



# **Grand Valley Industrial Development**

## **Transportation Impact Study**

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**Town of Grand Valley**

Prepared for:  
**Thomasfield Homes**

December 2021

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# 1 Introduction

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This Transportation Impact Study (TIS) has been prepared in support of applications for Zoning By-law Amendment and Draft Plan of Subdivision for the lands owned by Thomasfield Homes in the Town of Grand Valley that are intended for employment uses. The site is located in the southeast part of the Town on the west side of Amaranth East Luther Townline (Townline) and north of County Road 109 (CR 109). The study was undertaken as a submission requirement in accordance with pre-submission consultation with Town staff and their consultants, RJ Burnside. The study is based on a Draft Plan of Subdivision prepared by Astrid J. Clos Planning Consultants. The scope of the TIS was discussed and agreed upon with Town staff and their consultants.

The primary purpose of this study is to assess the impact of the proposed draft plan on the transportation network in the area and identify any improvements that are needed to support the proposal. The study is focussed on the proposed site connection to Townline at Street B and also the CR 109/Townline intersection. In addition, one future scenario considers the future road connection to the lands to the west in order to develop the Town's planned collector road network.

It is the finding of this study that the proposal will generate about 306 and 343 trips in the weekday morning and afternoon peak hours, respectively. Improvements are proposed at the CR 109 intersection with Townline. With the recommended improvements, site traffic can be accommodated at the study area intersections.

## 2 Proposal and Site Transportation Context

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The application proposes the development of just over 13 hectares of land in the southeast part of the Town for industrial employment uses. The site is presently used for agricultural purposes. The development concept includes for seven industrial blocks in about 10.5 hectares of the lands with roads to service the blocks. A Site Location Plan and the proposed Draft Plan of Subdivision are attached to this report as figures in Appendix A.

Lands to the north and south of the proposal are identified for potential future development, but presently fall outside of the urban area of the Town. The proposal incorporates future connections to both Townline and to the lands to the south to facilitate that development should it proceed at a later date.

In addition, the Town identified the need for a collector road connection through the subject lands and connecting to the west in their March 2017 Transportation Master Plan. Although the timing and implementation of this connection are not known, a corridor in the Draft Plan has been protected in an alignment that the Town has requested. This study includes a future scenario where that connection is in place, providing the opportunity for traffic from this site to access the Town more directly to the west and for traffic from the Town to access CR 109 more directly through the new road connection.

The development of the Draft Plan creates three new public roads to service the site. Street B is a 26-metre-wide collector road the connects from Townline to the future new road to the west. Street A provides for a future connection to the south and would likely only be built when and if those lands develop. Street C provides access to blocks two (2) through six (6) and is intended to

temporarily terminate at the edge of the site with a temporary turning circle where, in future, it can be extended to Townline.

In consultation with Town staff and their consultants, this study is focused on the operation of the CR 109/Townline intersection along with the proposed new intersection of Street B with Townline. Weekday morning and afternoon peak hours were chosen for study when both site traffic and adjacent road traffic will peak. In addition, the new road connection to the west is included in one future scenario.

CR 109 is a public road under the jurisdiction of Dufferin County; it has two lanes and a rural cross-section in the study area. The posted speed limit is 80 kph in the vicinity of the Townline intersection. There are no auxiliary turn lanes at the CR 109 intersection with Townline.

Townline is a public road under the jurisdiction of the Town of Grand Valley; it has two gravel lanes and a rural cross-section in the study area. The speed limit is posted at 60 kph. The Town has plans to upgrade Townline generally between the subject site and CR 109 in 2022 to a paved surface. This study provides information to assist in determining the most appropriate design of the road at the proposed new intersection with Street B and at the CR 109 intersection.

## 3 Existing Traffic

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### 3.1 Sight Distance Assessment – Townline and Street B Intersection

Sight distances were reviewed at the proposed new intersection of Street B and Townline. Townline has a posted speed limit of 60 kph. A design speed of 70 kph was chosen to assess the available sight distance. The left turn from stop on Street B is the governing sight distance requirement and an intersection sight distance of 150 metres is required in accordance with guidance from the Transportation Association of Canada (Table 9.9.4 of the Geometric Design Guide for Canadian Roads).

Figures illustrating the available sight distance at the new Street B intersection with Townline are attached in Appendix A.

### 3.2 Existing Traffic Volumes

Traffic count data was collected at the CR 109/Townline intersection on Tuesday, October 26, 2021, during the morning and afternoon peak periods. The data was compared to data from Dufferin County for CR 109 both east and west of the intersection in 2017 and 2020. The 2021 data is comparable to or slightly higher than the 2017 data, but a little lower than the 2020 data, which was collected in August. In discussion with the Town's consultant, it was determined that the 2021 data should be factored up by five (5) percent to reflect that travel levels are still slightly depressed due to some people continuing to work from home.

Both the measured traffic data from October 2021 and the adjusted traffic data at the study area intersections in the weekday morning and afternoon peak hours are illustrated in the figures attached in Appendix A.

Traffic capacity analysis was undertaken using Synchro 11 software to assess the intersection operations at the CR 109/Townline intersection in both peak hours. The detailed Synchro worksheets are attached in Appendix B and summarized in the table below.

**Table 1: Existing (Adjusted) Traffic Operations - CR 109/Townline**

Measure of Effectiveness	Approach Lane					
	AM Peak Hour			PM Peak Hour		
	EB	WB	SB	EB	WB	SB
Level of Service	A	-	B	A	-	C
Delay (s)	-	-	13.1	-	-	19.2
Volume/Capacity	-	-	0.06	-	-	0.03
95 <sup>th</sup> Percentile Q (m)	-	-	1.4	-	-	0.7

The assessment indicates that the CR 109/Townline intersection is currently operating at acceptable levels.

The traffic count at CR 109/Townline was undertaken over the course of 10 hours in order to assess if traffic signals are warranted at the intersection and, if not, how close the intersection is to meeting provincial justification criteria. The existing traffic volumes do not meet provincial justification criteria for traffic signals as illustrated in the detailed assessment included in Appendix C. Although justifications 1A and 2A are met at 100% given the high volume of traffic on CR 109, justifications 1B and 2B are met at only 6 and 17 percent, respectively, because of the low volume of traffic on Townline.

## 4 Background Traffic

### 4.1 Background Traffic Forecasts

Two future horizon years were chosen for study. A five-year horizon (2026) was chosen to study the impact of the proposal on the existing road network and a 10-year horizon (2031) was chosen to study the impact of the proposal on the existing road network with the addition of the planned collector road to the west.

Background traffic was estimated by including for both a growth rate that reflects planned development in the Town's Transportation Master Plan and also specific development of the Moco Farms subdivision immediately to the west of the subject site and the Corseed Farms subdivision, both of which were included in a Traffic Impact Study submitted to the Town in July 2015 by JD Northcote Engineering Inc.

The Town's Transportation Master Plan (TMP) includes growth in traffic of about 35 percent over the 2021 to 2031 horizon, which includes background growth along with planned development in the Town. The background growth rate included in the TMP was 2.2 percent per year. The County's AADT data on CR 109 from 2017 and 2020 indicates growth of about 6.5 percent over three years. In discussion with the Town's consultant, who is also the author of the TMP, a 2.5 percent per year growth rate was chosen for CR 109 and a 3 percent per year growth rate was chosen for Townline.

The background growth, Moco Farms and Corseed Farms subdivision traffic and the future background traffic volumes for the 2026 and 2031 scenarios are illustrated in the figures in Appendix A for both weekday peak hours. It was assumed that when the new collector road is put in place between the Moco Farms subdivision and the subject site, that half of the Moco traffic destined to and from the east on CR 109 would use the new road connection.

Traffic capacity analysis was undertaken to assess the intersection operations at the CR 109/Townline intersection in both peak hours under both future background traffic scenarios. The detailed Synchro worksheets are attached in Appendix D for the 2026 horizon year and Appendix E for the 2031 horizon year and summarized in the table below.

**Table 2: Future Background Traffic Operations - CR 109/Townline**

Horizon Year	Measure of Effectiveness	Approach Lane					
		AM Peak Hour			PM Peak Hour		
		EB	WB	SB	EB	WB	SB
2026	Level of Service	A	-	C	A	-	D
	Delay (s)	-	-	15.7	-	-	26.7
	Volume/Capacity	-	-	0.08	-	-	0.05
	95 <sup>th</sup> Percentile Q (m)	-	-	2.0	-	-	1.2
2031	Level of Service	A	-	C	A	-	E
	Delay (s)	-	-	21.3	-	-	36.9
	Volume/Capacity	-	-	0.22	-	-	0.19
	95 <sup>th</sup> Percentile Q (m)	-	-	6.1	-	-	5.2

The assessment indicates that the CR 109/Townline intersection is expected to continue to operate at acceptable levels under future background traffic conditions in both scenarios, however, delays are expected to reach level of service D and E in the afternoon peak hour for the two future scenarios. The increased delays are in part due to higher traffic levels on CR 109 and, in the 2031 scenario, the increase in southbound left turn traffic.

## 5 Site Traffic

The amount of traffic generated by the proposed subdivision was estimated based on information in the Institute of Transportation Engineers (ITE) Trip Generation Manual, 10<sup>th</sup> Edition.

The industrial uses are proposed to cover just under 10.5 hectares. At a likely coverage of approximately 30 percent, the gross floor area of the industrial uses would be about 340,000 s.f.

The ITE Industrial Park category was chosen to best represent the proposed subdivision. In discussion with the Town's consultant, the data was filtered to include data for sites between 100,000 and 500,000 s.f. because the inclusion of the larger sites result in significantly lower average trip generation rates. Average rates for the filtered data were used to estimate site traffic. The traffic generation estimates for the site are summarized in the table below. Excerpts from the ITE Trip Generation Manual with the filtered data are included in Appendix F.

**Table 3: Site Traffic Generation Rates and Estimated Trips**

Land Use	GFA	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
Industrial Park (ITE LU 130) Trips/1,000 s.f.	-	0.74	0.16	0.90	0.21	0.80	1.01
Site Trips	340,000 s.f.	251	55	306	72	271	343

The resulting estimated site traffic is 306 and 343 vehicle trips measured in both directions (inbound and outbound) in the weekday morning and afternoon peak hours, respectively.

Site traffic was assigned to the road network in accordance with the trip distribution included in the TMP. A summary of the TMP distribution is included in the table below. The directions are relative to the built-up area of the Town of Grand Valley and the internal trips are expected to stay within the Town.

**Table 4: Transportation Master Plan Trip Distribution**

To/From	Employment Trips
North (on CR 25)	15%
South (on CR 25 north of CR 109)	40%
East (on Amaranth Street/Sideroad 5)	2%
West (on Concession Road 3)	3%
Internal (to Grand Valley)	40%
Total	100%

The distribution that was incorporated in this study relative to the site location is summarized in the table below for the two future scenarios – with and without the new collector road to the west. Generally, it was assumed that traffic destined to north, east, and west would travel via Townline north. In the scenario where the new road is available to the west, all the internal traffic was assigned to the new road. In the scenario where the new road is not available, internal traffic was split half and half to travel north to Amaranth Road and south to CR 25 to access the Town. Traffic to the south was split according to traffic patterns along CR 109, which are generally one third in the off-peak direction and two thirds in the peak direction.

**Table 5: Peak Hour Site Traffic Distribution – AM (PM)**

To/From	Without New Road (2026)		With New Road (2031)	
	Inbound	Outbound	Inbound	Outbound
North (on Townline)	40%	40%	20%	20%
West (on new road)	-	-	40%	40%
West (on CR 109)	47% (33%)	33% (47%)	27% (13%)	13% (27%)
East (on CR 109)	13% (47%)	27% (33%)	13% (27%)	27% (13%)
Total	100%	100%	100%	100%

The existing distribution of traffic in the area and the site traffic volumes for the weekday morning and afternoon peak hours for both future scenarios are illustrated in the figures in Appendix A.

## 6 Future Total Traffic

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Future total traffic was determined by adding the site traffic to future background traffic for the two scenarios. The future total traffic volumes for the two study peak hours and the two future scenarios are illustrated in the figures in Appendix A.

## 6.1 Turn Lane Assessment – Townline and Street B

Turn lanes can be provided at intersections to minimize delay to through traffic and to provide additional capacity where they are needed. Typically, in locations like Grand Valley, right turn lanes are considered when peak hour right turn volumes reach about 60 in one or both peak hours. In the 2026 horizon year, the southbound right turn volume from Townline to Street B is estimated to be 100 vehicles in the weekday morning peak hour. In the afternoon peak hour, the southbound right turn volume is estimated to be 29 vehicles. In the 2031 horizon year, with the addition of the new collector road, the morning peak hour southbound right turn volume drops to 50. Given that the through volume southbound on Townline is expected to be low in the 2026 horizon in the morning peak hour (28 vehicles) a southbound right turn lane is not recommended.

The need for a left turn lane is assessed using information from the Ministry of Transportation Geometric Design Guide for Ontario Highways. The assessment is based on the design speed of the road, the percent left turns in the stream of traffic and the traffic volumes at the intersection.

A design speed of 70 kph was chosen for Townline given the posted speed of 60 kph. At the subject intersection, the northbound left turning volumes make up between 70 and 91 percent of the traffic stream largely because the through volumes are expected to be low. The nomograph for 40 percent left turns was chosen since it is the highest available. Traffic volumes advancing with and opposing the left turns were plotted on the chosen nomographs and they are illustrated in the figures in Appendix G.

A left turn lane will not be warranted northbound on Townline at Street B.

## 6.2 Turn Lane Assessment – CR 109 and Townline

Right turn volumes from CR 109 to Townline are estimated to exceed 60 vehicles in the future total 2031 afternoon peak hour scenario, suggesting the need for a right turn lane.

A design speed of 100 kph was chosen for CR 109 given the posted speed of 80 kph. At the intersection with Townline, the eastbound left turning volumes make up between two (2) and 16 percent of the traffic stream. For the future total 2031 scenario in the afternoon peak hour, the left turn volume is two percent of the traffic stream and does not warrant a left turn lane. For the other future scenarios, traffic volumes advancing with and opposing the left turns were plotted on the chosen nomographs and they are illustrated in the figures in Appendix G.

A 40-metre eastbound left turn lane will be warranted on CR 109 at Townline in the 2026 future horizon and a 30-metre eastbound left turn lane will be warranted in the 2031 future horizon. It is recommended that a right turn lane and a left turn lane with 40 metres of storage be constructed to support both the subject development and the planned collector road connection.

## 6.3 Traffic Operations Assessment

A traffic operations assessment was undertaken for the two study area intersections in both the weekday morning and afternoon peak hours for both future total traffic conditions. The assessment includes the recommended turn lanes at the CR 109/Townline intersection. The



results of the analysis are summarized in the tables below and the detailed worksheets are included in Appendix H for the 2026 scenario and Appendix I for the 2031 scenario.

