Traffic Impact Study

Residential & Commercial Developments (East of CR10)

Fallis Line, Millbrook, ON

Township of Cavan Monaghan,

County of Peterborough

ASURZA ENGINEERS

April 28, 2021

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Project Nº 2124-19

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April 28, 2021

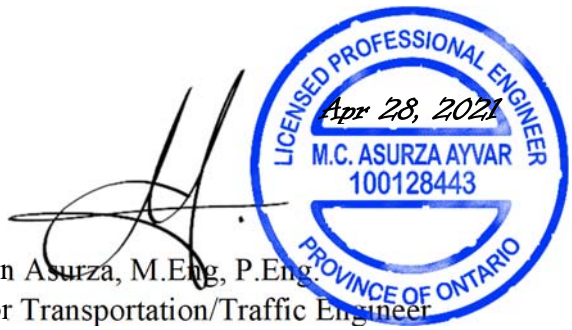
Mr. Peter Berardi,
Vargas Properties Inc.
235 – 380 Armour Rd.
Peterborough, ON
K9H 7L7

Dear Mr. Berardi,

Reference: Residential & Commercial Developments (East of CR10)
Traffic Impact Study Report
Township of Cavan Monaghan, County of Peterborough
Project Nº 2124-19

Asurza Engineers Ltd. is pleased to submit the enclosed Traffic Report for the proposed Residential & Commercial Developments in Millbrook. The study and report were prepared on behalf of the proponent as part of the documentation required by the Municipality of the Township of Cavan Monaghan.

Should you have any questions regarding this report, please do not hesitate to contact the undersigned.



Martin Asurza, M.Eng, P.Eng.
Senior Transportation/Traffic Engineer

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Executive Summary

Asurza Engineers Ltd. was retained to undertake a traffic impact study in order to review, assess, and determine any traffic impact the proposed development may generate on the adjacent road and intersections.

The subject sites, are vacant land, they are located on the east side of County Rd (CR10), south of Fallis Line in the Township of Cavan Monaghan, County of Peterborough.

The sites are proposed for development to include an area for residential and another area for commercial (see Exhibit 2). The residential development includes a mixture of single detached, townhouses and apartment units. The commercial development includes a gas stion, restaurant, supermarket, medical offices and general office building. For purposes of this study, the build-out of the commercial development is set for the year 2025; by the same year, it is expected the proposed residential development is 50% developed/occupied, and for the year 2030 is expected to be fully developed/occupied.

In order to evaluate existing conditions, traffic operations were evaluated at intersections within the study area. The traffic operations for the existing condition (2021) shows that turning movements at intersections are operating well, with level of service “A”, “B” or “C”.

In order to establish base conditions for comparison and evaluation of future scenarios, it is necessary to review results of traffic operations over time. The estimated normal growth traffic volumes are based under the

premise that existing geometric conditions is maintained and that traffic growth is expected over the next years.

As part of the background volumes; the study includes those major proposed developments that are approved or in construction. The traffic volumes of these developments were obtained from the "Millbrook Development Phase 2 – Traffic Impact Study for the Tower Hill Developments Ltd." Prepared by JD Engineering.

With the normal growth over time and the additional traffic generated by those approved or in construction developments, the intersections become more saturated with some movements that reach their capacity. The most impacted is the CR10/Fallis Line intersection with some movements at level of service "F".

Estimation of trips generated by the proposed development were derived from the Trip Generation Manual, 10th Edition, published by the Institute of Transportation Engineers (ITE). According to the ITE Trip Generation Rates, the proposed developments will generate approximately 450 new trips for the year 2025 and approximately 550 new trips for the year 2030.

Since the intersections are reaching their capacity (unsignalized intersections), they will require the installation of traffic signals to allow for additional traffic. For purposes of evaluating total volumes (including the new trips generated by the proposed developments) the intersections were assessed with traffic signals and auxiliary lanes. With these improvements, the CR10/Larmer Line and CR10/Fallis Line intersections will be able to handle the additional traffic generated by the proposed developments.

From the traffic point of view, it is concluded that no road geometric improvement is required and that the proposed development can take place without significant impact to existing conditions.

Therefore, from the traffic point of view and with the inclusion of the recommended improvements, the proposed developments can take place without significant impacts to traffic operations.

Table of Content

1 Introduction 9
1.1 Overview 9
1.2 Objectives 9
2 Existing Conditions 11
2.1 Study Area 11
2.2 The Site 12
2.3 Roadway Network 13
2.4 Traffic Data 14
2.5 Existing Traffic Volumes 15
2.6 Existing Traffic Operations 19
3 Background Traffic Volumes 22
3.1 Background Traffic Volumes 22
4 Proposed Development Traffic Forecasting 32
4.1 Traffic Impact Study Methodology 32
4.2 Site Trip Generation 32
4.3 Trip Distribution/Assignment 37
5 Future Traffic Operations 45
5.1 Future Traffic Volumes 45
5.2 Scenarios 45
5.3 Total Traffic Volumes for Horizon Years 45
5.4 Future Traffic Operations at Intersections 52
5.5 Future Traffic Operations at Accesses 54

6 Roadway Geometry Review.....63
6.1 Auxiliary Lanes Review 63
6.2 Stopping Sight Distance at Entrance.....63
7 Drive-Through Window – Vehicle Storage 65
7.1 The Restaurant with Drive-Through Window.....65
7.2 Review of Ontario Municipal Zoning By-Law Requirements.....65
8 Conclusions/Recommendations 67

List of Exhibits

Exhibit 1: *Study Area.*

Exhibit 2: *The Site.*

Exhibit 3: *Existing Lane Configuration at Intersections.*

Exhibit 4: *Existing AM Peak Hour Traffic Volumes (2021).*

Exhibit 5: *Existing PM Peak Hour Traffic Volumes (2021).*

Exhibit 6: *Existing SAT Peak Hour Traffic Volumes (2021).*

Exhibit 7: *Sketch of Development Within the Area.*

Exhibit 8: *Background AM Peak Hour Traffic Volumes (2025).*

Exhibit 9: *Background PM Peak Hour Traffic Volumes (2025).*

Exhibit 10: *Background SAT Peak Hour Traffic Volumes (2025).*

Exhibit 11: *Background AM Peak Hour Traffic Volumes (2030).*

Exhibit 12: *Background PM Peak Hour Traffic Volumes (2030).*

Exhibit 13: *Background SAT Peak Hour Traffic Volumes (2030).*

Exhibit 14: *AM Peak Hour Developments Trips - 2025.*

Exhibit 15: *PM Peak Hour Developments Trips - 2025.*

Exhibit 16: *SAT Peak Hour Developments Trips - 2025.*

Exhibit 17: *AM Peak Hour Developments Trips - 2030.*

Exhibit 18: *PM Peak Hour Developments Trips - 2030.*

Exhibit 19: *SAT Peak Hour Developments Trips - 2030.*

Exhibit 20: *AM Peak Hour Total Trips – 2025.*

Exhibit 21: *PM Peak Hour Total Trips – 2025.*

Exhibit 22: *SAT Peak Hour Total Trips – 2025.*

Exhibit 23: *AM Peak Hour Total Trips – 2030.*

Exhibit 24: *PM Peak Hour Total Trips – 2030.*

Exhibit 25: *SAT Peak Hour Total Trips – 2030.*

Exhibit 26: *AM Generated Trips at Accesses – 2025.*

Exhibit 27: *PM Generated Trips at Accesses – 2025.*

Exhibit 28: *SAT Generated Trips at Accesses – 2025.*

Exhibit 29: *AM Generated Trips at Accesses – 2030.*

Exhibit 30: *PM Generated Trips at Accesses – 2030.*

Exhibit 31: *SAT Generated Trips at Accesses – 2030.*

Exhibit 32: *CR10/Fallis Line Intersection – Sketch of Improvements.*

Exhibit 33: *CR10/Larmer Line Intersection – Sketch of Improvements.*

List of Tables

Table 1: *Level of Service Definition.*

Table 2: *Existing 2021 Intersection Capacity – AM, PM, SAT Peak Hour.*

Table 3: *Background 2025 Intersection Capacity – AM, PM, SAT Peak Hour.*

Table 4: *Background 2030 Intersection Capacity – AM, PM, SAT Peak Hour.*

Table 5: *Trips Rates per Land Use.*

Table 6: *Trips Generated by the Proposed Residential Development.*

Table 7: *Trips Generated by the Proposed Commercial Development.*

Table 8: *Total Traffic Volumes Operation Results – Horizon Year 2025.*

Table 9: *Total Traffic Volumes Operation Results – Horizon Year 2030.*

Table 10: *Traffic Operation Results at Accesses – Horizon Year 2025.*

Table 11: *Traffic Operation Results at Accesses – Horizon Year 2030.*

Table 12: *Various Ontario Municipal Zoning By-Law Requirements.*

Appendices

Appendix A – Preliminary Site Plan

Appendix B – Traffic Data and Data Projections

Appendix C – Synchro Reports – Existing Conditions Year 2021

Appendix D – Synchro Reports – Background Horizon Year 2025

Appendix E – Synchro Reports – Background Horizon Year 2030

Appendix F – Trip Distribution Process

Appendix G – Intersection Synchro Reports – Total Horizon Year 2025

Appendix H – Intersection Synchro Reports – Total Horizon Year 2030

Appendix I – Accesses Synchro Reports – Total Horizon Year 2025

Appendix J – Accesses Synchro Reports – Total Horizon Year 2030

Appendix K – Left Turn Lane Warrants Review

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1 Introduction

1.1 Overview

Asurza Engineers Ltd. was retained by The Applicant or Developer, to undertake a traffic impact study for the proposed Developments located at the southeast quadrant of the County Road 10/Fallis Line intersection, in the Township of Cavan Monaghan, County of Peterborough. The report was prepared for the Township's review and approval in order to permit the proposed developments.

1.2 Objectives

The purpose of this study is to determine any traffic impact the proposed developments may generate on the adjacent roadway, as well as to identify the required improvements to maintain acceptable operational levels on the roadway within the study area.

