.0	0.0	0.0
Lane LOS			A
Approach Delay (s)	0.0	0.0	0.0
Approach LOS			A

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	0.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	0	0	0	0	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	0	0	0	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	0				0	0
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	0				0	0
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1636				1029	1091

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	0	0	0
Volume Left	0	0	0
Volume Right	0	0	0
cSH	1700	1700	1700
Volume to Capacity	0.00	0.00	0.00
Queue Length 95th (m)	0.0	0.0	0.0
Control Delay (s)	0.0	0.0	0.0
Lane LOS			A
Approach Delay (s)	0.0	0.0	0.0
Approach LOS			A

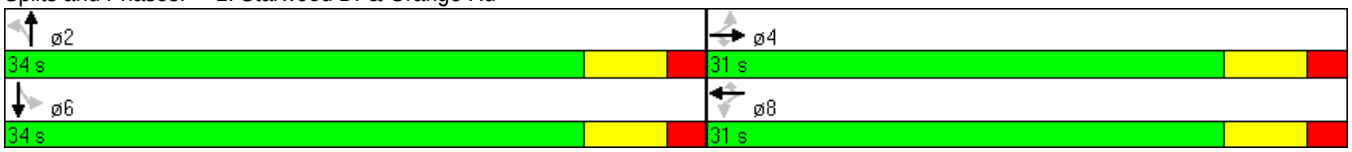
Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	0.0%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Volume (vph)	74	263	82	138	338	41	103	206	32	159
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	
Protected Phases		4			8			2		6
Permitted Phases	4		4	8		8	2		6	
Detector Phase	4	4	4	8	8	8	2	2	6	6
Switch Phase										
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	31.0	31.0	31.0	31.0	31.0	31.0	34.0	34.0	34.0	34.0
Total Split (s)	31.0	31.0	31.0	31.0	31.0	31.0	34.0	34.0	34.0	34.0
Total Split (%)	47.7%	47.7%	47.7%	47.7%	47.7%	47.7%	52.3%	52.3%	52.3%	52.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag										
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	None	None	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	19.9	19.9	19.9	19.9	19.9	19.9	37.1	37.1	37.1	37.1
Actuated g/C Ratio	0.31	0.31	0.31	0.31	0.31	0.31	0.57	0.57	0.57	0.57
v/c Ratio	0.38	0.49	0.16	0.55	0.61	0.08	0.16	0.28	0.06	0.19
Control Delay	21.6	20.4	4.2	25.9	23.1	5.0	9.1	8.4	8.6	7.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	21.6	20.4	4.2	25.9	23.1	5.0	9.1	8.4	8.6	7.9
LOS	C	C	A	C	C	A	A	A	A	A
Approach Delay		17.5			22.4			8.6		8.0
Approach LOS		B			C			A		A

Intersection Summary

Cycle Length: 65
Actuated Cycle Length: 65
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 65
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.61
Intersection Signal Delay: 15.6 Intersection LOS: B
Intersection Capacity Utilization 71.1% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 1: Starwood Dr & Grange Rd



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	78	277	86	145	356	43	108	291	34	201
v/c Ratio	0.38	0.49	0.16	0.55	0.61	0.08	0.16	0.28	0.06	0.19
Control Delay	21.6	20.4	4.2	25.9	23.1	5.0	9.1	8.4	8.6	7.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	21.6	20.4	4.2	25.9	23.1	5.0	9.1	8.4	8.6	7.9
Queue Length 50th (m)	7.8	28.6	0.0	15.3	38.4	0.0	5.7	14.3	1.7	9.5
Queue Length 95th (m)	15.8	40.3	7.1	27.0	52.0	5.1	16.6	35.3	6.7	24.8
Internal Link Dist (m)		193.7			181.2			338.3		108.7
Turn Bay Length (m)	30.0		30.0	25.0		25.0	20.0		20.0	
Base Capacity (vph)	278	766	721	356	789	696	684	1024	606	1054
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.28	0.36	0.12	0.41	0.45	0.06	0.16	0.28	0.06	0.19

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	74	263	82	138	338	41	103	206	70	32	159	32
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96		1.00	0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1805	1845	1615	1752	1900	1615	1800	1767		1800	1829	
Flt Permitted	0.35	1.00	1.00	0.46	1.00	1.00	0.63	1.00		0.56	1.00	
Satd. Flow (perm)	669	1845	1615	857	1900	1615	1197	1767		1061	1829	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	78	277	86	145	356	43	108	217	74	34	167	34
RTOR Reduction (vph)	0	0	60	0	0	30	0	15	0	0	9	0
Lane Group Flow (vph)	78	277	26	145	356	13	108	276	0	34	192	0
Confl. Peds. (#/hr)							3		4	4		3
Heavy Vehicles (%)	0%	3%	0%	3%	0%	0%	0%	2%	5%	0%	1%	0%
Turn Type	Perm		Perm	Perm		Perm	Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)	17.9	17.9	17.9	17.9	17.9	17.9	35.1	35.1		35.1	35.1	
Effective Green, g (s)	19.9	19.9	19.9	19.9	19.9	19.9	37.1	37.1		37.1	37.1	
Actuated g/C Ratio	0.31	0.31	0.31	0.31	0.31	0.31	0.57	0.57		0.57	0.57	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	205	565	494	262	582	494	683	1009		606	1044	
v/s Ratio Prot		0.15			c0.19			c0.16			0.10	
v/s Ratio Perm	0.12		0.02	0.17		0.01	0.09			0.03		
v/c Ratio	0.38	0.49	0.05	0.55	0.61	0.03	0.16	0.27		0.06	0.18	
Uniform Delay, d1	17.7	18.4	15.9	18.8	19.3	15.8	6.6	7.1		6.2	6.7	
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	1.2	0.7	0.0	2.5	1.9	0.0	0.5	0.7		0.2	0.4	
Delay (s)	18.9	19.1	16.0	21.4	21.2	15.8	7.1	7.8		6.4	7.1	
Level of Service	B	B	B	C	C	B	A	A		A	A	
Approach Delay (s)		18.4			20.8			7.6			7.0	
Approach LOS		B			C			A			A	

Intersection Summary			
HCM Average Control Delay	14.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.39		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	71.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	12	380	6	36	561	12	4	2	24	2	2	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	13	404	6	38	597	13	4	2	26	2	2	5
Pedestrians		8			3			1			8	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		1			0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		205										
pX, platoon unblocked				0.91			0.91	0.91	0.91	0.91	0.91	
vC, conflicting volume	618			412			1128	1128	411	1150	1125	619
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	618			302			1091	1091	302	1115	1087	619
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			97			97	99	96	99	99	99
cM capacity (veh/h)	966			1153			165	186	672	154	187	486

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	423	648	32	10
Volume Left	13	38	4	2
Volume Right	6	13	26	5
cSH	966	1153	424	265
Volume to Capacity	0.01	0.03	0.08	0.04
Queue Length 95th (m)	0.3	0.8	1.9	0.9
Control Delay (s)	0.4	0.9	14.2	19.1
Lane LOS	A	A	B	C
Approach Delay (s)	0.4	0.9	14.2	19.1
Approach LOS			B	C

Intersection Summary				
Average Delay	1.2			
Intersection Capacity Utilization	58.6%	ICU Level of Service	B	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	25	311	45	60	480	18	26	1	22	23	0	6
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	27	334	48	65	516	19	28	1	24	25	0	6
Pedestrians					2			2				
Lane Width (m)					3.6			3.6				
Walking Speed (m/s)					1.2			1.2				
Percent Blockage					0			0				
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		377										
pX, platoon unblocked												
vC, conflicting volume	535			385			1076	1079	363	1093	1093	526
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	535			385			1076	1079	363	1093	1093	526
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.3
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	97			95			85	99	97	86	100	99
cM capacity (veh/h)	1043			1183			184	202	684	174	199	535

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	410	600	53	31
Volume Left	27	65	28	25
Volume Right	48	19	24	6
cSH	1043	1183	275	202
Volume to Capacity	0.03	0.05	0.19	0.15
Queue Length 95th (m)	0.6	1.4	5.6	4.3
Control Delay (s)	0.8	1.5	21.2	26.0
Lane LOS	A	A	C	D
Approach Delay (s)	0.8	1.5	21.2	26.0
Approach LOS			C	D

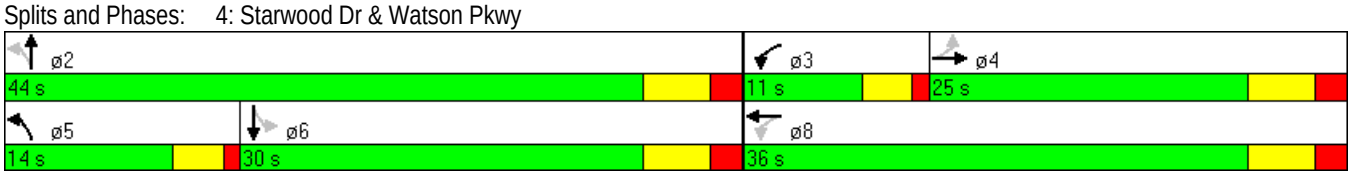
Intersection Summary				
Average Delay	2.9			
Intersection Capacity Utilization	55.3%	ICU Level of Service	B	
Analysis Period (min)	15			

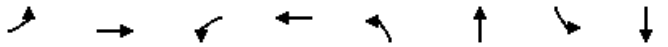
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	27	157	149	190	325	326	114	174
Turn Type	Perm		pm+pt		pm+pt		Perm	
Protected Phases		4	3	8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	3	8	5	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	25.0	25.0	10.0	25.0	10.0	25.0	25.0	25.0
Total Split (s)	25.0	25.0	11.0	36.0	14.0	44.0	30.0	30.0
Total Split (%)	31.3%	31.3%	13.8%	45.0%	17.5%	55.0%	37.5%	37.5%
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	0.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	None	C-Max	C-Max	C-Max
Act Effct Green (s)	19.0	19.0	30.0	30.0	42.0	42.0	27.7	27.7
Actuated g/C Ratio	0.24	0.24	0.38	0.38	0.52	0.52	0.35	0.35
v/c Ratio	0.12	0.78	0.61	0.53	0.56	0.28	0.40	0.21
Control Delay	24.1	35.3	27.3	18.7	16.1	8.6	25.9	15.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.1	35.3	27.3	18.7	16.1	8.6	25.9	15.0
LOS	C	D	C	B	B	A	C	B
Approach Delay		34.5		21.3		11.6		18.6
Approach LOS		C		C		B		B

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 70
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.78
Intersection Signal Delay: 19.4 Intersection LOS: B
Intersection Capacity Utilization 65.6% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 4: Starwood Dr & Watson Pkwy





Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	29	364	160	373	349	509	123	250
v/c Ratio	0.12	0.78	0.61	0.53	0.56	0.28	0.40	0.21
Control Delay	24.1	35.3	27.3	18.7	16.1	8.6	25.9	15.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.1	35.3	27.3	18.7	16.1	8.6	25.9	15.0
Queue Length 50th (m)	3.5	42.6	16.4	35.7	32.7	17.1	15.2	11.2
Queue Length 95th (m)	10.1	#76.4	29.7	60.7	52.3	26.6	31.5	19.9
Internal Link Dist (m)		236.3		51.2		97.2		81.9
Turn Bay Length (m)	30.0		30.0		30.0		30.0	
Base Capacity (vph)	269	508	262	746	622	1797	306	1176
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.11	0.72	0.61	0.50	0.56	0.28	0.40	0.21

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	157	181	149	190	157	325	326	147	114	174	59
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.92		1.00	0.93		1.00	0.95		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1804	1738		1805	1771		1805	3305		1805	3284	
Flt Permitted	0.54	1.00		0.19	1.00		0.51	1.00		0.46	1.00	
Satd. Flow (perm)	1025	1738		362	1771		976	3305		883	3284	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	29	169	195	160	204	169	349	351	158	123	187	63
RTOR Reduction (vph)	0	53	0	0	39	0	0	61	0	0	40	0
Lane Group Flow (vph)	29	311	0	160	334	0	349	448	0	123	210	0
Confl. Peds. (#/hr)	1											
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	0%	6%	0%	0%	5%	8%
Turn Type	Perm			pm+pt			pm+pt			Perm		
Protected Phases		4		3	8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	17.0	17.0		28.0	28.0		40.0	40.0		25.7	25.7	
Effective Green, g (s)	19.0	19.0		28.0	30.0		40.0	42.0		27.7	27.7	
Actuated g/C Ratio	0.24	0.24		0.35	0.38		0.50	0.52		0.35	0.35	
Clearance Time (s)	6.0	6.0		4.0	6.0		4.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	243	413		253	664		595	1735		306	1137	
v/s Ratio Prot		c0.18		c0.06	0.19		c0.08	0.14			0.06	
v/s Ratio Perm	0.03			0.17			c0.22			0.14		
v/c Ratio	0.12	0.75		0.63	0.50		0.59	0.26		0.40	0.18	
Uniform Delay, d1	23.9	28.3		20.2	19.3		12.6	10.4		19.9	18.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	7.6		5.1	0.6		1.5	0.4		3.9	0.4	
Delay (s)	24.2	35.9		25.3	19.9		14.0	10.8		23.8	18.6	
Level of Service	C	D		C	B		B	B		C	B	
Approach Delay (s)		35.0			21.5			12.1			20.3	
Approach LOS		D			C			B			C	

Intersection Summary			
HCM Average Control Delay	20.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	65.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	52	12	385	63	24	322
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	62	14	458	75	29	383
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						362
pX, platoon unblocked						
vC, conflicting volume	936	496			533	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	936	496			533	
tC, single (s)	6.5	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.6	3.3			2.2	
p0 queue free %	78	98			97	
cM capacity (veh/h)	280	574			1045	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	76	533	412
Volume Left	62	0	29
Volume Right	14	75	0
cSH	310	1700	1045
Volume to Capacity	0.25	0.31	0.03
Queue Length 95th (m)	7.6	0.0	0.7
Control Delay (s)	20.4	0.0	0.9
Lane LOS	C		A
Approach Delay (s)	20.4	0.0	0.9
Approach LOS	C		

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	47.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	36	14	31	57	8	28
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	38	15	32	59	8	29
Pedestrians						1
Lane Width (m)						3.6
Walking Speed (m/s)						1.2
Percent Blockage						0
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	108	63			92	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	108	63			92	
tC, single (s)	6.4	6.5			4.2	
tC, 2 stage (s)						
tF (s)	3.5	3.6			2.3	
p0 queue free %	96	98			99	
cM capacity (veh/h)	889	925			1448	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	52	92	38
Volume Left	38	0	8
Volume Right	15	59	0
cSH	899	1700	1448
Volume to Capacity	0.06	0.05	0.01
Queue Length 95th (m)	1.5	0.0	0.1
Control Delay (s)	9.3	0.0	1.7
Lane LOS	A		A
Approach Delay (s)	9.3	0.0	1.7
Approach LOS	A		

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	18.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	0	0	0	0	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	0	0	0	0	0	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	0				0	0
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	0				0	0
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1636				1029	1091

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	0	0	0
Volume Left	0	0	0
Volume Right	0	0	0
cSH	1700	1700	1700
Volume to Capacity	0.00	0.00	0.00
Queue Length 95th (m)	0.0	0.0	0.0
Control Delay (s)	0.0	0.0	0.0
Lane LOS			A
Approach Delay (s)	0.0	0.0	0.0
Approach LOS			A

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	0.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	0	0	0	0	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	0	0	0	0	0	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	0				0	0
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	0				0	0
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1636				1029	1091

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	0	0	0
Volume Left	0	0	0
Volume Right	0	0	0
cSH	1700	1700	1700
Volume to Capacity	0.00	0.00	0.00
Queue Length 95th (m)	0.0	0.0	0.0
Control Delay (s)	0.0	0.0	0.0
Lane LOS			A
Approach Delay (s)	0.0	0.0	0.0
Approach LOS			A

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	0.0%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix C

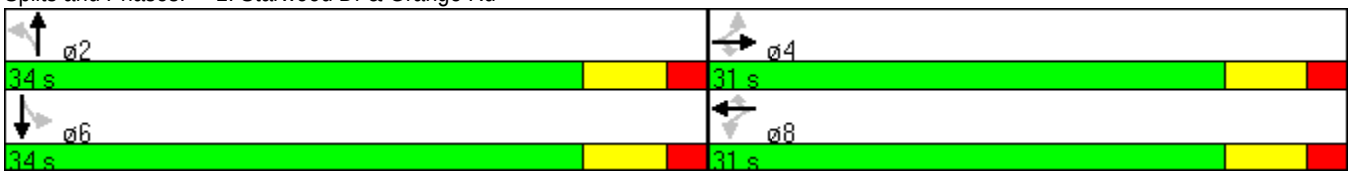
Total Traffic Operations

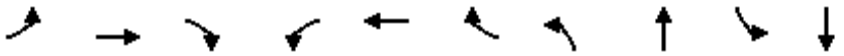
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Volume (vph)	117	192	65	91	152	92	54	218	51	254
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	
Protected Phases		4			8			2		6
Permitted Phases	4		4	8		8	2		6	
Detector Phase	4	4	4	8	8	8	2	2	6	6
Switch Phase										
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	31.0	31.0	31.0	31.0	31.0	31.0	34.0	34.0	34.0	34.0
Total Split (s)	31.0	31.0	31.0	31.0	31.0	31.0	34.0	34.0	34.0	34.0
Total Split (%)	47.7%	47.7%	47.7%	47.7%	47.7%	47.7%	52.3%	52.3%	52.3%	52.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag										
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	None	None	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	17.0	17.0	17.0	17.0	17.0	17.0	40.0	40.0	40.0	40.0
Actuated g/C Ratio	0.26	0.26	0.26	0.26	0.26	0.26	0.62	0.62	0.62	0.62
v/c Ratio	0.49	0.46	0.17	0.47	0.38	0.23	0.14	0.34	0.11	0.42
Control Delay	25.1	22.0	4.9	25.7	20.6	4.6	8.4	7.8	7.9	8.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	25.1	22.0	4.9	25.7	20.6	4.6	8.4	7.8	7.9	8.5
LOS	C	C	A	C	C	A	A	A	A	A
Approach Delay		20.0			17.6			7.9		8.4
Approach LOS		C			B			A		A

Intersection Summary

Cycle Length: 65
Actuated Cycle Length: 65
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 65
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.49
Intersection Signal Delay: 13.2 — Intersection LOS: B
Intersection Capacity Utilization 68.4% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 1: Starwood Dr & Grange Rd



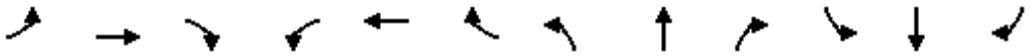


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	139	229	77	108	181	110	64	366	61	448
v/c Ratio	0.49	0.46	0.17	0.47	0.38	0.23	0.14	0.34	0.11	0.42
Control Delay	25.1	22.0	4.9	25.7	20.6	4.6	8.4	7.8	7.9	8.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	25.1	22.0	4.9	25.7	20.6	4.6	8.4	7.8	7.9	8.5
Queue Length 50th (m)	15.5	25.4	0.0	12.0	19.6	0.0	2.7	15.3	2.5	19.8
Queue Length 95th (m)	21.7	30.4	5.9	18.1	24.6	6.8	10.7	41.5	9.9	52.7
Internal Link Dist (m)		193.7			181.2			338.3		108.7
Turn Bay Length (m)	30.0		30.0	25.0		25.0	20.0		20.0	
Base Capacity (vph)	447	789	665	362	759	702	461	1064	575	1076
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.31	0.29	0.12	0.30	0.24	0.16	0.14	0.34	0.11	0.42

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	117	192	65	91	152	92	54	218	89	51	254	123
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.96	1.00	1.00	0.95	1.00	0.98		1.00	0.98	
Flpb, ped/bikes	0.98	1.00	1.00	0.99	1.00	1.00	0.97	1.00		0.96	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96		1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1730	1900	1492	1634	1827	1535	1581	1702		1735	1718	
Flt Permitted	0.59	1.00	1.00	0.51	1.00	1.00	0.45	1.00		0.51	1.00	
Satd. Flow (perm)	1077	1900	1492	872	1827	1535	749	1702		933	1718	
Peak-hour factor, PHF	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Adj. Flow (vph)	139	229	77	108	181	110	64	260	106	61	302	146
RTOR Reduction (vph)	0	0	57	0	0	81	0	16	0	0	19	0
Lane Group Flow (vph)	139	229	20	108	181	29	64	350	0	61	429	0
Confl. Peds. (#/hr)	23		15	15		23	48		58	58		48
Heavy Vehicles (%)	2%	0%	4%	9%	4%	0%	11%	5%	2%	0%	2%	4%
Turn Type	Perm		Perm	Perm		Perm	Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)	15.0	15.0	15.0	15.0	15.0	15.0	38.0	38.0		38.0	38.0	
Effective Green, g (s)	17.0	17.0	17.0	17.0	17.0	17.0	40.0	40.0		40.0	40.0	
Actuated g/C Ratio	0.26	0.26	0.26	0.26	0.26	0.26	0.62	0.62		0.62	0.62	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	282	497	390	228	478	401	461	1047		574	1057	
v/s Ratio Prot		0.12			0.10			0.21			c0.25	
v/s Ratio Perm	c0.13		0.01	0.12		0.02	0.09			0.07		
v/c Ratio	0.49	0.46	0.05	0.47	0.38	0.07	0.14	0.33		0.11	0.41	
Uniform Delay, d1	20.3	20.2	18.0	20.2	19.7	18.1	5.3	6.1		5.1	6.4	
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	1.4	0.7	0.1	1.6	0.5	0.1	0.6	0.9		0.4	1.2	
Delay (s)	21.7	20.8	18.0	21.8	20.2	18.1	5.9	6.9		5.5	7.6	
Level of Service	C	C	B	C	C	B	A	A		A	A	
Approach Delay (s)		20.6			20.0			6.8			7.3	
Approach LOS		C			C			A			A	

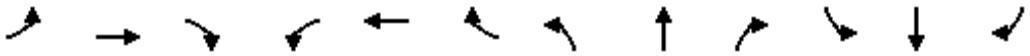
Intersection Summary			
HCM Average Control Delay	13.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	68.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	3	303	16	39	328	5	16	2	44	9	9	8
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Hourly flow rate (vph)	4	394	21	51	426	6	21	3	57	12	12	10
Pedestrians		8			14			3			3	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		1			1			0			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		205										
pX, platoon unblocked				0.94			0.94	0.94	0.94	0.94	0.94	
vC, conflicting volume	435			417			969	951	421	1018	959	440
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	435			343			933	914	347	985	922	440
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			96			90	99	91	94	95	98
cM capacity (veh/h)	1132			1146			209	244	646	184	242	615

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	418	483	81	34
Volume Left	4	51	21	12
Volume Right	21	6	57	10
cSH	1132	1146	406	262
Volume to Capacity	0.00	0.04	0.20	0.13
Queue Length 95th (m)	0.1	1.1	5.8	3.5
Control Delay (s)	0.1	1.3	16.0	20.8
Lane LOS	A	A	C	C
Approach Delay (s)	0.1	1.3	16.0	20.8
Approach LOS			C	C

Intersection Summary			
Average Delay	2.6		
Intersection Capacity Utilization	55.2%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	9	332	38	17	228	11	87	0	60	30	2	18
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	10	361	41	18	248	12	95	0	65	33	2	20
Pedestrians		7						8			5	
Lane Width (m)		3.6						3.6			3.6	
Walking Speed (m/s)		1.2						1.2			1.2	
Percent Blockage		1						1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		377										
pX, platoon unblocked												
vC, conflicting volume	265			410			728	711	390	762	726	266
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	265			410			728	711	390	762	726	266
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.3
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	99			98			70	100	90	88	99	97
cM capacity (veh/h)	1305			1152			319	348	659	283	342	744

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	412	278	160	54
Volume Left	10	18	95	33
Volume Right	41	12	65	20
cSH	1305	1152	404	368
Volume to Capacity	0.01	0.02	0.40	0.15
Queue Length 95th (m)	0.2	0.4	14.8	4.1
Control Delay (s)	0.3	0.7	19.6	16.5
Lane LOS	A	A	C	C
Approach Delay (s)	0.3	0.7	19.6	16.5
Approach LOS			C	C

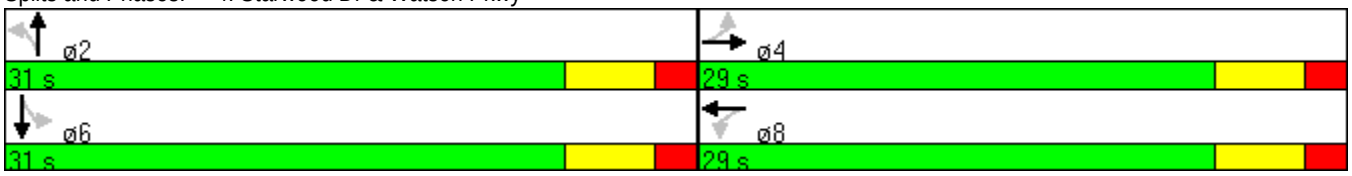
Intersection Summary			
Average Delay	4.8		
Intersection Capacity Utilization	39.2%	ICU Level of Service	A
Analysis Period (min)	15		