**Table 6: Future Total Traffic Operations - CR 109/Townline**

Horizon Year	Measure of Effectiveness	Approach Lane					
		AM Peak Hour			PM Peak Hour		
		EBL	WBR	SB	EBL	WBR	SB
2026	Level of Service	A	-	C	A	-	E
	Delay (s)	8.4	-	22.5	9.8	-	42.7
	Volume/Capacity	0.11	-	0.25	0.04	-	0.68
	95 <sup>th</sup> Percentile Q (m)	2.8	-	7.3	0.8	-	34.7
	Storage (m)	40	40	-	40	40	-
2031	Level of Service	A	-	D	B	-	F
	Delay (s)	8.4	-	29.7	10.1	-	57.3
	Volume/Capacity	0.07	-	0.37	0.02	-	0.71
	95 <sup>th</sup> Percentile Q (m)	1.6	-	12.3	0.4	-	34.8
	Storage (m)	40	40	-	40	40	-

The analysis indicates that the CR 109 intersection with Townline is expected to operate at level of service E or better except under the 2031 future total scenario in the afternoon peak hour when the southbound traffic would operate with delays representing a level of service F.

An assessment was undertaken to determine whether or not traffic signals are warranted at the CR 109/Townline intersection under future traffic conditions in 2031. Ontario Traffic Manual Book 12 provides justification criteria for traffic signals, including Justification 7 for projected volumes. Justification 7 uses AM and PM peak hour volumes alone or in combination to determine whether traffic signals are justified. The table below summarizes the requirements and the volumes through the intersection.

**Table 7: Justification 7 Traffic Signal Warrant Assessment - CR 109/Townline Future Total 2031**

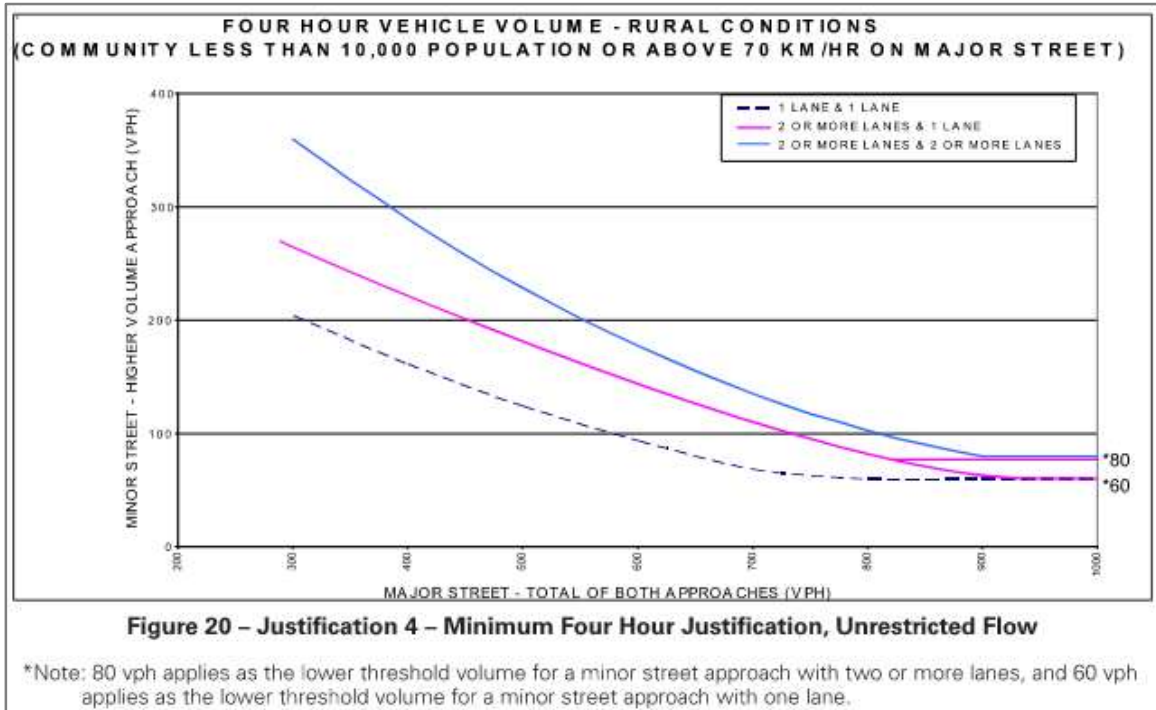
Justification	Requirement	AM/2	PM/2	AM+PM/4	Requirement Met?
1A Total Volume	480	597	775	686	Yes
1B Minor Volume	180	39	67	53	No
2A Major Volume	480	558	708	633	Yes
2B Crossing Volume	50	29	50	29	No

The intersection does not meet the justification 7 criteria for traffic signals. It is possible that the intersection will meet the four-hour volume criteria (justification 4), although data is only available for two hours. A figure showing the Justification 4 graph for unrestricted flow conditions is included below.

In both peak hours the major flow volumes on CR 109 are between 1100 and 1400 vehicles per hour. It is likely that in the future there will be four hours in the morning and afternoon peak periods that would exceed 900 vehicles per hour given the profile of traffic along CR 109 gathered during the 10 hours of survey that suggest two elevated hours of traffic in the morning and three in the afternoon. On the minor street, the morning peak hour approach volume is 78 vehicles and the afternoon peak hour approach volume is 134. It is likely that the minimum

threshold of 60 vehicles per hour could be reached in at least four hours in the morning and afternoon peak periods as well.

**Figure 1: Ontario Traffic Manual Book 12 Justification 4**



Given that the intersection at CR 109 and Townline is forecast to experience level of service F delays for the side street in 2031 and that the Town intends that this approach together with the new collector road provide a future bypass opportunity of the CR 25/ CR 109 intersection, it is likely that traffic signals will be warranted at the intersection at some point in the future. It is the recommendation of this study that when the intersection is improved that the utilities needed to support traffic signals be installed to assist in adding traffic signal hardware in the future should they be warranted.

In the meantime, the 2031 horizon year shows a level of service F for the traffic on the Townline approach to CR 109 in the afternoon peak hour. If the intersection is not signalized there will be high levels of delay for Townline traffic.

An assessment of traffic operations at the intersection was undertaken assuming a traffic signal is installed. The assessment confirms acceptable operations of the intersection as outlined in the table below.

**Table 8: Future Total 2031 Signalized Traffic Operations - CR 109/Townline**

Measure of Effectiveness	Approach Lane									
	AM Peak Hour					PM Peak Hour				
	EBL	EB	WBR	WB	SB	EBL	EB	WBR	WB	SB
Level of Service	A	C	B	A	B	A	B	C	A	B
Delay (s)	9.0	21.1	11.0	2.4	15.2	8.8	11.9	22.8	2.5	14.7
Volume/Capacity	0.16	0.81	0.40	0.08	0.15	0.11	0.56	0.87	0.08	0.28
95 <sup>th</sup> Percentile Q (m)	10.0	96.6	37.0	4.1	17.2	3.1	63.8	131.3	4.6	23.8
Storage (m)	40	-	40	-	-	40	-	40	-	-

The CR 109 and Townline intersection is expected to operate at acceptable levels in 2031 as a signalized intersection.

The operations assessment for the new Townline/Street B intersection is summarized in the table below with the detailed worksheets in Appendix H and Appendix I for the 2026 and 2031 future total scenarios.

**Table 9: Future Total Traffic Operations – Townline/Street B**

Horizon Year	Measure of Effectiveness	Approach Lane					
		AM Peak Hour			PM Peak Hour		
		EB	NB	SB	EB	NB	SB
2026	Level of Service	B	A	A	B	A	A
	Delay (s)	10.5	-	-	10.5	-	-
	Volume/Capacity	0.08	-	-	0.31	-	-
	95 <sup>th</sup> Percentile Q (m)	2.1	-	-	10.1	-	-
2031	Level of Service	A	A	A	A	A	A
	Delay (s)	9.3	-	-	9.7	-	-
	Volume/Capacity	0.07	-	-	0.20	-	-
	95 <sup>th</sup> Percentile Q (m)	1.7	-	-	5.7	-	-

The new Townline intersection with Street B is expected to operate at acceptable levels of service under both future total traffic scenarios in both weekday peak hours.

## 7 Conclusions and Recommendations

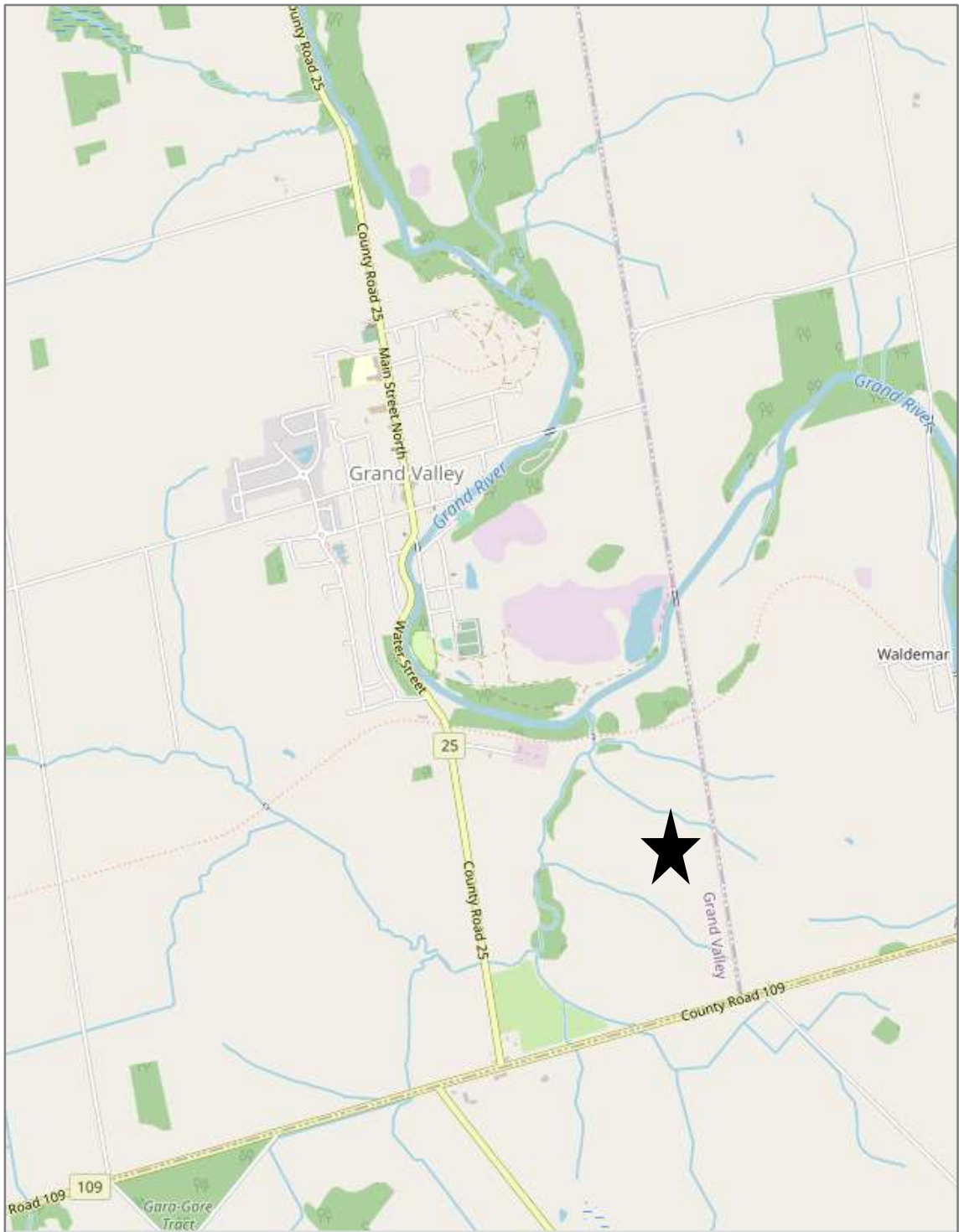
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This Transportation Impact Study has been undertaken in accordance with Town requirements in order to understand the transportation context and infrastructure required to support the proposed Draft Plan of Subdivision. The conclusions of this study are as follows:

- The Site is estimated to generate 306 and 343 vehicle trips in each of the weekday morning and afternoon peak hours, respectively.
- The concept includes new public road access to Townline and protects for a future connection both to undesignated lands to the south and for a new collector road connection to the west.
- Turn lanes from Townline to the new Street B will not be needed or warranted.
- The new Townline intersection with Street B is expected to operate at acceptable levels of service under both future total traffic scenarios in both weekday peak hours.
- The CR 109/Townline intersection is currently operating at acceptable levels. Future traffic volumes suggest that a left turn lane from CR 109 to Townline will be warranted in both future scenarios and that a right turn lane from CR 109 to Townline will also be needed. With these improvements, the intersection is generally expected to continue to operate at acceptable levels under future traffic conditions with and without the proposal with the exception of the 2031 PM peak hour. It is likely that traffic signals will be warranted at the intersection in 2031 and the analysis suggests the intersection will operate at acceptable levels with a traffic signal.