The general scope of this study includes the following key elements:

- Establish a baseline traffic conditions for the study area.
- Estimate the traffic growth for future planning horizons.
- Estimate the additional traffic the proposed development will generate.
- Estimate the total future traffic and identify impacts within the study area.
- Identify any operational and/or geometric issues within the study area.
- Provide recommendations to address any deficiencies, if identified.

To achieve these objectives, the traffic study makes use of accepted methodologies and procedures including informational reports, publications from recognized institutions and agencies, recommended best practice manuals and municipal guidelines when available. These documents will be noted within the report in the associated topic of discussion.

2 Existing Conditions

2.1 Study Area

The Township of Cavan Monaghan, with a population of 8,829 residents, according to the 2016 Census, is located approximately 20 kilometres southwest of the city of Peterborough.

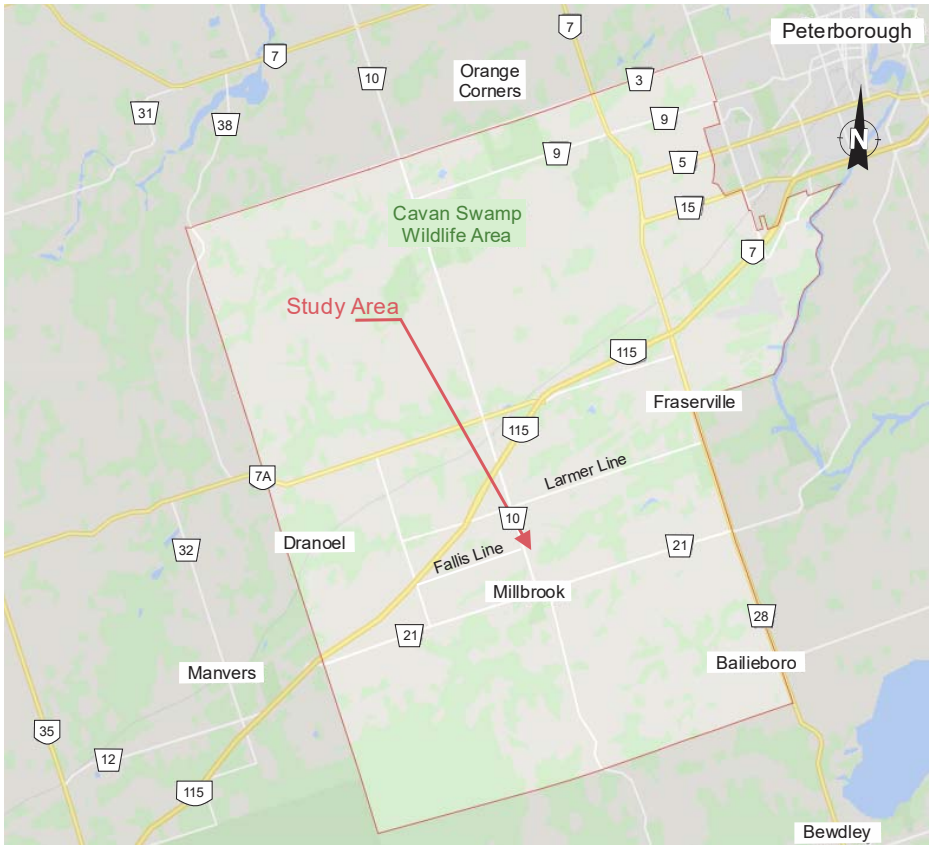

Exhibit 1: *Study Area.*

The proposed development is located east of County Road 10 (CR10) and south of Fallis Line. The traffic study includes the operational analysis of the following intersections:

- CR10/Larmer Line. unsignalized intersection
- CR10/Fallis Line. unsignalized intersection
- CR10/Centennial Ln unsignalized intersection
- CR10/CR21. unsignalized intersection

2.2 The Site

The subject sites for the residential and commercial developments, are vacant lands located on the east of County Road 10 (CR10), see Exhibit 2.

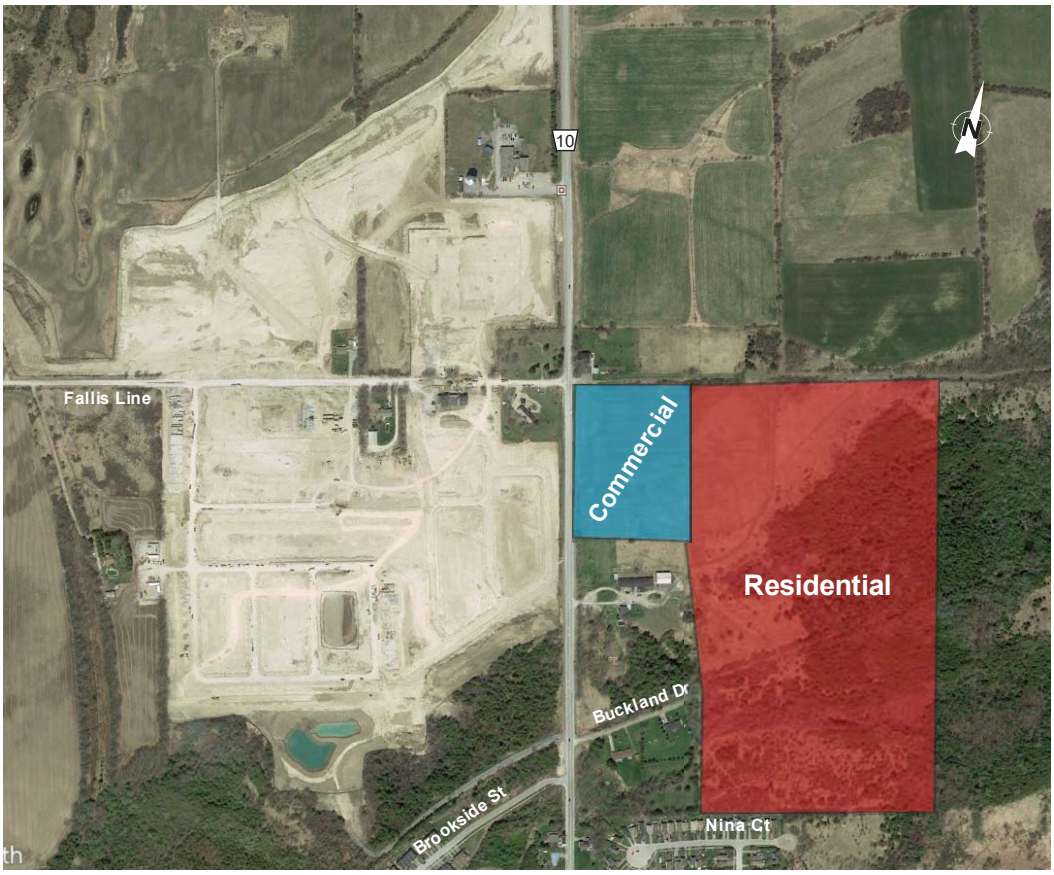

Exhibit 2: *The Site.*

These sites are intended for development to include a residential development with a total of 244 units, as noted below:

- 35’ Single Detached – 54 units
- 45’ Single Detached – 44 units
- 52’ Single Detached – 18 units
- 24’ Street Townhouse – 58 unites
- Medium Density (5-Storey Building) – 70 units

And a Commercial development to include the following:

- Office Buildings/Retail
- Medical-Dental Office Building
- Supermarket
- Fast-Food Restaurant with Drive-Through Window
- Gasoline/Service Station with Convenience Market

The commercial development will provide on-site parking facilities (See Preliminary Site Plan in **Appendix A**).

The build-out of the commercial development is anticipated for the year 2025; by the same year, it is expected the residential development is 50% developed/occupied, and for the 2030 is already fully developed/occupied.

2.3 Roadway Network

County Road (CR10) within the study area is a two-lane (one lane per direction) north/south arterial road. In general, CR10 shows a rural cross-section with granular shoulders and ditches for surface water drainage; as the road approached the Downtown, CR10 becomes and urban roadway with curb & gutter, sidewalks and catchbasin for surface water collection. CR10 (locally named as Tupper St) connects with King St (CR21) to make a 4-leg 4-way stop intersection. This intersection surrounding shows a commercial area environment with the intersection being the core center of Millbrook. CR10 posted speed is 80 km/h north of the site; within the site is reduced to 60 km/h and within the urban area, the posted speed is 50 Km/h.

Larmer Line is a two-lane (one lane per direction) east/west rural road. It connects with CR10 to make a 4-leg intersection with stop signs at both

approaches of Larmer Line. There is no posted speed on Larmer Line; however, according to the Ontario Traffic Act, any road is restricted to 50 km/h unless posted otherwise.

Fallis Line is a two-lane (one lane per direction) east/west rural road. It also connects with CR10 to form a 4-leg intersection; the east leg of Fallis Line is more like an unpaved pathway which currently serves like a driveway for the adjacent property. Fallis Line has a posted speed limit of 60 km/h.

Centennial Lane is a two-lane (one lane per direction) local road, it connects with CR10 to form a 4-leg intersection. The west approach is actually the access of the Millbrook/South Cavan Public School. There is no posted speed on Centennial Rd; therefore, the legislative speed limit is 50 km/h.

County Road 21 (CR21), also locally know as King Street, is a two-lane (one lane per direction) east/west urban arterial road. The road has a mix of a residential and commercial environment within the intersection area. A speed of 50 Km/h is posted within this area.

2.4 Traffic Data

Due to the provincial actions to control Covid-19, regular traffic has been impacted; therefore, the use of field traffic counts has been very limited or included as supplementary information when required. For purposes of this study, traffic data was obtained from the turning movement count reports included in the “Millbrook Development Phase 2 – Traffic Impact Study for the Tower Hill Developments Ltd.” Prepared by JD Engineering; these counts were done in the year 2017 (Pre-Covid) for the CR10/Larmer Line and CR10/Fallis Line intersections.

The County of Peterborough provided turning movement counts for the CR10/CR21/Distillery St intersection, counts were performed in 2018.

Field traffic counts for the CR10/Centennial Lane/School driveway intersection was performed in 2021 to obtain the traffic activities from the school; the intersection was estimated to 2021 assuming no impacts to traffic due to Covid-19.