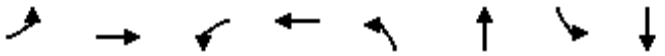
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	61	54	28	36	113	113	39	350
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Total Split (s)	29.0	29.0	29.0	29.0	31.0	31.0	31.0	31.0
Total Split (%)	48.3%	48.3%	48.3%	48.3%	51.7%	51.7%	51.7%	51.7%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	12.6	12.6	12.6	12.6	39.4	39.4	39.4	39.4
Actuated g/C Ratio	0.21	0.21	0.21	0.21	0.66	0.66	0.66	0.66
v/c Ratio	0.23	0.70	0.24	0.18	0.22	0.09	0.05	0.20
Control Delay	19.4	10.5	21.6	11.5	7.1	3.8	5.7	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.4	10.5	21.6	11.5	7.1	3.8	5.7	5.0
LOS	B	B	C	B	A	A	A	A
Approach Delay		11.6		14.5		5.2		5.0
Approach LOS		B		B		A		A

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 50
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.70
Intersection Signal Delay: 8.2 — Intersection LOS: A
Intersection Capacity Utilization 52.0% — ICU Level of Service A
Analysis Period (min) 15

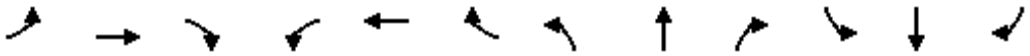
Splits and Phases: 4: Starwood Dr & Watson Pkwy





Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	66	442	30	71	123	178	42	430
v/c Ratio	0.23	0.70	0.24	0.18	0.22	0.09	0.05	0.20
Control Delay	19.4	10.5	21.6	11.5	7.1	3.8	5.7	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.4	10.5	21.6	11.5	7.1	3.8	5.7	5.0
Queue Length 50th (m)	6.7	7.6	3.0	3.8	4.1	1.9	1.3	6.8
Queue Length 95th (m)	12.7	24.9	7.8	10.1	17.0	7.5	6.4	19.4
Internal Link Dist (m)		236.3		51.2		97.2		81.9
Turn Bay Length (m)	30.0		30.0		30.0		30.0	
Base Capacity (vph)	563	896	251	757	554	2041	798	2168
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.12	0.49	0.12	0.09	0.22	0.09	0.05	0.20

Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	61	54	352	28	36	29	113	113	51	39	350	46
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.87		1.00	0.93		1.00	0.95		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1803	1639		1805	1772		1597	3081		1805	3286	
Flt Permitted	0.71	1.00		0.32	1.00		0.50	1.00		0.64	1.00	
Satd. Flow (perm)	1349	1639		603	1772		843	3081		1215	3286	
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)	66	59	383	30	39	32	123	123	55	42	380	50
RTOR Reduction (vph)	0	289	0	0	25	0	0	19	0	0	11	0
Lane Group Flow (vph)	66	153	0	30	46	0	123	159	0	42	419	0
Confl. Peds. (#/hr)	1											
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	13%	17%	0%	0%	7%	15%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	10.6	10.6		10.6	10.6		37.4	37.4		37.4	37.4	
Effective Green, g (s)	12.6	12.6		12.6	12.6		39.4	39.4		39.4	39.4	
Actuated g/C Ratio	0.21	0.21		0.21	0.21		0.66	0.66		0.66	0.66	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	283	344		127	372		554	2023		798	2158	
v/s Ratio Prot		c0.09			0.03			0.05			0.13	
v/s Ratio Perm	0.05			0.05			c0.15			0.03		
v/c Ratio	0.23	0.44		0.24	0.12		0.22	0.08		0.05	0.19	
Uniform Delay, d1	19.7	20.6		19.7	19.2		4.1	3.7		3.7	4.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.4	0.9		1.0	0.1		0.9	0.1		0.1	0.2	
Delay (s)	20.1	21.6		20.7	19.4		5.1	3.8		3.8	4.3	
Level of Service	C	C		C	B		A	A		A	A	
Approach Delay (s)		21.4			19.8			4.3			4.2	
Approach LOS		C			B			A			A	

Intersection Summary			
HCM Average Control Delay	11.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.28		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	52.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	165	49	302	58	26	486
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.80	0.80	0.80	0.80	0.80	0.80
Hourly flow rate (vph)	206	61	378	72	32	608
Pedestrians	21					
Lane Width (m)	3.6					
Walking Speed (m/s)	1.2					
Percent Blockage	2					
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						362
pX, platoon unblocked						
vC, conflicting volume	1107	435			471	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1107	435			471	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	8	90			97	
cM capacity (veh/h)	224	615			1082	

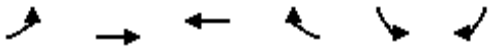
Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	268	450	640
Volume Left	206	0	32
Volume Right	61	72	0
cSH	262	1700	1082
Volume to Capacity	1.02	0.26	0.03
Queue Length 95th (m)	83.1	0.0	0.7
Control Delay (s)	103.4	0.0	0.8
Lane LOS	F		A
Approach Delay (s)	103.4	0.0	0.8
Approach LOS	F		

Intersection Summary			
Average Delay	20.8		
Intersection Capacity Utilization	65.6%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	171	39	31	53	17	43
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83
Hourly flow rate (vph)	206	47	37	64	20	52
Pedestrians			1			
Lane Width (m)			3.6			
Walking Speed (m/s)			1.2			
Percent Blockage			0			
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	163	69			101	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	163	69			101	
tC, single (s)	6.6	6.2			4.2	
tC, 2 stage (s)						
tF (s)	3.7	3.3			2.3	
p0 queue free %	73	95			99	
cM capacity (veh/h)	776	988			1437	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	253	101	72
Volume Left	206	0	20
Volume Right	47	64	0
cSH	808	1700	1437
Volume to Capacity	0.31	0.06	0.01
Queue Length 95th (m)	10.7	0.0	0.3
Control Delay (s)	11.5	0.0	2.2
Lane LOS	B		A
Approach Delay (s)	11.5	0.0	2.2
Approach LOS	B		

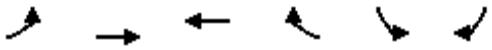
Intersection Summary			
Average Delay	7.2		
Intersection Capacity Utilization	28.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	6	5	14	2	0	22
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	7	5	15	2	0	24
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	17				35	16
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	17				35	16
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	98
cM capacity (veh/h)	1613				979	1069

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	12	17	24
Volume Left	7	0	0
Volume Right	0	2	24
cSH	1613	1700	1069
Volume to Capacity	0.00	0.01	0.02
Queue Length 95th (m)	0.1	0.0	0.5
Control Delay (s)	4.0	0.0	8.4
Lane LOS	A		A
Approach Delay (s)	4.0	0.0	8.4
Approach LOS			A

Intersection Summary			
Average Delay	4.7		
Intersection Capacity Utilization	15.6%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	1	0	0	0	0	5
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1	0	0	0	0	5
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	0				2	0
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	0				2	0
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1636				1025	1091

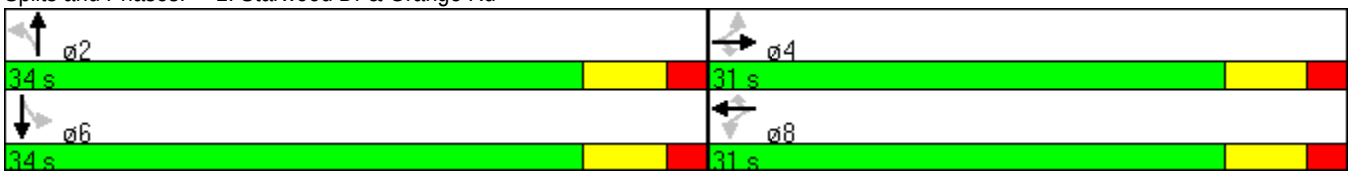
Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	1	0	5
Volume Left	1	0	0
Volume Right	0	0	5
cSH	1636	1700	1091
Volume to Capacity	0.00	0.00	0.00
Queue Length 95th (m)	0.0	0.0	0.1
Control Delay (s)	7.2	0.0	8.3
Lane LOS	A		A
Approach Delay (s)	7.2	0.0	8.3
Approach LOS			A

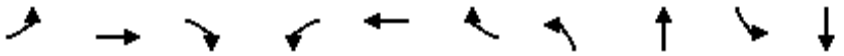
Intersection Summary			
Average Delay	8.1		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Volume (vph)	74	294	82	141	351	66	103	206	71	159
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	
Protected Phases		4			8			2		6
Permitted Phases	4		4	8		8	2		6	
Detector Phase	4	4	4	8	8	8	2	2	6	6
Switch Phase										
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	31.0	31.0	31.0	31.0	31.0	31.0	34.0	34.0	34.0	34.0
Total Split (s)	31.0	31.0	31.0	31.0	31.0	31.0	34.0	34.0	34.0	34.0
Total Split (%)	47.7%	47.7%	47.7%	47.7%	47.7%	47.7%	52.3%	52.3%	52.3%	52.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag										
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	None	None	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	20.2	20.2	20.2	20.2	20.2	20.2	36.8	36.8	36.8	36.8
Actuated g/C Ratio	0.31	0.31	0.31	0.31	0.31	0.31	0.57	0.57	0.57	0.57
v/c Ratio	0.39	0.54	0.15	0.61	0.62	0.13	0.16	0.29	0.13	0.19
Control Delay	21.9	21.2	4.1	29.2	23.3	4.3	9.2	8.5	9.2	8.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	21.9	21.2	4.1	29.2	23.3	4.3	9.2	8.5	9.2	8.0
LOS	C	C	A	C	C	A	A	A	A	A
Approach Delay		18.2			22.5			8.7		8.3
Approach LOS		B			C			A		A

Intersection Summary	
Cycle Length: 65	
Actuated Cycle Length: 65	
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green	
Natural Cycle: 65	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.62	
Intersection Signal Delay: 15.9	Intersection LOS: B
Intersection Capacity Utilization 71.8%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 1: Starwood Dr & Grange Rd





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	78	309	86	148	369	69	108	297	75	201
v/c Ratio	0.39	0.54	0.15	0.61	0.62	0.13	0.16	0.29	0.13	0.19
Control Delay	21.9	21.2	4.1	29.2	23.3	4.3	9.2	8.5	9.2	8.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	21.9	21.2	4.1	29.2	23.3	4.3	9.2	8.5	9.2	8.0
Queue Length 50th (m)	7.7	32.3	0.0	15.9	39.8	0.0	5.8	14.8	4.0	9.7
Queue Length 95th (m)	16.1	45.2	7.1	28.9	54.2	6.4	16.6	35.8	12.5	24.8
Internal Link Dist (m)		193.7			181.2			338.3		108.7
Turn Bay Length (m)	30.0		30.0	25.0		25.0	20.0		20.0	
Base Capacity (vph)	268	766	721	324	789	711	678	1013	594	1045
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	0.29	0.40	0.12	0.46	0.47	0.10	0.16	0.29	0.13	0.19

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	74	294	82	141	351	66	103	206	76	71	159	32
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96		1.00	0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1805	1845	1615	1752	1900	1615	1800	1762		1800	1829	
Flt Permitted	0.34	1.00	1.00	0.42	1.00	1.00	0.63	1.00		0.55	1.00	
Satd. Flow (perm)	644	1845	1615	780	1900	1615	1197	1762		1049	1829	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	78	309	86	148	369	69	108	217	80	75	167	34
RTOR Reduction (vph)	0	0	59	0	0	48	0	16	0	0	9	0
Lane Group Flow (vph)	78	309	27	148	369	21	108	281	0	75	192	0
Confl. Peds. (#/hr)							3		4	4		3
Heavy Vehicles (%)	0%	3%	0%	3%	0%	0%	0%	2%	5%	0%	1%	0%
Turn Type	Perm		Perm	Perm		Perm	Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)	18.2	18.2	18.2	18.2	18.2	18.2	34.8	34.8		34.8	34.8	
Effective Green, g (s)	20.2	20.2	20.2	20.2	20.2	20.2	36.8	36.8		36.8	36.8	
Actuated g/C Ratio	0.31	0.31	0.31	0.31	0.31	0.31	0.57	0.57		0.57	0.57	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	200	573	502	242	590	502	678	998		594	1035	
v/s Ratio Prot		0.17			c0.19			c0.16			0.10	
v/s Ratio Perm	0.12		0.02	0.19		0.01	0.09			0.07		
v/c Ratio	0.39	0.54	0.05	0.61	0.63	0.04	0.16	0.28		0.13	0.19	
Uniform Delay, d1	17.6	18.5	15.7	19.1	19.2	15.6	6.7	7.3		6.6	6.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.3	1.0	0.0	4.5	2.1	0.0	0.5	0.7		0.4	0.4	
Delay (s)	18.8	19.5	15.7	23.6	21.2	15.7	7.2	8.0		7.0	7.2	
Level of Service	B	B	B	C	C	B	A	A		A	A	
Approach Delay (s)		18.7			21.2			7.8			7.2	
Approach LOS		B			C			A			A	

Intersection Summary			
HCM Average Control Delay	15.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	71.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	12	442	20	36	593	12	13	2	24	2	2	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	13	470	21	38	631	13	14	2	26	2	2	5
Pedestrians		8			3			1			8	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		1			0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		205										
pX, platoon unblocked				0.89			0.89	0.89	0.89	0.89	0.89	
vC, conflicting volume	652			492			1236	1236	485	1258	1240	653
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	652			362			1201	1201	353	1226	1206	653
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			96			90	99	96	98	99	99
cM capacity (veh/h)	938			1068			134	156	613	125	155	464

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	504	682	41	10
Volume Left	13	38	14	2
Volume Right	21	13	26	5
cSH	938	1068	262	227
Volume to Capacity	0.01	0.04	0.16	0.04
Queue Length 95th (m)	0.3	0.9	4.4	1.1
Control Delay (s)	0.4	0.9	21.3	21.6
Lane LOS	A	A	C	C
Approach Delay (s)	0.4	0.9	21.3	21.6
Approach LOS			C	C

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	61.5%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	25	328	90	79	488	18	50	1	31	23	0	6
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	27	353	97	85	525	19	54	1	33	25	0	6
Pedestrians					2			2				
Lane Width (m)					3.6			3.6				
Walking Speed (m/s)					1.2			1.2				
Percent Blockage					0			0				
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		377										
pX, platoon unblocked												
vC, conflicting volume	544			451			1168	1171	405	1195	1210	534
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	544			451			1168	1171	405	1195	1210	534
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.3
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	97			92			66	99	95	83	100	99
cM capacity (veh/h)	1035			1118			156	175	648	143	166	529

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	476	629	88	31
Volume Left	27	85	54	25
Volume Right	97	19	33	6
cSH	1035	1118	220	169
Volume to Capacity	0.03	0.08	0.40	0.18
Queue Length 95th (m)	0.6	2.0	14.5	5.2
Control Delay (s)	0.8	2.0	31.9	31.1
Lane LOS	A	A	D	D
Approach Delay (s)	0.8	2.0	31.9	31.1
Approach LOS			D	D

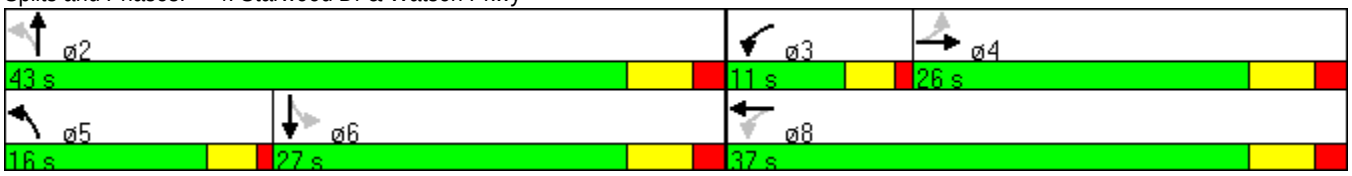
Intersection Summary			
Average Delay	4.4		
Intersection Capacity Utilization	65.9%	ICU Level of Service	C
Analysis Period (min)	15		

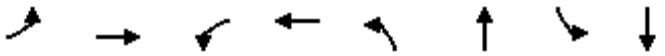
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	27	157	149	190	346	326	114	174
Turn Type	Perm		pm+pt		pm+pt		Perm	
Protected Phases		4	3	8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	3	8	5	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	25.0	25.0	10.0	25.0	10.0	25.0	25.0	25.0
Total Split (s)	26.0	26.0	11.0	37.0	16.0	43.0	27.0	27.0
Total Split (%)	32.5%	32.5%	13.8%	46.3%	20.0%	53.8%	33.8%	33.8%
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	0.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	None	C-Max	C-Max	C-Max
Act Effct Green (s)	19.5	19.5	30.5	30.5	41.5	41.5	25.6	25.6
Actuated g/C Ratio	0.24	0.24	0.38	0.38	0.52	0.52	0.32	0.32
v/c Ratio	0.12	0.78	0.61	0.52	0.60	0.29	0.43	0.23
Control Delay	23.4	34.1	26.8	18.1	17.2	9.0	29.0	16.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.4	34.1	26.8	18.1	17.2	9.0	29.0	16.8
LOS	C	C	C	B	B	A	C	B
Approach Delay		33.3		20.7		12.4		20.8
Approach LOS		C		C		B		C

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 70
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.78
Intersection Signal Delay: 19.7 Intersection LOS: B
Intersection Capacity Utilization 67.4% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 4: Starwood Dr & Watson Pkwy





Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	29	374	160	373	372	509	123	250
v/c Ratio	0.12	0.78	0.61	0.52	0.60	0.29	0.43	0.23
Control Delay	23.4	34.1	26.8	18.1	17.2	9.0	29.0	16.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.4	34.1	26.8	18.1	17.2	9.0	29.0	16.8
Queue Length 50th (m)	3.5	43.2	16.2	35.2	36.0	17.4	16.2	12.2
Queue Length 95th (m)	9.9	73.8	29.0	59.1	57.9	27.5	33.4	21.4
Internal Link Dist (m)		236.3		51.2		97.2		81.9
Turn Bay Length (m)	30.0		30.0		30.0		30.0	
Base Capacity (vph)	282	532	262	768	628	1773	283	1091
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.70	0.61	0.49	0.59	0.29	0.43	0.23

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	157	191	149	190	157	346	326	147	114	174	59
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.92		1.00	0.93		1.00	0.95		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1804	1734		1805	1771		1805	3305		1805	3284	
Flt Permitted	0.54	1.00		0.19	1.00		0.50	1.00		0.46	1.00	
Satd. Flow (perm)	1025	1734		353	1771		959	3305		883	3284	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	29	169	205	160	204	169	372	351	158	123	187	63
RTOR Reduction (vph)	0	57	0	0	39	0	0	61	0	0	39	0
Lane Group Flow (vph)	29	317	0	160	334	0	372	448	0	123	211	0
Confl. Peds. (#/hr)	1											
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	0%	6%	0%	0%	5%	8%
Turn Type	Perm			pm+pt			pm+pt			Perm		
Protected Phases		4		3	8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	17.5	17.5		28.5	28.5		39.5	39.5		23.7	23.7	
Effective Green, g (s)	19.5	19.5		28.5	30.5		39.5	41.5		25.7	25.7	
Actuated g/C Ratio	0.24	0.24		0.36	0.38		0.49	0.52		0.32	0.32	
Clearance Time (s)	6.0	6.0		4.0	6.0		4.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	250	423		253	675		598	1714		284	1055	
v/s Ratio Prot		c0.18		c0.06	0.19		c0.09	0.14			0.06	
v/s Ratio Perm	0.03			0.17			c0.22			0.14		
v/c Ratio	0.12	0.75		0.63	0.49		0.62	0.26		0.43	0.20	
Uniform Delay, d1	23.5	28.0		20.0	18.9		13.1	10.7		21.4	19.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	7.3		5.1	0.6		2.0	0.4		4.8	0.4	
Delay (s)	23.7	35.3		25.1	19.4		15.1	11.1		26.2	20.1	
Level of Service	C	D		C	B		B	B		C	C	
Approach Delay (s)		34.5			21.1			12.8			22.1	
Approach LOS		C			C			B			C	

Intersection Summary			
HCM Average Control Delay	20.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	67.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	75	12	391	98	24	325
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	89	14	465	117	29	387
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						362
pX, platoon unblocked						
vC, conflicting volume	968	524			582	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	968	524			582	
tC, single (s)	6.5	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.6	3.3			2.2	
p0 queue free %	67	97			97	
cM capacity (veh/h)	268	553			1002	

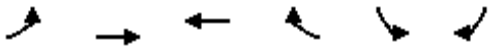
Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	104	582	415
Volume Left	89	0	29
Volume Right	14	117	0
cSH	288	1700	1002
Volume to Capacity	0.36	0.34	0.03
Queue Length 95th (m)	12.6	0.0	0.7
Control Delay (s)	24.3	0.0	0.9
Lane LOS	C		A
Approach Delay (s)	24.3	0.0	0.9
Approach LOS	C		

Intersection Summary			
Average Delay	2.6		
Intersection Capacity Utilization	48.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	59	23	31	92	22	28
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	61	24	32	96	23	29
Pedestrians						1
Lane Width (m)						3.6
Walking Speed (m/s)						1.2
Percent Blockage						0
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	155	81			128	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	155	81			128	
tC, single (s)	6.4	6.5			4.2	
tC, 2 stage (s)						
tF (s)	3.5	3.6			2.3	
p0 queue free %	93	97			98	
cM capacity (veh/h)	827	903			1404	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	85	128	52
Volume Left	61	0	23
Volume Right	24	96	0
cSH	847	1700	1404
Volume to Capacity	0.10	0.08	0.02
Queue Length 95th (m)	2.7	0.0	0.4
Control Delay (s)	9.7	0.0	3.4
Lane LOS	A		A
Approach Delay (s)	9.7	0.0	3.4
Approach LOS	A		

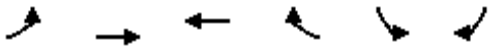
Intersection Summary			
Average Delay	3.8		
Intersection Capacity Utilization	25.6%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	21	16	10	1	0	16
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	23	17	11	1	0	17
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	12				74	11
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	12				74	11
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				100	98
cM capacity (veh/h)	1620				922	1075

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	40	12	17
Volume Left	23	0	0
Volume Right	0	1	17
cSH	1620	1700	1075
Volume to Capacity	0.01	0.01	0.02
Queue Length 95th (m)	0.3	0.0	0.4
Control Delay (s)	4.2	0.0	8.4
Lane LOS	A		A
Approach Delay (s)	4.2	0.0	8.4
Approach LOS			A

Intersection Summary			
Average Delay	4.5		
Intersection Capacity Utilization	18.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	5	0	0	0	0	4
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	5	0	0	0	0	4
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	0				11	0
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	0				11	0
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1636				1011	1091

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	5	0	4
Volume Left	5	0	0
Volume Right	0	0	4
cSH	1636	1700	1091
Volume to Capacity	0.00	0.00	0.00
Queue Length 95th (m)	0.1	0.0	0.1
Control Delay (s)	7.2	0.0	8.3
Lane LOS	A		A
Approach Delay (s)	7.2	0.0	8.3
Approach LOS			A

Intersection Summary			
Average Delay	7.7		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix D

OTM Traffic Control Signal Warrants

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

Paradigm
www.ptsl.com

Horizon Year: Existing Traffic
Region/City/Township: City of Guelph

Major Street: Starwood Drive
Minor Street: Lee Street
North/South?: N

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

PM Forecast Only? N

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

	Major Street **Starwood Drive**						*Minor Street* **Lee Street**						
	Eastbound			Westbound			Northbound			Southbound			Peds Crossing
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	Main Road
AM Peak Hour	3	217	2	2	213	5	5	2	13	8	8	7	0
PM Peak Hour	11	151	4	23	290	11	4	2	12	2	2	5	0

Average Hourly Volumes			
Volume	AM	PM	AHV
1A - All	485	517	251
1B - Minor	43	27	18
2A - Major	442	490	233
2B - Cross	21	8	7

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	All Approaches	480	720	600	900	251
					% Fulfilled	34.8%

1B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	Minor Street Approaches	120	170	120	170	18
					% Fulfilled	10.3%

Warrant 2 - Delay To Cross Traffic

2A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	Major Street Approaches	480	720	600	900	233
					% Fulfilled	32.4%

2B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	Traffic Crossing Major Street	50	75	50	75	7
					% Fulfilled	9.7%

1A - MINIMUM VEHICULAR VOLUME: Total vehicle volume on all approaches for average day
1B - MINIMUM VEHICULAR VOLUME: Total vehicle volume on minor streets
2A - DELAY TO CROSS TRAFFIC: Total vehicle volume on major street for average day
2B - DELAY TO CROSS TRAFFIC: Total vehicle and pedestrian volume crossing major street: comprising: (1) lefts from both minor street, (2) heaviest through from minor street, (3) 50% of heavier left turn from major street when following criteria met: (a)