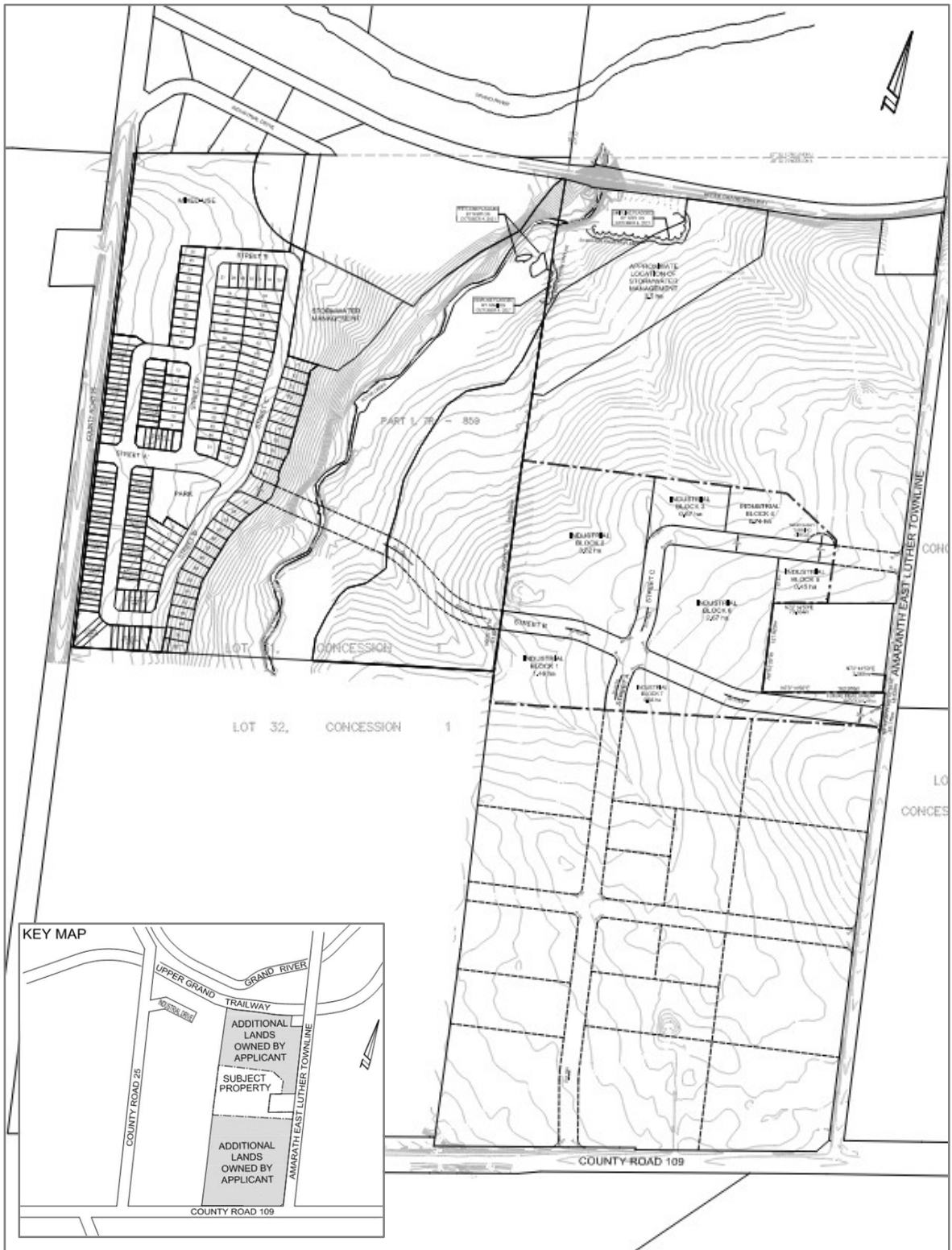
## Appendix A: Figures

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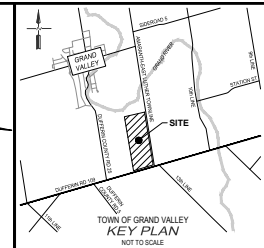
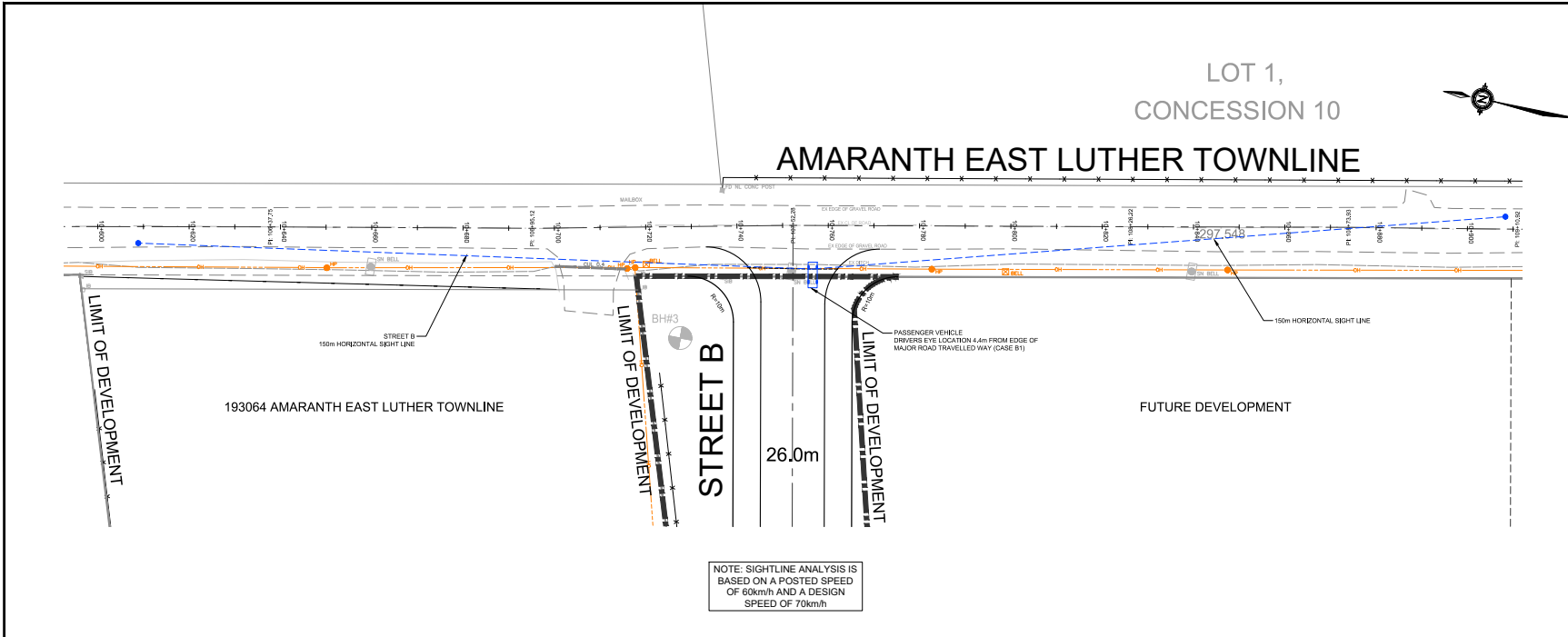
**Site Location Plan**

© OpenStreetMap contributors 2021



**Grand Valley Industrial Draft Plan of Subdivision**

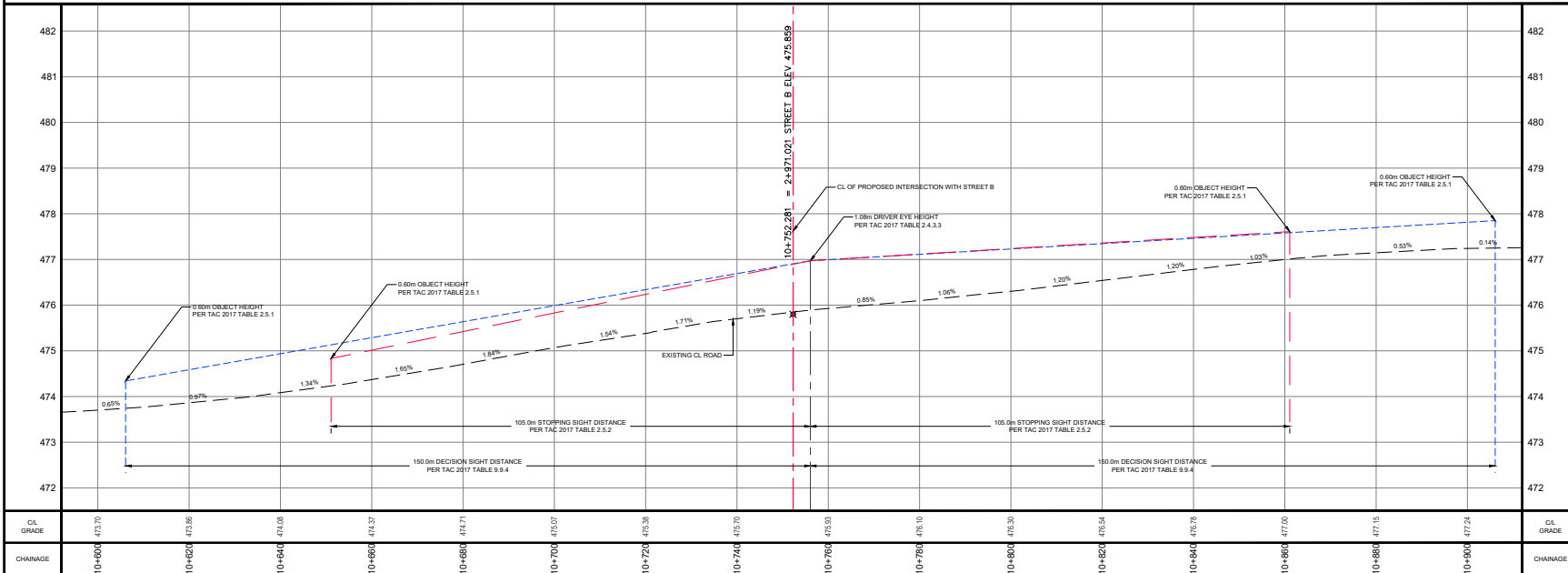
Source: Astrid J. Clos Planning Consultants



NOTES:  
 1. TOPOGRAPHIC AND EXISTING FEATURES SURVEY COMPLETED BY VAN HARTEN SURVEY INC., DATED 2021-07-07.

BENCH MARKS:  
 BENCHMARK

THE POSITION OF POLE LINES, CONCRETE WATERMANS, SIGNS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS AND THEREFORE THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR ANY DAMAGE TO THEM.



NO.	DATE	REVISION DESCRIPTION	CHG.



GRAND VALLEY BUSINESS PARK

THOMASFIELD HOMES LTD.

TOWN OF GRAND VALLEY

SIGHT LINE ANALYSIS  
 INTERSECTION OF STREET B

DRAWN BY: RPM	APPROVED BY: AEK	PROJECT NO.: 117184	DRAWING NO.: 1
DESIGNED BY: RPM	DATE: 2024-09-17	SCALE: HORIZ: 1:500 VERT: 1:100	

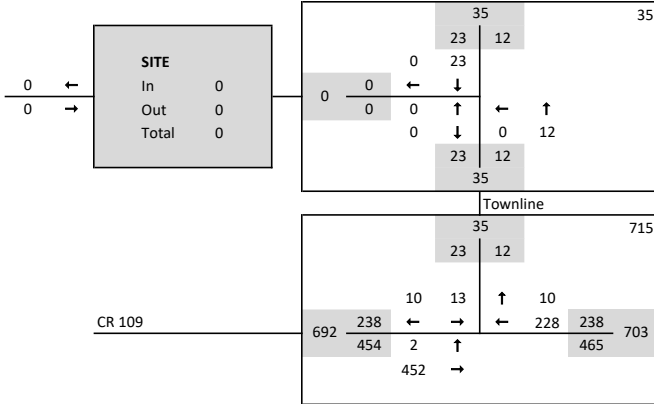
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**Traffic Volume Diagrams**  
Grand Valley Industrial Lands

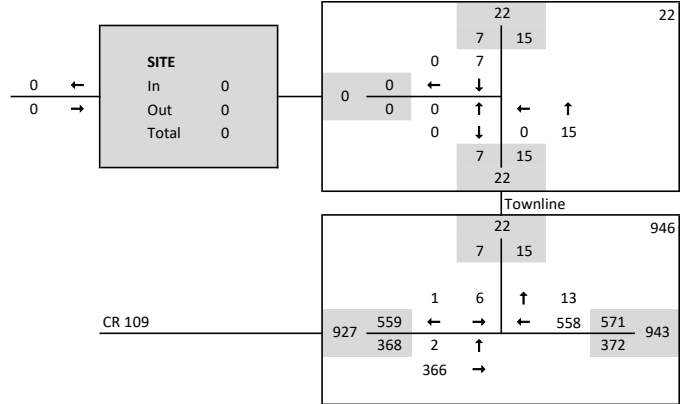
**AM Peak Hour**  
Existing Traffic

Tuesday, October 26, 2021, 7:15 AM

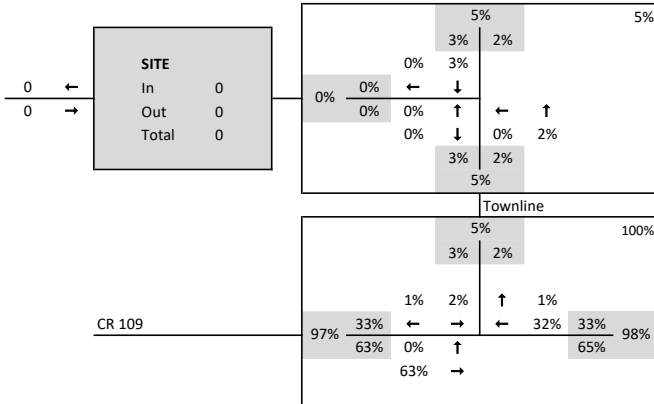


**PM Peak Hour**  
Existing Traffic

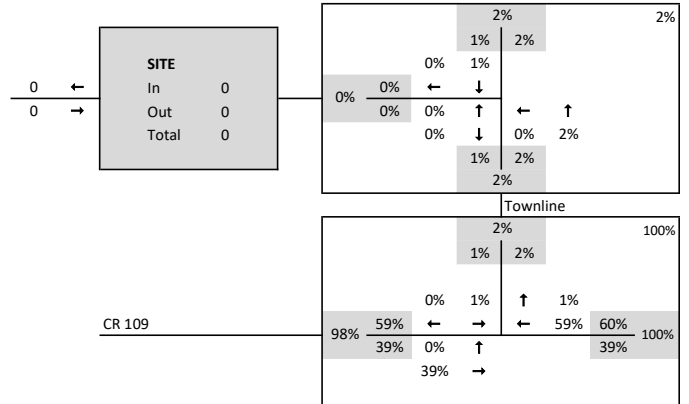
Tuesday, October 26, 2020, 4:30 PM



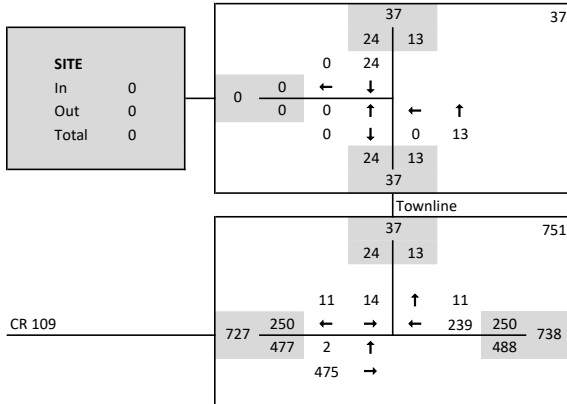
**Distribution**



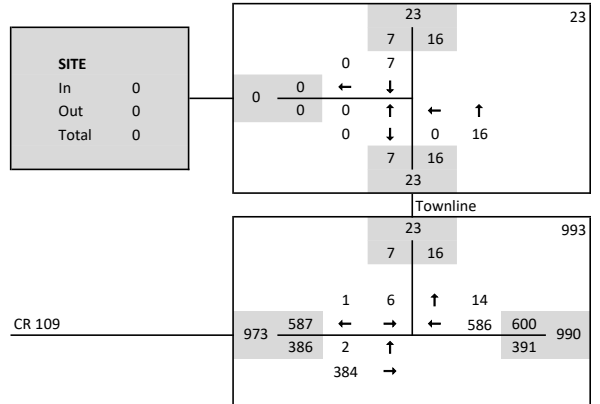
**Distribution**



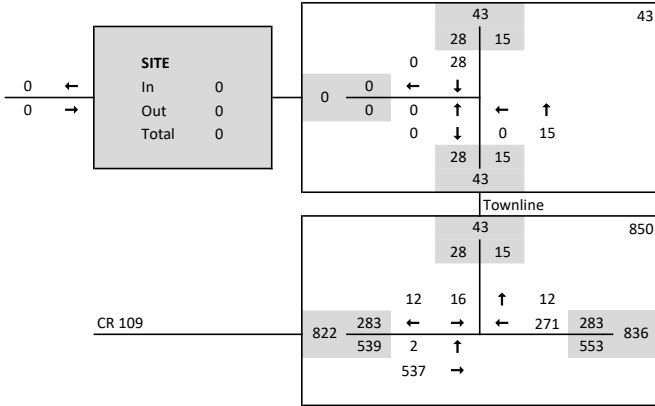
**Adjusted 2021 Traffic**



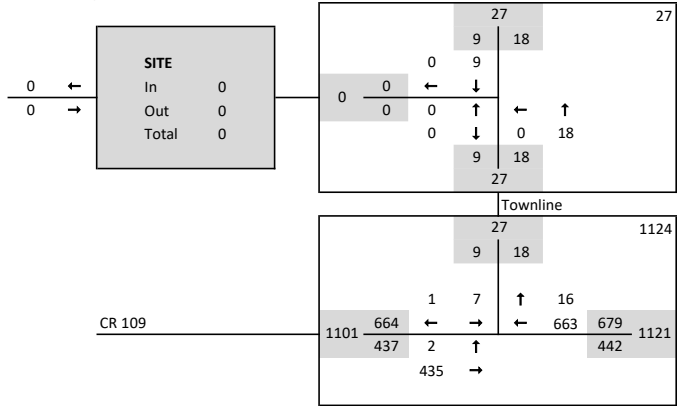
**Adjusted 2021 Traffic**



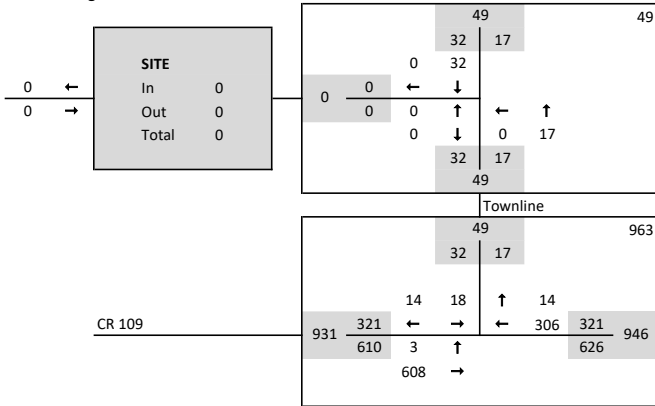
**AM Peak Hour**  
**Future Background Growth 2026**