2.5 Existing Traffic Volumes

The existing lane configuration and traffic control at intersections are shown in Exhibit 3. Existing traffic turning volumes for the morning, afternoon and Saturday peak hours at the performed intersections are shown in Exhibit 4, 5 and 6, respectively.

Existing Lane Configuration at Intersections

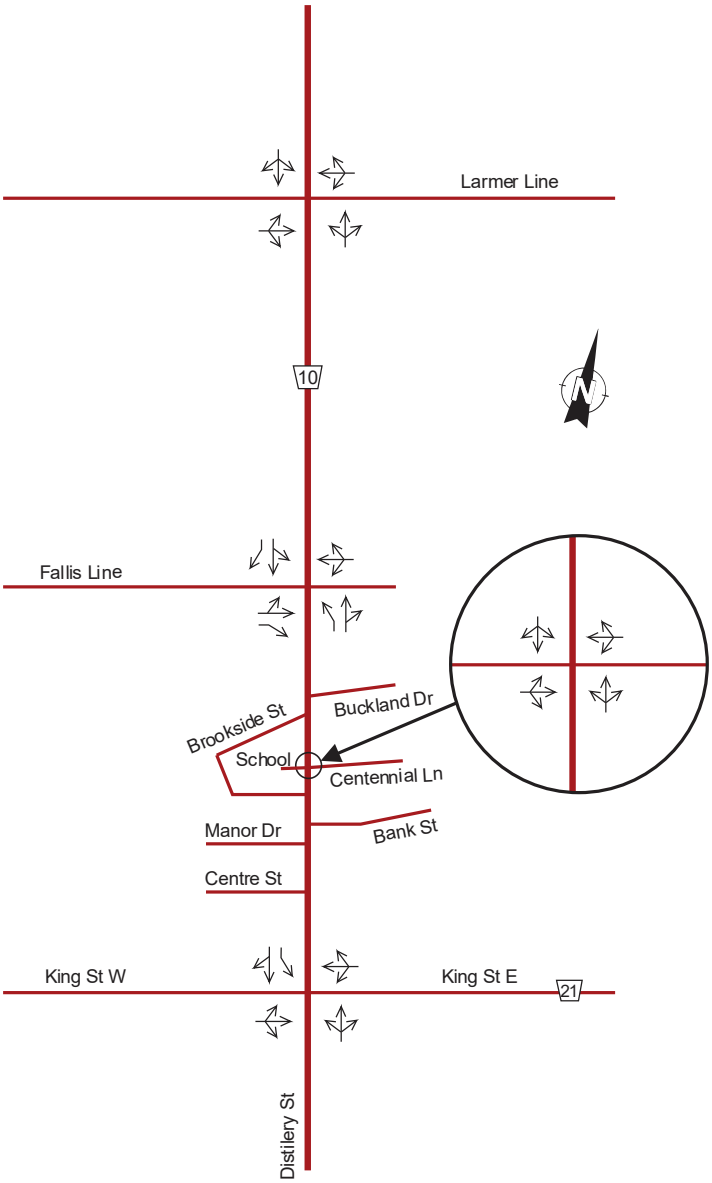

Exhibit 3: *Existing Lane Configuration at Intersections.*

AM Peak Hour - Existing Volumes 2021

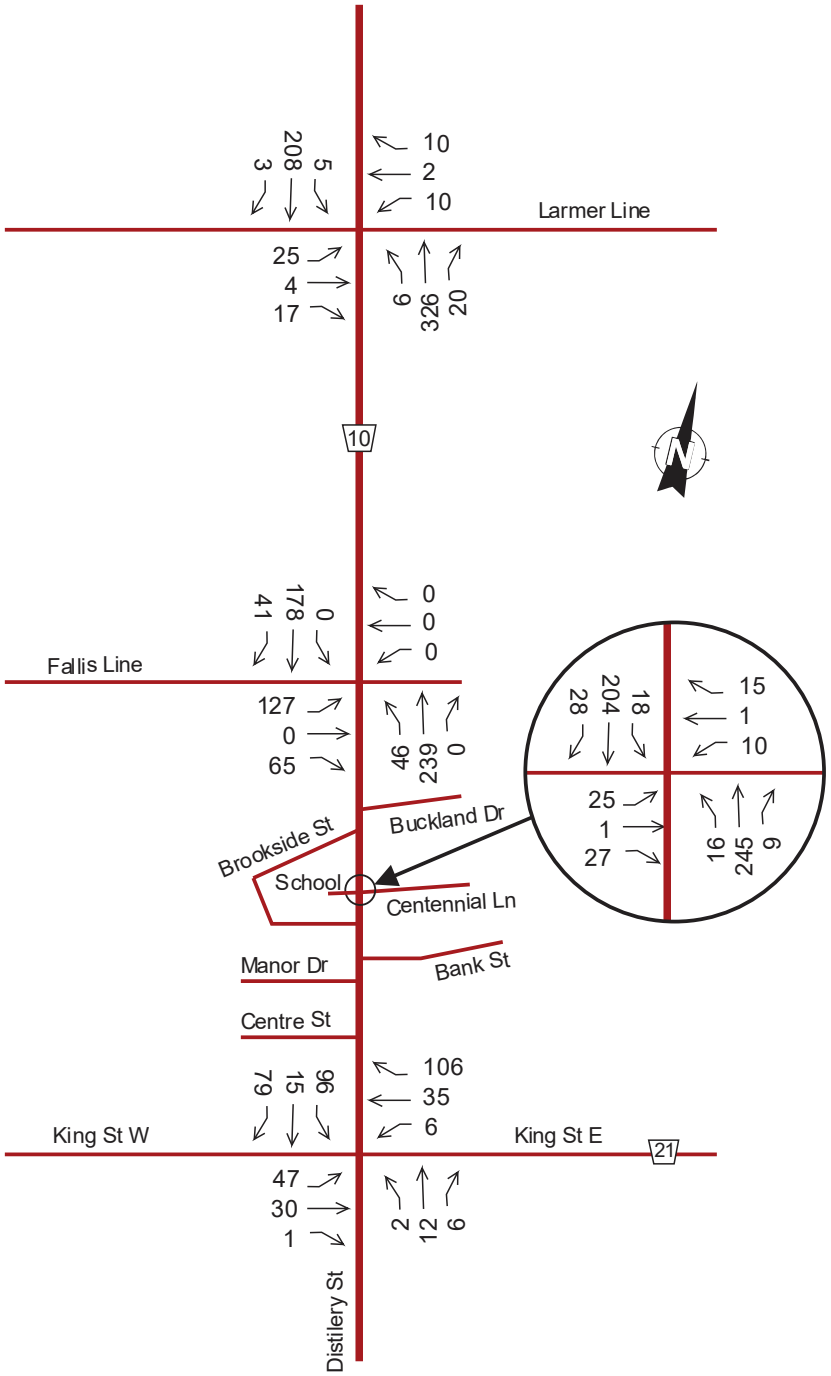

Exhibit 4: *Existing AM Peak Hour Traffic Volumes (2021).*

PM Peak Hour - Existing Volumes 2021

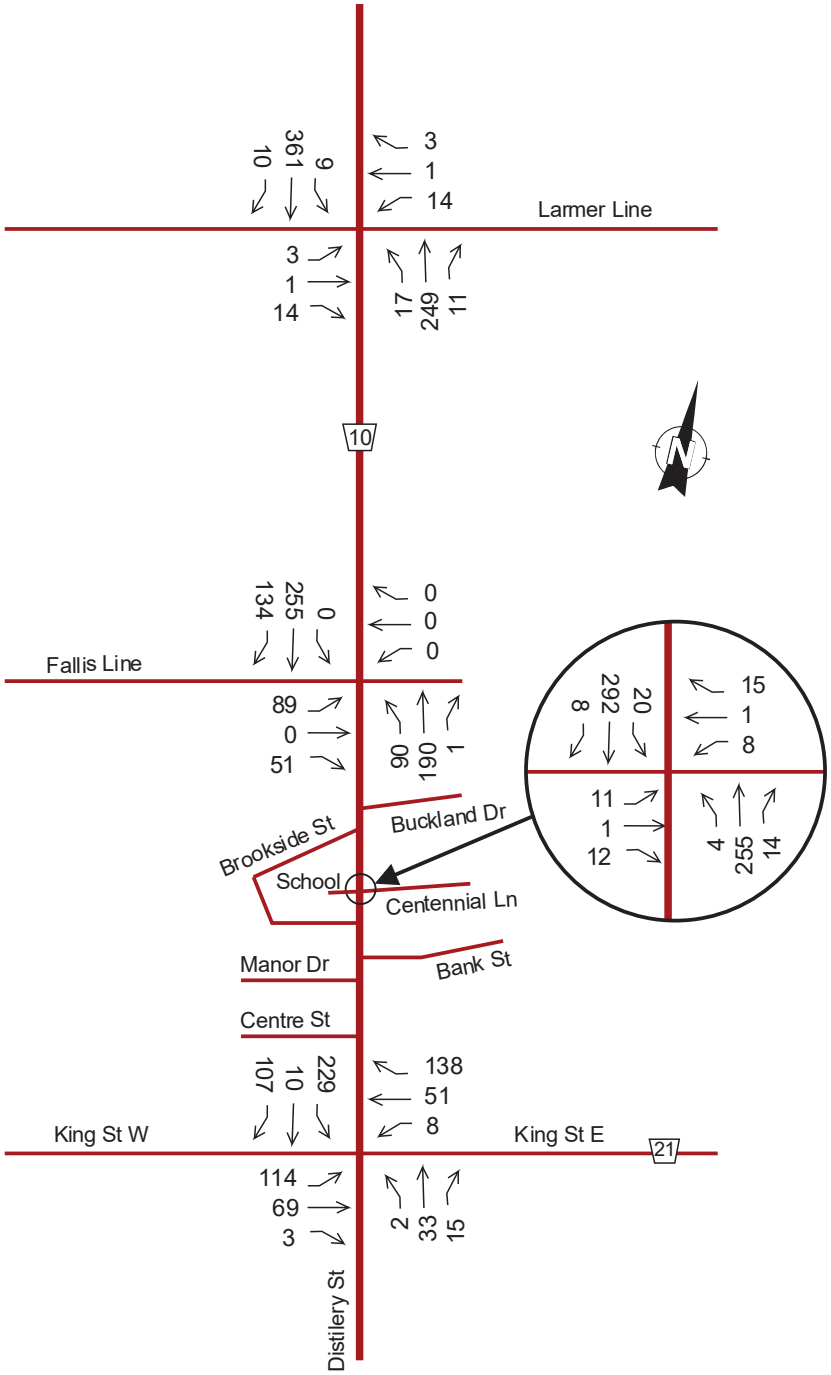

Exhibit 5: *Existing PM Peak Hour Traffic Volumes (2021).*

SAT Peak Hour - Existing Volumes 2021

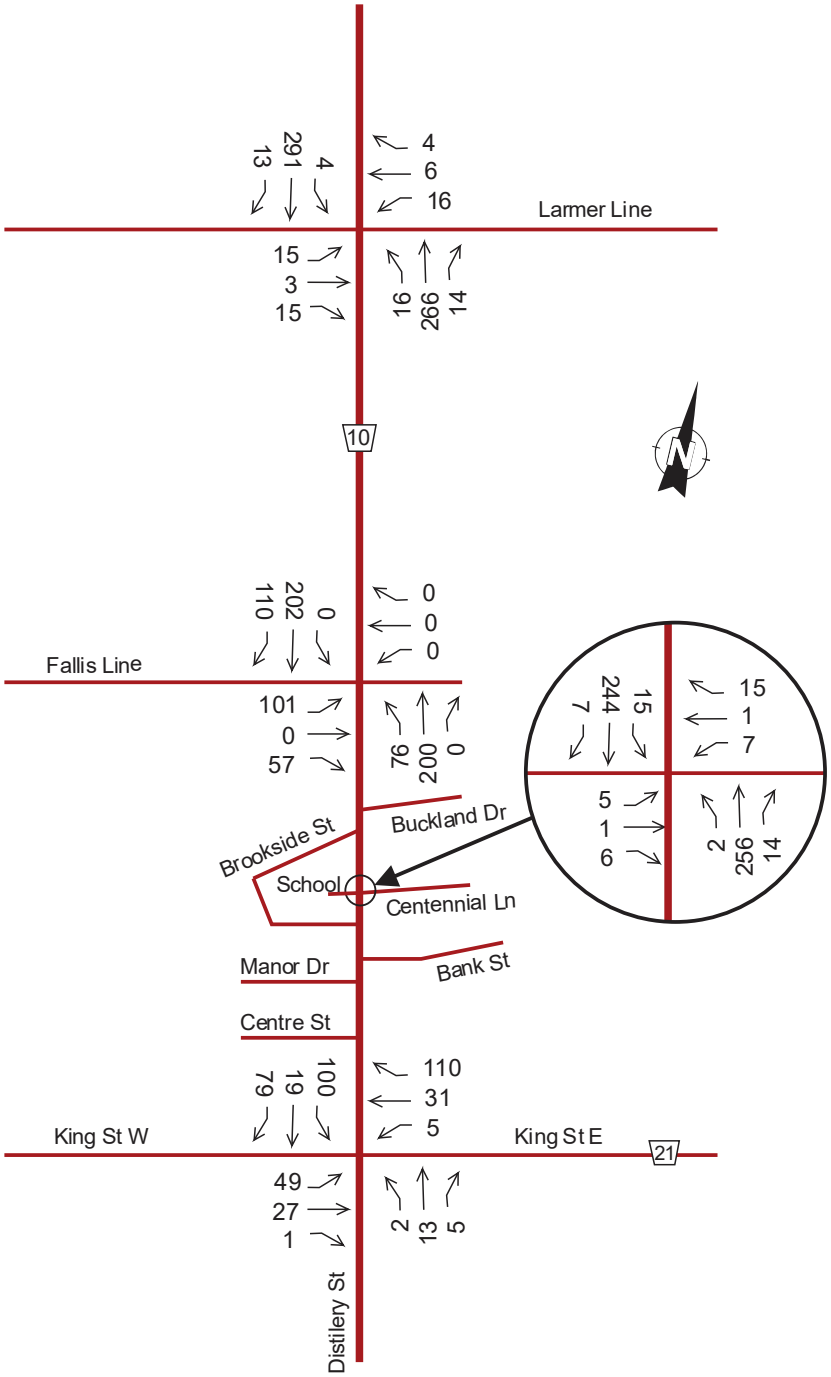

Exhibit 6: *Existing SAT Peak Hour Traffic Volumes (2021).*

The Tower Hills South residential development is still in construction but close to its final stage. The last year 2020, the number of units already built/occupied reached approximately 75% of the total; for purposes of this study, it is expected that during the 2021 (existing year) the 100% is built and occupied; therefore, the above noted exhibits include the total traffic generated by the Tower Hills South as part of the existing traffic volumes. The same for the Millbrook Community Centre, the trips generated by this facility were included as part of the existing volumes. The traffic volumes of these developments were obtained from the "Millbrook Development Phase 2 – Traffic Impact Study for the Tower Hill Developments Ltd." Prepared by JD Engineering; the same is included in the appendix of this report.

2.6 Existing Traffic Operations

Intersection level of service (LOS) is a recognized method of qualifying the efficiency of traffic flow at intersections. The assigned LOS is determined on the delay caused by the control system 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.

For stop-controlled intersection, the method assesses the available and critical gaps in the traffic stream, which make it possible for the side road traffic to enter the main street flow. High delays are indicative of insufficient gaps in the approaching traffic flow to allow vehicles from the side street to execute their turning movements.

LOS	Signalized Intersection Control Delay (sec/veh)	Stop Controlled Intersection Control Delay (sec/veh)
A	0 - 10	0 - 10
B	> 10 - 20	> 10 - 15
C	> 20 - 35	> 15 - 25
D	> 35 - 55	> 25 - 35
E	> 55 - 80	> 35 - 50
F	> 80	> 50

Table 1: *Level of Service Definition.*