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

Paradigm
www.ptsl.com

Horizon Year: Background Traffic
Region/City/Township: City of Guelph

Major Street: Starwood Drive
Minor Street: Lee Street
North/South?: N

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

PM Forecast Only? N

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

	Major Street **Starwood Drive**						*Minor Street* **Lee Street**						
	Eastbound			Westbound			Northbound			Southbound			Peds Crossing
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	Main Road
AM Peak Hour	3	280	9	39	276	5	5	2	44	9	9	8	0
PM Peak Hour	12	380	6	36	561	12	4	2	24	2	2	5	0

Average Hourly Volumes			
Volume	AM	PM	AHV
1A - All	689	1046	434
1B - Minor	77	39	29
2A - Major	612	1007	405
2B - Cross	23	8	8

Warrant 1 - Minimum Vehicular Volume

	Approach Lanes	1		2 or more		Average
1A	Flow Conditions	Free	Restricted	Free	Restricted	Hourly Volume
			X			
	All Approaches	480	720	600	900	434
					% Fulfilled	60.2%

	Approach Lanes	1		2 or more		Average
1B	Flow Conditions	Free	Restricted	Free	Restricted	Hourly Volume
			X			
	Minor Street Approaches	120	170	120	170	29
					% Fulfilled	17.1%

Warrant 2 - Delay To Cross Traffic

	Approach Lanes	1		2 or more		Average
2A	Flow Conditions	Free	Restricted	Free	Restricted	Hourly Volume
			X			
	Major Street Approaches	480	720	600	900	405
					% Fulfilled	56.2%

	Approach Lanes	1		2 or more		Average
2B	Flow Conditions	Free	Restricted	Free	Restricted	Hourly Volume
			X			
	Traffic Crossing Major Street	50	75	50	75	8
					% Fulfilled	10.3%

1A - MINIMUM VEHICULAR VOLUME: Total vehicle volume on all approaches for average day
1B - MINIMUM VEHICULAR VOLUME: Total vehicle volume on minor streets
2A - DELAY TO CROSS TRAFFIC: Total vehicle volume on major street for average day
2B - DELAY TO CROSS TRAFFIC: Total vehicle and pedestrian volume crossing major street: comprising: (1) lefts from both minor street, (2) heaviest through from minor street, (3) 50% of heavier left turn from major street when following criteria met: (a)

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

Paradigm
www.ptsl.com

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

Major Street: Starwood Drive
Minor Street: Lee Street
North/South?: N

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

PM Forecast Only? N

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

	Major Street **Starwood Drive**						*Minor Street* **Lee Street**						
	Eastbound			Westbound			Northbound			Southbound			Peds Crossing
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	Main Road
AM Peak Hour	3	303	16	39	328	5	16	2	44	9	9	8	0
PM Peak Hour	12	442	20	36	593	12	13	2	24	2	2	5	0

Average Hourly Volumes			
Volume	AM	PM	AHV
1A - All	782	1163	486
1B - Minor	88	48	34
2A - Major	694	1115	452
2B - Cross	34	17	13

Warrant 1 - Minimum Vehicular Volume

	Approach Lanes	1		2 or more		Average
1A	Flow Conditions	Free	Restricted	Free	Restricted	Hourly Volume
			X			
	All Approaches	480	720	600	900	486
					% Fulfilled	67.5%

	Approach Lanes	1		2 or more		Average
1B	Flow Conditions	Free	Restricted	Free	Restricted	Hourly Volume
			X			
	Minor Street Approaches	120	170	120	170	34
					% Fulfilled	20.0%

Warrant 2 - Delay To Cross Traffic

	Approach Lanes	1		2 or more		Average
2A	Flow Conditions	Free	Restricted	Free	Restricted	Hourly Volume
			X			
	Major Street Approaches	480	720	600	900	452
					% Fulfilled	62.8%

	Approach Lanes	1		2 or more		Average
2B	Flow Conditions	Free	Restricted	Free	Restricted	Hourly Volume
			X			
	Traffic Crossing Major Street	50	75	50	75	13
					% Fulfilled	17.0%

1A - MINIMUM VEHICULAR VOLUME: Total vehicle volume on all approaches for average day
1B - MINIMUM VEHICULAR VOLUME: Total vehicle volume on minor streets
2A - DELAY TO CROSS TRAFFIC: Total vehicle volume on major street for average day
2B - DELAY TO CROSS TRAFFIC: Total vehicle and pedestrian volume crossing major street: comprising: (1) lefts from both minor street, (2) heaviest through from minor street, (3) 50% of heavier left turn from major street when following criteria met: (a)

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

Paradigm
www.ptsl.com

Horizon Year: Existing Traffic
Region/City/Township: City of Guelph

Major Street: Starwood Drive
Minor Street: Keating St/Fleming Road
North/South?: N

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

PM Forecast Only? N

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

	Major Street **Starwood Drive**						*Minor Street* **Keating St/Fleming Road**						
	Eastbound			Westbound			Northbound			Southbound			Peds Crossing
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	Main Road
AM Peak Hour	8	194	7	4	117	10	16	0	12	28	2	17	0
PM Peak Hour	23	110	8	29	224	17	5	1	3	21	0	6	0

Average Hourly Volumes			
Volume	AM	PM	AHV
1A - All	415	447	216
1B - Minor	75	36	28
2A - Major	340	411	188
2B - Cross	46	27	18

Warrant 1 - Minimum Vehicular Volume

	Approach Lanes	1		2 or more		Average Hourly Volume
1A	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	All Approaches	480	720	600	900	216
					% Fulfilled	29.9%

	Approach Lanes	1		2 or more		Average Hourly Volume
1B	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	Minor Street Approaches	120	170	120	170	28
					% Fulfilled	16.3%

Warrant 2 - Delay To Cross Traffic

	Approach Lanes	1		2 or more		Average Hourly Volume
2A	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	Major Street Approaches	480	720	600	900	188
					% Fulfilled	26.1%

	Approach Lanes	1		2 or more		Average Hourly Volume
2B	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	Traffic Crossing Major Street	50	75	50	75	18
					% Fulfilled	24.3%

1A - MINIMUM VEHICULAR VOLUME: Total vehicle volume on all approaches for average day
1B - MINIMUM VEHICULAR VOLUME: Total vehicle volume on minor streets
2A - DELAY TO CROSS TRAFFIC: Total vehicle volume on major street for average day
2B - DELAY TO CROSS TRAFFIC: Total vehicle and pedestrian volume crossing major street: comprising: (1) lefts from both minor street, (2) heaviest through from minor street, (3) 50% of heavier left turn from major street when following criteria met: (a)

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

Paradigm
www.ptsl.com

Horizon Year: Background Traffic
Region/City/Township: City of Guelph

Major Street: Starwood Drive
Minor Street: Keating St/Fleming Road
North/South?: N

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

PM Forecast Only? N

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

	Major Street						*Minor Street*						
	Starwood Drive						**Keating St/Fleming Road**						
	Eastbound			Westbound			Northbound			Southbound			Peds Crossing
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	Main Road
AM Peak Hour	9	329	18	16	212	11	51	0	40	30	2	18	0
PM Peak Hour	25	311	45	60	480	18	26	1	22	23	0	6	0

Average Hourly Volumes			
Volume	AM	PM	AHV
1A - All	736	1017	438
1B - Minor	141	78	55
2A - Major	595	939	384
2B - Cross	83	50	33

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	All Approaches	480	720	600	900	438
					% Fulfilled	60.9%

1B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	Minor Street Approaches	120	170	120	170	55
					% Fulfilled	32.2%

Warrant 2 - Delay To Cross Traffic

2A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	Major Street Approaches	480	720	600	900	384
					% Fulfilled	53.3%

2B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	Traffic Crossing Major Street	50	75	50	75	33
					% Fulfilled	44.3%

1A - MINIMUM VEHICULAR VOLUME: Total vehicle volume on all approaches for average day
1B - MINIMUM VEHICULAR VOLUME: Total vehicle volume on minor streets
2A - DELAY TO CROSS TRAFFIC: Total vehicle volume on major street for average day
2B - DELAY TO CROSS TRAFFIC: Total vehicle and pedestrian volume crossing major street: comprising: (1) lefts from both minor street, (2) heaviest through from minor street, (3) 50% of heavier left turn from major street when following criteria met: (a)

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

Paradigm
www.ptsl.com

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

Major Street: Starwood Drive
Minor Street: Keating St/Fleming Road
North/South?: N

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

PM Forecast Only? N

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

	Major Street						*Minor Street*						
	Starwood Drive						**Keating St/Fleming Road**						
	Eastbound			Westbound			Northbound			Southbound			Peds Crossing
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	Main Road
AM Peak Hour	9	332	38	17	228	11	87	0	60	30	2	18	0
PM Peak Hour	25	328	90	79	488	18	50	1	31	23	0	6	0

Average Hourly Volumes			
Volume	AM	PM	AHV
1A - All	832	1139	493
1B - Minor	197	111	77
2A - Major	635	1028	416
2B - Cross	119	74	48

Warrant 1 - Minimum Vehicular Volume

	Approach Lanes	1		2 or more		Average
1A	Flow Conditions	Free	Restricted	Free	Restricted	Hourly Volume
			X			
	All Approaches	480	720	600	900	493
					% Fulfilled	68.4%

	Approach Lanes	1		2 or more		Average
1B	Flow Conditions	Free	Restricted	Free	Restricted	Hourly Volume
			X			
	Minor Street Approaches	120	170	120	170	77
					% Fulfilled	45.3%

Warrant 2 - Delay To Cross Traffic

	Approach Lanes	1		2 or more		Average
2A	Flow Conditions	Free	Restricted	Free	Restricted	Hourly Volume
			X			
	Major Street Approaches	480	720	600	900	416
					% Fulfilled	57.7%

	Approach Lanes	1		2 or more		Average
2B	Flow Conditions	Free	Restricted	Free	Restricted	Hourly Volume
			X			
	Traffic Crossing Major Street	50	75	50	75	48
					% Fulfilled	64.3%

1A - MINIMUM VEHICULAR VOLUME: Total vehicle volume on all approaches for average day
1B - MINIMUM VEHICULAR VOLUME: Total vehicle volume on minor streets
2A - DELAY TO CROSS TRAFFIC: Total vehicle volume on major street for average day
2B - DELAY TO CROSS TRAFFIC: Total vehicle and pedestrian volume crossing major street: comprising: (1) lefts from both minor street, (2) heaviest through from minor street, (3) 50% of heavier left turn from major street when following criteria met: (a)

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

Paradigm
www.ptsl.com

Horizon Year: Existing Traffic
Region/City/Township: City of Guelph

Major Street: Watson Parkway
Minor Street: Starwood Drive
North/South?: Y

Number of Approach Lanes: 2 or more
Tee Intersection? Y
Flow Conditions: Free

PM Forecast Only? N

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

	Major Street **Watson Parkway**						*Minor Street* **Starwood Drive**						
	Northbound			Southbound			Eastbound			Westbound			Peds Crossing
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	Main Road
AM Peak Hour	62	105	0	0	325	26	42	0	233	0	0	0	0
PM Peak Hour	240	326	0	0	176	44	19	0	124	0	0	0	0

Average Hourly Volumes			
Volume	AM	PM	AHV
1A - All	793	929	431
1B - Minor	275	143	105
2A - Major	518	786	326
2B - Cross	42	19	15

Warrant 1 - Minimum Vehicular Volume

	Approach Lanes	1		2 or more		Average Hourly Volume
1A	Flow Conditions	Free	Restricted	Free	Restricted	
				X		
	All Approaches	480	720	600	900	431
					% Fulfilled	71.8%

	Approach Lanes	1		2 or more		Average Hourly Volume
1B	Flow Conditions	Free	Restricted	Free	Restricted	
				X		
	Minor Street Approaches	180	255	180	255	105
					% Fulfilled	58.1%

Warrant 2 - Delay To Cross Traffic

	Approach Lanes	1		2 or more		Average Hourly Volume
2A	Flow Conditions	Free	Restricted	Free	Restricted	
				X		
	Major Street Approaches	480	720	600	900	326
					% Fulfilled	54.3%

	Approach Lanes	1		2 or more		Average Hourly Volume
2B	Flow Conditions	Free	Restricted	Free	Restricted	
				X		
	Traffic Crossing Major Street	50	75	50	75	15
					% Fulfilled	30.5%

1A - MINIMUM VEHICULAR VOLUME: Total vehicle volume on all approaches for average day
1B - MINIMUM VEHICULAR VOLUME: Total vehicle volume on minor streets
2A - DELAY TO CROSS TRAFFIC: Total vehicle volume on major street for average day
2B - DELAY TO CROSS TRAFFIC: Total vehicle and pedestrian volume crossing major street: comprising: (1) lefts from both minor street, (2) heaviest through from minor street, (3) 50% of heavier left turn from major street when following criteria met: (a)

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

Paradigm
www.ptsl.com

Horizon Year: Background Traffic
Region/City/Township: City of Guelph

Major Street: Watson Parkway
Minor Street: Starwood Drive
North/South?: Y

Number of Approach Lanes: 2 or more
Tee Intersection? N
Flow Conditions: Free

PM Forecast Only? N

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

	Major Street						*Minor Street*						
	Watson Parkway						**Starwood Drive**						
	Northbound			Southbound			Eastbound			Westbound			Peds Crossing
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	Main Road
AM Peak Hour	111	113	51	39	350	46	60	54	329	28	36	29	0
PM Peak Hour	325	326	147	114	174	59	27	157	181	149	190	157	0

Average Hourly Volumes			
Volume	AM	PM	AHV
1A - All	1246	2006	813
1B - Minor	536	861	349
2A - Major	710	1145	464
2B - Cross	142	366	127

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
				X		
	All Approaches	480	720	600	900	813
					% Fulfilled	135.5%

1B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
				X		
	Minor Street Approaches	120	170	120	170	349
					% Fulfilled	291.0%

Warrant 2 - Delay To Cross Traffic

2A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
				X		
	Major Street Approaches	480	720	600	900	464
					% Fulfilled	77.3%

2B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
				X		
	Traffic Crossing Major Street	50	75	50	75	127
					% Fulfilled	254.0%

1A - MINIMUM VEHICULAR VOLUME: Total vehicle volume on all approaches for average day
1B - MINIMUM VEHICULAR VOLUME: Total vehicle volume on minor streets
2A - DELAY TO CROSS TRAFFIC: Total vehicle volume on major street for average day
2B - DELAY TO CROSS TRAFFIC: Total vehicle and pedestrian volume crossing major street: comprising: (1) lefts from both minor street, (2) heaviest through from minor street, (3) 50% of heavier left turn from major street when following criteria met: (a)

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

Paradigm
www.ptsl.com

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

Major Street: Watson Parkway
Minor Street: Starwood Drive
North/South?: Y

Number of Approach Lanes: 2 or more
Tee Intersection? N
Flow Conditions: Free

PM Forecast Only? N

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

	Major Street						*Minor Street*						
	Watson Parkway						**Starwood Drive**						
	Northbound			Southbound			Eastbound			Westbound			Peds Crossing
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	Main Road
AM Peak Hour	113	113	51	39	350	46	61	54	352	28	36	29	0
PM Peak Hour	346	326	147	114	174	59	27	157	191	149	190	157	0

Average Hourly Volumes			
Volume	AM	PM	AHV
1A - All	1272	2037	827
1B - Minor	560	871	358
2A - Major	712	1166	470
2B - Cross	143	366	127

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
				X		
	All Approaches	480	720	600	900	827
					% Fulfilled	137.9%

1B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
				X		
	Minor Street Approaches	120	170	120	170	358
					% Fulfilled	298.1%

Warrant 2 - Delay To Cross Traffic

2A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
				X		
	Major Street Approaches	480	720	600	900	470
					% Fulfilled	78.3%

2B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
				X		
	Traffic Crossing Major Street	50	75	50	75	127
					% Fulfilled	254.5%

1A - MINIMUM VEHICULAR VOLUME: Total vehicle volume on all approaches for average day
1B - MINIMUM VEHICULAR VOLUME: Total vehicle volume on minor streets
2A - DELAY TO CROSS TRAFFIC: Total vehicle volume on major street for average day
2B - DELAY TO CROSS TRAFFIC: Total vehicle and pedestrian volume crossing major street: comprising: (1) lefts from both minor street, (2) heaviest through from minor street, (3) 50% of heavier left turn from major street when following criteria met: (a)

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

Paradigm
www.ptsl.com

Horizon Year: Existing Traffic
Region/City/Township: City of Guelph

Major Street: Grange Road
Minor Street: Cityview Drive
North/South?: N

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

PM Forecast Only? N

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

	Major Street **Grange Road**						*Minor Street* **Cityview Drive**						
	Eastbound			Westbound			Northbound			Southbound			Peds Crossing
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	Main Road
AM Peak Hour	0	208	6	10	400	0	0	0	0	29	0	4	0
PM Peak Hour	0	326	24	6	256	0	0	0	0	25	0	1	0

Average Hourly Volumes			
Volume	AM	PM	AHV
1A - All	657	638	324
1B - Minor	33	26	15
2A - Major	624	612	309
2B - Cross	29	25	14

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	All Approaches	480	720	600	900	324
					% Fulfilled	45.0%

1B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	Minor Street Approaches	120	170	120	170	15
					% Fulfilled	8.7%

Warrant 2 - Delay To Cross Traffic

2A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	Major Street Approaches	480	720	600	900	309
					% Fulfilled	42.9%

2B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	Traffic Crossing Major Street	50	75	50	75	14
					% Fulfilled	18.0%

1A - MINIMUM VEHICULAR VOLUME: Total vehicle volume on all approaches for average day
1B - MINIMUM VEHICULAR VOLUME: Total vehicle volume on minor streets
2A - DELAY TO CROSS TRAFFIC: Total vehicle volume on major street for average day
2B - DELAY TO CROSS TRAFFIC: Total vehicle and pedestrian volume crossing major street: comprising: (1) lefts from both minor street, (2) heaviest through from minor street, (3) 50% of heavier left turn from major street when following criteria met: (a)

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

Paradigm
www.ptsl.com

Horizon Year: Background Traffic
Region/City/Township: City of Guelph

Major Street: Grange Road
Minor Street: Cityview Drive
North/South?: N

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

PM Forecast Only? N

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

	Major Street						*Minor Street*						
	Grange Road						**Cityview Drive**						
	Eastbound			Westbound			Northbound			Southbound			Peds Crossing
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	Main Road
AM Peak Hour	0	301	52	26	479	0	0	0	0	129	0	49	0
PM Peak Hour	0	385	63	24	322	0	0	0	0	52	0	12	0

Average Hourly Volumes			
Volume	AM	PM	AHV
1A - All	1036	858	474
1B - Minor	178	64	61
2A - Major	858	794	413
2B - Cross	129	52	45

Warrant 1 - Minimum Vehicular Volume

		1		2 or more		Average
1A	Approach Lanes					
	Flow Conditions	Free	Restricted	Free	Restricted	Hourly Volume
			X			
	All Approaches	480	720	600	900	474
					% Fulfilled	65.8%

		1		2 or more		Average
1B	Approach Lanes					
	Flow Conditions	Free	Restricted	Free	Restricted	Hourly Volume
			X			
	Minor Street Approaches	180	255	180	255	61
					% Fulfilled	23.7%

Warrant 2 - Delay To Cross Traffic

		1		2 or more		Average
2A	Approach Lanes					
	Flow Conditions	Free	Restricted	Free	Restricted	Hourly Volume
			X			
	Major Street Approaches	480	720	600	900	413
					% Fulfilled	57.4%

		1		2 or more		Average
2B	Approach Lanes					
	Flow Conditions	Free	Restricted	Free	Restricted	Hourly Volume
			X			
	Traffic Crossing Major Street	50	75	50	75	45
					% Fulfilled	60.3%

1A - MINIMUM VEHICULAR VOLUME: Total vehicle volume on all approaches for average day
1B - MINIMUM VEHICULAR VOLUME: Total vehicle volume on minor streets
2A - DELAY TO CROSS TRAFFIC: Total vehicle volume on major street for average day
2B - DELAY TO CROSS TRAFFIC: Total vehicle and pedestrian volume crossing major street: comprising: (1) lefts from both minor street, (2) heaviest through from minor street, (3) 50% of heavier left turn from major street when following criteria met: (a)

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

Paradigm
www.ptsl.com

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

Major Street: Grange Road
Minor Street: Cityview Drive
North/South?: N

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

PM Forecast Only? N

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

	Major Street **Grange Road**						*Minor Street* **Cityview Drive**						
	Eastbound			Westbound			Northbound			Southbound			Peds Crossing
Time Period	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	Main Road
AM Peak Hour	0	302	58	26	486	0	0	0	0	165	0	49	0
PM Peak Hour	0	391	98	24	325	0	0	0	0	75	0	12	0

Average Hourly Volumes			
Volume	AM	PM	AHV
1A - All	1086	925	503
1B - Minor	214	87	75
2A - Major	872	838	428
2B - Cross	165	75	60

Warrant 1 - Minimum Vehicular Volume

	Approach Lanes	1		2 or more		Average Hourly Volume
1A	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	All Approaches	480	720	600	900	503
					% Fulfilled	69.8%

	Approach Lanes	1		2 or more		Average Hourly Volume
1B	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	Minor Street Approaches	120	170	120	170	75
					% Fulfilled	44.3%

Warrant 2 - Delay To Cross Traffic

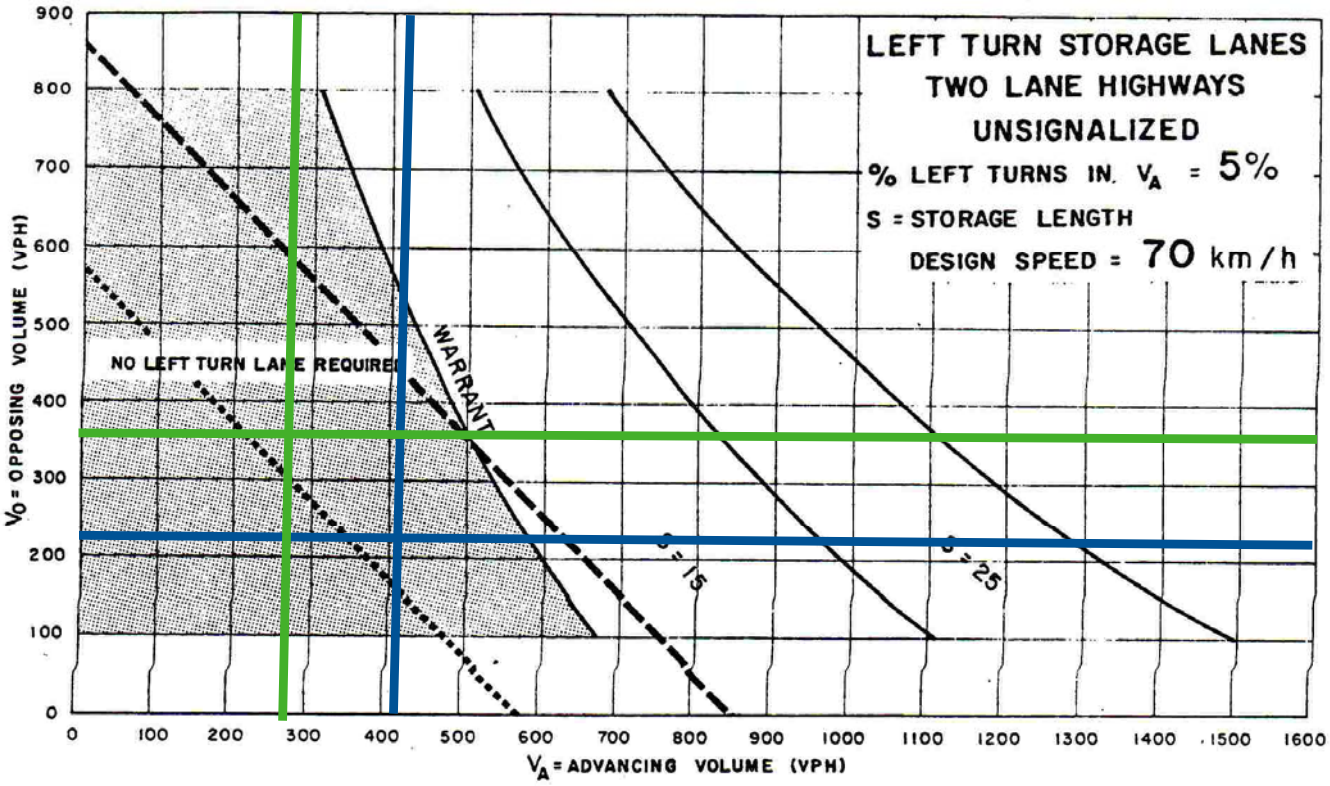
	Approach Lanes	1		2 or more		Average Hourly Volume
2A	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	Major Street Approaches	480	720	600	900	428
					% Fulfilled	59.4%

	Approach Lanes	1		2 or more		Average Hourly Volume
2B	Flow Conditions	Free	Restricted	Free	Restricted	
			X			
	Traffic Crossing Major Street	50	75	50	75	60
					% Fulfilled	80.0%