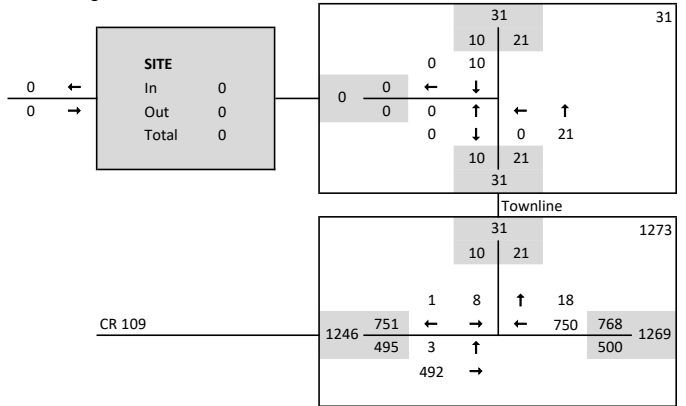
**PM Peak Hour**  
**Future Background Growth 2026**



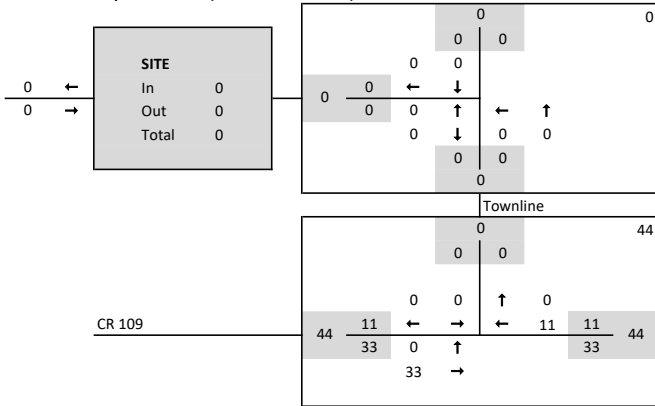
**Future Background Growth 2031**



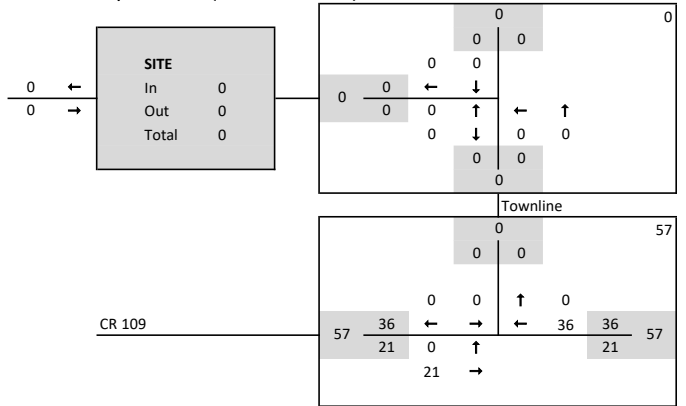
**Future Background Growth 2031**



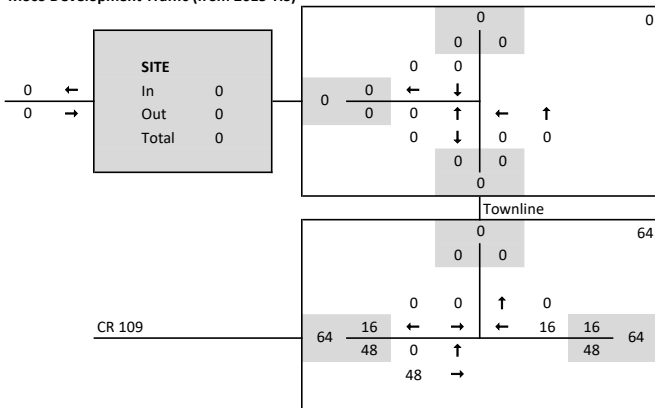
**Corseed Development Traffic (from 2015 Moco TIS)**



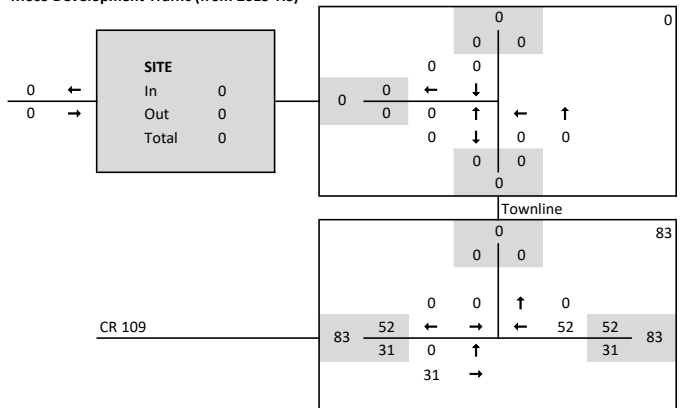
**Corseed Development Traffic (from 2015 Moco TIS)**



**Moco Development Traffic (from 2015 TIS)**

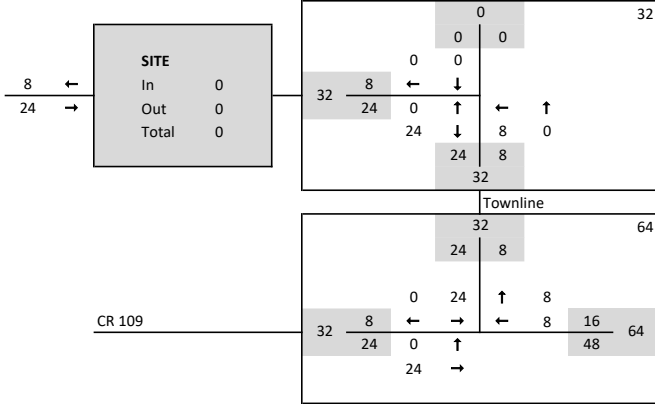


**Moco Development Traffic (from 2015 TIS)**



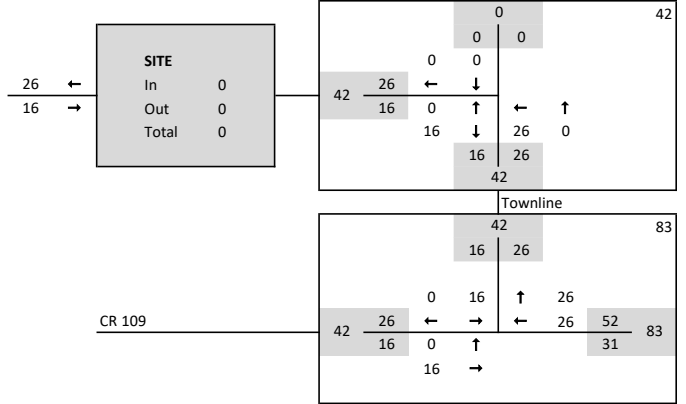
**AM Peak Hour**

**Moco Development Traffic (with new road)**

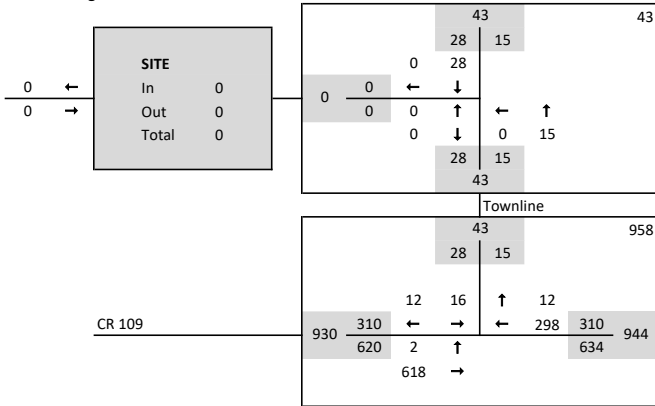


**PM Peak Hour**

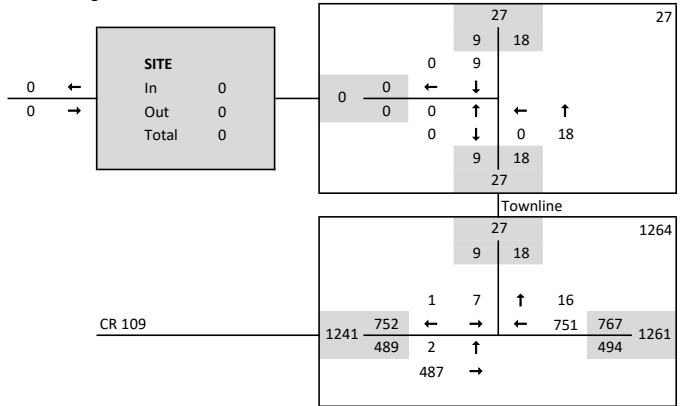
**Moco Development Traffic (with new road)**