Table 1 shows the level of service criteria for signalized and stop-controlled intersections. The level of service ranges from the letter 'A' to 'F' where 'A' represents the ideal traffic condition and 'F' represents the extreme congested traffic condition.

		Existing 2021											
		AM Peak Hour				PM Peak Hour				SAT Peak Hour			
		V/C	Delay (s)	Q_{95} (m)	LOS	V/C	Delay (s)	Q_{95} (m)	LOS	V/C	Delay (s)	Q_{95} (m)	LOS
CR10 / Larmer Line	EB-LTR	0.11	13.5	2.7	B	0.04	12.0	0.9	B	0.08	13.4	1.9	B
	WB-LTR	0.05	13.0	1.2	B	0.06	15.9	1.3	C	0.07	15.1	1.8	C
	NB-LTR	0.00	0.2	0.1	A	0.02	0.6	0.4	A	0.01	0.6	0.3	A
	SB-LTR	0.00	0.2	0.1	A	0.01	0.3	0.2	A	0.00	0.1	0.1	A
CR10 / Fallis Line	EB-TL	0.32	14.7	10.5	B	0.28	16.2	8.8	C	0.28	14.9	8.7	B
	EB-R	0.32	14.7	10.5	B	0.28	16.2	8.8	C	0.28	14.9	8.7	B
	WB-LTR	0.00	0.0	0.0	A	0.00	0.0	0.0	A	0.00	0.0	0.0	A
	NB-L	0.04	7.8	0.9	A	0.09	8.5	2.1	A	0.07	8.2	1.7	A
	NB-TR	0.15	0.0	0.0	A	0.12	0.0	0.0	A	0.13	0.0	0.0	A
	SB-TL	0.00	0.0	0.0	A	0.00	0.0	0.0	A	0.00	0.0	0.0	A
	SB-R	0.03	0.0	0.0	A	0.09	0.0	0.0	A	0.07	0.0	0.0	A
CR10 / Centennial Rd	EB-LTR	0.11	12.6	2.7	B	0.05	13.0	1.3	B	0.02	12.1	0.6	B
	WB-LTR	0.05	12.1	1.3	B	0.05	12.1	1.2	B	0.04	11.5	1.0	B
	NB-LTR	0.01	0.6	0.3	A	0.00	0.1	0.1	A	0.00	0.1	0.0	A
	SB-LTR	0.02	0.7	0.4	A	0.02	0.6	0.4	A	0.01	0.6	0.3	A
CR10 / Kiing St / Distillery Rd	EB-LTR	0.11	8.4	14.9	A	0.31	11.0	20.9	B	0.11	8.4	11.9	A
	WB-LTR	0.19	8.2	20.2	A	0.30	10.1	18.9	B	0.18	8.1	17.2	A
	NB-LTR	0.03	7.8	14.5	A	0.08	9.1	15.1	A	0.03	7.9	11.6	A
	SB-L	0.16	8.5	16.9	A	0.43	12.7	29.8	B	0.17	8.6	18.0	A
	SB-TR	0.13	7.0	14.9	A	0.18	8.0	19.9	A	0.13	7.1	23.0	A

Table 2: *Existing 2021 Intersection Capacity – AM, PM, SAT Peak Hour.*

The Synchro software, based on the Highway Capacity Manual 2000 methodologies (HCM 2000), was used to estimate the existing operations at the intersections. Results are summarized in ***Table 2.***

The intersection analysis considered the following:

- The average delay in seconds for each movement.
- The volume to capacity (v/c) ratio for each movement.
- The level of service for each movement.

During typical peak hours, results show that all movements at intersections are operating well with Level of Service (LOS) “A”, “B” or “C” for peak hours.

3 Background Traffic Volumes

3.1 Background Traffic Volumes

In order to establish base conditions for comparison and evaluation of future scenarios, it is necessary to review results of traffic operations over time. The estimated normal growth traffic volumes are based under the premise that existing geometric conditions is maintained and that traffic growth is expected over the next years.