1A - MINIMUM VEHICULAR VOLUME: Total vehicle volume on all approaches for average day
1B - MINIMUM VEHICULAR VOLUME: Total vehicle volume on minor streets
2A - DELAY TO CROSS TRAFFIC: Total vehicle volume on major street for average day
2B - DELAY TO CROSS TRAFFIC: Total vehicle and pedestrian volume crossing major street: comprising: (1) lefts from both minor street, (2) heaviest through from minor street, (3) 50% of heavier left turn from major street when following criteria met: (a)

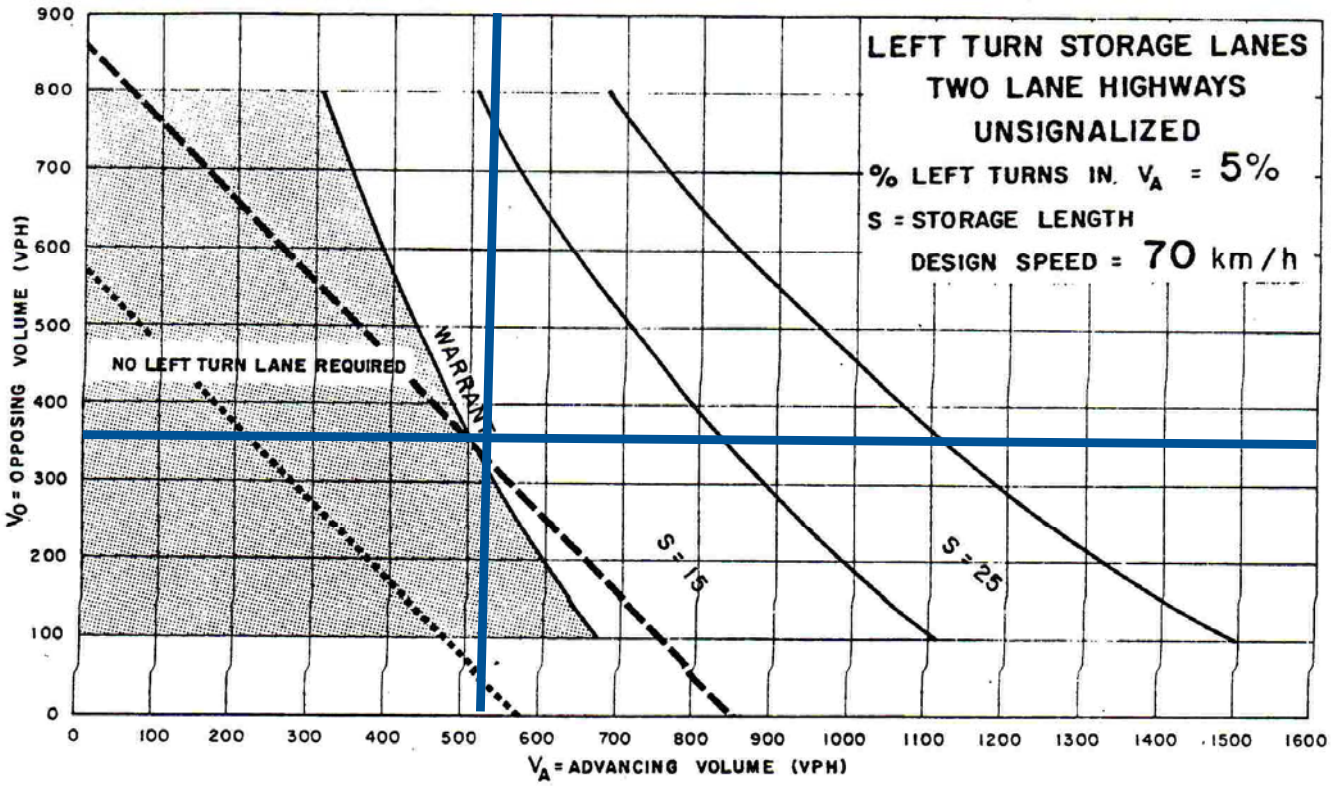
Appendix E

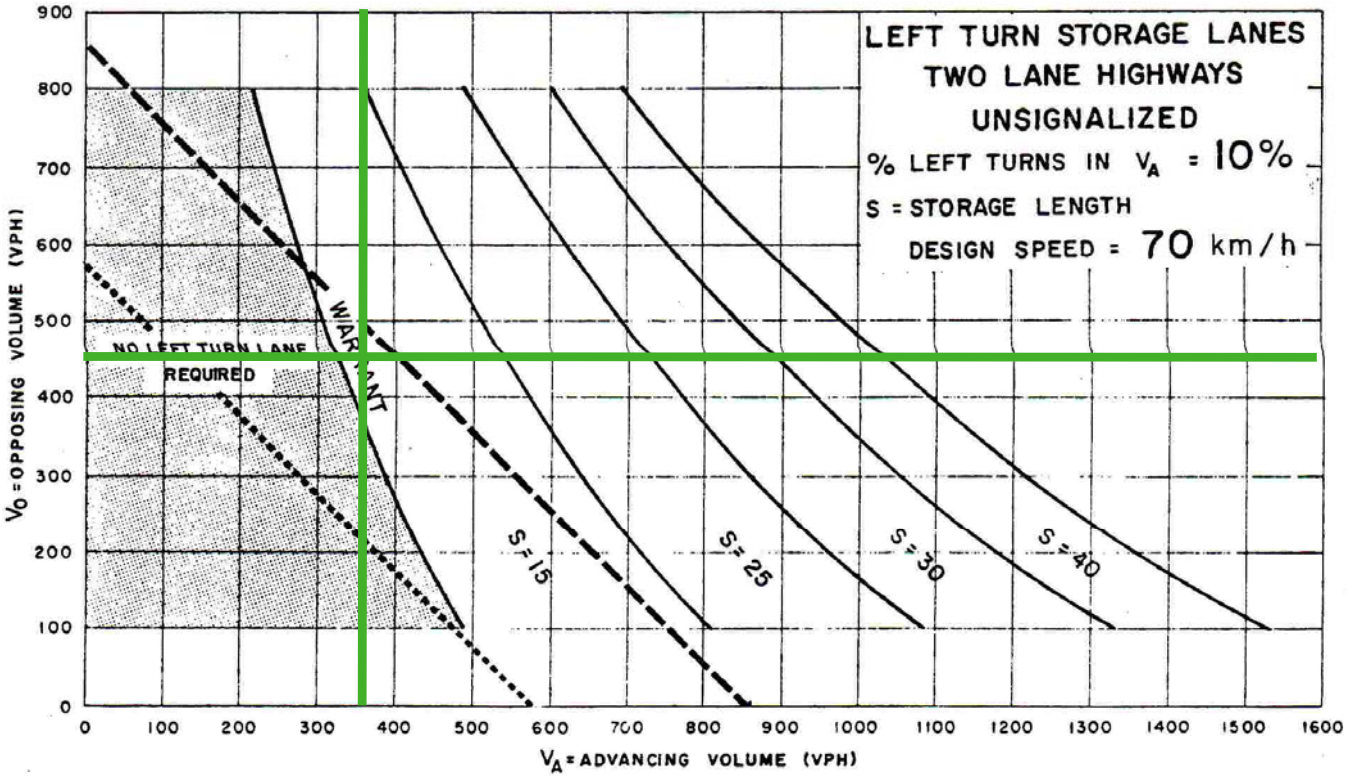
Left-Turn Lane Warrants



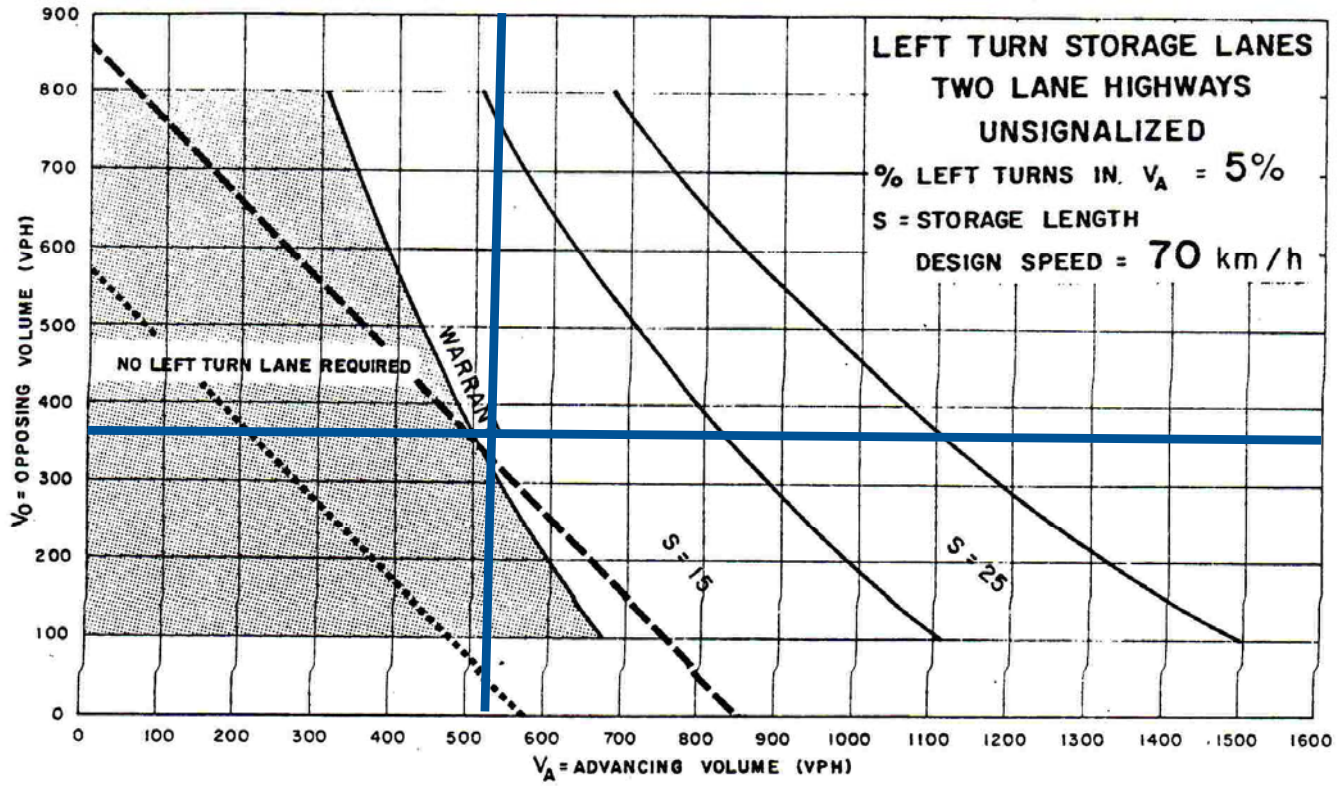
AM Peak Hour *PM Peak Hour*

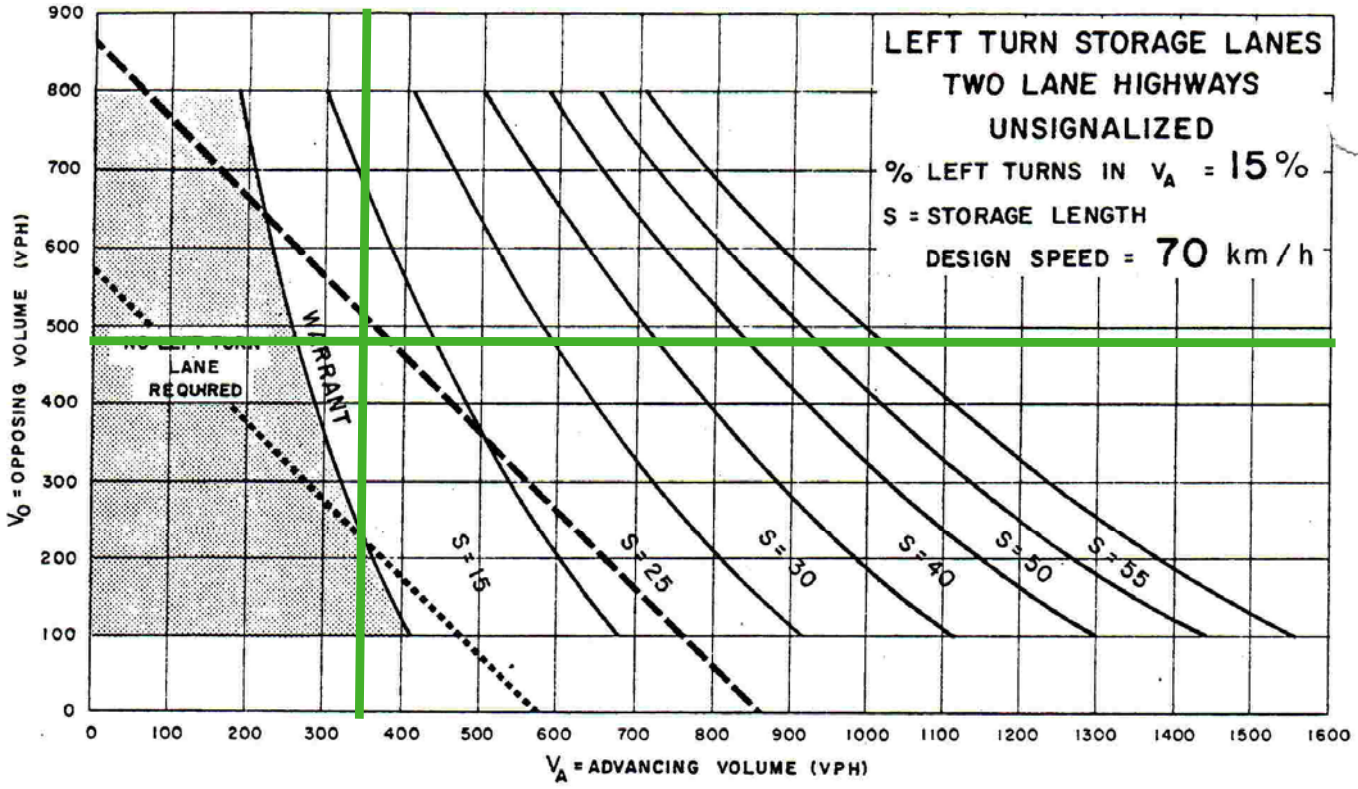
Intersection: **Grange Road & Cityview Drive**
Horizon Year: **Existing Traffic**
Movement: **Southbound Left-Turn**





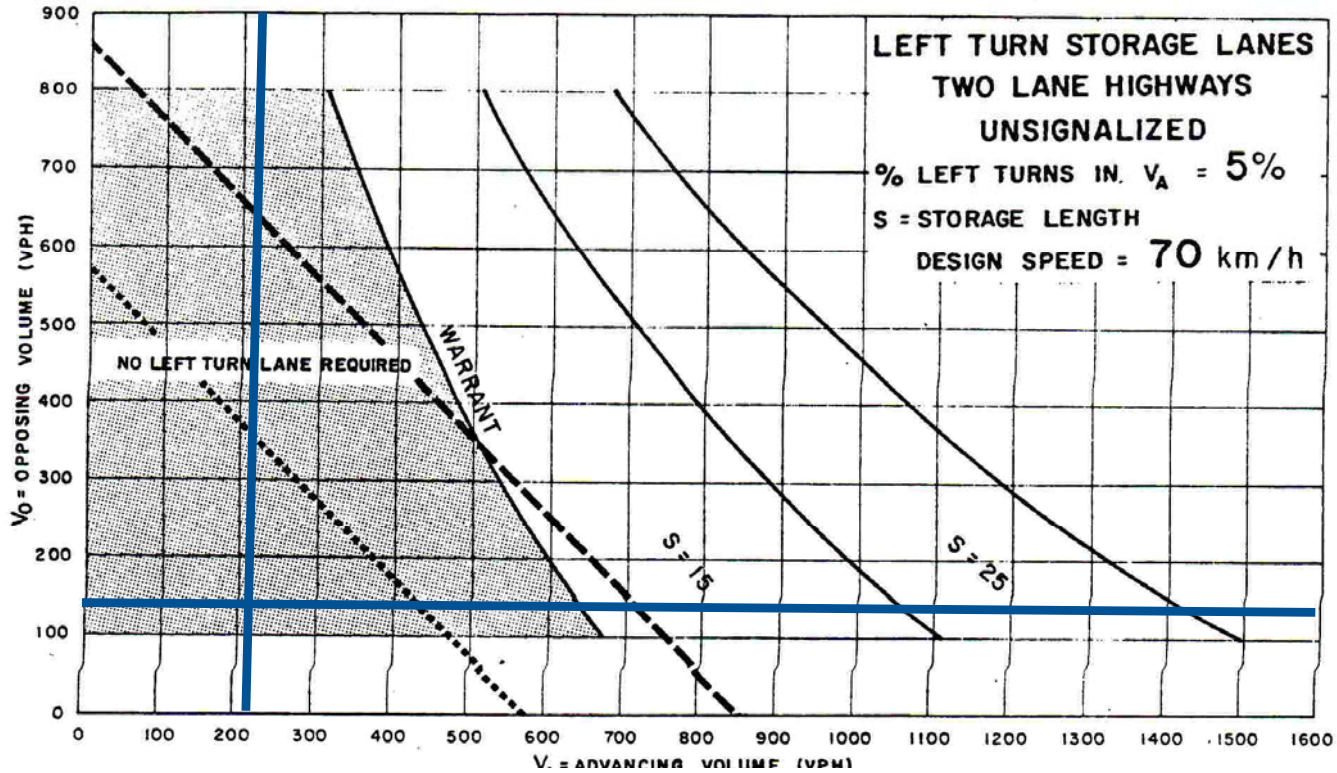
AM Peak Hour *PM Peak Hour*

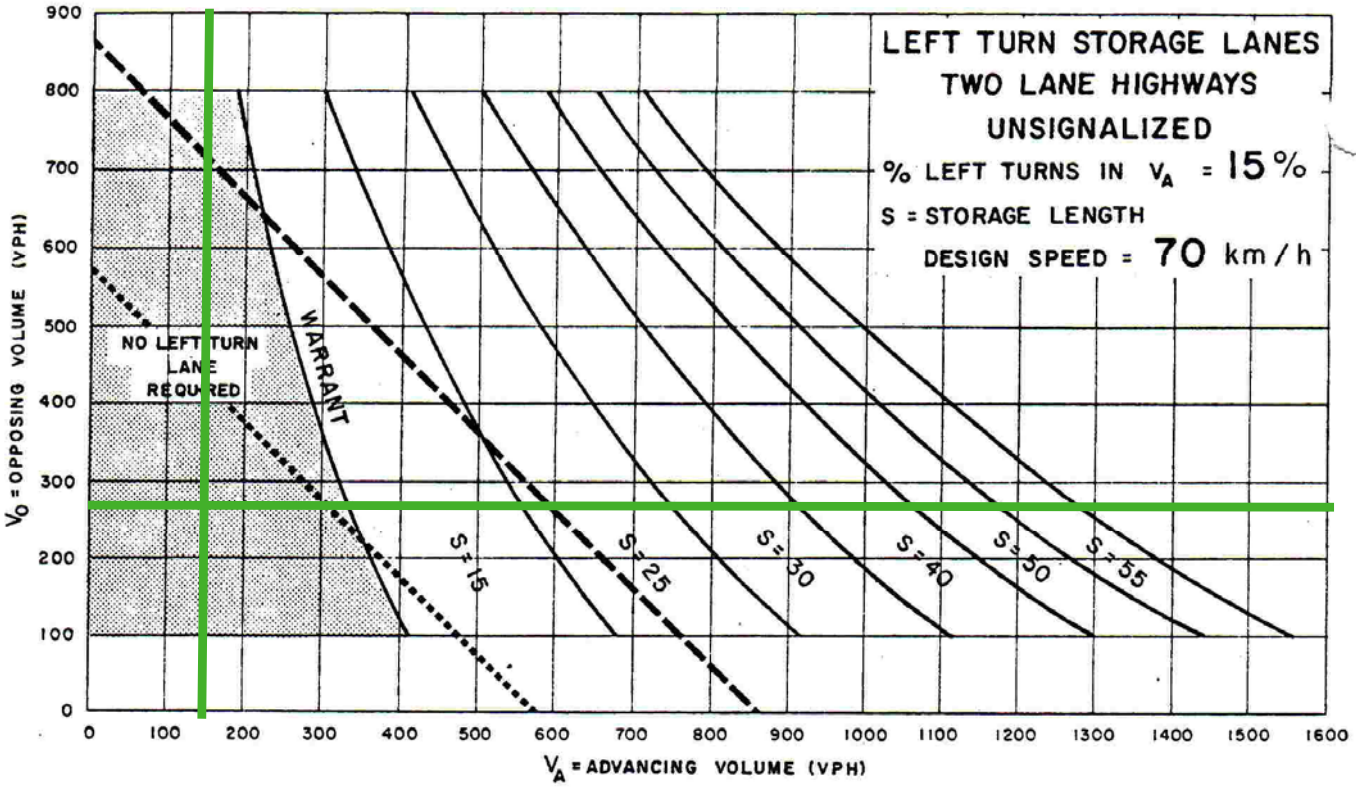




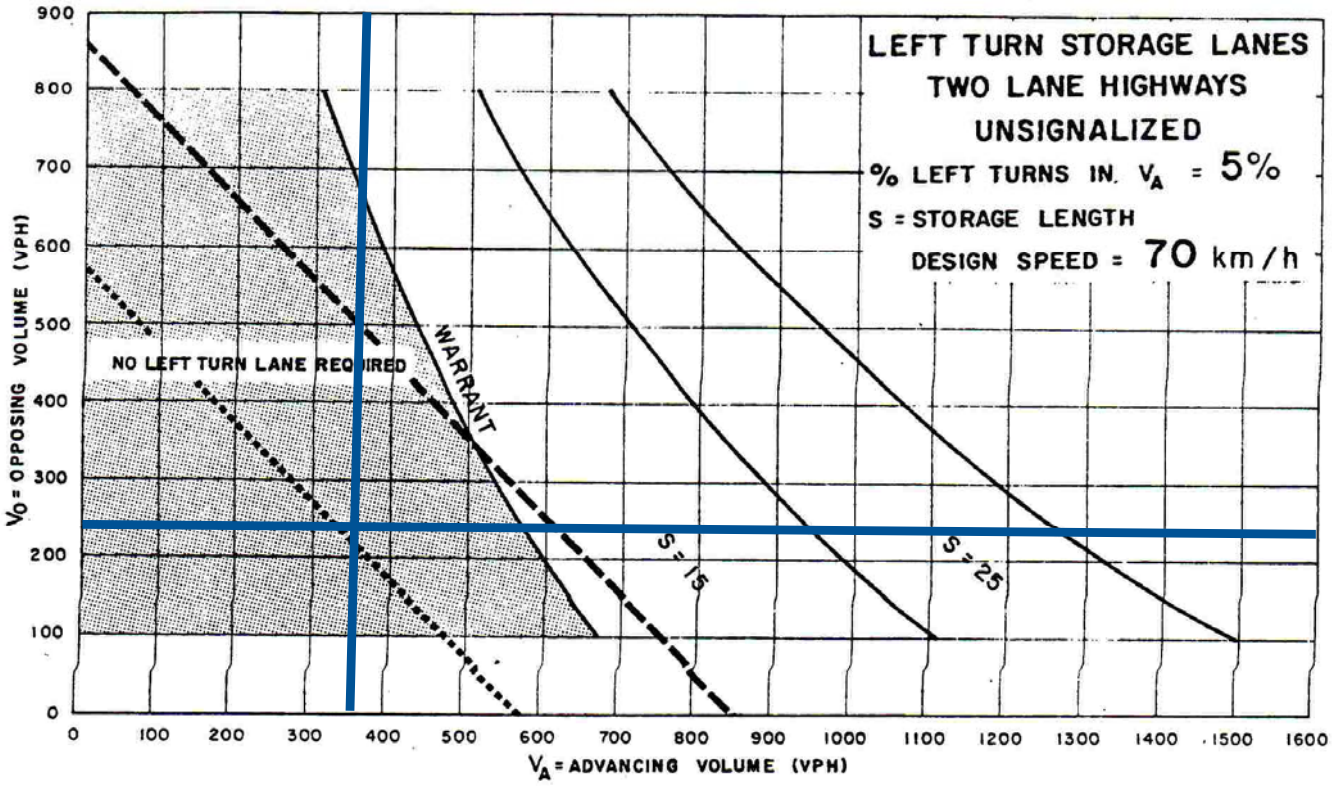
AM Peak Hour ***PM Peak Hour***

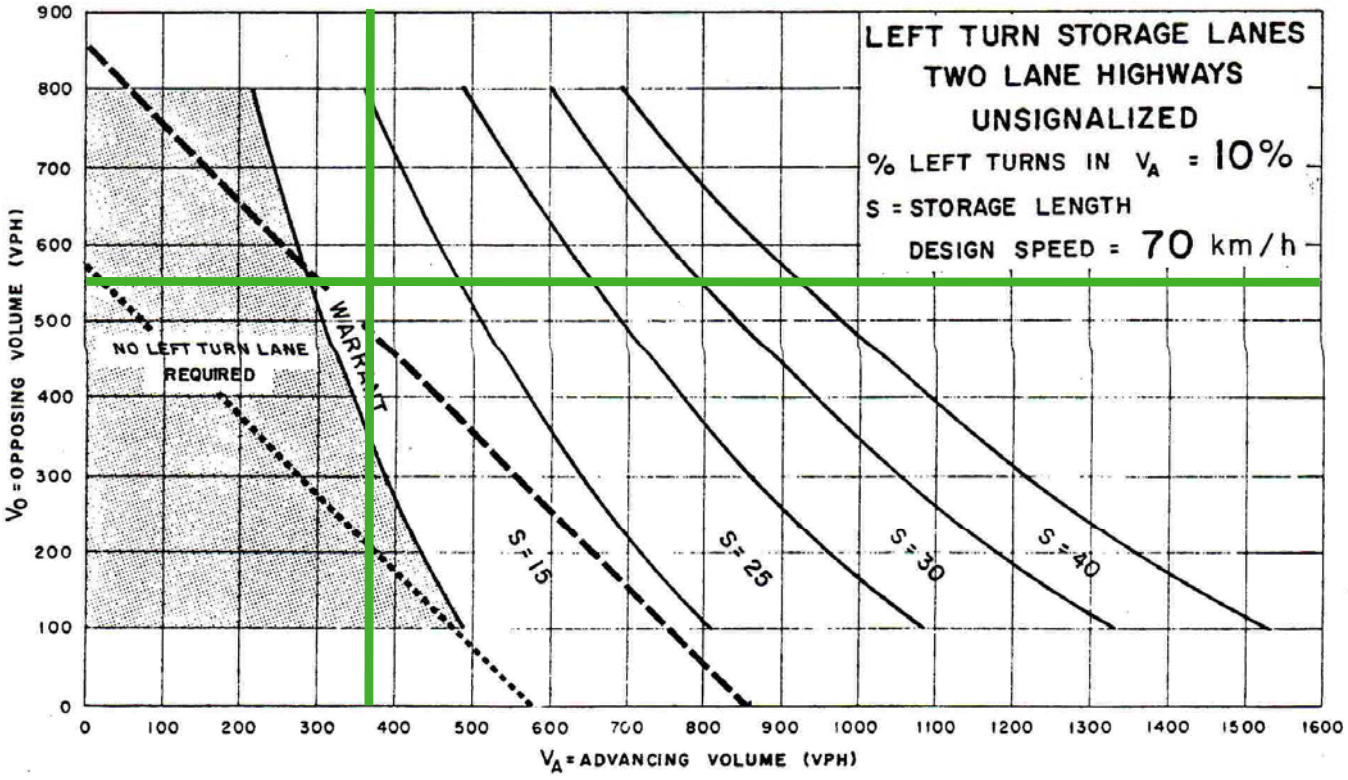
Intersection: **Grange Road & Cityview Drive**
Horizon Year: **Five-Year Total Traffic**
Movement: **Southbound Left-Turn**