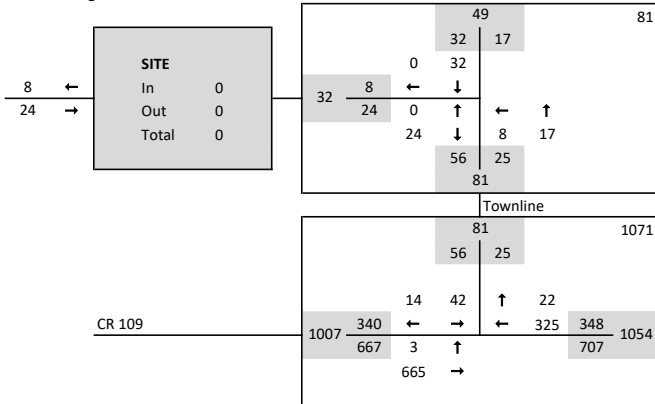
**Future Background Traffic 2026**



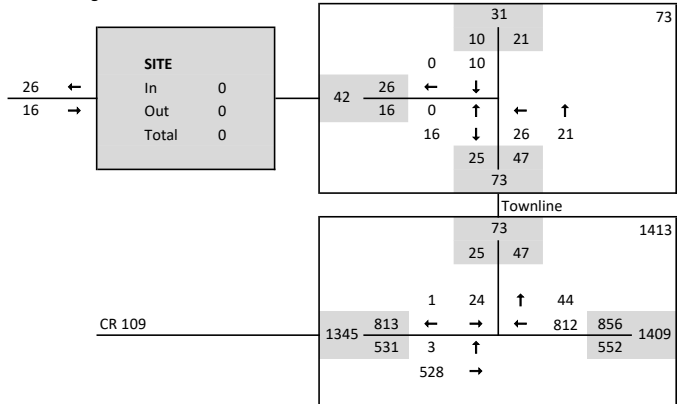
**Future Background Traffic 2026**



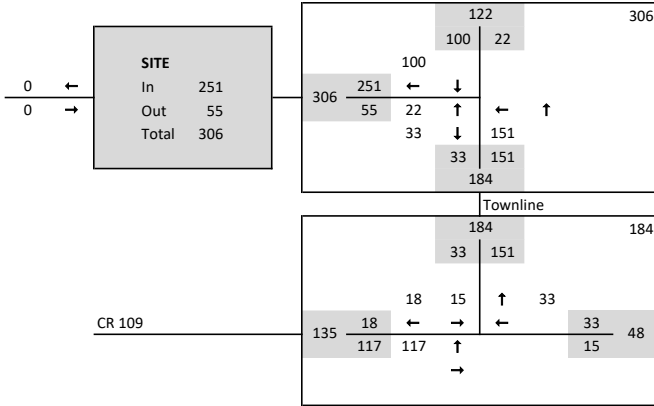
**Future Background Traffic 2031**



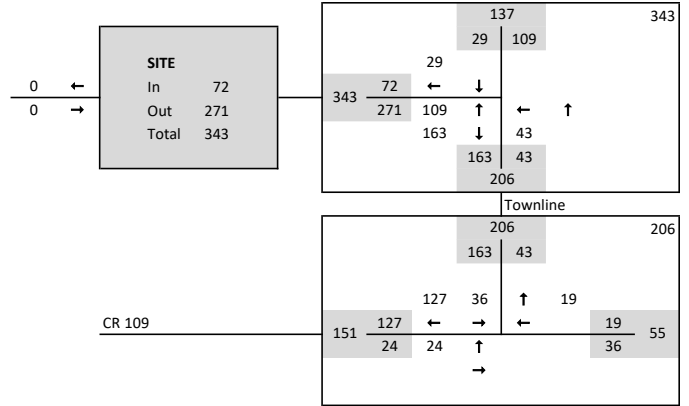
**Future Background Traffic 2031**



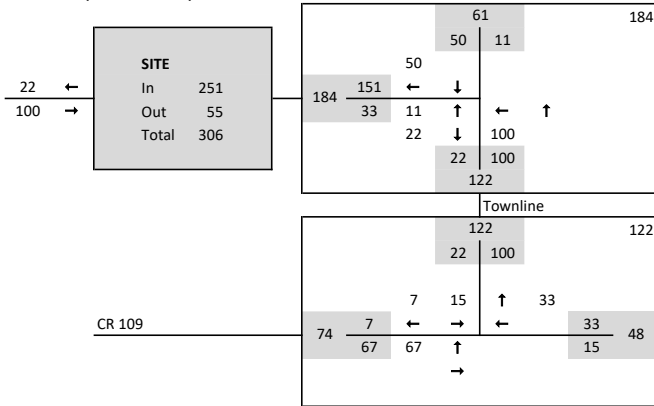
**AM Peak Hour  
Site Traffic**



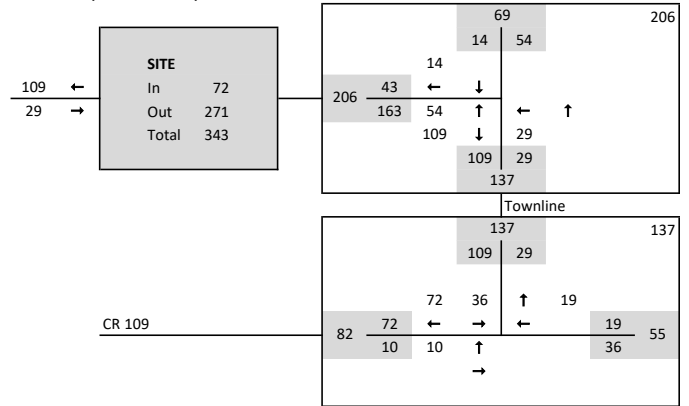
**PM Peak Hour  
Site Traffic**



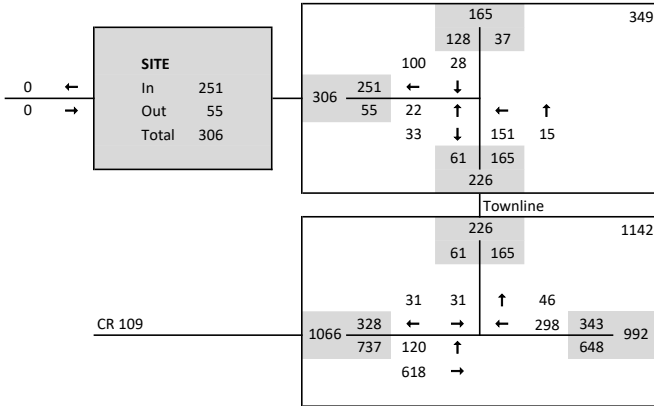
**Site Traffic (with new road)**



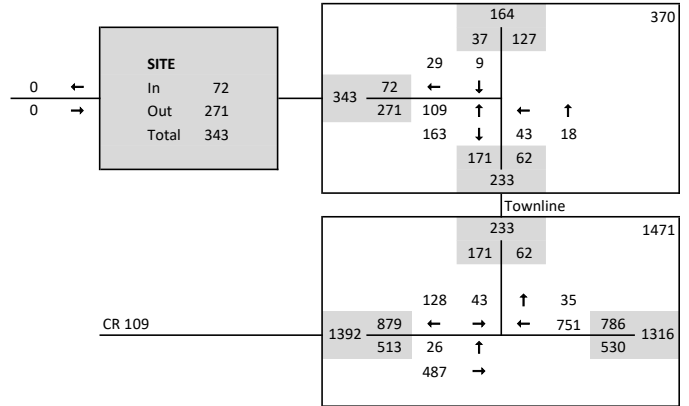
**Site Traffic (with new road)**



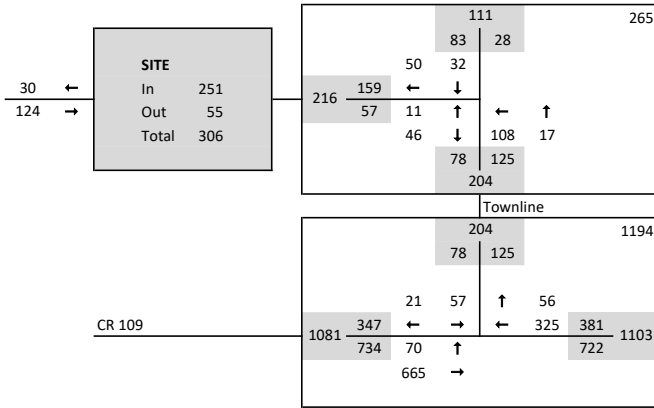
**Future Total Traffic 2026**



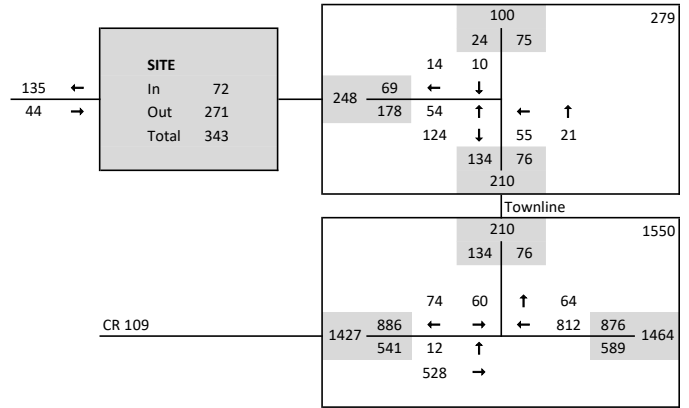
**Future Total Traffic 2026**



**Future Total Traffic 2031**



**Future Total Traffic 2031**



## **Appendix B: Adjusted 2021 Capacity Analysis**

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# HCM Unsignalized Intersection Capacity Analysis

## 3: CR 109 & Townline

12/07/2021



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↶	↷		↶	↷
Traffic Volume (veh/h)	2	475	239	11	14	11
Future Volume (Veh/h)	2	475	239	11	14	11
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)	2	516	260	12	15	12
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	272				786	266
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	272				786	266
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				96	98
cM capacity (veh/h)	1291				360	773
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	518	272	27			
Volume Left	2	0	15			
Volume Right	0	12	12			
cSH	1291	1700	472			
Volume to Capacity	0.00	0.16	0.06			
Queue Length 95th (m)	0.0	0.0	1.4			
Control Delay (s)	0.0	0.0	13.1			
Lane LOS	A		B			
Approach Delay (s)	0.0	0.0	13.1			
Approach LOS			B			
<b>Intersection Summary</b>						
Average Delay			0.5			
Intersection Capacity Utilization			36.6%	ICU Level of Service		A
Analysis Period (min)			15			

# HCM Unsignalized Intersection Capacity Analysis

## 3: CR 109 & Townline

12/07/2021



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔	↔		↔	
Traffic Volume (veh/h)	2	384	586	14	6	1
Future Volume (Veh/h)	2	384	586	14	6	1
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)	2	417	637	15	7	1
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	652				1066	644
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	652				1066	644
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				97	100
cM capacity (veh/h)	935				246	473
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	419	652	8			
Volume Left	2	0	7			
Volume Right	0	15	1			
cSH	935	1700	261			
Volume to Capacity	0.00	0.38	0.03			
Queue Length 95th (m)	0.0	0.0	0.7			
Control Delay (s)	0.1	0.0	19.2			
Lane LOS	A		C			
Approach Delay (s)	0.1	0.0	19.2			
Approach LOS			C			
<b>Intersection Summary</b>						
Average Delay			0.2			
Intersection Capacity Utilization			41.7%		ICU Level of Service	A
Analysis Period (min)			15			

**Appendix C: Traffic Signal Warrant**  
**Country Road 109/Amaranth East Luther Townline**

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# Input Data Sheet

Analysis Sheet

Results Sheet

Proposed Collision

GO TO Justification:

What are the intersecting roadways?

CR 109/Amaranth Townline

What is the direction of the Main Road street?

East-West

When was the data collected?

2021-10-26

## Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road?

1

b.- Number of lanes on the Minor Road?

1

c.- How many approaches?

3

d.- What is the operating environment?

Rural

Population < 10,000

AND

Speed >= 70 km/hr

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Eastbound Approach			Minor Northbound Approach			Main Westbound Approach			Minor Southbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	0	414	0	0	0	0	0	214	8	12	0	11	1
9:00	4	441	0	0	0	0	0	226	9	13	0	3	0
10:00	1	290	0	0	0	0	0	222	14	6	0	4	0
12:00	5	243	0	0	0	0	0	227	3	6	0	1	0
16:00	4	295	0	0	0	0	0	412	3	10	0	1	0
17:00	6	320	0	0	0	0	0	521	15	8	0	1	0
18:00	0	327	0	0	0	0	0	552	13	5	0	3	0
19:00	4	213	0	0	0	0	0	353	5	6	0	3	0
<b>Total</b>	<b>24</b>	<b>2,543</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2,727</b>	<b>70</b>	<b>66</b>	<b>0</b>	<b>27</b>	<b>1</b>

## Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	0

\* Include only collisions that are susceptible to correction through the installation of traffic signal control

## Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		50%		0%		0%		
<b>Net 8 Hour Pedestrian Volume at Crossing</b>									0
<b>Net 8 Hour Vehicular Volume on Street Being Crossed</b>									6,411

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	0	0	0	0	0	0	0	0	
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		50%		0%		0%		
<b>Net 8 Hour Volume of Total Pedestrians</b>									0
<b>Net 8 Hour Volume of Delayed Pedestrians</b>									0

**Justification 1: Minimum Vehicle Volumes**

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	10:00	12:00	16:00	17:00	18:00	19:00		
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>										
1A	480	720	600	900	659	696	537	485	725	871	900	584		
	COMPLIANCE %				100	100	100	100	100	100	100	100	100	800
1B	180	255	180	255	23	16	10	7	11	9	8	9		
	COMPLIANCE %				13	9	6	4	6	5	4	5	52	6
Free Flow Signal Justification 1:					Both 1A and 1B 100% Fulfilled each of 8 hours Lesser of 1A or 1B at least 80% fulfilled each of 8 hours								Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
													Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>

**Justification 2: Delay to Cross Traffic**

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW	8:00	9:00	10:00	12:00	16:00	17:00	18:00	19:00		
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>										
2A	480	720	600	900	636	680	527	478	714	862	892	575		
	COMPLIANCE %				100	100	100	100	100	100	100	100	100	800
2B	50	75	50	75	13	13	6	6	10	8	5	6		
	COMPLIANCE %				26	26	12	12	20	16	10	12	134	17
Free Flow Signal Justification 2:					Both 2A and 2B 100% fulfilled each of 8 hours Lesser of 2A or 2B at least 80% fulfilled each of 8 hours								Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
													Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>

**Justification 3: Combination**

Combination Justification 1 and 2

Justification Satisfied 80% or More				Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	YES <input type="checkbox"/>	NO <input checked="" type="checkbox"/>	YES <input type="checkbox"/>	NO <input checked="" type="checkbox"/>
Justification 2	Delay Cross Traffic	YES <input type="checkbox"/>	NO <input checked="" type="checkbox"/>	NOT JUSTIFIED	

**Justification 4: Four Hour Volume**

Justification	Time Period	Total Volume of Both Approaches (Main)	Heaviest Minor Approach	Required Value	Average % Compliance	Overall % Compliance
		X	Y (actual)	Y (warrant threshold)		
Justification 4	9:00	680	16	214	7 %	6 %
	16:00	714	11	202	5 %	
	17:00	862	9	153	6 %	
	18:00	892	8	145	6 %	

**Justification 5: Collision Experience**

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	0 %
	13-24	0 %	
	25-36	0 %	

**Justification 6: Pedestrian Volume**

**Pedestrian Volume Analysis**

	8 Hour Vehicular Volume $V_8$	Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000	Not Justified				
	> 7000					

**Pedestrian Delay Analysis**

	Net Total 8 Hour Volume of Total Pedestrians	Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

# Results Sheet

[Input Sheet](#)

[Analysis Sheet](#)

[Proposed Collision](#)

[GO TO Justification:](#)

Intersection: CR 109/Amaranth Townline

Count Date: 2021-10-26

## Summary Results

Justification	Compliance	Signal Justified?	
		YES	NO
1. Minimum Vehicular Volume	A Total Volume 100 %	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	B Crossing Volume 6 %	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2. Delay to Cross Traffic	A Main Road 100 %	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	B Crossing Road 17 %	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3. Combination	A Justificaton 1 6 %	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	B Justification 2 17 %	<input type="checkbox"/>	<input checked="" type="checkbox"/>
4. 4-Hr Volume	6 %	<input type="checkbox"/>	<input checked="" type="checkbox"/>

5. Collision Experience	0 %	<input type="checkbox"/>	<input checked="" type="checkbox"/>
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6. Pedestrians	A Volume	Justification not met	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	B Delay	Justification not met	<input type="checkbox"/>	<input checked="" type="checkbox"/>

## **Appendix D: Future Background 2026 Capacity Analysis**

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# HCM Unsignalized Intersection Capacity Analysis

## 3: CR 109 & Townline

12/07/2021



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (veh/h)	2	618	298	12	16	12
Future Volume (Veh/h)	2	618	298	12	16	12
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)	2	672	324	13	17	13
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	337				1006	330
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	337				1006	330
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				94	98
cM capacity (veh/h)	1222				267	711
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	674	337	30			
Volume Left	2	0	17			
Volume Right	0	13	13			
cSH	1222	1700	366			
Volume to Capacity	0.00	0.20	0.08			
Queue Length 95th (m)	0.0	0.0	2.0			
Control Delay (s)	0.0	0.0	15.7			
Lane LOS	A		C			
Approach Delay (s)	0.0	0.0	15.7			
Approach LOS			C			
<b>Intersection Summary</b>						
Average Delay			0.5			
Intersection Capacity Utilization			44.1%	ICU Level of Service		A
Analysis Period (min)			15			

# HCM Unsignalized Intersection Capacity Analysis

## 3: CR 109 & Townline

12/07/2021



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔	↔		↔	
Traffic Volume (veh/h)	2	487	751	16	7	1
Future Volume (Veh/h)	2	487	751	16	7	1
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)	2	529	816	17	8	1
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	833				1358	824
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	833				1358	824
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				95	100
cM capacity (veh/h)	800				164	373
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	531	833	9			
Volume Left	2	0	8			
Volume Right	0	17	1			
cSH	800	1700	175			
Volume to Capacity	0.00	0.49	0.05			
Queue Length 95th (m)	0.1	0.0	1.2			
Control Delay (s)	0.1	0.0	26.7			
Lane LOS	A		D			
Approach Delay (s)	0.1	0.0	26.7			
Approach LOS			D			
<b>Intersection Summary</b>						
Average Delay			0.2			
Intersection Capacity Utilization			50.5%	ICU Level of Service		A
Analysis Period (min)			15			

## **Appendix E: Future Background 2031 Capacity Analysis**

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# HCM Unsignalized Intersection Capacity Analysis

## 3: CR 109 & Townline

12/07/2021



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (veh/h)	3	665	325	22	42	14
Future Volume (Veh/h)	3	665	325	22	42	14
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)	3	723	353	24	46	15
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	377				1094	365
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	377				1094	365
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				81	98
cM capacity (veh/h)	1181				236	680
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	726	377	61			
Volume Left	3	0	46			
Volume Right	0	24	15			
cSH	1181	1700	281			
Volume to Capacity	0.00	0.22	0.22			
Queue Length 95th (m)	0.1	0.0	6.1			
Control Delay (s)	0.1	0.0	21.3			
Lane LOS	A		C			
Approach Delay (s)	0.1	0.0	21.3			
Approach LOS			C			
<b>Intersection Summary</b>						
Average Delay			1.2			
Intersection Capacity Utilization			47.4%		ICU Level of Service	A
Analysis Period (min)			15			