As part of the background volumes; the study includes those major proposed developments that are approved or in construction, the sketch of these developments is shown in Exhibit 7. The traffic volumes of these developments were obtained from the "Millbrook Development Phase 2 – Traffic Impact Study for the Tower Hill Developments Ltd." Prepared by JD Engineering; these trips are included in the appendix.

Annual growth rate was estimated at 2.0% per year; this rate was used to project existing traffic volumes over the next years.

For estimation of the horizons years traffic volumes, the growth rate was applied to the existing volumes. The growth rate is yearly compounded.

The following Exhibits 8, 9 and 10 show the projected traffic volumes for the morning, afternoon and Saturday peak hours for the horizon years 2025 and 2030, respectively.

Sketch of Developments Within the Area

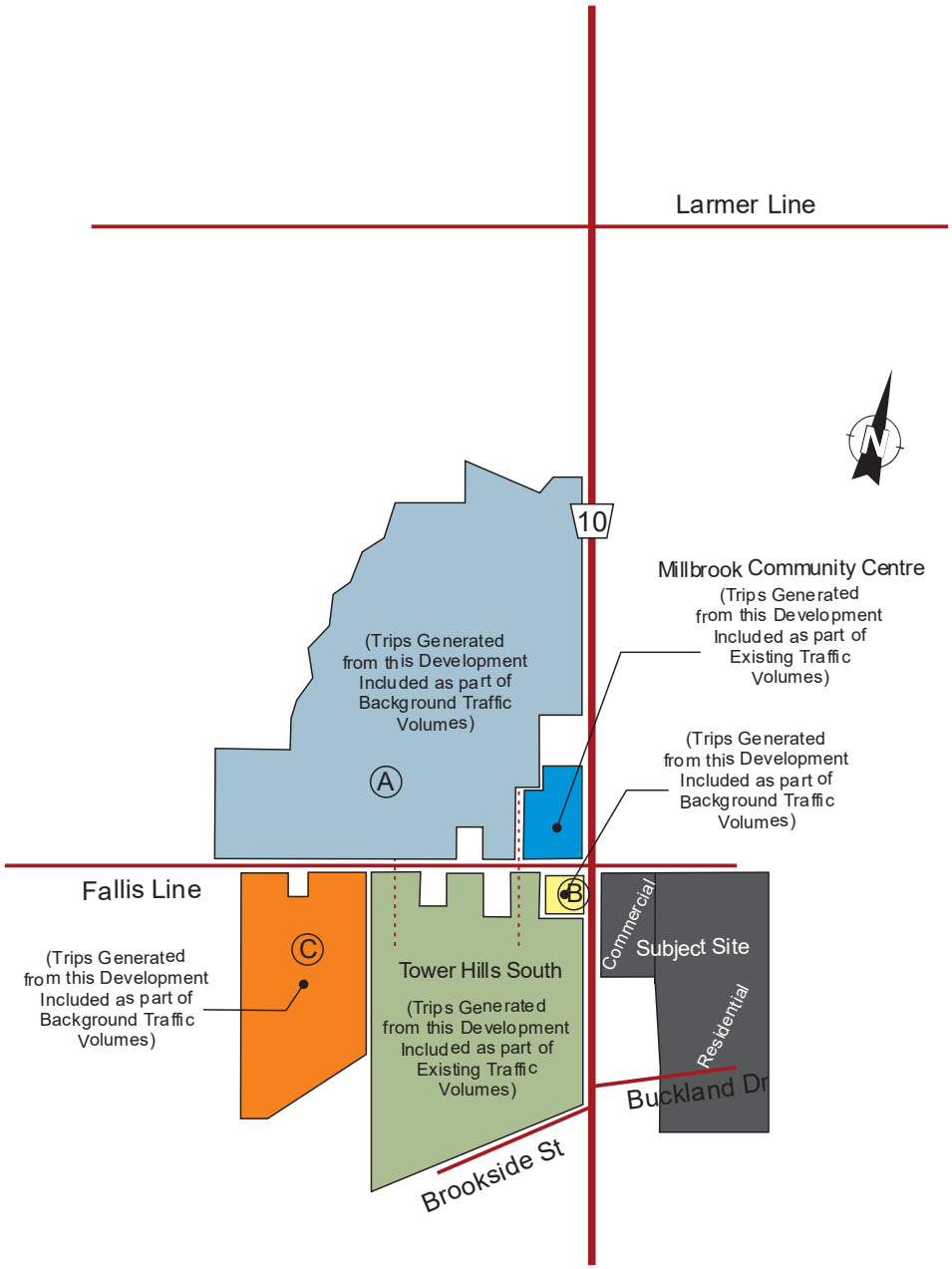

Exhibit 7: *Sketch of Developments Within the Area.*

AM Peak Hour - Background Volumes 2025

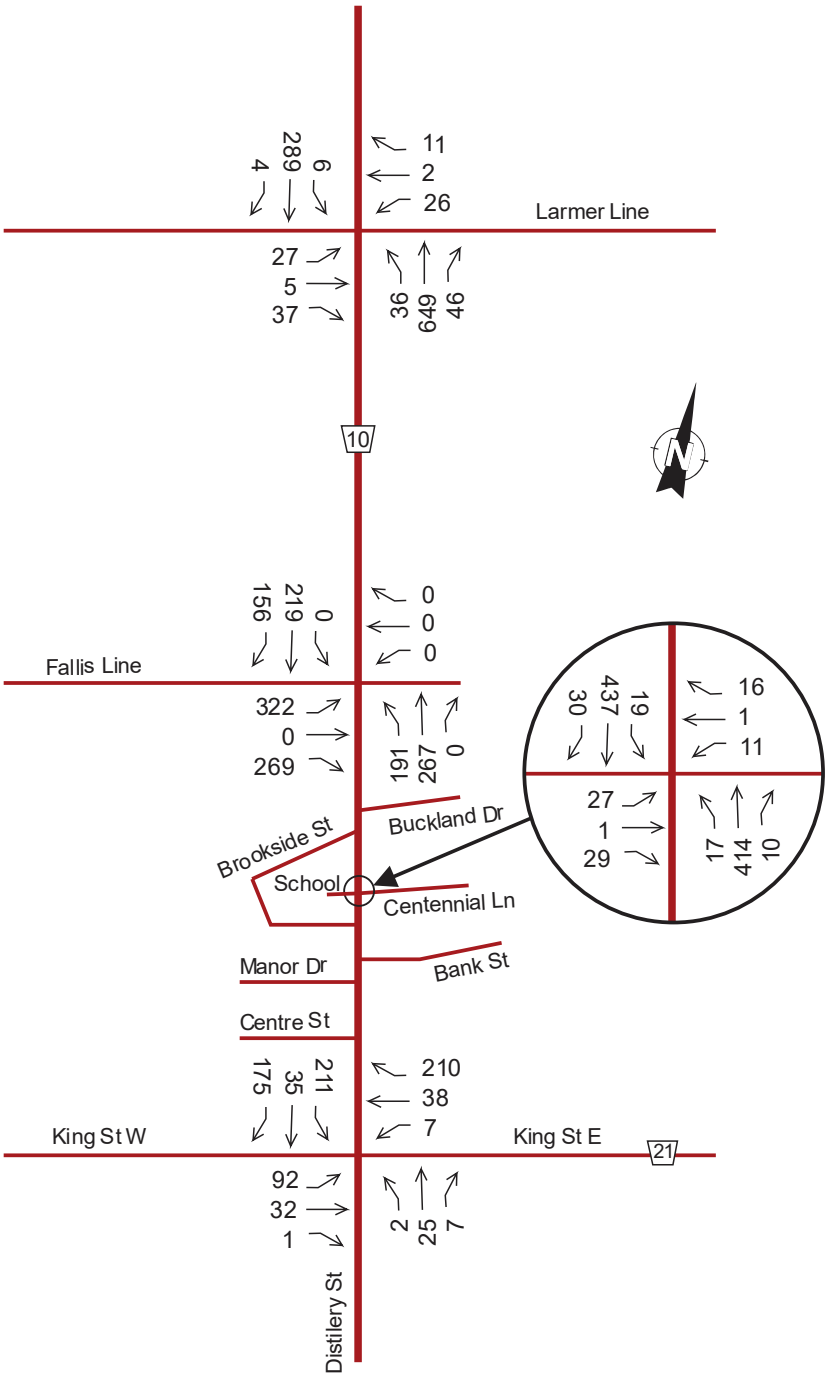

Exhibit 8: *Background AM Peak Hour Traffic Volumes (2025).*