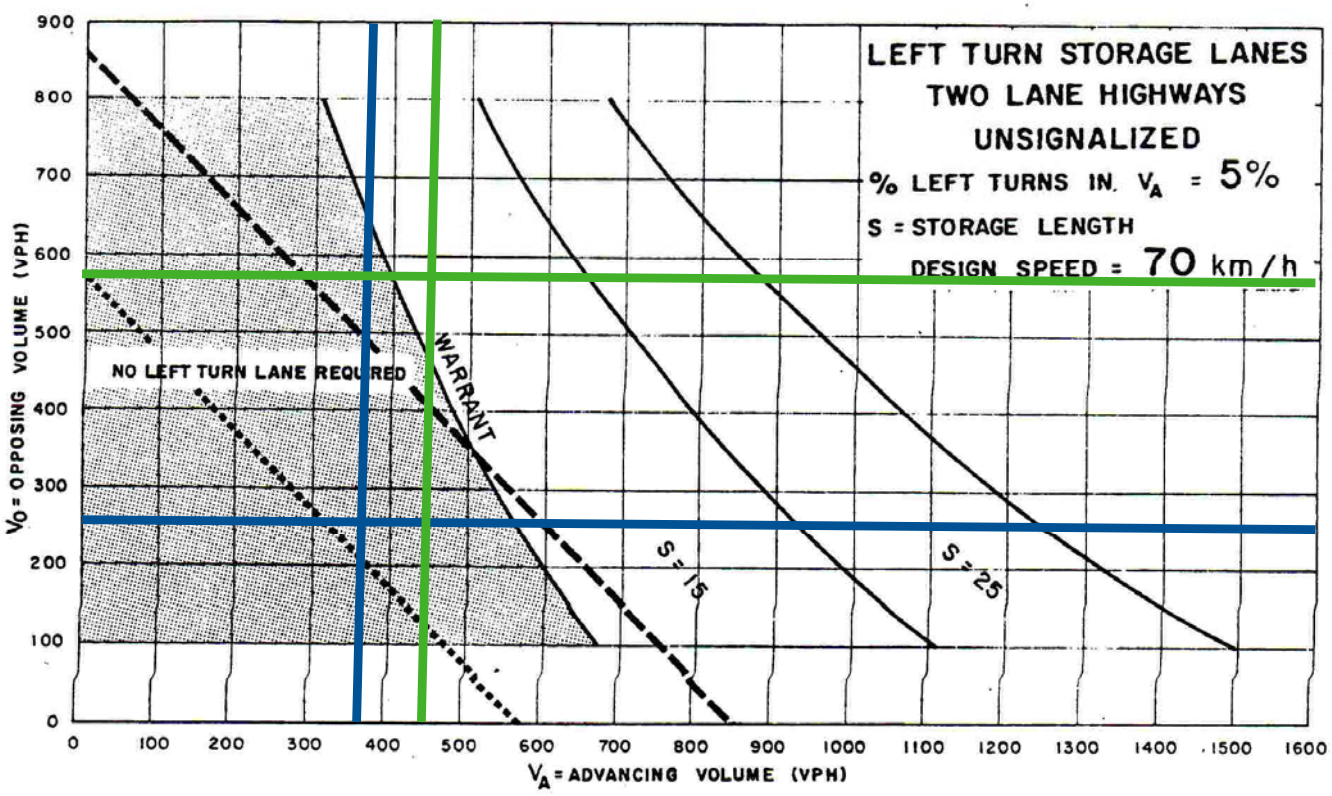


AM Peak Hour *PM Peak Hour*

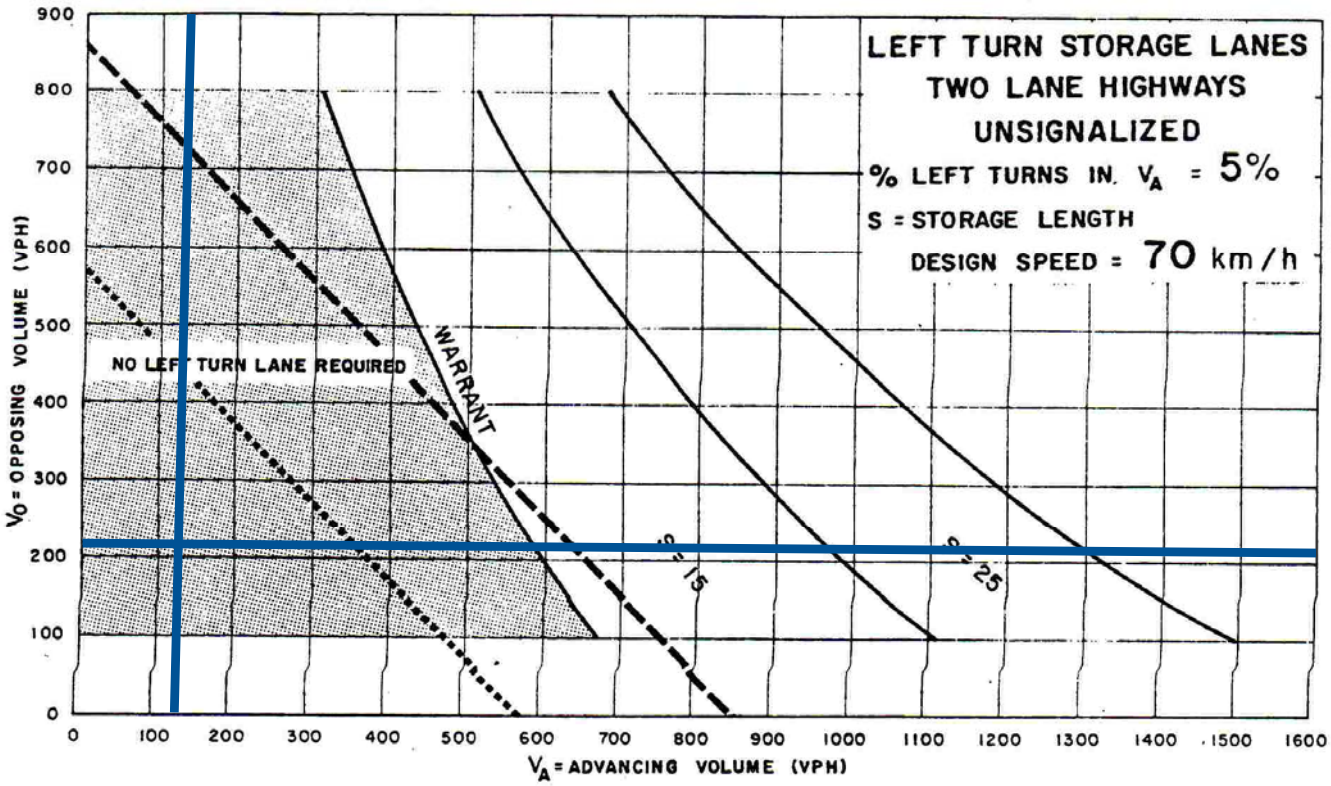


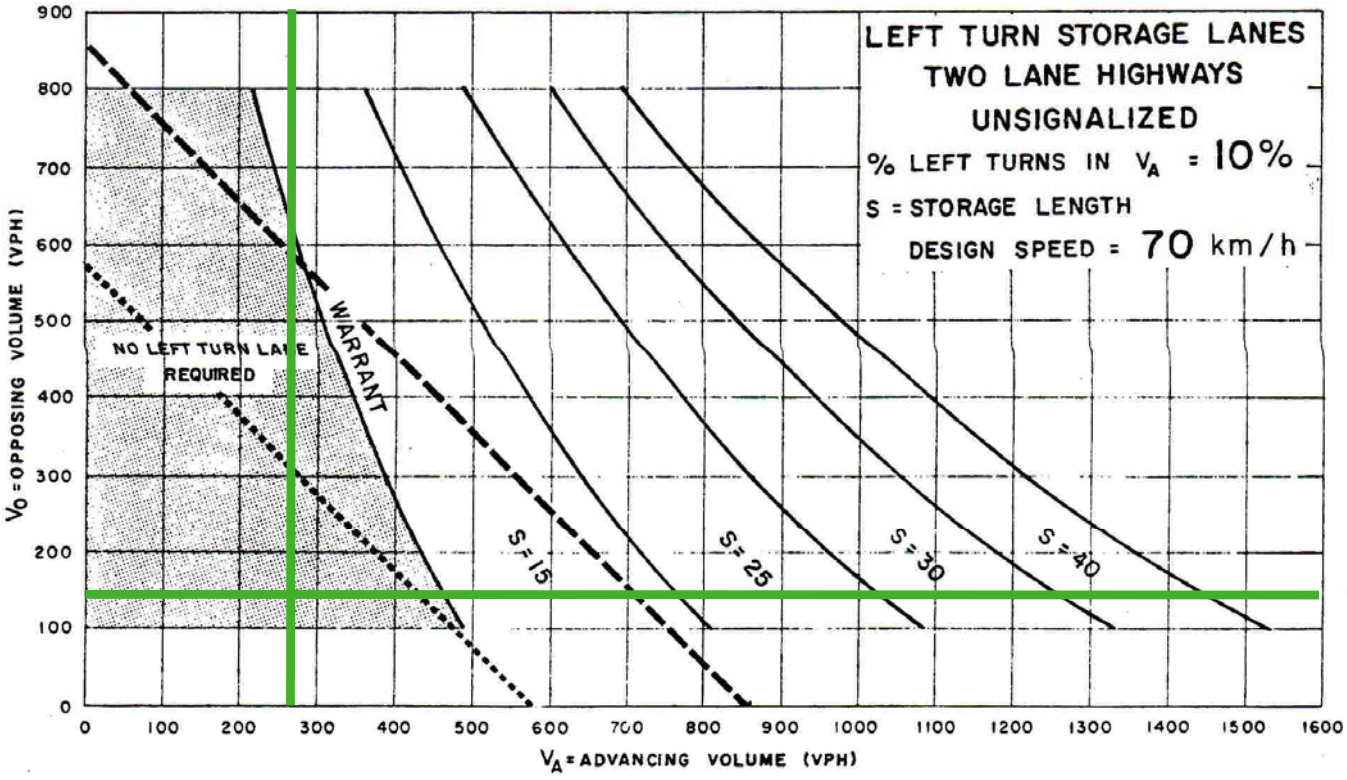


AM Peak Hour *PM Peak Hour*

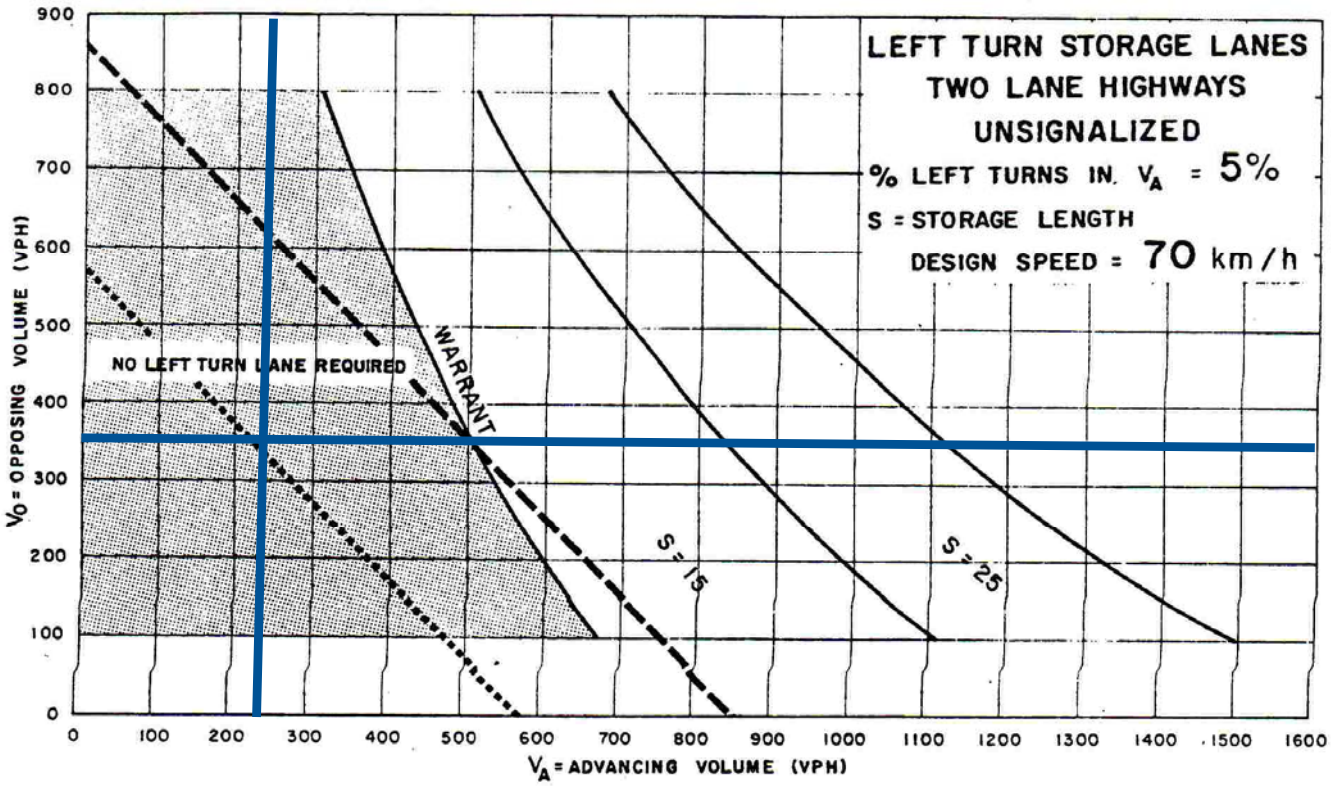


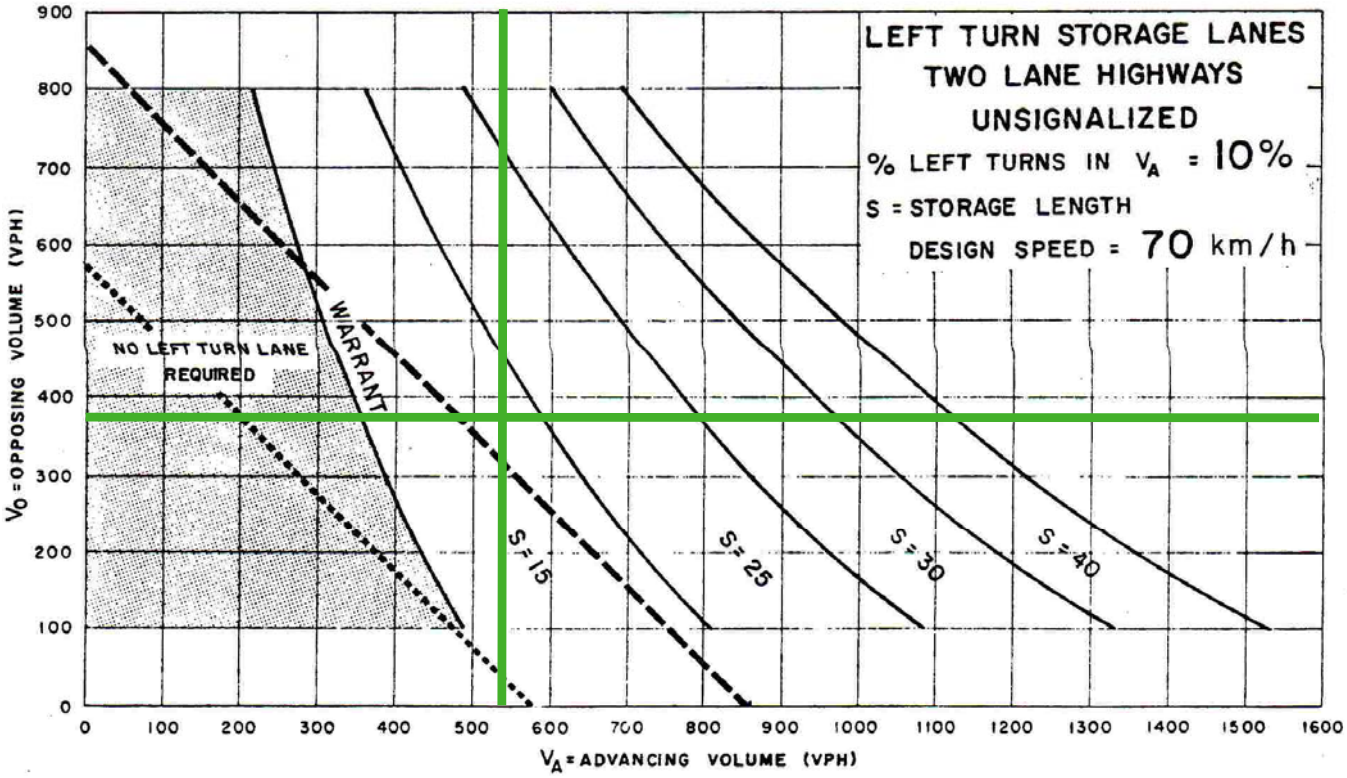
AM Peak Hour *PM Peak Hour*



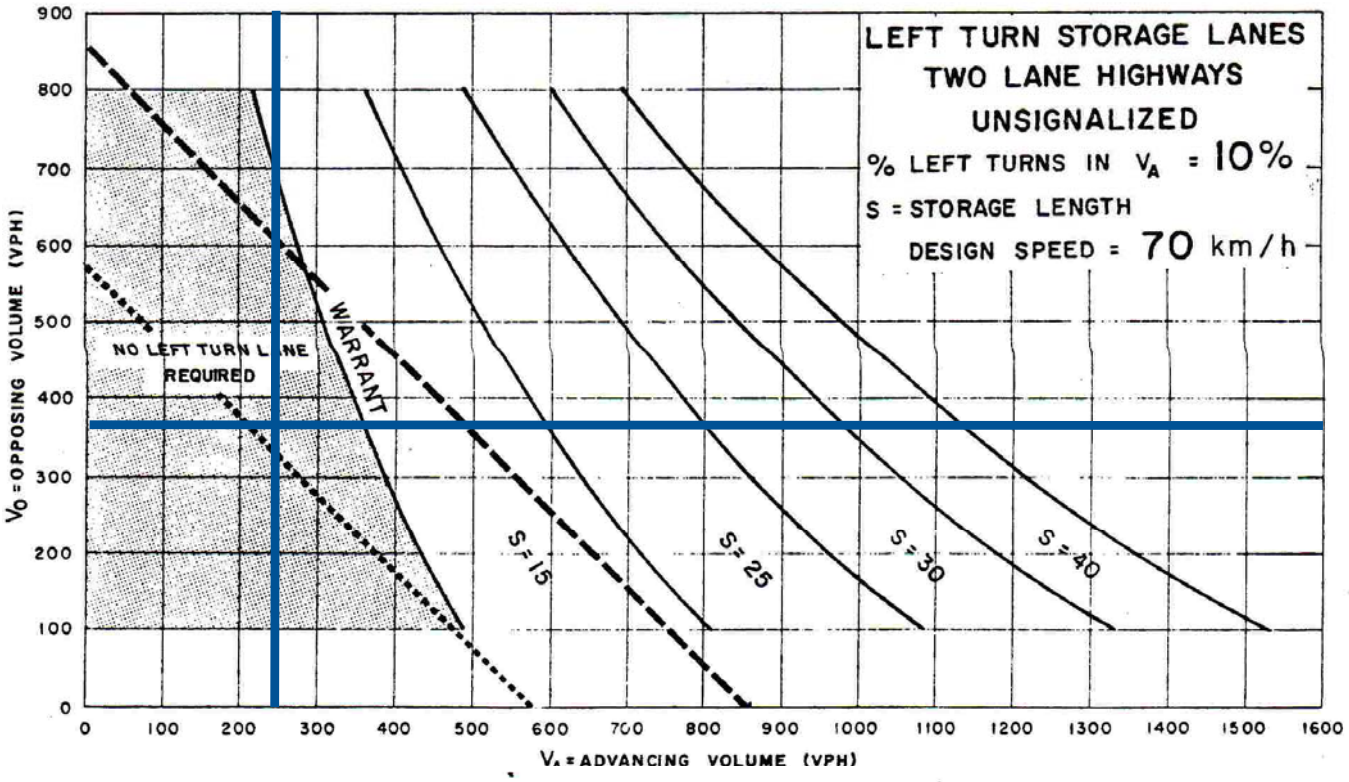


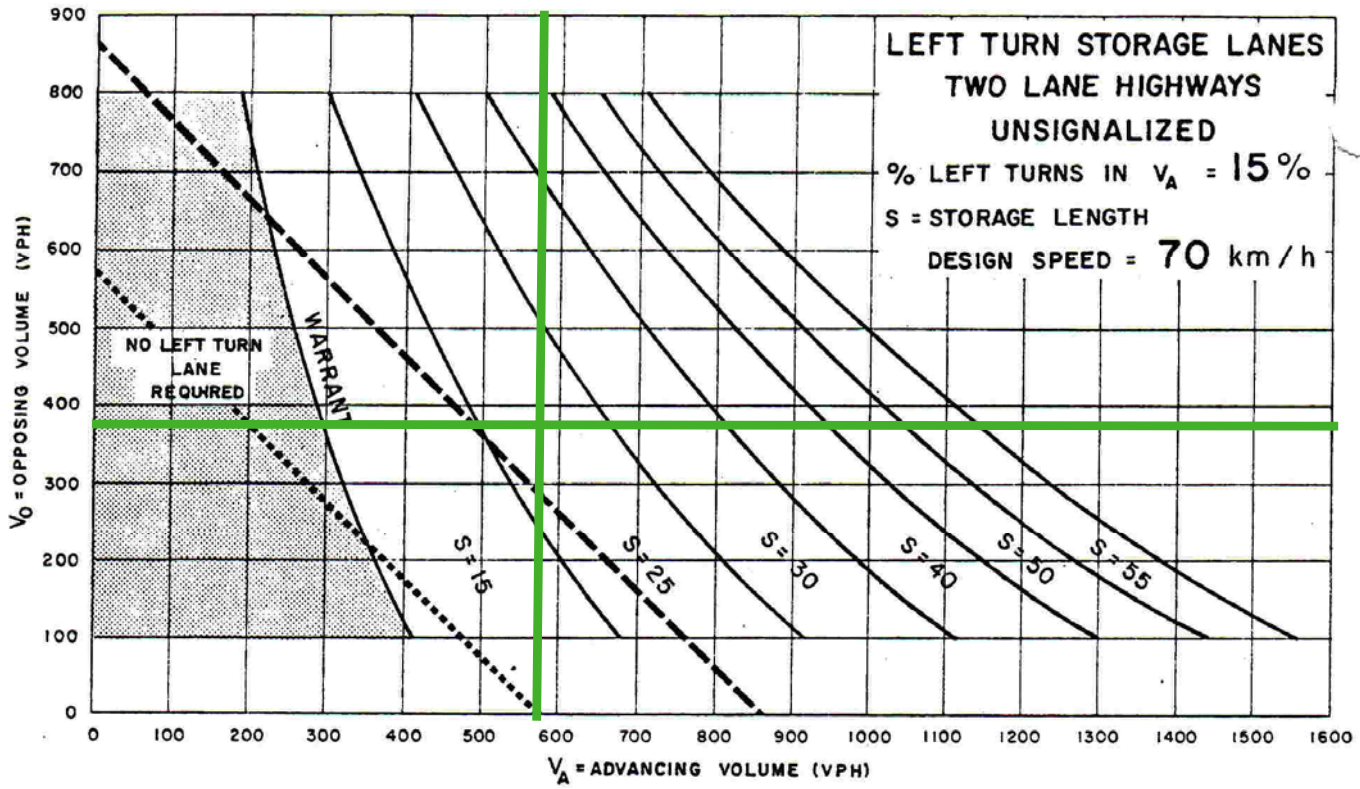
AM Peak Hour *PM Peak Hour*





AM Peak Hour *PM Peak Hour*