# HCM Unsignalized Intersection Capacity Analysis

## 3: CR 109 & Townline

12/07/2021



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (veh/h)	3	528	812	44	24	1
Future Volume (Veh/h)	3	528	812	44	24	1
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)	3	574	883	48	26	1
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	931				1487	907
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	931				1487	907
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				81	100
cM capacity (veh/h)	735				136	334
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	577	931	27			
Volume Left	3	0	26			
Volume Right	0	48	1			
cSH	735	1700	139			
Volume to Capacity	0.00	0.55	0.19			
Queue Length 95th (m)	0.1	0.0	5.2			
Control Delay (s)	0.1	0.0	36.9			
Lane LOS	A		E			
Approach Delay (s)	0.1	0.0	36.9			
Approach LOS			E			
<b>Intersection Summary</b>						
Average Delay			0.7			
Intersection Capacity Utilization			55.4%	ICU Level of Service		B
Analysis Period (min)			15			

## **Appendix F: ITE Trip Generation Manual Excerpts**

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# Industrial Park (130)

**Vehicle Trip Ends vs: 1000 Sq. Ft. GFA**  
**On a: Weekday,**  
**Peak Hour of Adjacent Street Traffic,**  
**One Hour Between 7 and 9 a.m.**  
**Setting/Location: General Urban/Suburban**  
 Number of Studies: 12 out of 31  
 Avg. 1000 Sq. Ft. GFA: 267  
 Directional Distribution: 82% entering , 18% exiting

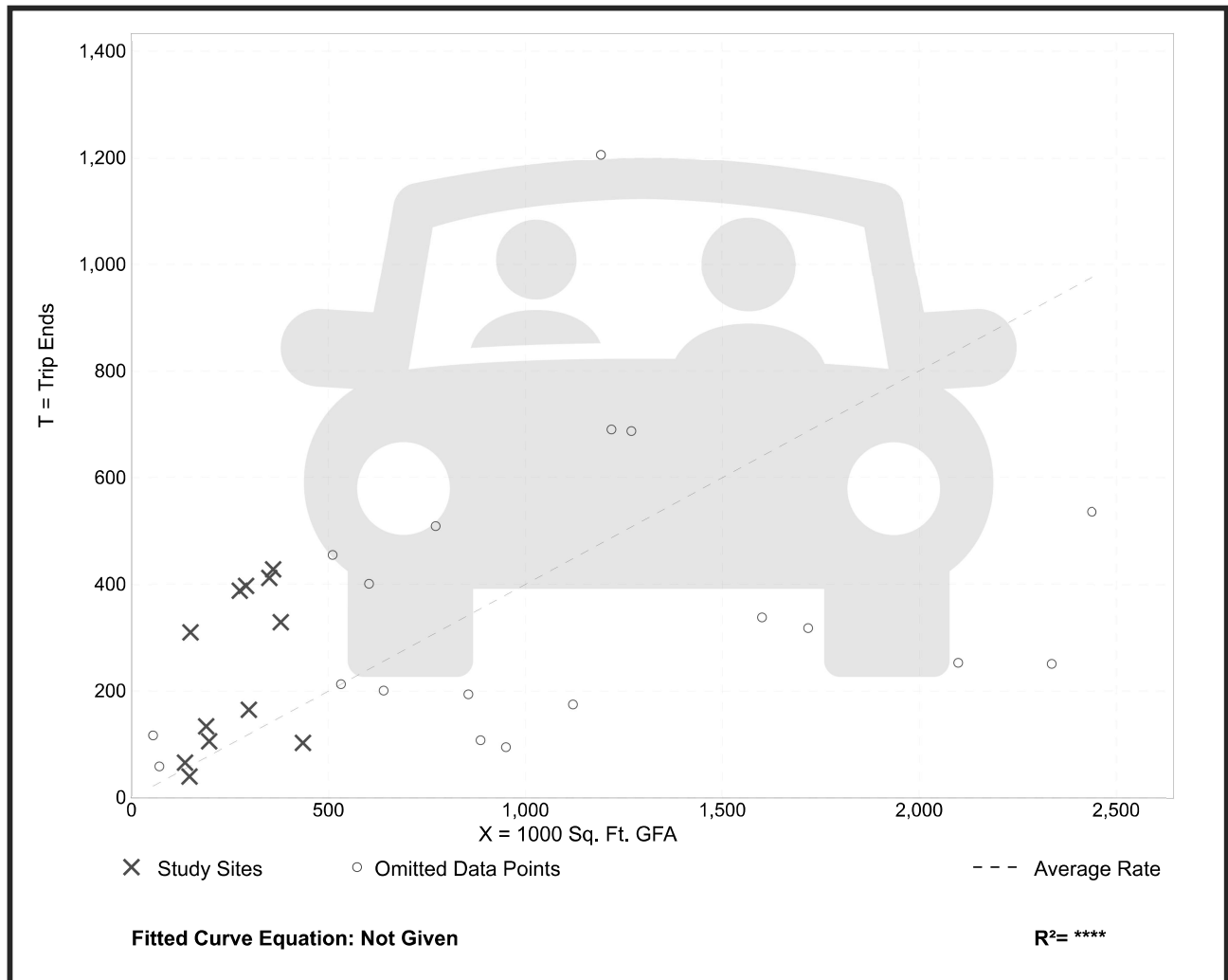
## Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
0.90	0.24 - 2.07	0.50

Data Filtered By: [IV Value: 100-500]

## Data Plot and Equation

*Caution – Filtered Data Set*



# Industrial Park (130)

**Vehicle Trip Ends vs: 1000 Sq. Ft. GFA**  
**On a: Weekday,**  
**Peak Hour of Adjacent Street Traffic,**  
**One Hour Between 4 and 6 p.m.**  
**Setting/Location: General Urban/Suburban**  
 Number of Studies: 14 out of 32  
 Avg. 1000 Sq. Ft. GFA: 243  
 Directional Distribution: 21% entering , 79% exiting

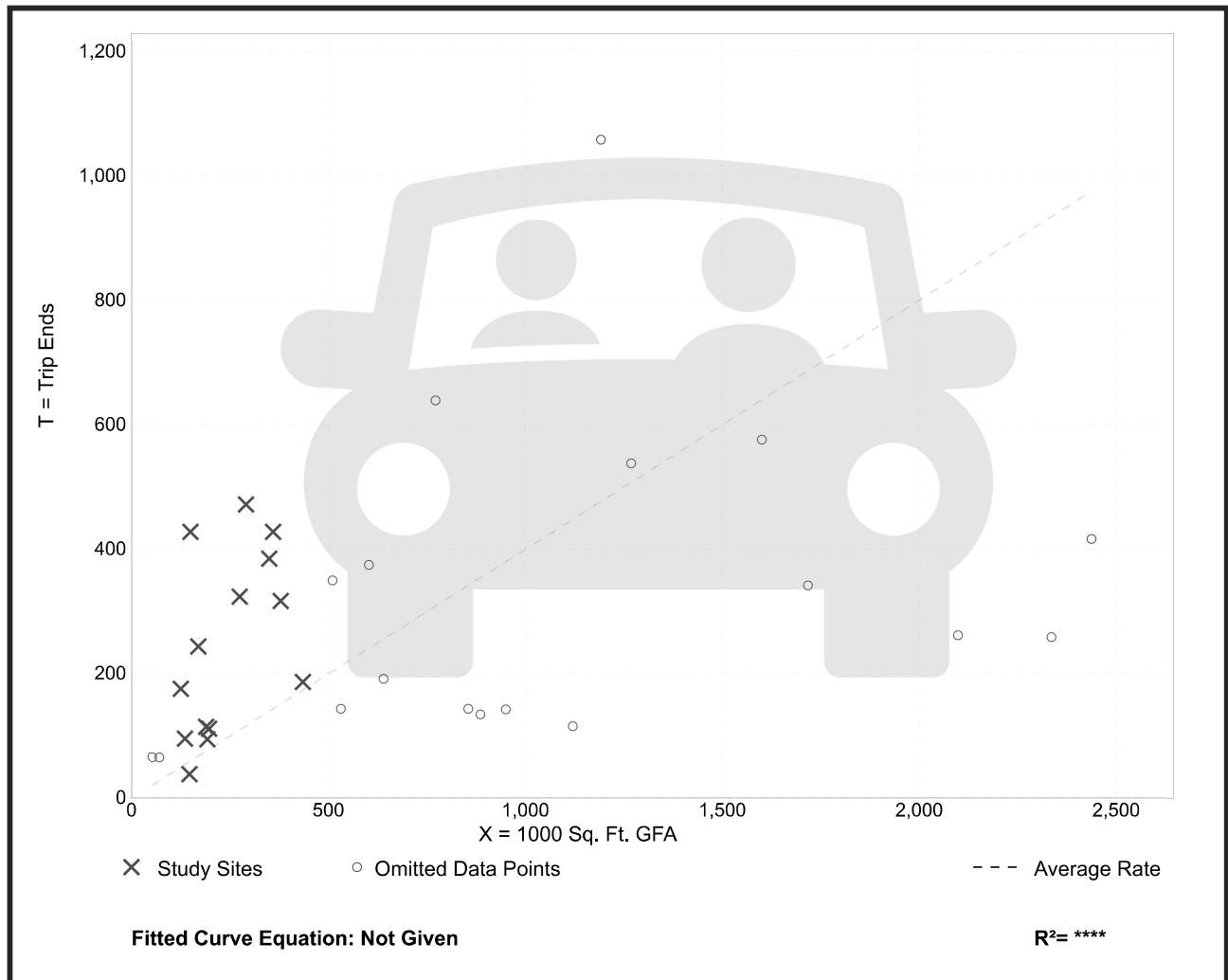
## Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
1.01	0.26 - 2.85	0.58

Data Filtered By: [IV Value: 100-500]