PM Peak Hour - Background Volumes 2025

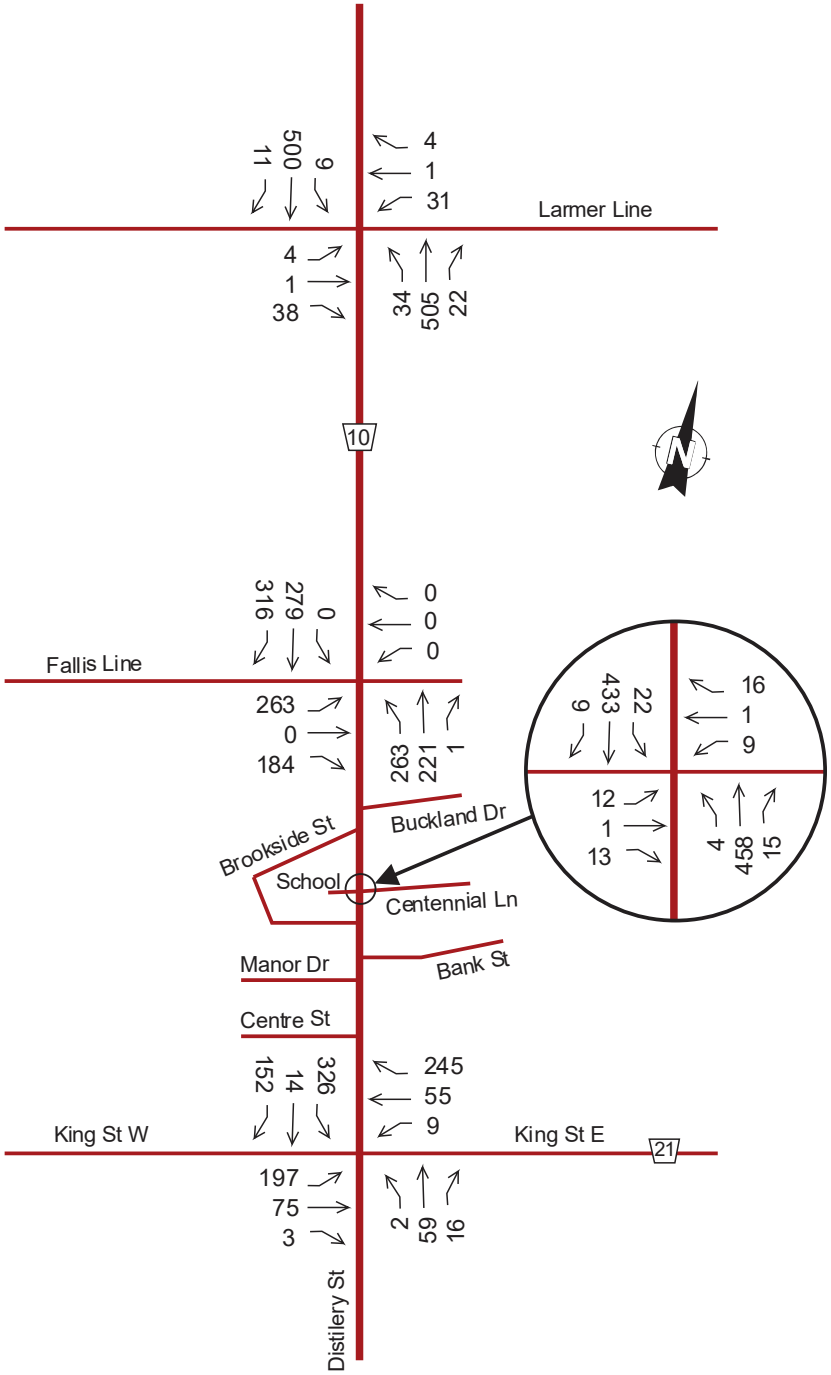

Exhibit 9: *Background PM Peak Hour Traffic Volumes (2025).*

SAT Peak Hour - Background Volumes 2025

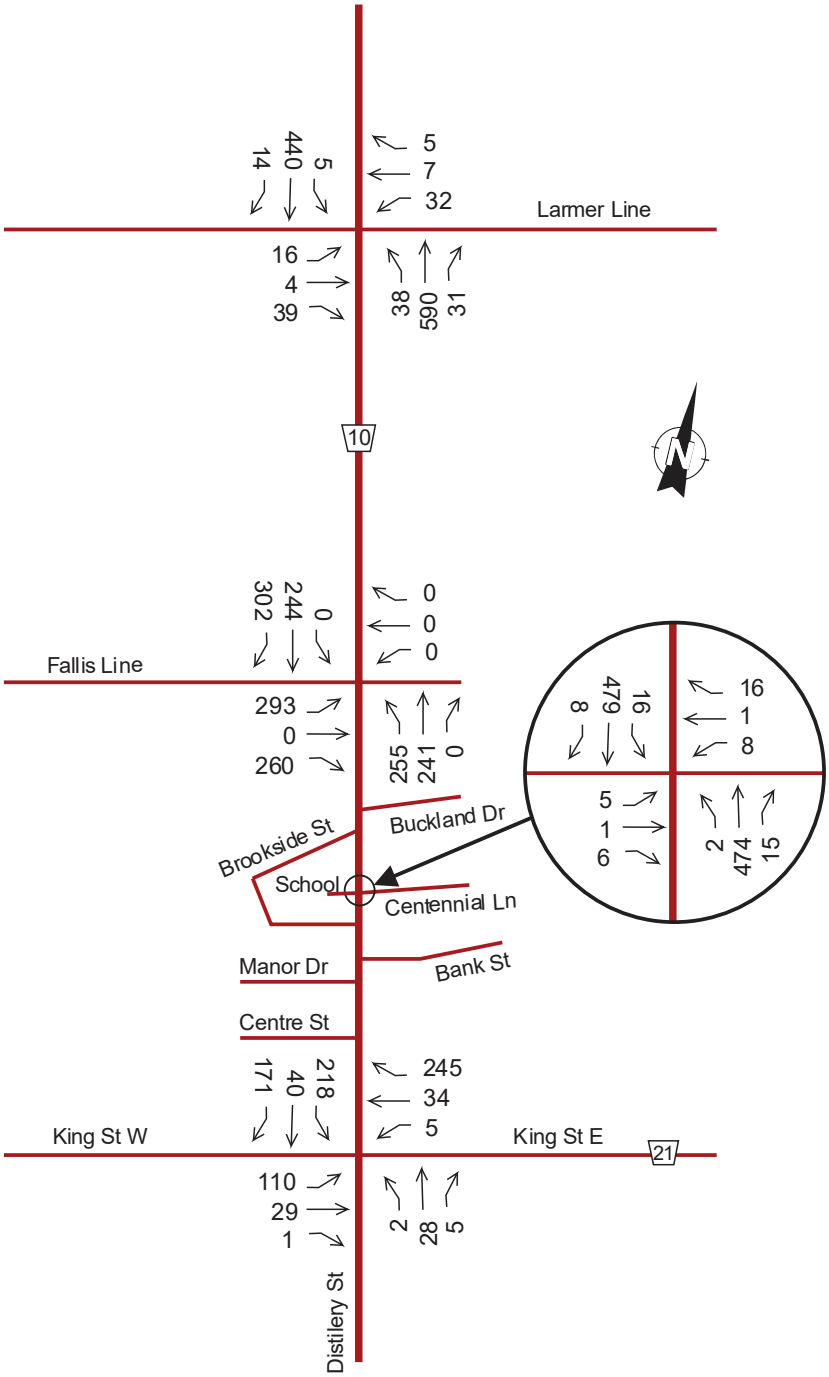

Exhibit 10: *Background SAT Peak Hour Traffic Volumes (2025).*

AM Peak Hour - Background Volumes 2030

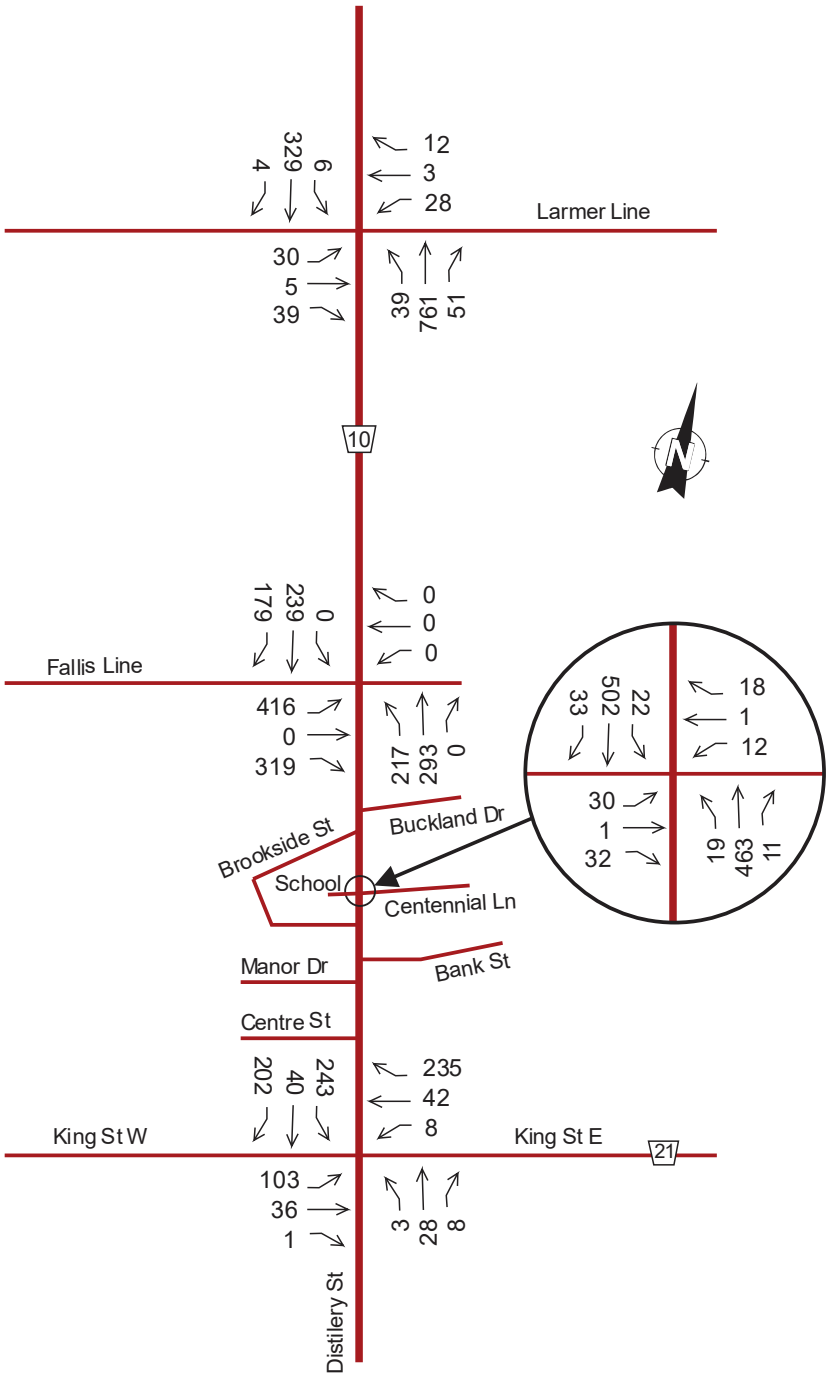

Exhibit 11: *Background AM Peak Hour Traffic Volumes (2030).*

PM Peak Hour - Background Volumes 2030

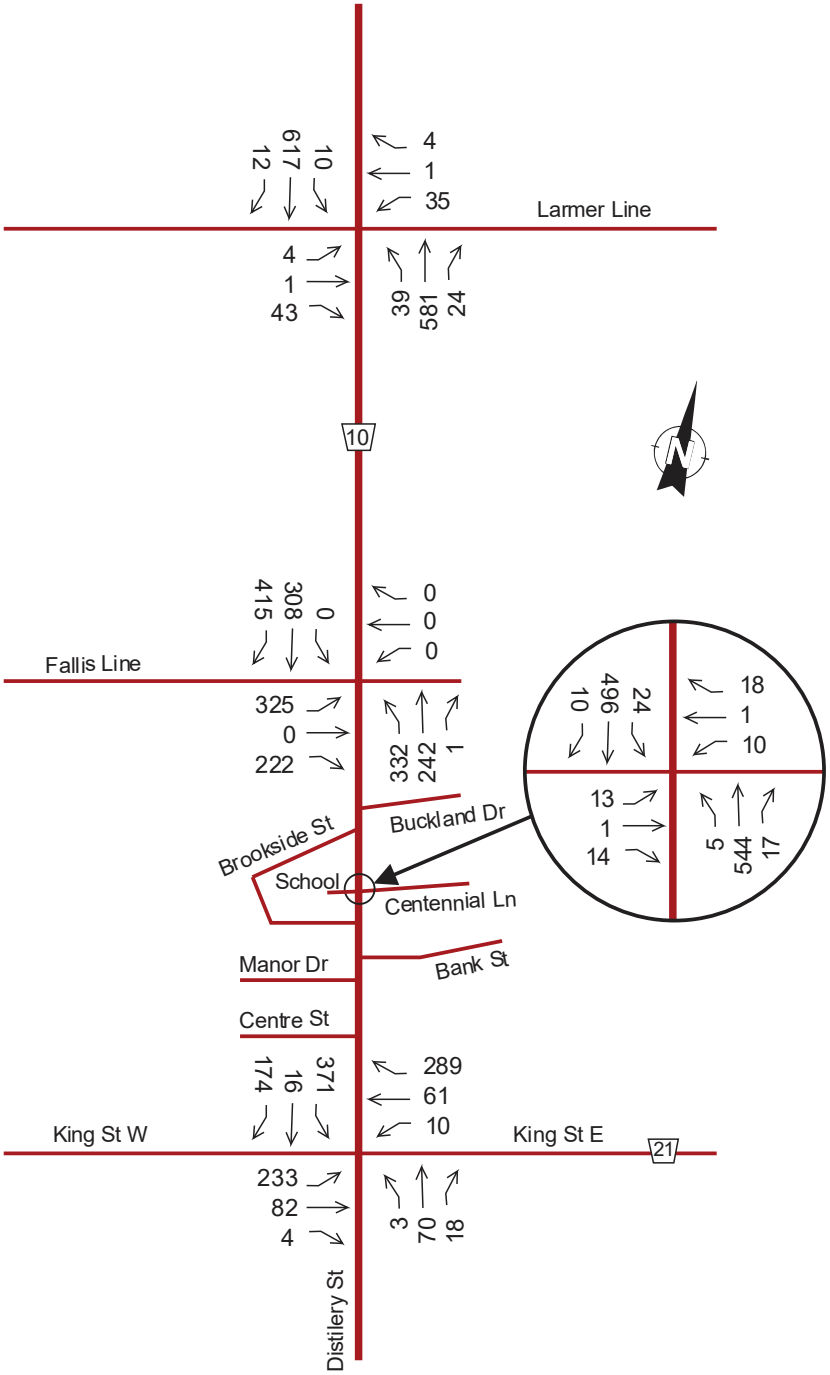

Exhibit 12: *Background PM Peak Hour Traffic Volumes (2030).*

SAT Peak Hour - Background Volumes 2030

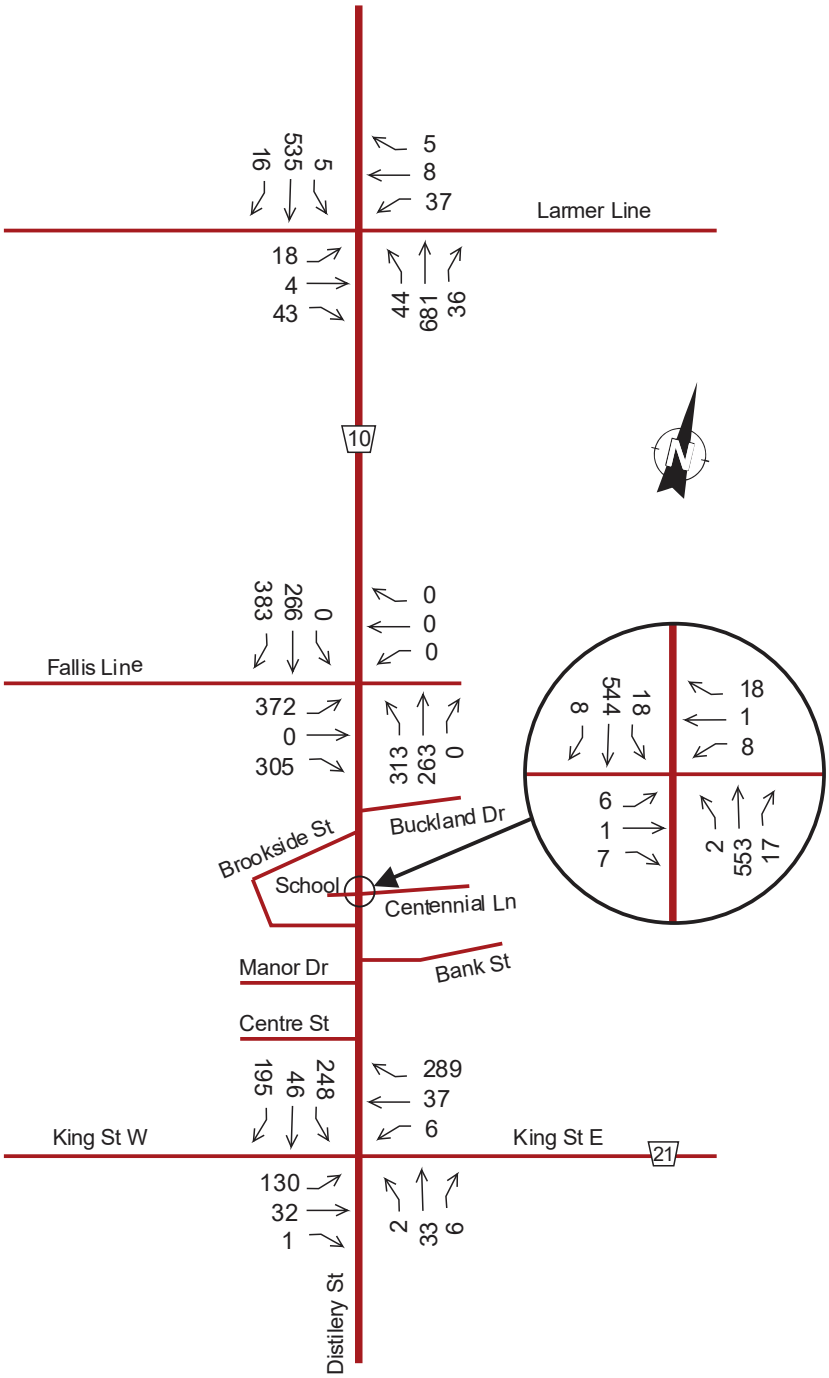

Exhibit 13: *Background SAT Peak Hour Traffic Volumes (2030).*

The traffic operation results for the base and horizon years are shown in the following table:

		Background 2025											
		AM Peak Hour				PM Peak Hour				SAT Peak Hour			
		V/C	Delay (s)	Q_{95} (m)	LOS	V/C	Delay (s)	Q_{95} (m)	LOS	V/C	Delay (s)	Q_{95} (m)	LOS
CR10 / Larmer Line	EB-LTR	0.27	22.4	8.0	C	0.11	14.7	2.9	B	0.22	21.2	6.4	C