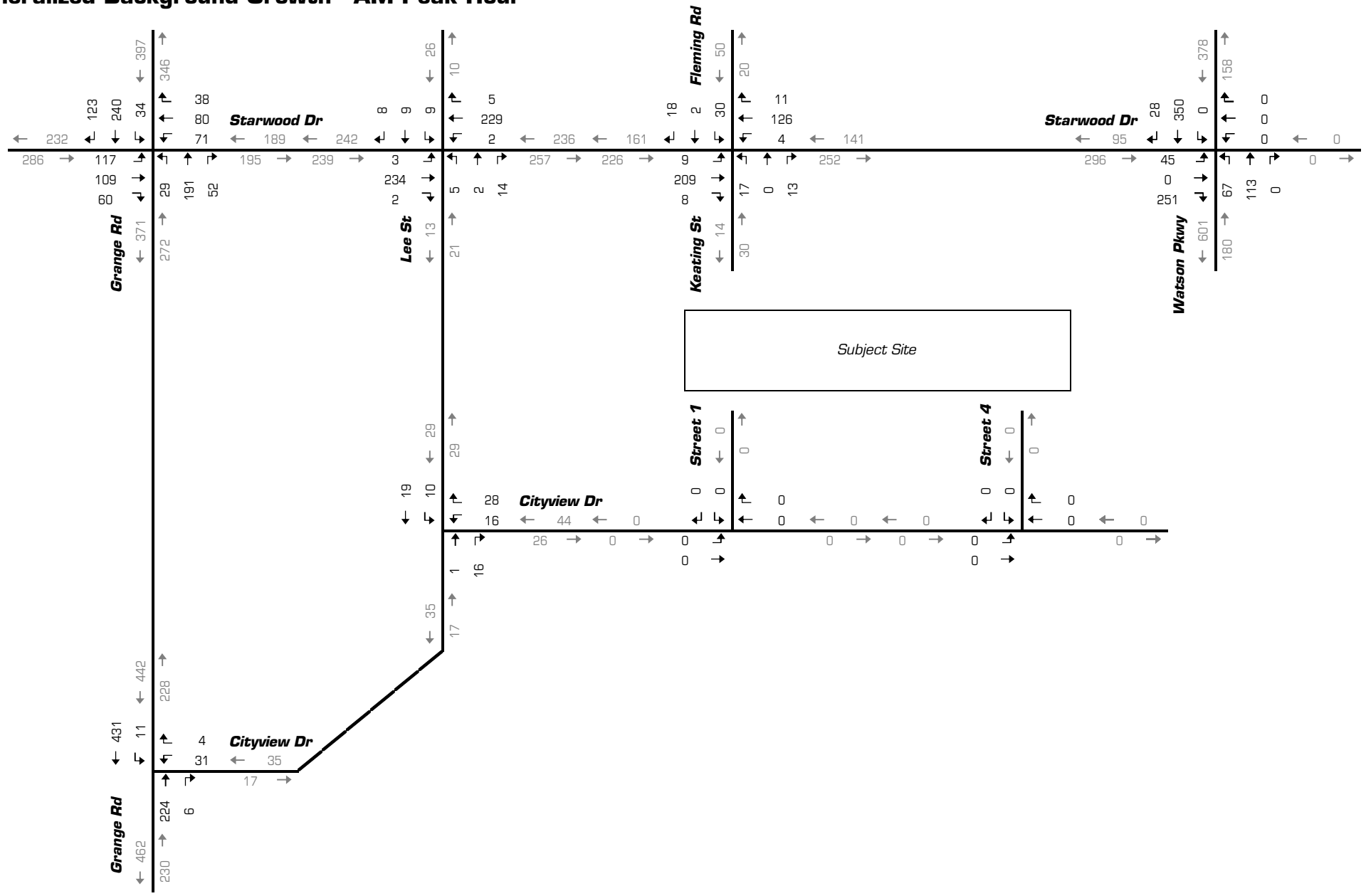
AM Peak Hour ***PM Peak Hour***

Intersection: **Starwood Drive & Keating Street/Fleming Drive**
Horizon Year: **Five-Year Total Traffic**
Movement: **Westbound Left-Turn**

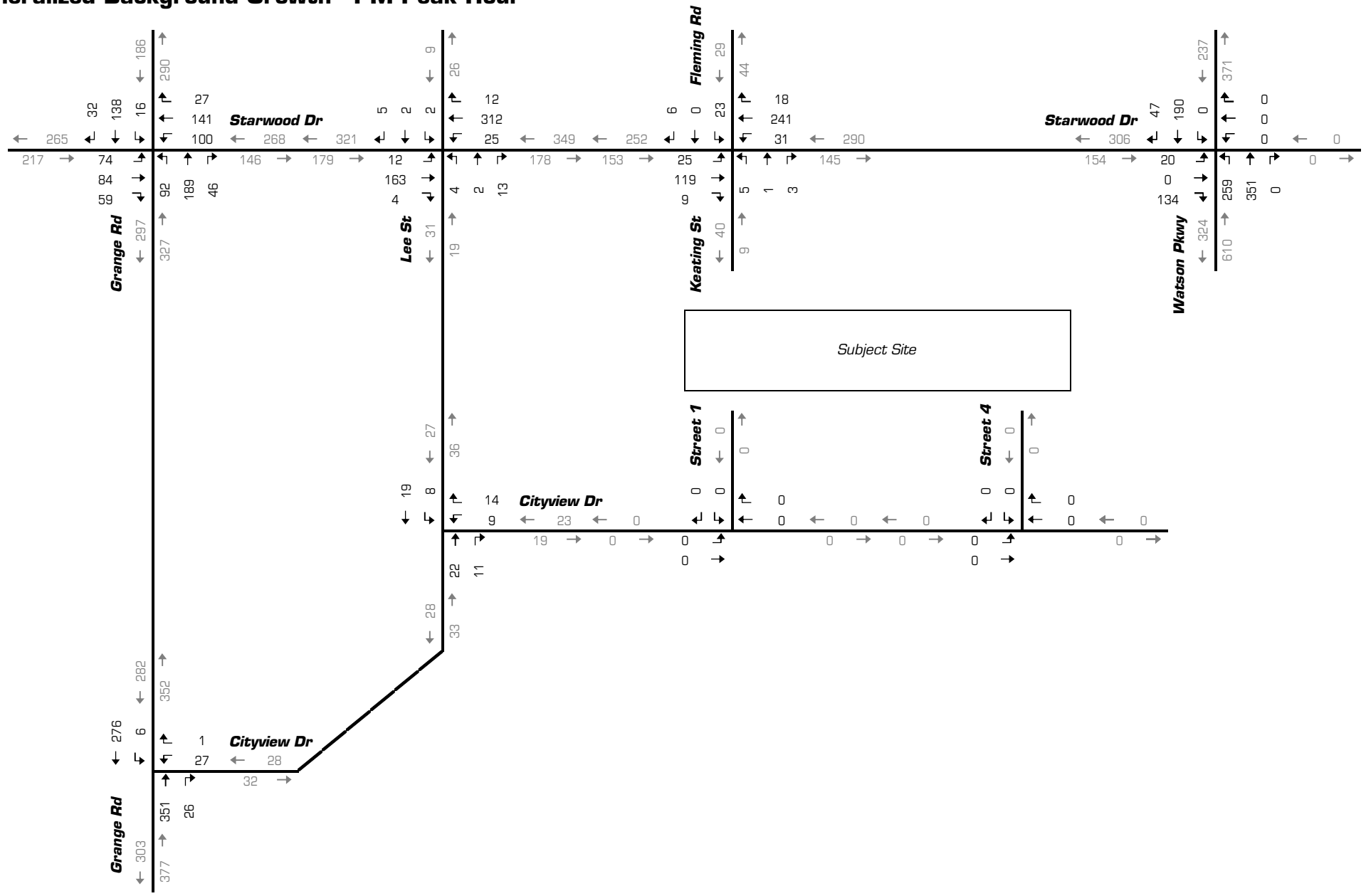
Appendix F

Traffic Forecasts

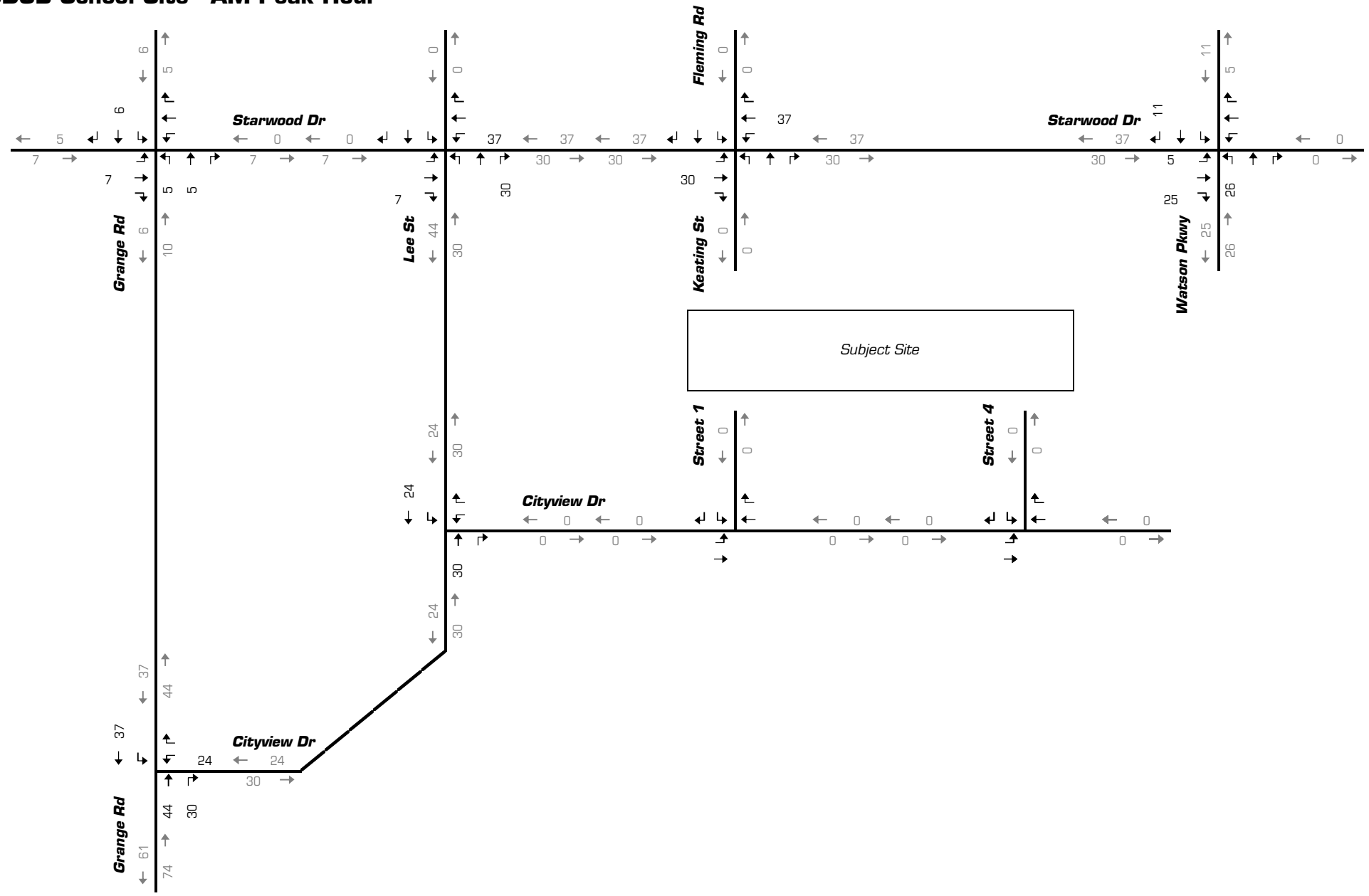
Generalized Background Growth - AM Peak Hour



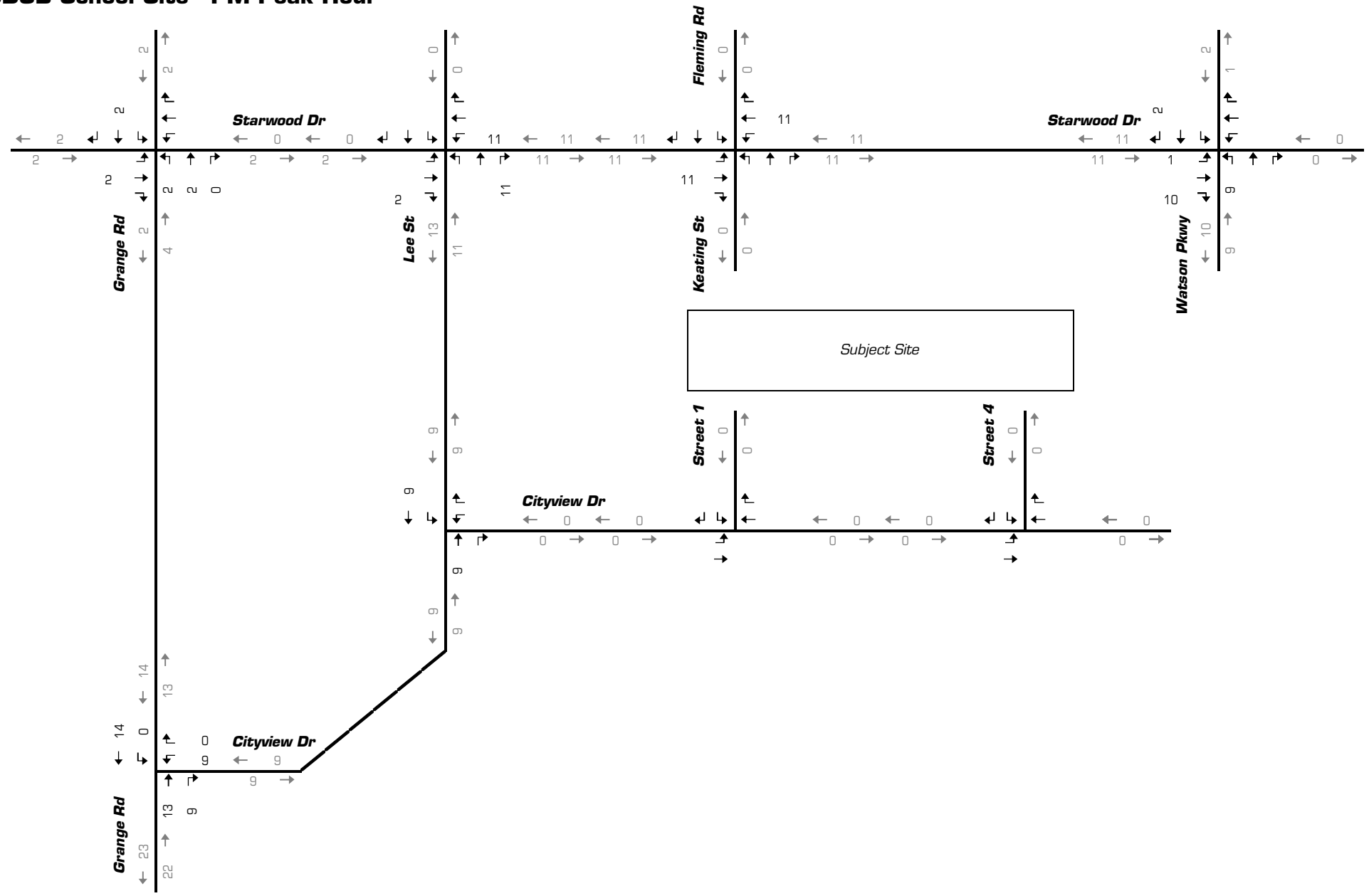
Generalized Background Growth - PM Peak Hour