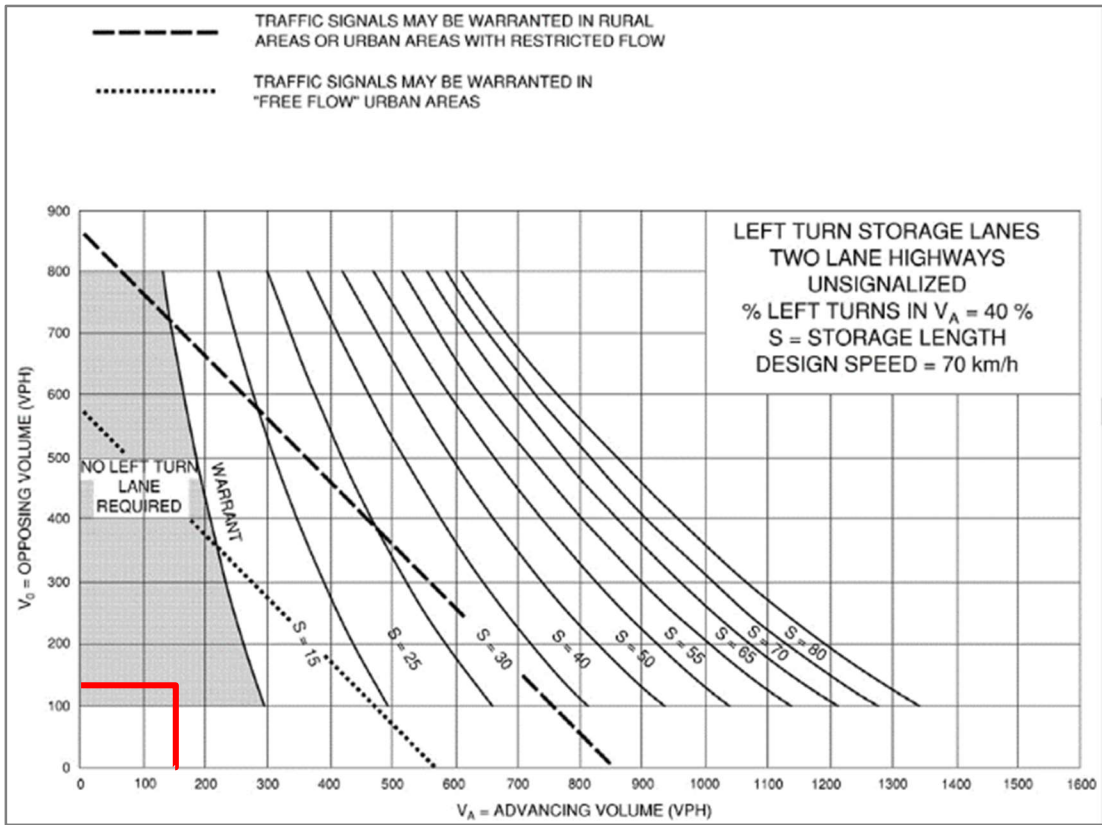
## Data Plot and Equation

*Caution – Filtered Data Set*

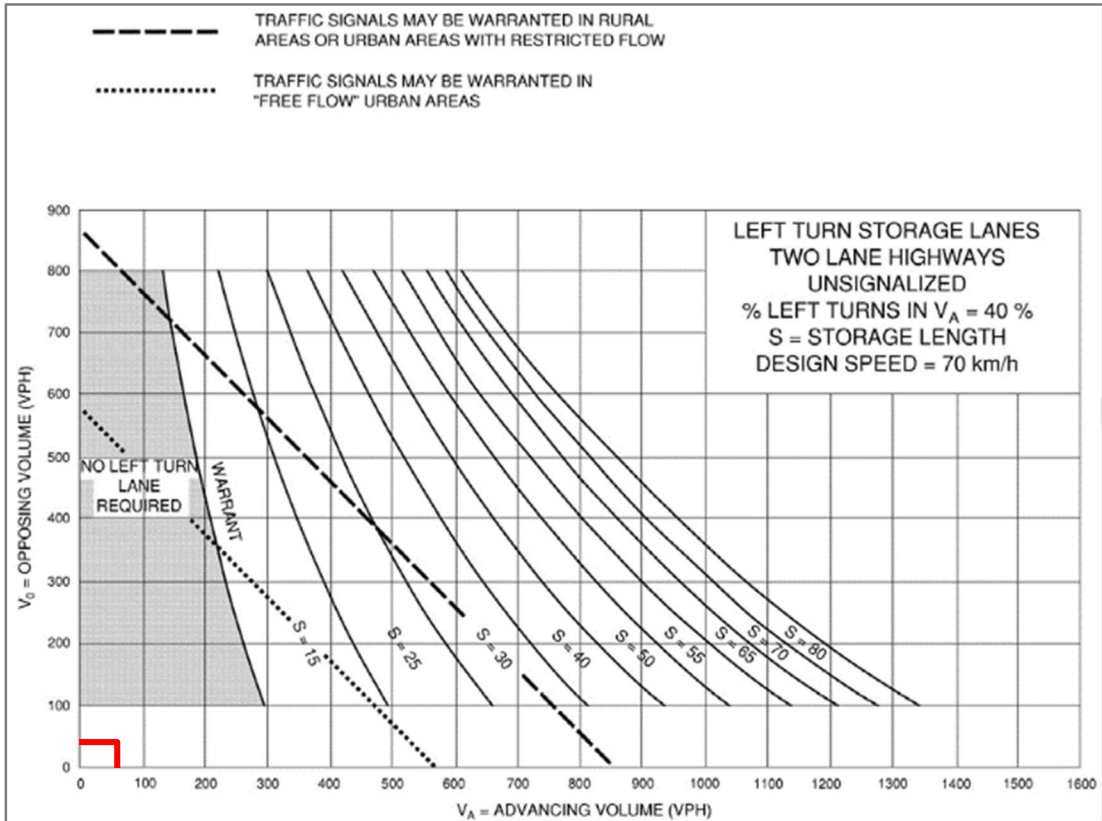


## **Appendix G: Left Turn Lane Warrant Analysis**

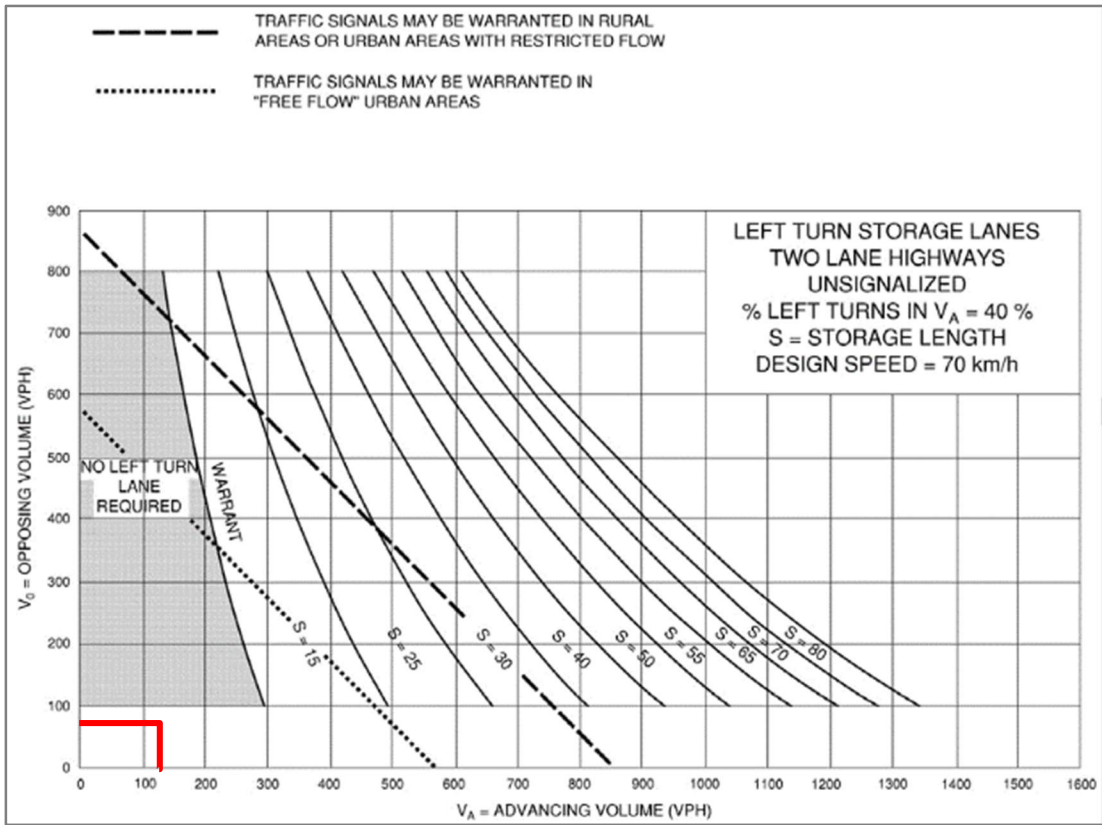
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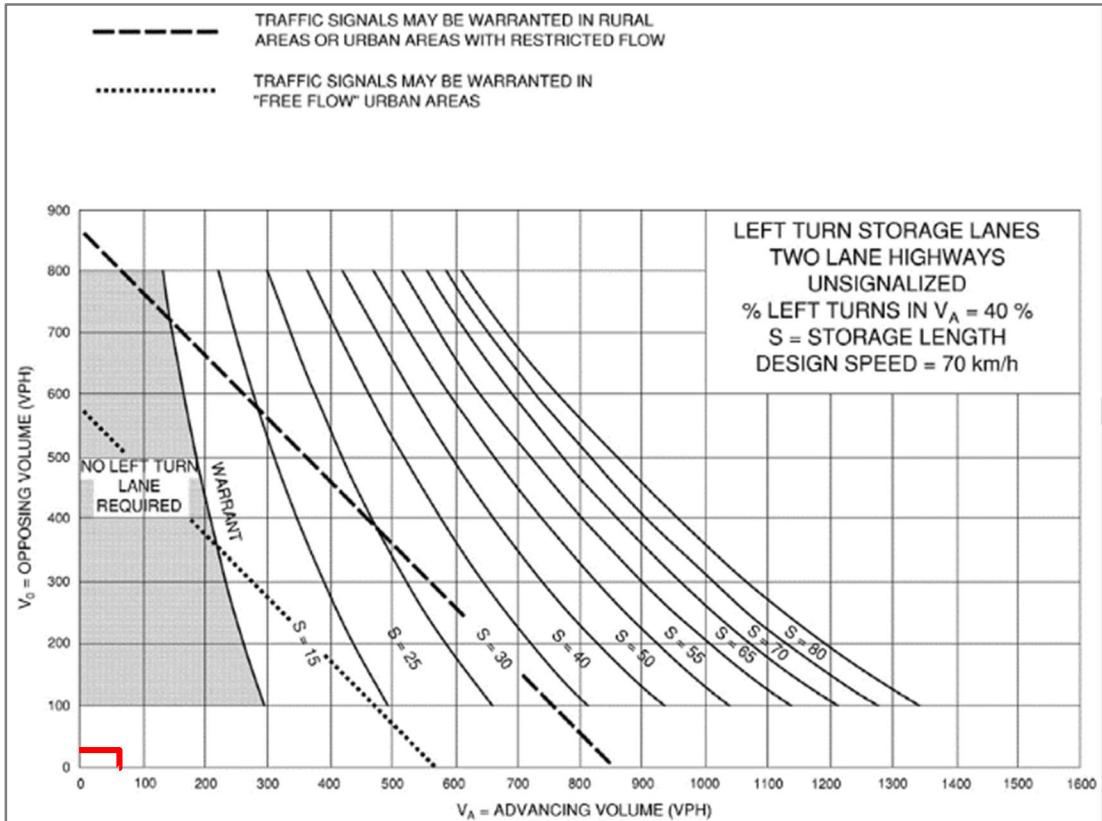
**2026 AM Peak Hour Left Turn Lane Warrant – Townline/Street B**



**2026 PM Peak Hour Left Turn Lane Warrant – Townline/Street B**

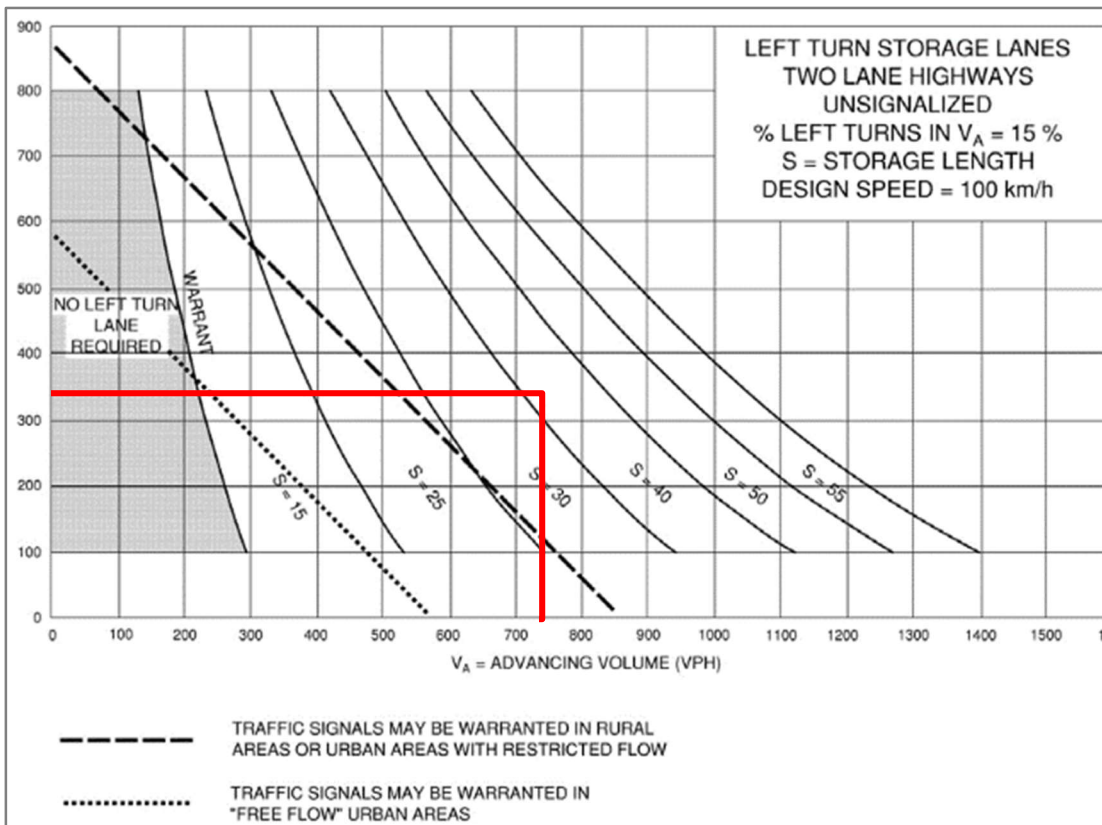


**2031 AM Peak Hour Left Turn Lane Warrant – Townline/Street B**

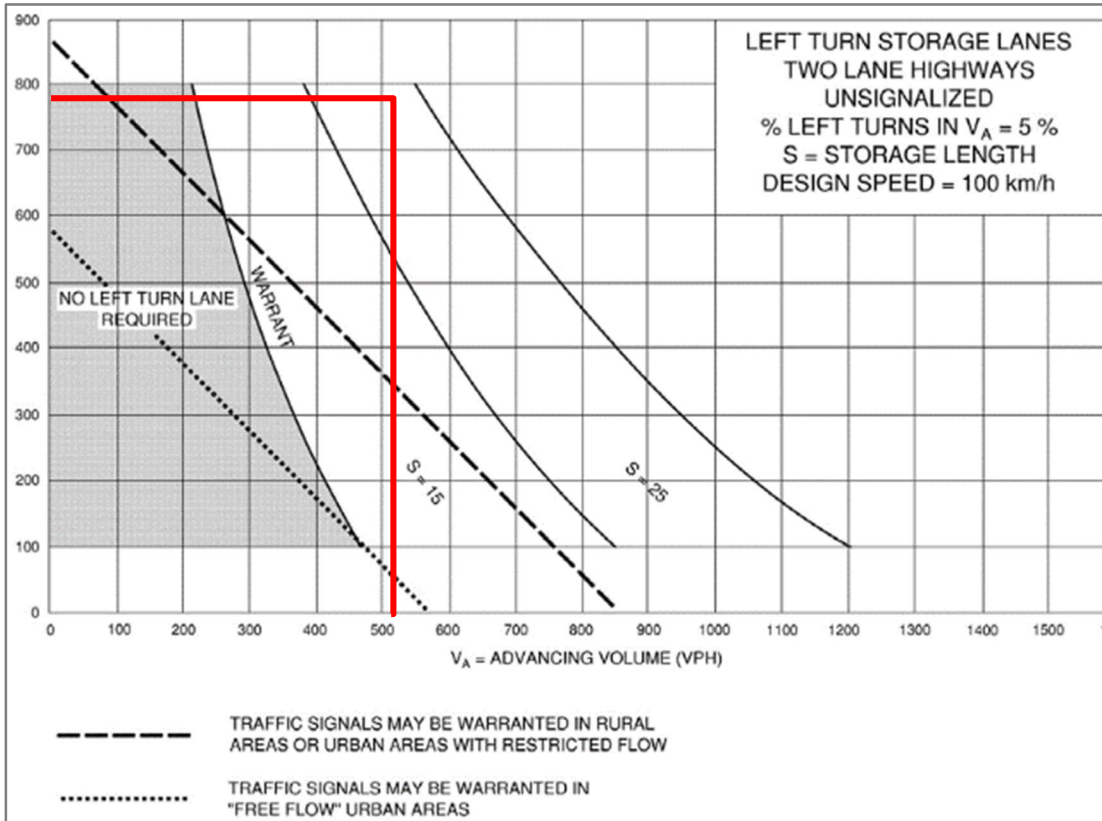


**2031 PM Peak Hour Left Turn Lane Warrant – Townline/Street B**

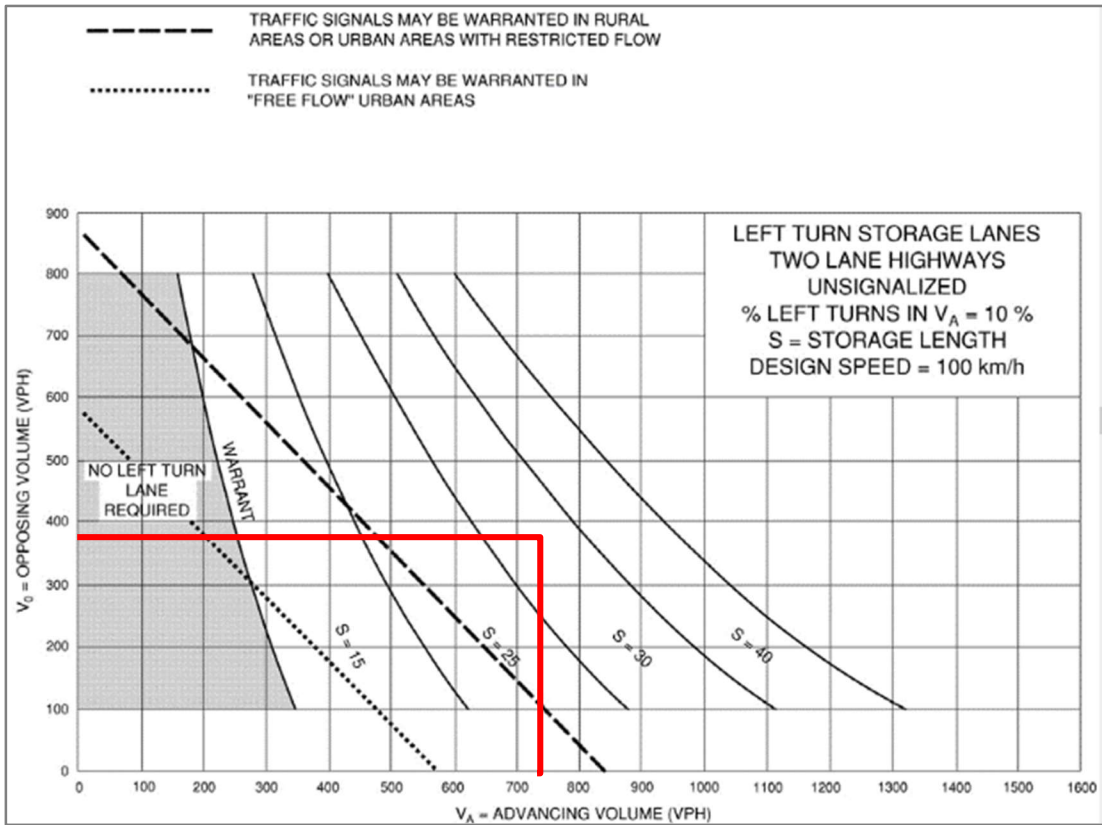




2026 AM Peak Hour Left Turn Lane Warrant – CR 109/Townline



2026 PM Peak Hour Left Turn Lane Warrant – CR 109/Townline



**2031 AM Peak Hour Left Turn Lane Warrant – CR 109/Townline**

## **Appendix H: Future Total 2026 Capacity Analysis**

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# HCM Unsignalized Intersection Capacity Analysis