	WB-LTR	0.23	30.2	6.5	D	0.27	38.3	7.7	E	0.34	42.6	10.4	E
	NB-LTR	0.03	0.8	0.7	A	0.04	1.0	0.9	A	0.04	1.0	0.9	A
	SB-LTR	0.01	0.3	0.2	A	0.01	0.3	0.2	A	0.01	0.2	0.1	A
CR10 / Fallis Line	EB-TL	1.99	458.4	344.5	F	2.26	293.6	293.6	F	2.42	681.4	370.1	F
	EB-R	1.99	458.4	344.5	F	2.26	293.6	293.6	F	2.42	681.4	370.1	F
	WB-LTR	0.00	0.0	0.0	A	0.00	0.0	0.0	A	0.00	0.0	0.0	A
	NB-L	0.18	8.8	5.0	A	0.30	10.5	9.8	B	0.28	10.1	8.8	B
	NB-TR	0.17	0.0	0.0	A	0.14	0.0	0.0	A	0.15	0.0	0.0	A
	SB-TL	0.00	0.0	0.0	A	0.00	0.0	0.0	A	0.00	0.0	0.0	A
	SB-R	0.10	0.0	0.0	A	0.20	0.0	0.0	A	0.19	0.0	0.0	A
CR10 / Centennial Rd	EB-LTR	0.21	20.4	5.9	C	0.10	18.6	2.4	C	0.05	18.7	1.1	C
	WB-LTR	0.10	17.9	2.5	C	0.09	17.0	2.1	C	0.08	17.1	2.1	C
	NB-LTR	0.02	0.6	0.4	A	0.00	0.1	0.1	A	0.00	0.1	0.0	A
	SB-LTR	0.02	0.5	0.4	A	0.02	0.7	0.5	A	0.02	0.5	0.4	A
CR10 / Kiing St / Distillery Rd	EB-LTR	0.22	10.3	23.1	B	0.55	17.2	24.8	C	0.25	10.7	17.6	B
	WB-LTR	0.38	10.9	20.0	B	0.55	16.1	27.5	C	0.42	11.5	32.2	B
	NB-LTR	0.06	9.1	16.0	A	0.17	11.5	16.5	B	0.06	9.3	14.0	A
	SB-L	0.40	12.0	19.5	B	0.71	24.7	26.3	C	0.42	12.6	22.4	B
	SB-TR	0.32	9.4	23.0	A	0.30	10.4	18.3	B	0.33	9.7	22.7	A