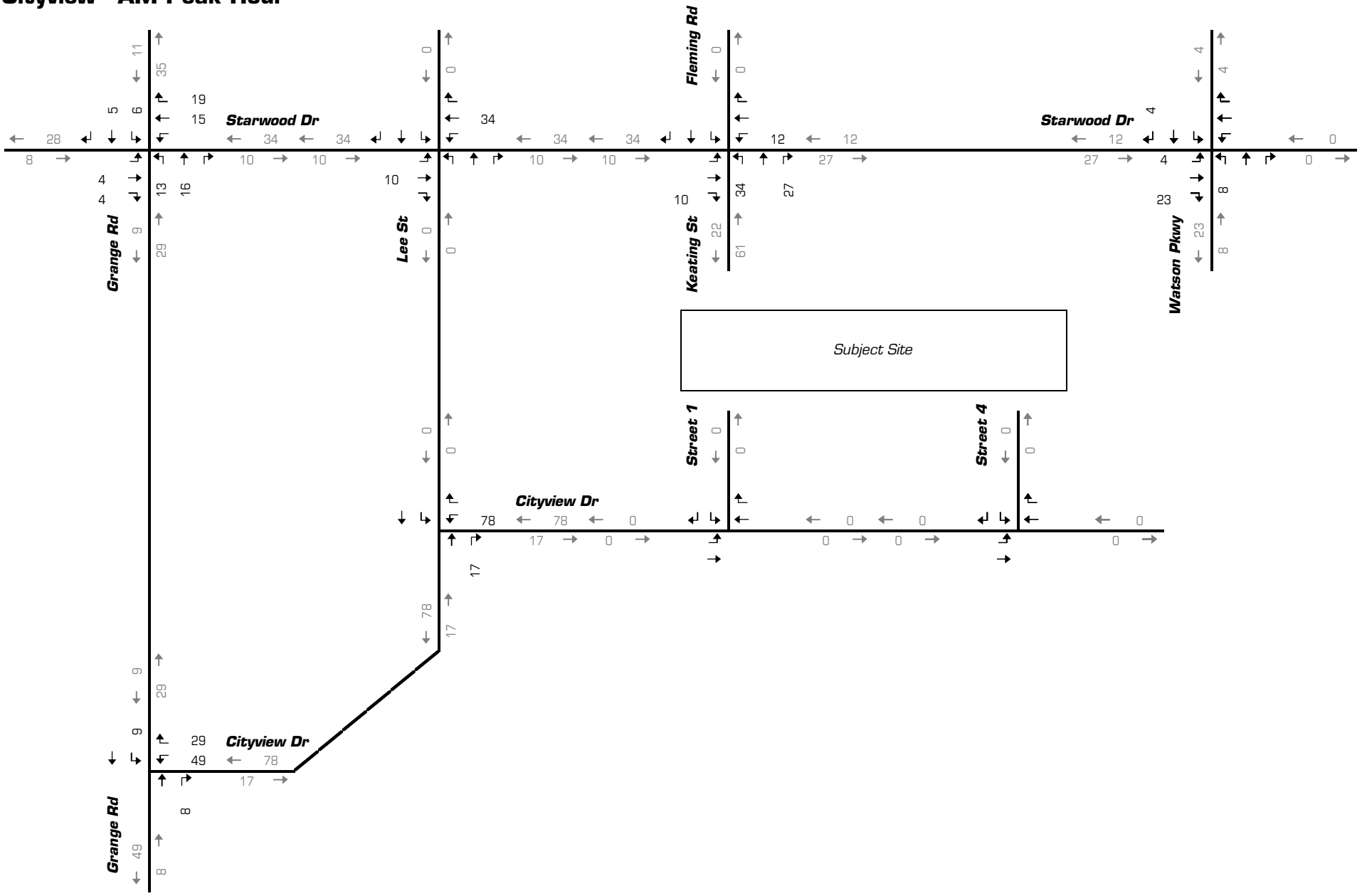
UGDSB School Site - AM Peak Hour



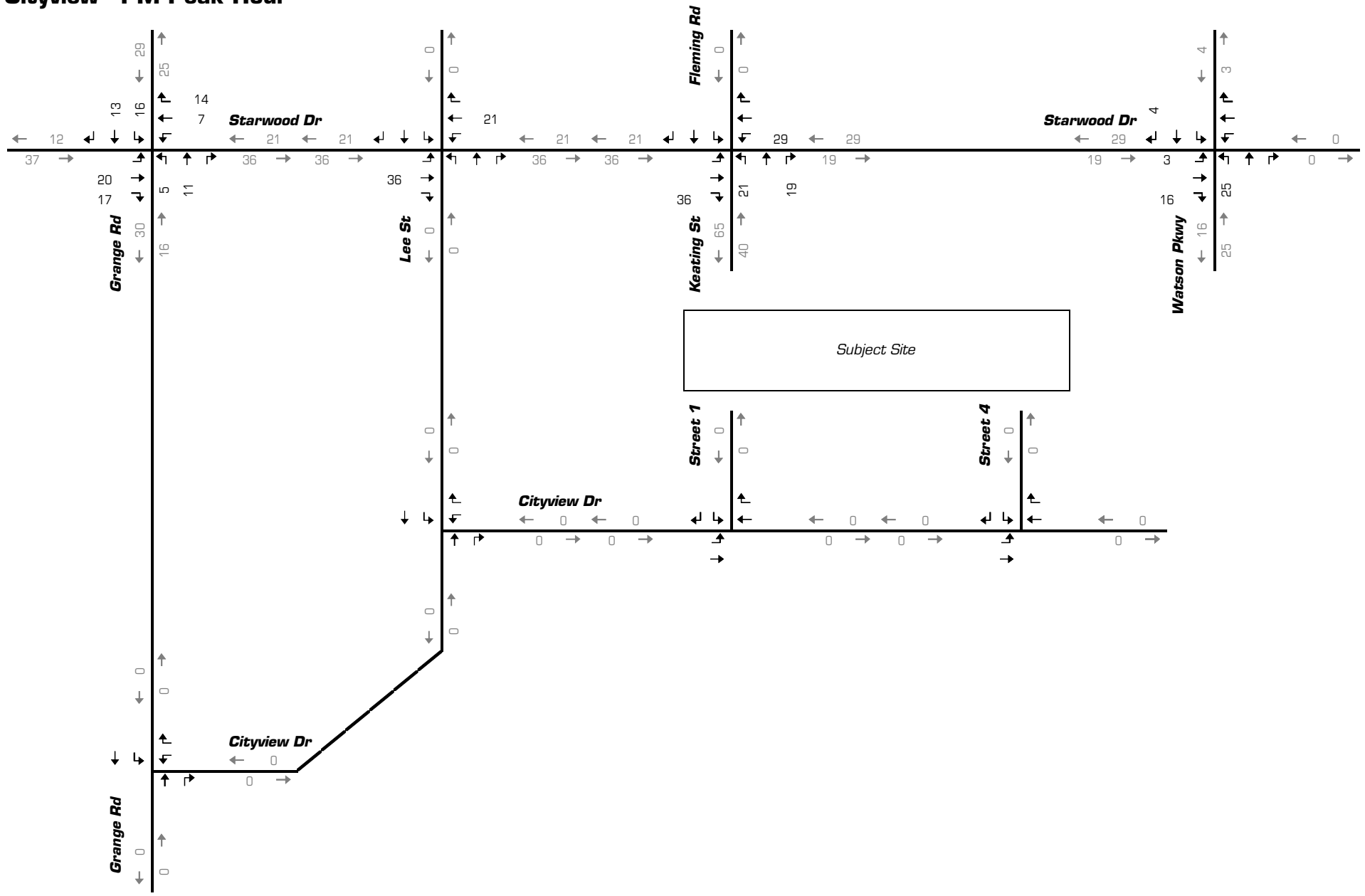
UGDSB School Site - PM Peak Hour



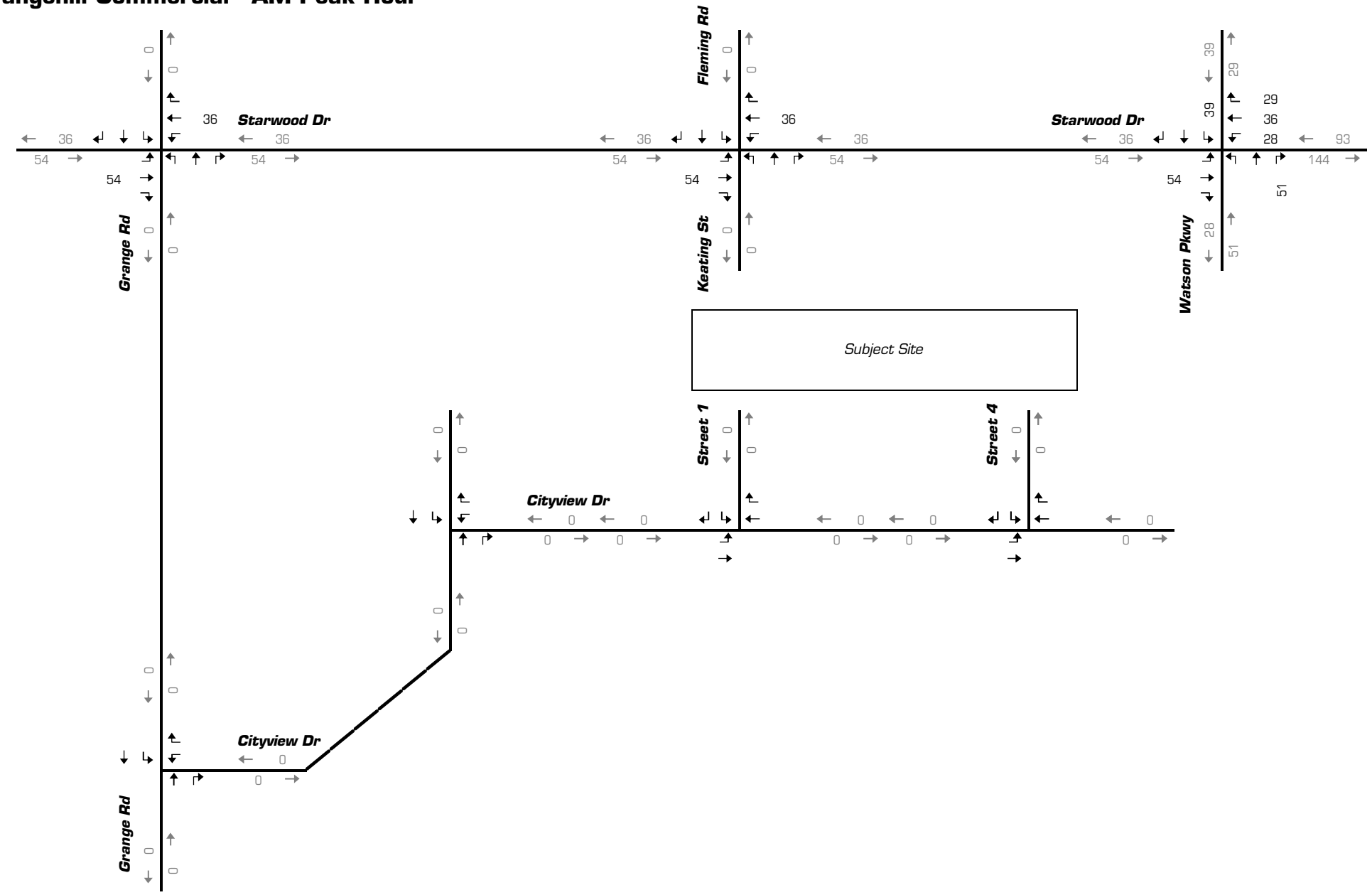
55 Cityview - AM Peak Hour



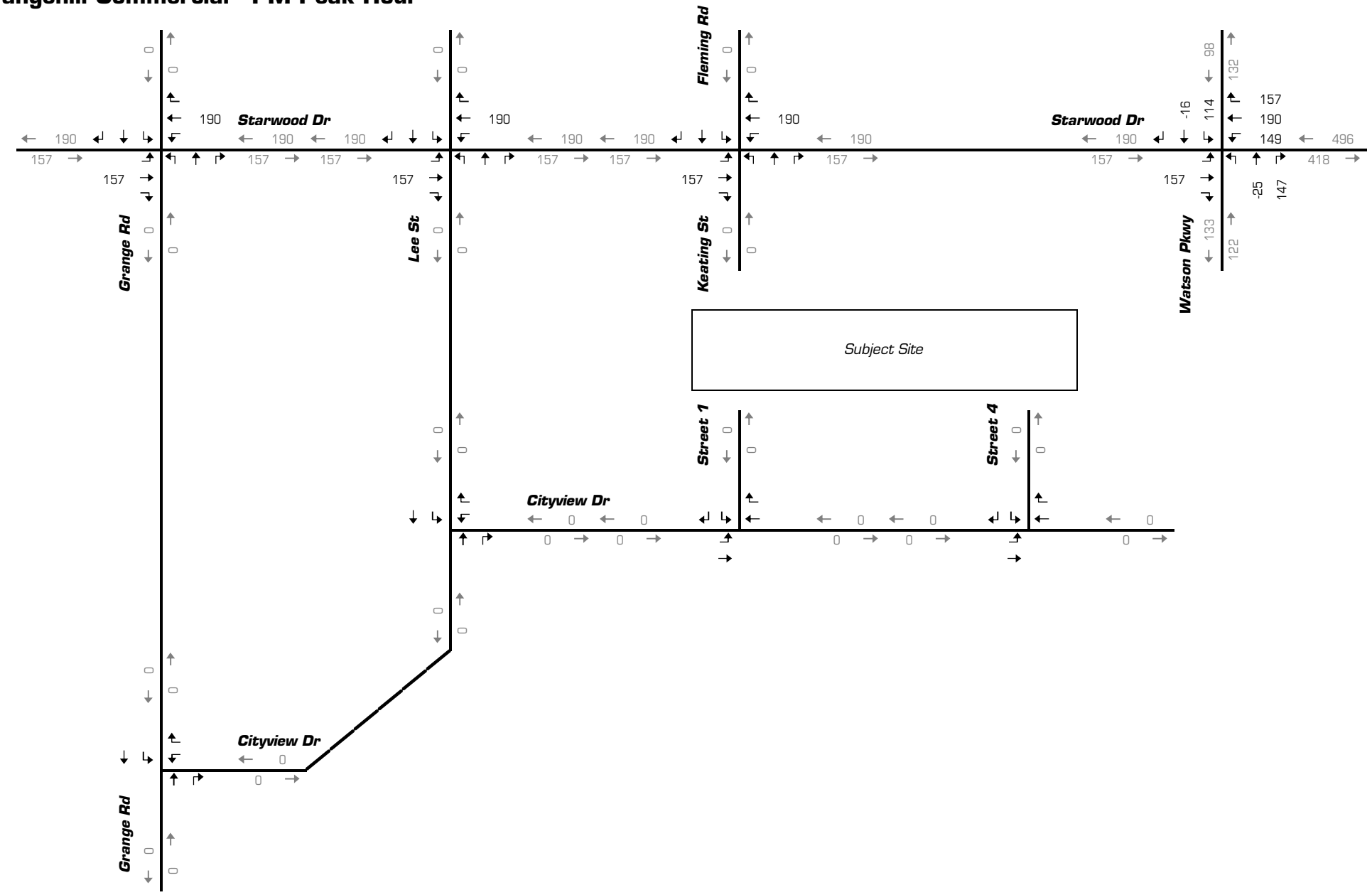
55 Cityview - PM Peak Hour



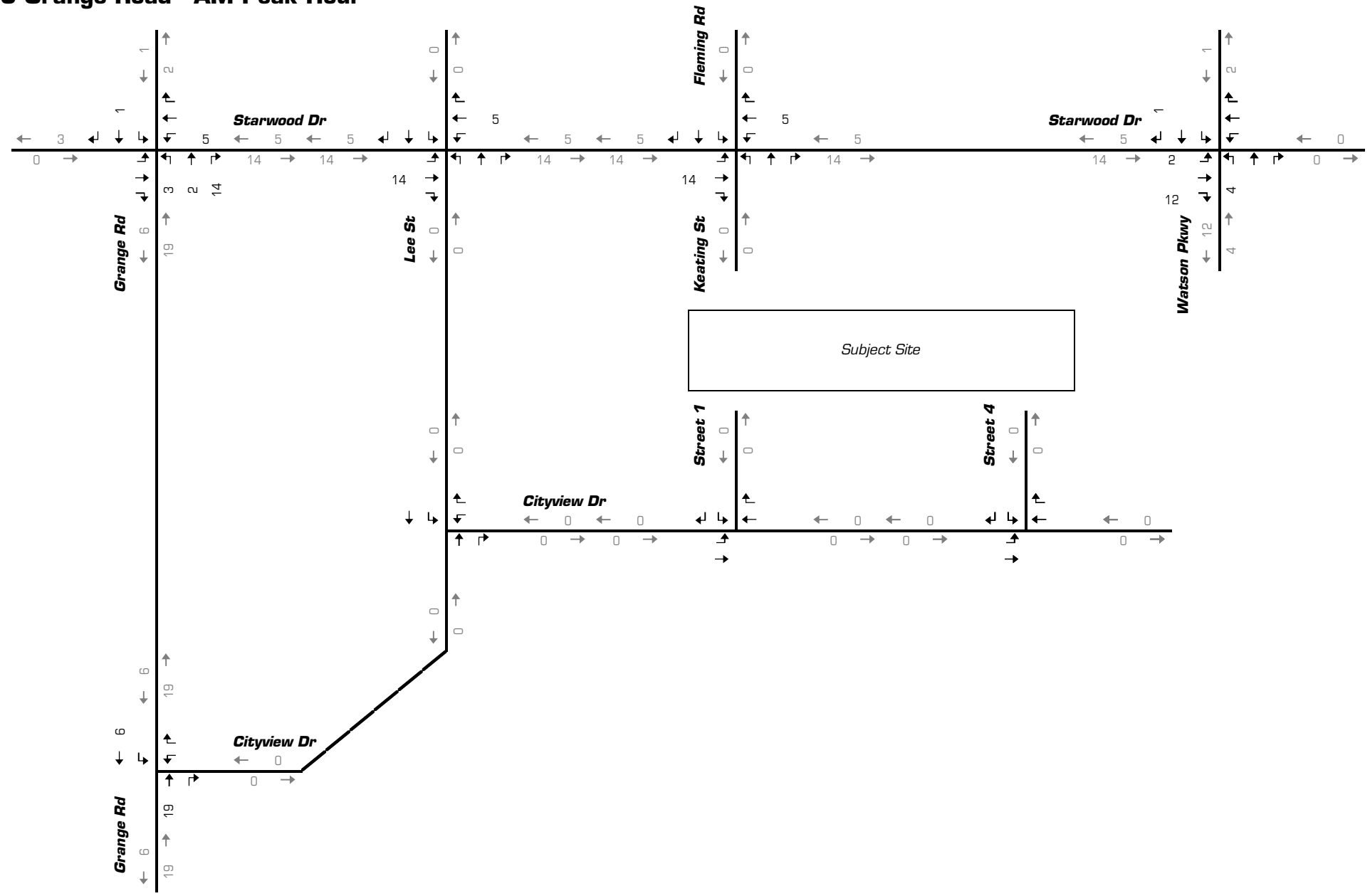
Grangehill Commercial - AM Peak Hour



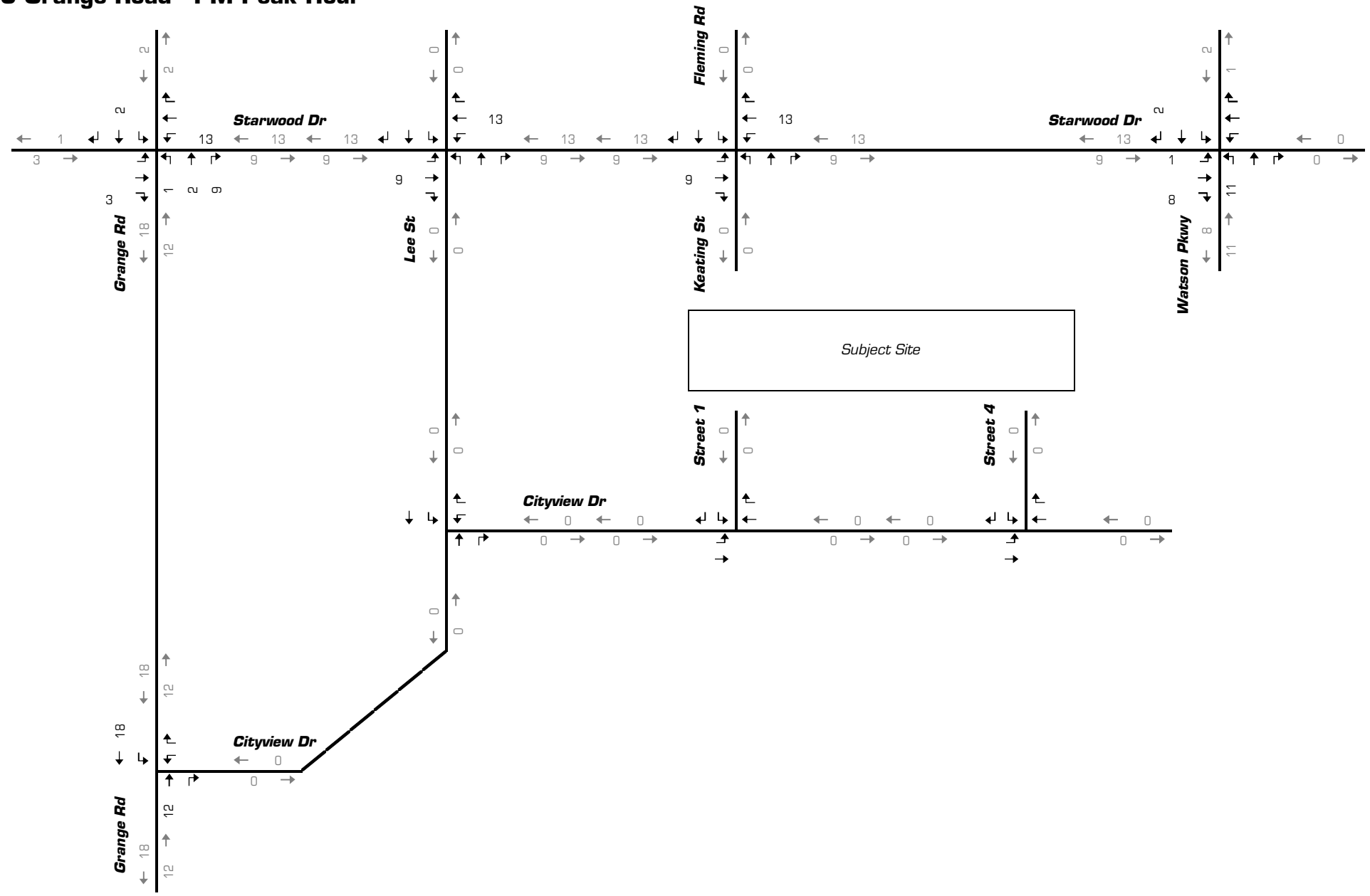
Grangehill Commercial - PM Peak Hour



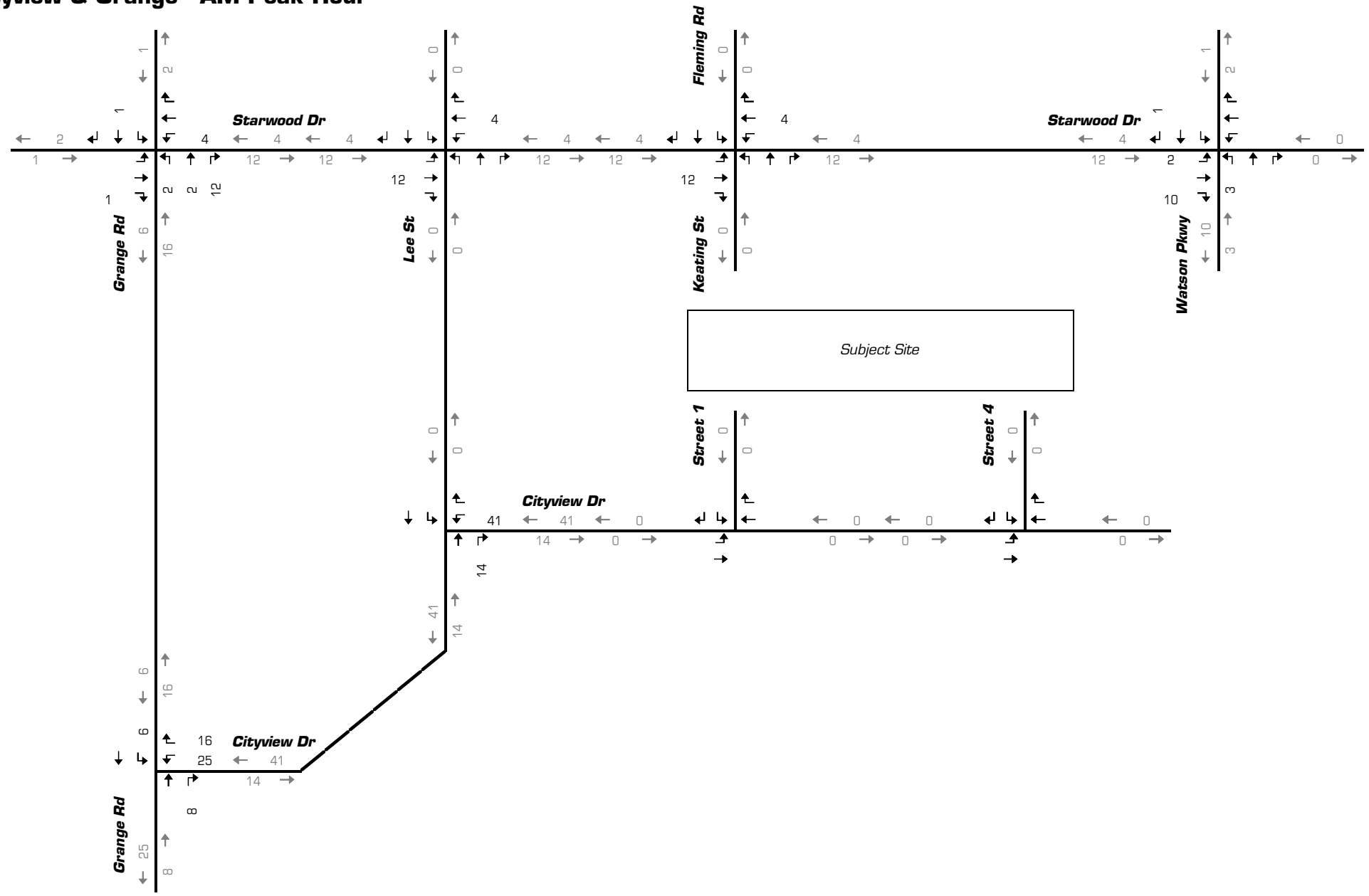
300 Grange Road - AM Peak Hour



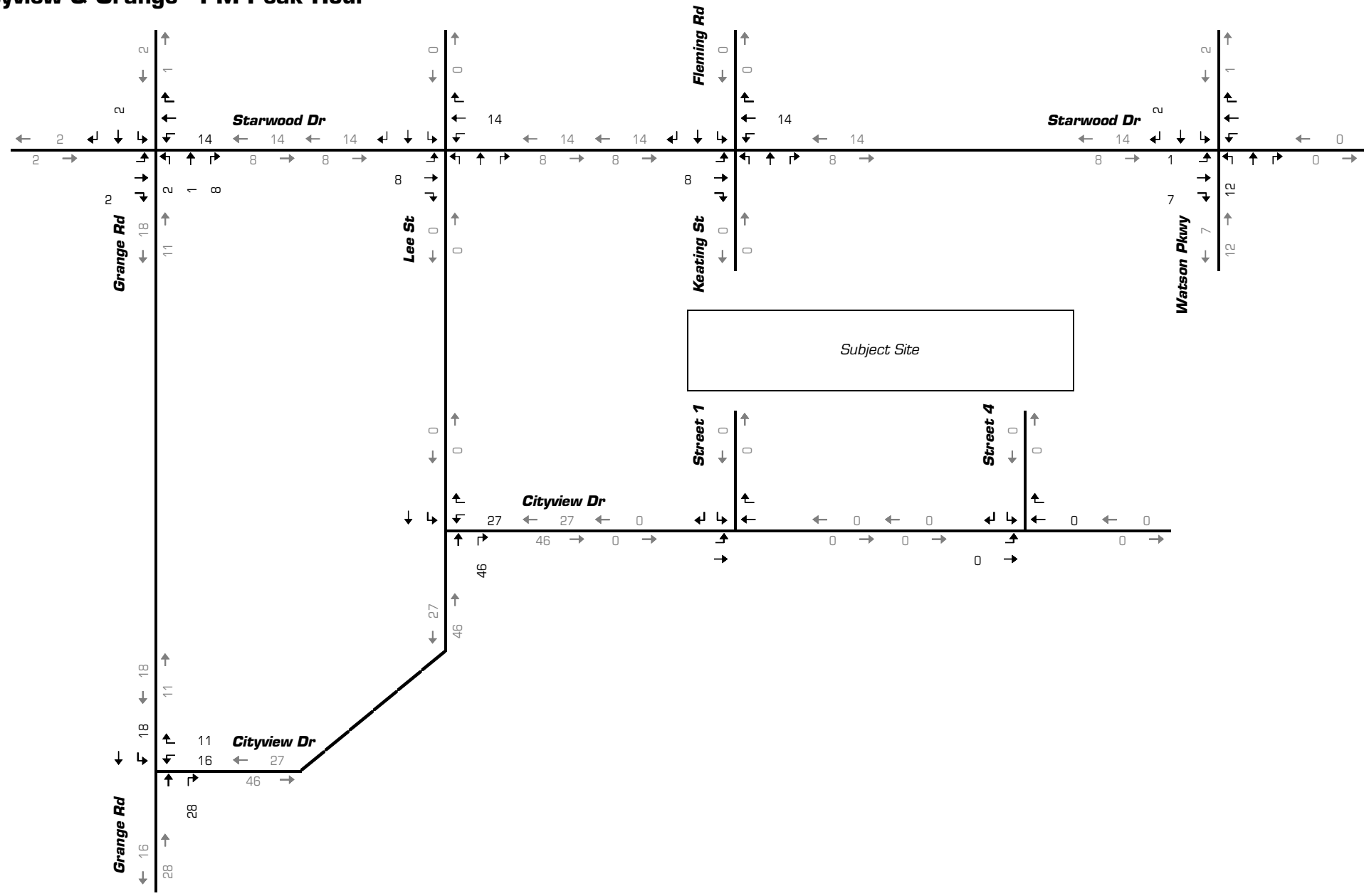
300 Grange Road - PM Peak Hour



Cityview & Grange - AM Peak Hour

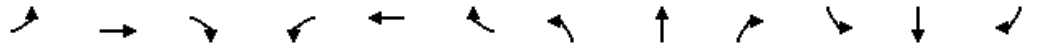


Cityview & Grange - PM Peak Hour



Appendix G

Scenario One – Total Traffic Operations



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	9	357	13	17	228	11	87	0	13	30	2	18
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	10	388	14	18	248	12	95	0	14	33	2	20
Pedestrians		7						8			5	
Lane Width (m)		3.6						3.6			3.6	
Walking Speed (m/s)		1.2						1.2			1.2	
Percent Blockage		1						1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		377										
pX, platoon unblocked												
vC, conflicting volume	265			410			741	724	403	725	726	266
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	265			410			741	724	403	725	726	266
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.3
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	99			98			70	100	98	90	99	97
cM capacity (veh/h)	1305			1152			312	342	647	326	342	744

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	412	278	109	54
Volume Left	10	18	95	33
Volume Right	14	12	14	20
cSH	1305	1152	334	409
Volume to Capacity	0.01	0.02	0.32	0.13
Queue Length 95th (m)	0.2	0.4	11.0	3.6
Control Delay (s)	0.3	0.7	20.9	15.1
Lane LOS	A	A	C	C
Approach Delay (s)	0.3	0.7	20.9	15.1
Approach LOS			C	C

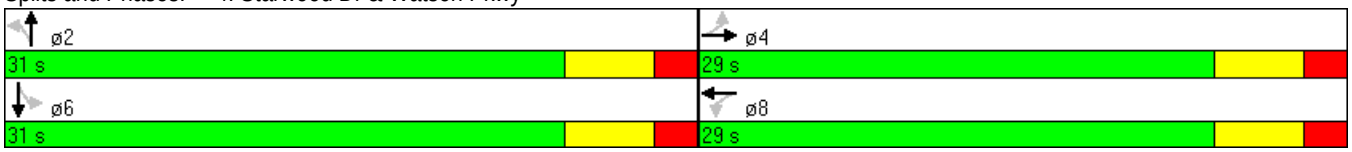
Intersection Summary				
Average Delay	4.0			
Intersection Capacity Utilization	36.6%	ICU Level of Service	A	
Analysis Period (min)	15			