## 3: CR 109 & Townline

12/07/2021



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	120	618	298	46	31	31
Future Volume (Veh/h)	120	618	298	46	31	31
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)	130	672	324	50	34	34
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	374				1256	324
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	374				1256	324
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	89				80	95
cM capacity (veh/h)	1184				168	717
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	130	672	324	50	68	
Volume Left	130	0	0	0	34	
Volume Right	0	0	0	50	34	
cSH	1184	1700	1700	1700	273	
Volume to Capacity	0.11	0.40	0.19	0.03	0.25	
Queue Length 95th (m)	2.8	0.0	0.0	0.0	7.3	
Control Delay (s)	8.4	0.0	0.0	0.0	22.5	
Lane LOS	A				C	
Approach Delay (s)	1.4		0.0		22.5	
Approach LOS					C	
Intersection Summary						
Average Delay			2.1			
Intersection Capacity Utilization			42.8%		ICU Level of Service	A
Analysis Period (min)			15			

# HCM Unsignalized Intersection Capacity Analysis

## 3: CR 109 & Townline

12/07/2021



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	26	487	751	35	43	128
Future Volume (Veh/h)	26	487	751	35	43	128
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)	28	529	816	38	47	139
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	854				1401	816
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	854				1401	816
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	96				68	63
cM capacity (veh/h)	785				149	377
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	28	529	816	38	186	
Volume Left	28	0	0	0	47	
Volume Right	0	0	0	38	139	
cSH	785	1700	1700	1700	272	
Volume to Capacity	0.04	0.31	0.48	0.02	0.68	
Queue Length 95th (m)	0.8	0.0	0.0	0.0	34.7	
Control Delay (s)	9.8	0.0	0.0	0.0	42.7	
Lane LOS	A				E	
Approach Delay (s)	0.5		0.0		42.7	
Approach LOS					E	
Intersection Summary						
Average Delay			5.1			
Intersection Capacity Utilization			56.5%		ICU Level of Service	B
Analysis Period (min)			15			

# HCM Unsignalized Intersection Capacity Analysis

## 5: Townline & Street B

12/07/2021



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↘			↕	↕	
Traffic Volume (veh/h)	22	33	151	15	28	100
Future Volume (Veh/h)	22	33	151	15	28	100
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)	24	36	164	16	30	109
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	428	84	139			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	428	84	139			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	95	96	89			
cM capacity (veh/h)	517	975	1445			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	60	180	139			
Volume Left	24	164	0			
Volume Right	36	0	109			
cSH	720	1445	1700			
Volume to Capacity	0.08	0.11	0.08			
Queue Length 95th (m)	2.1	2.9	0.0			
Control Delay (s)	10.5	7.2	0.0			
Lane LOS	B	A				
Approach Delay (s)	10.5	7.2	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			5.1			
Intersection Capacity Utilization			30.1%	ICU Level of Service	A	
Analysis Period (min)			15			

# HCM Unsignalized Intersection Capacity Analysis

## 5: Townline & Street B

12/07/2021



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	109	163	43	18	9	29
Future Volume (Veh/h)	109	163	43	18	9	29
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)	118	177	47	20	10	32
<b>Pedestrians</b>						
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	140	26	42			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	140	26	42			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	86	83	97			
cM capacity (veh/h)	827	1050	1567			
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>NB 1</b>	<b>SB 1</b>			
Volume Total	295	67	42			
Volume Left	118	47	0			
Volume Right	177	0	32			
cSH	948	1567	1700			
Volume to Capacity	0.31	0.03	0.02			
Queue Length 95th (m)	10.1	0.7	0.0			
Control Delay (s)	10.5	5.2	0.0			
Lane LOS	B	A				
Approach Delay (s)	10.5	5.2	0.0			
Approach LOS	B					
<b>Intersection Summary</b>						
Average Delay			8.5			
Intersection Capacity Utilization			32.7%	ICU Level of Service	A	
Analysis Period (min)			15			

## **Appendix I: Future Total 2031 Capacity Analysis**

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# HCM Unsignalized Intersection Capacity Analysis

## 3: CR 109 & Townline

12/07/2021



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	70	665	325	56	57	21
Future Volume (Veh/h)	70	665	325	56	57	21
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)	76	723	353	61	62	23
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	414				1228	353
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	414				1228	353
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	93				66	97
cM capacity (veh/h)	1145				184	691
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	76	723	353	61	85	
Volume Left	76	0	0	0	62	
Volume Right	0	0	0	61	23	
cSH	1145	1700	1700	1700	229	
Volume to Capacity	0.07	0.43	0.21	0.04	0.37	
Queue Length 95th (m)	1.6	0.0	0.0	0.0	12.3	
Control Delay (s)	8.4	0.0	0.0	0.0	29.7	
Lane LOS	A				D	
Approach Delay (s)	0.8		0.0		29.7	
Approach LOS					D	
Intersection Summary						
Average Delay			2.4			
Intersection Capacity Utilization			46.1%		ICU Level of Service	A
Analysis Period (min)			15			

# HCM Unsignalized Intersection Capacity Analysis

## 3: CR 109 & Townline

12/07/2021



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	12	528	812	64	60	74
Future Volume (Veh/h)	12	528	812	64	60	74
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)	13	574	883	70	65	80
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	953				1483	883
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	953				1483	883
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				52	77
cM capacity (veh/h)	721				135	345
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	13	574	883	70	145	
Volume Left	13	0	0	0	65	
Volume Right	0	0	0	70	80	
cSH	721	1700	1700	1700	203	
Volume to Capacity	0.02	0.34	0.52	0.04	0.71	
Queue Length 95th (m)	0.4	0.0	0.0	0.0	34.8	
Control Delay (s)	10.1	0.0	0.0	0.0	57.3	
Lane LOS	B				F	
Approach Delay (s)	0.2		0.0		57.3	
Approach LOS					F	
Intersection Summary						
Average Delay			5.0			
Intersection Capacity Utilization			57.3%		ICU Level of Service	B
Analysis Period (min)			15			

Lanes, Volumes, Timings  
3: CR 109 & Townline

12/07/2021



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	70	665	325	56	57	21
Future Volume (vph)	70	665	325	56	57	21
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	40.0			40.0	0.0	0.0
Storage Lanes	1			1	1	0
Taper Length (m)	2.5				2.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt				0.850	0.963	
Flt Protected	0.950				0.965	
Satd. Flow (prot)	1789	1883	1883	1601	1750	0
Flt Permitted	0.518				0.965	
Satd. Flow (perm)	976	1883	1883	1601	1750	0
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				61	22	
Link Speed (k/h)		80	80		60	
Link Distance (m)		731.1	635.9		618.3	
Travel Time (s)		32.9	28.6		37.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	76	723	353	61	62	23
Shared Lane Traffic (%)						
Lane Group Flow (vph)	76	723	353	61	85	0
Turn Type	Perm	NA	NA	Perm	Prot	
Protected Phases		4	8		6	
Permitted Phases	4			8		
Detector Phase	4	4	8	8	6	
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0	
Total Split (s)	55.0	55.0	55.0	55.0	25.0	
Total Split (%)	68.8%	68.8%	68.8%	68.8%	31.3%	
Maximum Green (s)	49.0	49.0	49.0	49.0	19.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	Max	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0	
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0	
Pedestrian Calls (#/hr)	0	0	0	0	0	
Act Effct Green (s)	28.5	28.5	28.5	28.5	19.4	
Actuated g/C Ratio	0.47	0.47	0.47	0.47	0.32	
v/c Ratio	0.16	0.81	0.40	0.08	0.15	
Control Delay	9.0	21.1	11.0	2.4	15.2	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	9.0	21.1	11.0	2.4	15.2	

Lanes, Volumes, Timings  
3: CR 109 & Townline

12/07/2021

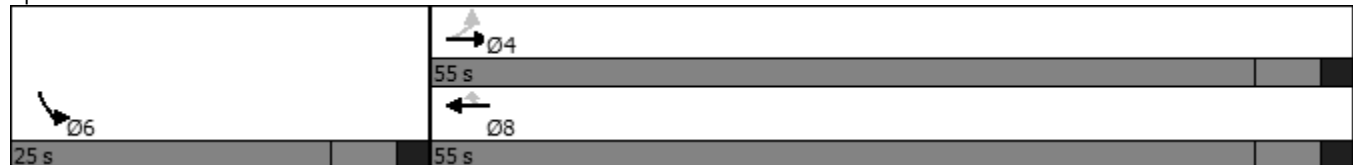


Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
LOS	A	C	B	A	B	
Approach Delay		19.9	9.7		15.2	
Approach LOS		B	A		B	
Queue Length 50th (m)	4.4	62.1	22.9	0.0	4.8	
Queue Length 95th (m)	10.0	96.6	37.0	4.1	17.2	
Internal Link Dist (m)		707.1	611.9		594.3	
Turn Bay Length (m)	40.0			40.0		
Base Capacity (vph)	809	1562	1562	1338	579	
Starvation Cap Reductn	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	
Reduced v/c Ratio	0.09	0.46	0.23	0.05	0.15	

Intersection Summary

Area Type: Other  
 Cycle Length: 80  
 Actuated Cycle Length: 60.2  
 Natural Cycle: 60  
 Control Type: Semi Act-Uncoord  
 Maximum v/c Ratio: 0.81  
 Intersection Signal Delay: 16.4  
 Intersection LOS: B  
 Intersection Capacity Utilization 49.4%  
 ICU Level of Service A  
 Analysis Period (min) 15

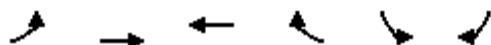
Splits and Phases: 3: CR 109 & Townline



# Lanes, Volumes, Timings

## 3: CR 109 & Townline

12/07/2021



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	12	528	812	64	60	74
Future Volume (vph)	12	528	812	64	60	74
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	40.0			40.0	0.0	0.0
Storage Lanes	1			1	1	0
Taper Length (m)	2.5				2.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt				0.850	0.926	
Flt Protected	0.950				0.978	
Satd. Flow (prot)	1789	1883	1883	1601	1706	0
Flt Permitted	0.120				0.978	
Satd. Flow (perm)	226	1883	1883	1601	1706	0
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				60	71	
Link Speed (k/h)		80	80		60	
Link Distance (m)		731.1	635.9		618.3	
Travel Time (s)		32.9	28.6		37.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	13	574	883	70	65	80
Shared Lane Traffic (%)						
Lane Group Flow (vph)	13	574	883	70	145	0
Turn Type	Perm	NA	NA	Perm	Prot	
Protected Phases		4	8		6	
Permitted Phases	4			8		
Detector Phase	4	4	8	8	6	
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0	
Total Split (s)	56.0	56.0	56.0	56.0	24.0	
Total Split (%)	70.0%	70.0%	70.0%	70.0%	30.0%	
Maximum Green (s)	50.0	50.0	50.0	50.0	18.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	Max	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0	
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0	
Pedestrian Calls (#/hr)	0	0	0	0	0	
Act Effct Green (s)	36.2	36.2	36.2	36.2	18.4	
Actuated g/C Ratio	0.54	0.54	0.54	0.54	0.28	
v/c Ratio	0.11	0.56	0.87	0.08	0.28	
Control Delay	8.8	11.9	22.8	2.5	14.7	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	8.8	11.9	22.8	2.5	14.7	

Lanes, Volumes, Timings  
3: CR 109 & Townline

12/07/2021



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
LOS	A	B	C	A	B	
Approach Delay		11.9	21.4		14.7	
Approach LOS		B	C		B	
Queue Length 50th (m)	0.7	41.9	84.4	0.5	7.0	
Queue Length 95th (m)	3.1	63.8	131.3	4.6	23.8	
Internal Link Dist (m)		707.1	611.9		594.3	
Turn Bay Length (m)	40.0			40.0		
Base Capacity (vph)	172	1439	1439	1237	520	
Starvation Cap Reductn	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	
Reduced v/c Ratio	0.08	0.40	0.61	0.06	0.28	

Intersection Summary

Area Type:	Other
Cycle Length:	80
Actuated Cycle Length:	66.9
Natural Cycle:	60
Control Type:	Semi Act-Uncoord
Maximum v/c Ratio:	0.87
Intersection Signal Delay:	17.5
Intersection LOS:	B
Intersection Capacity Utilization:	60.6%
ICU Level of Service:	B
Analysis Period (min):	15

Splits and Phases: 3: CR 109 & Townline

	<p>56 s</p>	<p>56 s</p>
<p>24 s</p>		

# HCM Unsignalized Intersection Capacity Analysis

## 5: Townline & Street B

12/07/2021



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	11	46	108	17	32	50
Future Volume (Veh/h)	11	46	108	17	32	50
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)	12	50	117	18	35	54
<b>Pedestrians</b>						
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	314	62	89			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	314	62	89			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	95	92			
cM capacity (veh/h)	626	1003	1506			
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>NB 1</b>	<b>SB 1</b>			
Volume Total	62	135	89			
Volume Left	12	117	0			
Volume Right	50	0	54			
cSH	898	1506	1700			
Volume to Capacity	0.07	0.08	0.05			
Queue Length 95th (m)	1.7	1.9	0.0			
Control Delay (s)	9.3	6.7	0.0			
Lane LOS	A	A				
Approach Delay (s)	9.3	6.7	0.0			
Approach LOS	A					
<b>Intersection Summary</b>						
Average Delay			5.2			
Intersection Capacity Utilization			23.7%	ICU Level of Service	A	
Analysis Period (min)			15			

# HCM Unsignalized Intersection Capacity Analysis

## 5: Townline & Street B

12/07/2021



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	54	124	55	21	10	14
Future Volume (Veh/h)	54	124	55	21	10	14
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)	59	135	60	23	11	15
<b>Pedestrians</b>						
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	162	18	26			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	162	18	26			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	93	87	96			
cM capacity (veh/h)	798	1060	1588			
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>NB 1</b>	<b>SB 1</b>			
Volume Total	194	83	26			
Volume Left	59	60	0			
Volume Right	135	0	15			
cSH	964	1588	1700			
Volume to Capacity	0.20	0.04	0.02			
Queue Length 95th (m)	5.7	0.9	0.0			
Control Delay (s)	9.7	5.4	0.0			
Lane LOS	A	A				
Approach Delay (s)	9.7	5.4	0.0			
Approach LOS	A					
<b>Intersection Summary</b>						
Average Delay			7.7			
Intersection Capacity Utilization			28.1%	ICU Level of Service	A	
Analysis Period (min)			15			