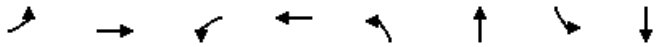
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	61	54	28	36	113	113	39	350
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Total Split (s)	29.0	29.0	29.0	29.0	31.0	31.0	31.0	31.0
Total Split (%)	48.3%	48.3%	48.3%	48.3%	51.7%	51.7%	51.7%	51.7%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	12.6	12.6	12.6	12.6	39.4	39.4	39.4	39.4
Actuated g/C Ratio	0.21	0.21	0.21	0.21	0.66	0.66	0.66	0.66
v/c Ratio	0.23	0.70	0.24	0.18	0.22	0.09	0.05	0.20
Control Delay	19.4	10.5	21.6	11.5	7.1	3.8	5.7	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.4	10.5	21.6	11.5	7.1	3.8	5.7	5.0
LOS	B	B	C	B	A	A	A	A
Approach Delay		11.6		14.5		5.2		5.0
Approach LOS		B		B		A		A

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 50
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.70
Intersection Signal Delay: 8.2 Intersection LOS: A
Intersection Capacity Utilization 52.0% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 4: Starwood Dr & Watson Pkwy





Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	66	442	30	71	123	178	42	430
v/c Ratio	0.23	0.70	0.24	0.18	0.22	0.09	0.05	0.20
Control Delay	19.4	10.5	21.6	11.5	7.1	3.8	5.7	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.4	10.5	21.6	11.5	7.1	3.8	5.7	5.0
Queue Length 50th (m)	6.7	7.6	3.0	3.8	4.1	1.9	1.3	6.8
Queue Length 95th (m)	12.7	24.9	7.8	10.1	17.0	7.5	6.4	19.4
Internal Link Dist (m)		195.1		51.2		97.2		81.9
Turn Bay Length (m)	30.0		30.0		30.0		30.0	
Base Capacity (vph)	563	896	251	757	554	2041	798	2168
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.12	0.49	0.12	0.09	0.22	0.09	0.05	0.20

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	61	54	352	28	36	29	113	113	51	39	350	46
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.87		1.00	0.93		1.00	0.95		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1803	1639		1805	1772		1597	3081		1805	3286	
Flt Permitted	0.71	1.00		0.32	1.00		0.50	1.00		0.64	1.00	
Satd. Flow (perm)	1349	1639		603	1772		843	3081		1215	3286	
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)	66	59	383	30	39	32	123	123	55	42	380	50
RTOR Reduction (vph)	0	289	0	0	25	0	0	19	0	0	11	0
Lane Group Flow (vph)	66	153	0	30	46	0	123	159	0	42	419	0
Confl. Peds. (#/hr)	1											
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	13%	17%	0%	0%	7%	15%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	10.6	10.6		10.6	10.6		37.4	37.4		37.4	37.4	
Effective Green, g (s)	12.6	12.6		12.6	12.6		39.4	39.4		39.4	39.4	
Actuated g/C Ratio	0.21	0.21		0.21	0.21		0.66	0.66		0.66	0.66	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	283	344		127	372		554	2023		798	2158	
v/s Ratio Prot		c0.09			0.03			0.05			0.13	
v/s Ratio Perm	0.05			0.05			c0.15			0.03		
v/c Ratio	0.23	0.44		0.24	0.12		0.22	0.08		0.05	0.19	
Uniform Delay, d1	19.7	20.6		19.7	19.2		4.1	3.7		3.7	4.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.4	0.9		1.0	0.1		0.9	0.1		0.1	0.2	
Delay (s)	20.1	21.6		20.7	19.4		5.1	3.8		3.8	4.3	
Level of Service	C	C		C	B		A	A		A	A	
Approach Delay (s)		21.4			19.8			4.3			4.2	
Approach LOS		C			B			A			A	

Intersection Summary			
HCM Average Control Delay	11.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.28		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	52.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	375	25	0	210	0	47
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	408	27	0	228	0	51
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)				219		
pX, platoon unblocked						
vC, conflicting volume			435		649	421
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			435		649	421
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	92
cM capacity (veh/h)			1136		437	637

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	435	228	51
Volume Left	0	0	0
Volume Right	27	0	51
cSH	1700	1700	637
Volume to Capacity	0.26	0.13	0.08
Queue Length 95th (m)	0.0	0.0	2.1
Control Delay (s)	0.0	0.0	11.1
Lane LOS			B
Approach Delay (s)	0.0	0.0	11.1
Approach LOS			B

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	31.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	25	391	27	79	488	18	50	1	3	23	0	6
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	27	420	29	85	525	19	54	1	3	25	0	6
Pedestrians					2			2				
Lane Width (m)					3.6			3.6				
Walking Speed (m/s)					1.2			1.2				
Percent Blockage					0			0				
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		377										
pX, platoon unblocked												
vC, conflicting volume	544			451			1201	1205	439	1199	1210	534
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	544			451			1201	1205	439	1199	1210	534
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.3
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	97			92			64	99	99	83	100	99
cM capacity (veh/h)	1035			1118			148	167	620	149	166	529

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	476	629	58	31
Volume Left	27	85	54	25
Volume Right	29	19	3	6
cSH	1035	1118	155	175
Volume to Capacity	0.03	0.08	0.37	0.18
Queue Length 95th (m)	0.6	2.0	12.7	5.0
Control Delay (s)	0.8	2.0	41.4	29.9
Lane LOS	A	A	E	D
Approach Delay (s)	0.8	2.0	41.4	29.9
Approach LOS			E	D

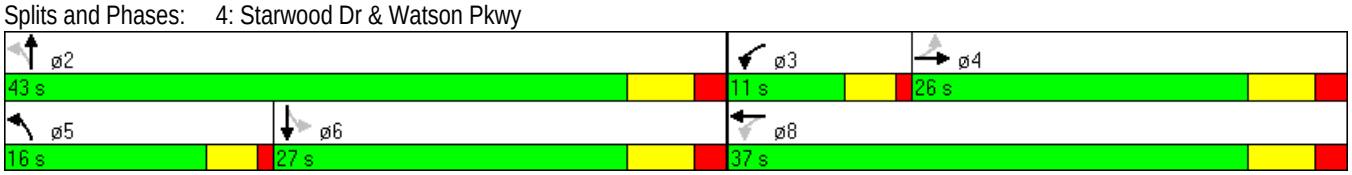
Intersection Summary				
Average Delay	4.1			
Intersection Capacity Utilization	64.6%	ICU Level of Service	C	
Analysis Period (min)	15			

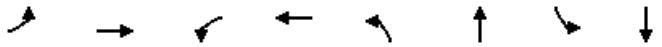
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	27	157	149	190	346	326	114	174
Turn Type	Perm		pm+pt		pm+pt		Perm	
Protected Phases		4	3	8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	3	8	5	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	25.0	25.0	10.0	25.0	10.0	25.0	25.0	25.0
Total Split (s)	26.0	26.0	11.0	37.0	16.0	43.0	27.0	27.0
Total Split (%)	32.5%	32.5%	13.8%	46.3%	20.0%	53.8%	33.8%	33.8%
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	0.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	None	C-Max	C-Max	C-Max
Act Effct Green (s)	19.5	19.5	30.5	30.5	41.5	41.5	25.6	25.6
Actuated g/C Ratio	0.24	0.24	0.38	0.38	0.52	0.52	0.32	0.32
v/c Ratio	0.12	0.78	0.61	0.52	0.60	0.29	0.43	0.23
Control Delay	23.4	34.1	26.8	18.1	17.2	9.0	29.0	16.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.4	34.1	26.8	18.1	17.2	9.0	29.0	16.8
LOS	C	C	C	B	B	A	C	B
Approach Delay		33.3		20.7		12.4		20.8
Approach LOS		C		C		B		C

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 70
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.78
Intersection Signal Delay: 19.7 Intersection LOS: B
Intersection Capacity Utilization 67.4% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 4: Starwood Dr & Watson Pkwy





Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	29	374	160	373	372	509	123	250
v/c Ratio	0.12	0.78	0.61	0.52	0.60	0.29	0.43	0.23
Control Delay	23.4	34.1	26.8	18.1	17.2	9.0	29.0	16.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.4	34.1	26.8	18.1	17.2	9.0	29.0	16.8
Queue Length 50th (m)	3.5	43.2	16.2	35.2	36.0	17.4	16.2	12.2
Queue Length 95th (m)	9.9	73.8	29.0	59.1	57.9	27.5	33.4	21.4
Internal Link Dist (m)		195.1		51.2		97.2		81.9
Turn Bay Length (m)	30.0		30.0		30.0		30.0	
Base Capacity (vph)	282	532	262	768	628	1773	283	1091
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.70	0.61	0.49	0.59	0.29	0.43	0.23

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	157	191	149	190	157	346	326	147	114	174	59
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.92		1.00	0.93		1.00	0.95		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1804	1734		1805	1771		1805	3305		1805	3284	
Flt Permitted	0.54	1.00		0.19	1.00		0.50	1.00		0.46	1.00	
Satd. Flow (perm)	1025	1734		353	1771		959	3305		883	3284	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	29	169	205	160	204	169	372	351	158	123	187	63
RTOR Reduction (vph)	0	57	0	0	39	0	0	61	0	0	39	0
Lane Group Flow (vph)	29	317	0	160	334	0	372	448	0	123	211	0
Confl. Peds. (#/hr)	1											
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	0%	6%	0%	0%	5%	8%
Turn Type	Perm			pm+pt			pm+pt			Perm		
Protected Phases		4		3	8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	17.5	17.5		28.5	28.5		39.5	39.5		23.7	23.7	
Effective Green, g (s)	19.5	19.5		28.5	30.5		39.5	41.5		25.7	25.7	
Actuated g/C Ratio	0.24	0.24		0.36	0.38		0.49	0.52		0.32	0.32	
Clearance Time (s)	6.0	6.0		4.0	6.0		4.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	250	423		253	675		598	1714		284	1055	
v/s Ratio Prot		c0.18		c0.06	0.19		c0.09	0.14			0.06	
v/s Ratio Perm	0.03			0.17			c0.22			0.14		
v/c Ratio	0.12	0.75		0.63	0.49		0.62	0.26		0.43	0.20	
Uniform Delay, d1	23.5	28.0		20.0	18.9		13.1	10.7		21.4	19.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	7.3		5.1	0.6		2.0	0.4		4.8	0.4	
Delay (s)	23.7	35.3		25.1	19.4		15.1	11.1		26.2	20.1	
Level of Service	C	D		C	B		B	B		C	C	
Approach Delay (s)		34.5			21.1			12.8			22.1	
Approach LOS		C			C			B			C	

Intersection Summary			
HCM Average Control Delay	20.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	67.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	354	63	0	601	0	28
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	381	68	0	646	0	30
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)				219		
pX, platoon unblocked					0.89	
vC, conflicting volume			448		1061	415
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			448		1005	415
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	95
cM capacity (veh/h)			1123		240	642

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	448	646	30
Volume Left	0	0	0
Volume Right	68	0	30
cSH	1700	1700	642
Volume to Capacity	0.26	0.38	0.05
Queue Length 95th (m)	0.0	0.0	1.2
Control Delay (s)	0.0	0.0	10.9
Lane LOS			B
Approach Delay (s)	0.0	0.0	10.9
Approach LOS			B

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	35.0%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix H

Scenario Two – Total Traffic Operations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	9	357	13	16	281	11	34	0	13	30	2	18
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	10	388	14	17	305	12	37	0	14	33	2	20
Pedestrians		7						8			5	
Lane Width (m)		3.6						3.6			3.6	
Walking Speed (m/s)		1.2						1.2			1.2	
Percent Blockage		1						1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		377										
pX, platoon unblocked												
vC, conflicting volume	322			410			797	780	403	780	781	323
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	322			410			797	780	403	780	781	323
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.3
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	99			98			87	100	98	89	99	97
cM capacity (veh/h)	1244			1152			286	318	647	299	318	690

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	412	335	51	54
Volume Left	10	17	37	33
Volume Right	14	12	14	20
cSH	1244	1152	338	377
Volume to Capacity	0.01	0.02	0.15	0.14
Queue Length 95th (m)	0.2	0.4	4.2	4.0
Control Delay (s)	0.3	0.6	17.5	16.2
Lane LOS	A	A	C	C
Approach Delay (s)	0.3	0.6	17.5	16.2
Approach LOS			C	C

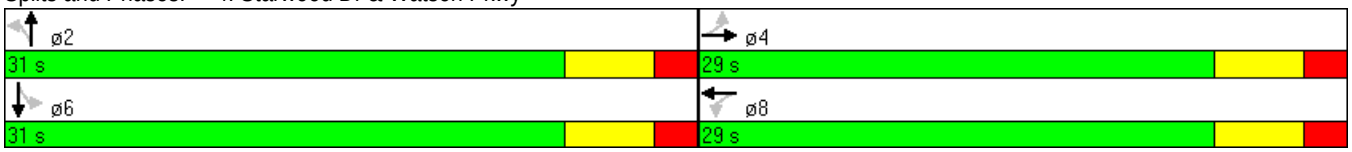
Intersection Summary				
Average Delay	2.4			
Intersection Capacity Utilization	35.4%	ICU Level of Service	A	
Analysis Period (min)	15			

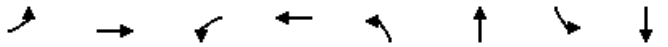
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	61	54	28	36	125	113	39	350
Turn Type	Perm		Perm		Perm		Perm	
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Total Split (s)	29.0	29.0	29.0	29.0	31.0	31.0	31.0	31.0
Total Split (%)	48.3%	48.3%	48.3%	48.3%	51.7%	51.7%	51.7%	51.7%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	12.6	12.6	12.6	12.6	39.4	39.4	39.4	39.4
Actuated g/C Ratio	0.21	0.21	0.21	0.21	0.66	0.66	0.66	0.66
v/c Ratio	0.23	0.70	0.24	0.18	0.25	0.09	0.05	0.20
Control Delay	19.4	10.5	21.6	11.5	7.4	3.8	5.7	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.4	10.5	21.6	11.5	7.4	3.8	5.7	5.0
LOS	B	B	C	B	A	A	A	A
Approach Delay		11.6		14.5		5.4		5.0
Approach LOS		B		B		A		A

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 50
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.70
Intersection Signal Delay: 8.2 Intersection LOS: A
Intersection Capacity Utilization 52.6% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 4: Starwood Dr & Watson Pkwy





Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	66	442	30	71	136	178	42	430
v/c Ratio	0.23	0.70	0.24	0.18	0.25	0.09	0.05	0.20
Control Delay	19.4	10.5	21.6	11.5	7.4	3.8	5.7	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.4	10.5	21.6	11.5	7.4	3.8	5.7	5.0
Queue Length 50th (m)	6.7	7.6	3.0	3.8	4.7	1.9	1.3	6.8
Queue Length 95th (m)	12.7	24.9	7.8	10.1	18.9	7.5	6.4	19.4
Internal Link Dist (m)		236.3		51.2		97.2		81.9
Turn Bay Length (m)	30.0		30.0		30.0		30.0	
Base Capacity (vph)	563	896	251	757	554	2041	798	2168
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.12	0.49	0.12	0.09	0.25	0.09	0.05	0.20

Intersection Summary

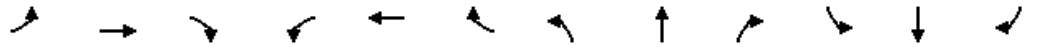
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	61	54	352	28	36	29	125	113	51	39	350	46
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.87		1.00	0.93		1.00	0.95		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1803	1639		1805	1772		1597	3081		1805	3286	
Flt Permitted	0.71	1.00		0.32	1.00		0.50	1.00		0.64	1.00	
Satd. Flow (perm)	1349	1639		603	1772		843	3081		1215	3286	
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)	66	59	383	30	39	32	136	123	55	42	380	50
RTOR Reduction (vph)	0	289	0	0	25	0	0	19	0	0	11	0
Lane Group Flow (vph)	66	153	0	30	46	0	136	159	0	42	419	0
Confl. Peds. (#/hr)	1											
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	13%	17%	0%	0%	7%	15%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	10.6	10.6		10.6	10.6		37.4	37.4		37.4	37.4	
Effective Green, g (s)	12.6	12.6		12.6	12.6		39.4	39.4		39.4	39.4	
Actuated g/C Ratio	0.21	0.21		0.21	0.21		0.66	0.66		0.66	0.66	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	283	344		127	372		554	2023		798	2158	
v/s Ratio Prot		c0.09			0.03			0.05			0.13	
v/s Ratio Perm	0.05			0.05			c0.16			0.03		
v/c Ratio	0.23	0.44		0.24	0.12		0.25	0.08		0.05	0.19	
Uniform Delay, d1	19.7	20.6		19.7	19.2		4.2	3.7		3.7	4.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.4	0.9		1.0	0.1		1.1	0.1		0.1	0.2	
Delay (s)	20.1	21.6		20.7	19.4		5.3	3.8		3.8	4.3	
Level of Service	C	C		C	B		A	A		A	A	
Approach Delay (s)		21.4			19.8			4.4			4.2	
Approach LOS		C			B			A			A	

Intersection Summary			
HCM Average Control Delay	11.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.29		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	52.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	362	28	1	193	0	53	0	47	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	393	30	1	210	0	58	0	51	0	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)					260							
pX, platoon unblocked												
vC, conflicting volume	210			424			621	621	409	672	636	210
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	210			424			621	621	409	672	636	210
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			86	100	92	100	100	100
cM capacity (veh/h)	1373			1146			403	406	647	343	398	836

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	424	211	109	0
Volume Left	0	1	58	0
Volume Right	30	0	51	0
cSH	1373	1146	489	1700
Volume to Capacity	0.00	0.00	0.22	0.00
Queue Length 95th (m)	0.0	0.0	6.7	0.0
Control Delay (s)	0.0	0.1	14.4	0.0
Lane LOS		A	B	A
Approach Delay (s)	0.0	0.1	14.4	0.0
Approach LOS			B	A

Intersection Summary				
Average Delay	2.1			
Intersection Capacity Utilization	33.2%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	25	391	27	60	522	18	16	1	3	23	0	6
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	27	420	29	65	561	19	17	1	3	25	0	6
Pedestrians					2			2				
Lane Width (m)					3.6			3.6				
Walking Speed (m/s)					1.2			1.2				
Percent Blockage					0			0				
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		377										
pX, platoon unblocked												
vC, conflicting volume	581			451			1197	1200	439	1194	1205	571
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	581			451			1197	1200	439	1194	1205	571
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.3
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	97			94			89	99	99	84	100	99
cM capacity (veh/h)	1003			1118			151	171	620	152	170	504

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	476	645	22	31
Volume Left	27	65	17	25
Volume Right	29	19	3	6
cSH	1003	1118	172	178
Volume to Capacity	0.03	0.06	0.13	0.18
Queue Length 95th (m)	0.7	1.5	3.4	4.9
Control Delay (s)	0.8	1.5	28.9	29.4
Lane LOS	A	A	D	D
Approach Delay (s)	0.8	1.5	28.9	29.4
Approach LOS			D	D

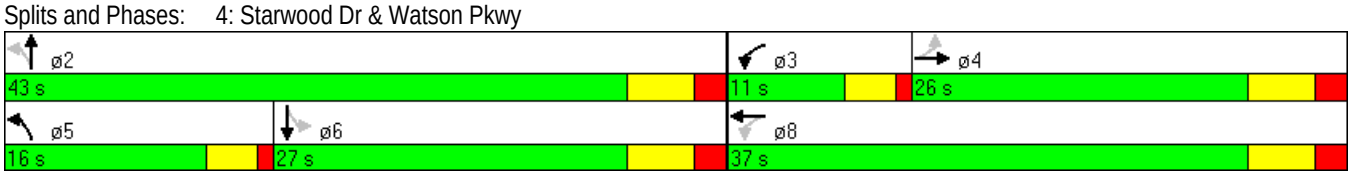
Intersection Summary				
Average Delay	2.5			
Intersection Capacity Utilization	59.1%	ICU Level of Service	B	
Analysis Period (min)	15			

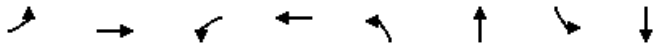
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	27	157	149	190	354	326	114	174
Turn Type	Perm		pm+pt		pm+pt		Perm	
Protected Phases		4	3	8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	3	8	5	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	25.0	25.0	10.0	25.0	10.0	25.0	25.0	25.0
Total Split (s)	26.0	26.0	11.0	37.0	16.0	43.0	27.0	27.0
Total Split (%)	32.5%	32.5%	13.8%	46.3%	20.0%	53.8%	33.8%	33.8%
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	0.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	None	C-Max	C-Max	C-Max
Act Effct Green (s)	19.5	19.5	30.5	30.5	41.5	41.5	25.5	25.5
Actuated g/C Ratio	0.24	0.24	0.38	0.38	0.52	0.52	0.32	0.32
v/c Ratio	0.12	0.78	0.61	0.52	0.61	0.29	0.44	0.23
Control Delay	23.4	34.1	26.8	18.1	17.7	9.0	29.1	16.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.4	34.1	26.8	18.1	17.7	9.0	29.1	16.6
LOS	C	C	C	B	B	A	C	B
Approach Delay		33.3		20.7		12.7		20.7
Approach LOS		C		C		B		C

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 70
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.78
Intersection Signal Delay: 19.8 — Intersection LOS: B
Intersection Capacity Utilization 67.9% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 4: Starwood Dr & Watson Pkwy





Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	29	374	160	373	381	509	123	253
v/c Ratio	0.12	0.78	0.61	0.52	0.61	0.29	0.44	0.23
Control Delay	23.4	34.1	26.8	18.1	17.7	9.0	29.1	16.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.4	34.1	26.8	18.1	17.7	9.0	29.1	16.6
Queue Length 50th (m)	3.5	43.2	16.2	35.2	37.1	17.4	16.2	12.1
Queue Length 95th (m)	9.9	73.8	29.0	59.1	59.4	27.5	33.4	21.4
Internal Link Dist (m)		236.3		51.2		97.2		81.9
Turn Bay Length (m)	30.0		30.0		30.0		30.0	
Base Capacity (vph)	282	532	262	768	625	1773	282	1089
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.70	0.61	0.49	0.61	0.29	0.44	0.23

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	157	191	149	190	157	354	326	147	114	174	61
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.92		1.00	0.93		1.00	0.95		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1804	1734		1805	1771		1805	3305		1805	3279	
Flt Permitted	0.54	1.00		0.19	1.00		0.50	1.00		0.46	1.00	
Satd. Flow (perm)	1025	1734		353	1771		953	3305		883	3279	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	29	169	205	160	204	169	381	351	158	123	187	66
RTOR Reduction (vph)	0	57	0	0	39	0	0	61	0	0	42	0
Lane Group Flow (vph)	29	317	0	160	334	0	381	448	0	123	211	0
Confl. Peds. (#/hr)	1											
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	0%	6%	0%	0%	5%	8%
Turn Type	Perm			pm+pt			pm+pt			Perm		
Protected Phases		4		3	8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	17.5	17.5		28.5	28.5		39.5	39.5		23.6	23.6	
Effective Green, g (s)	19.5	19.5		28.5	30.5		39.5	41.5		25.6	25.6	
Actuated g/C Ratio	0.24	0.24		0.36	0.38		0.49	0.52		0.32	0.32	
Clearance Time (s)	6.0	6.0		4.0	6.0		4.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	250	423		253	675		597	1714		283	1049	
v/s Ratio Prot		c0.18		c0.06	0.19		c0.09	0.14			0.06	
v/s Ratio Perm	0.03			0.17			c0.22			0.14		
v/c Ratio	0.12	0.75		0.63	0.49		0.64	0.26		0.43	0.20	
Uniform Delay, d1	23.5	28.0		20.0	18.9		13.2	10.7		21.5	19.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	7.3		5.1	0.6		2.2	0.4		4.8	0.4	
Delay (s)	23.7	35.3		25.1	19.4		15.4	11.1		26.3	20.2	
Level of Service	C	D		C	B		B	B		C	C	
Approach Delay (s)		34.5			21.1			12.9			22.2	
Approach LOS		C			C			B			C	

Intersection Summary			
HCM Average Control Delay	20.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	67.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	354	63	19	553	0	34	0	28	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	0	381	68	20	595	0	37	0	30	0	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)					260							
pX, platoon unblocked	0.91						0.91	0.91		0.91	0.91	0.91
vC, conflicting volume	595			448			1050	1050	415	1080	1084	595
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	501			448			1003	1003	415	1036	1041	501
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			98			82	100	95	100	100	100
cM capacity (veh/h)	973			1123			199	217	642	180	206	520

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	448	615	67	0
Volume Left	0	20	37	0
Volume Right	68	0	30	0
cSH	973	1123	289	1700
Volume to Capacity	0.00	0.02	0.23	0.00
Queue Length 95th (m)	0.0	0.4	7.0	0.0
Control Delay (s)	0.0	0.5	21.2	0.0
Lane LOS		A	C	A
Approach Delay (s)	0.0	0.5	21.2	0.0
Approach LOS			C	A

Intersection Summary				
Average Delay	1.5			
Intersection Capacity Utilization	54.7%	ICU Level of Service	A	
Analysis Period (min)	15			