Table 3: *Background 2025 Intersection Capacity – AM, PM, SAT Peak Hour.*

		Background 2030											
		AM Peak Hour				PM Peak Hour				SAT Peak Hour			
		V/C	Delay (s)	Q_{95} (m)	LOS	V/C	Delay (s)	Q_{95} (m)	LOS	V/C	Delay (s)	Q_{95} (m)	LOS
CR10 / Larmer Line	EB-LTR	0.37	31.2	12.3	D	0.15	17.5	4.1	C	0.34	30.5	10.6	D
	WB-LTR	0.33	43.0	10.2	E	0.45	68.7	14.3	F	0.56	82.2	19.7	F
	NB-LTR	0.04	0.9	0.8	A	0.05	1.2	1.1	A	0.05	1.3	1.2	A
	SB-LTR	0.01	0.3	0.2	A	0.01	0.3	0.3	A	0.01	0.2	0.1	A
CR10 / Fallis Line	EB-TL	3.06		207.1	F	4.32		344.7	F	4.31		352.6	F
	EB-R	3.06		72.4	F	4.32		82.1	F	4.31		80.9	F
	WB-LTR	0.00	0.0	0.0	A	0.00		0.0	A	0.00	0.0	0.0	A
	NB-L	0.21	9.1	6.1	A	0.43	12.6	16.8	B	0.38	11.5	13.7	B
	NB-TR	0.19	0.0	0.0	A	0.16	0.0	0.0	A	0.17	0.0	0.0	A
	SB-TL	0.00	0.0	0.0	A	0.00	0.0	0.0	A	0.00	0.0	0.0	A
	SB-R	0.11	0.0	0.0	A	0.27	0.0	0.0	A	0.24	0.0	0.0	A
CR10 / Centennial Rd	EB-LTR	0.28	25.7	8.6	D	0.13	23.0	3.4	C	0.07	22.7	1.7	C
	WB-LTR	0.13	21.0	3.4	C	0.12	20.4	3.0	C	0.11	19.7	2.7	C
	NB-LTR	0.02	0.6	0.5	A	0.01	0.1	0.1	A	0.00	0.1	0.1	A
	SB-LTR	0.02	0.6	0.5	A	0.03	0.7	0.6	A	0.02	0.5	0.5	A
CR10 / Kiing St / Distillery Rd	EB-LTR	0.25	11.1	19.9	B	0.69	25.0	43.4	D	0.30	11.8	17.8	B
	WB-LTR	0.44	12.2	27.0	B	0.71	24.1	41.6	C	0.52	13.7	33.1	B
	NB-LTR	0.07	9.5	16.4	A	0.22	13.4	16.4	B	0.08	9.9	12.9	A
	SB-L	0.47	13.8	20.8	B	0.88	43.9	29.9	E	0.50	14.8	23.5	B
	SB-TR	0.39	10.4	19.9	B	0.38	12.5	22.4	B	0.40	11.0	22.1	B

Table 4: *Horizon Year 2030 Intersection Capacity – AM, PM, SAT Peak Hour.*

4 Proposed Development Traffic Forecasting

4.1 Traffic Impact Study Methodology

The traffic impact analysis was completed in accordance with the Transportation Impact Analysis for Site Developments methodologies published by the Institute of Transportation Engineers (ITE) and with The Traffic Impact Assessment Guidelines published by the County of Peterborough.

4.2 Site Trip Generation

Estimation of trips generated by the proposed development were derived from the latest Trip Generation Manual, 10th Edition, published by the Institute of Transportation Engineers (ITE). The land use which most closely describe the proposed residential and commercial developments are the following:

- Single-Family Detached Housing – Land Use 210
- Multifamily Housing (Low Rise) – Land Use 220
- Multifamily Housing (Mid Rise) – Land Use 221
- General Office Building – Land Use 710
- Medical-Dental Office Building – Land Use 720
- Supermarket – Land Use 850
- Fast-Food Restaurant with Drive-Through Window – Land Use 934
- Gasoline/Service Station with Convenience Market – Land Use 945

According to the ITE Trip Generation Manual, Single-Family Detached Housing have the highest trip generation rate per dwelling unit of all residential uses because they are largest units in size and have more residents and more vehicles per unit than other residential uses.

Multifamily Housing (Low Rise) includes apartments, townhouses, and condominiums located within the same building with at least three other dwelling units a that have one or two levels (floors); the Multifamily Housing (Mid Rise) also includes apartments, townhouses, and condominiums located within the same building with at least three other dwelling units but that have between three and ten levels (floors).

General Office Building land uses houses multiple tenants; it is a location where affairs of businesses, commercial or industrial organizations, or professional persons or firms are conducted. It may include a mixture of tenants including professional services, insurance companies, investment brokers, and tenant services, such as bank or saving and loan institutions, restaurants, or cafeteria and retail facilities.

Medical-Dental Office Building is a facility that provides diagnoses and outpatient care on a routine basis but is unable to provide prolonged in-house medical and surgical care. One or more private physicians or dentists generally operate this type of facility.

Supermarket, a retail store selling a complete assortment of food, food preparation and wrapping materials, and household cleaning items. Supermarkets may also contain products and services like ATMs, automobile supplies, bakeries, books and magazines, dry cleaning, floral arrangements, greeting cards, photo centers, pharmacies, and video rental areas.

Fast-Food Restaurant with Drive-Through Window is characterized by a large drive-through clientele, long hours of service and high turnover rates for eat-in customers. These limited-service eating establishments do not provide table service.

Gasoline/Service Station with Convenience Market, it is where the primary business is the fueling of motor vehicles. These service stations may also have ancillary facilities for servicing and repairing motor vehicles, and may have car wash. Some commonly sold convenience items are newspapers, coffee or other beverages, and snack items that are usually consumed in the car.

The trips rates for each land use are noted in the following table:

TRIP GENERATION RATES BY LAND USE										
ITE	ITE	Unit of	AM Peak Hr. of Adj. Street			PM Peak Hr. of Adj. Street			SAT Peak Hr. of Adj. Street		
Code	Land Use	Measure	Rate	In	Out	Rate	In	Out	Rate	In	Out
210	Single-Family Detached Housing	Dwelling Units	0.74	25%	75%	0.99	63%	37%	0.93	54%	46%
220	Multifamily Housing (Low Rise)	Dwelling Units	0.46	23%	77%	0.56	63%	37%	0.70	50%	50%
221	Multifamily Housing (Mid Rise)	Dwelling Units	0.36	26%	74%	0.44	61%	39%	0.44	49%	51%
710	General Office Building	GFA	1.16	86%	14%	1.15	16%	84%	0.53	54%	46%
720	Medical-Dental Office Building	GFA	2.78	78%	22%	3.46	28%	72%	3.10	57%	43%
850	Supermarket	GFA	3.82	60%	40%	9.24	51%	49%	10.34	51%	49%
934	Fast-Food Restaurant with Drive-Through Window	GFA	40.19	51%	49%	32.67	52%	48%	54.86	51%	49%
945	Gasoline/Service Station with Convenience Market	Fueling Positions	12.47	51%	49%	13.99	51%	49%	19.28	50%	50%
Pass By Reduction	General Office Building		0%			0%			0%		
	Medical-Dental Office Building		0%			0%			0%		
	Supermarket		40%			36%			26%		
	Fast-Food Restaurant with Drive-Through Window		49%			50%			50%		
	Gasoline/Service Station with Convenience Market		62%			56%			56%		
Internal Trip Reduction			20%			20%			20%		

Table 5: *Trips Rates per Land Use.*

According to the site plan, the number of units for the residential and commercial development are the following:

- Single-Family Detached Housing – 116 units
- Multifamily Housing (Low Rise) – 58 units
- Multifamily Housing (Mid Rise) – 70 units
- General Office Building – 15,800 GFA (Building A and C)
- Medical-Dental Office Building – 25,758 GFA (Building D)
- Supermarket – 26,593 GFA (Building A)
- Fast-Food Restaurant w/Drive-Through – 3,502 GFA (Building B)
- Gasoline/Service Station w/Convenience Market – 8 fueling positions

For purposes of this study, it is assumed that the subject proposed residential development is 50% built by the year 2025 and fully built/occupied by the year 2030.

The subject commercial site is expected to be fully built by the year 2025.

The estimated number of trips for the residential development is shown in the following table:

ESTIMATED NUMBER OF TRIPS BY LAND USE - RESIDENTIAL (YEAR 2025)											
ITE	ITE	Total	AM Peak Hr. of Adj. Street			PM Peak Hr. of Adj. Street			SAT Peak Hr. of Adj. Street		
Code	Land Use	Units	Trips	In	Out	Trips	In	Out	Trips	In	Out
210	Single-Family Detached Housing	58	43	11	32	57	36	21	54	29	25
220	Multifamily Housing (Low Rise)	29	13	3	10	16	10	6	20	10	10
221	Multifamily Housing (Mid Rise)	35	13	3	9	15	9	6	15	8	8
TOTAL TRIPS RESIDENTIAL			69	17	52	89	56	33	90	47	43

ESTIMATED NUMBER OF TRIPS BY LAND USE - RESIDENTIAL (YEAR 2030)											
ITE	ITE	Total	AM Peak Hr. of Adj. Street			PM Peak Hr. of Adj. Street			SAT Peak Hr. of Adj. Street		
Code	Land Use	Units	Trips	In	Out	Trips	In	Out	Trips	In	Out
210	Single-Family Detached Housing	116	86	21	64	115	72	42	108	58	50
220	Multifamily Housing (Low Rise)	58	27	6	21	32	20	12	41	20	20
221	Multifamily Housing (Mid Rise)	70	25	7	19	31	19	12	31	15	16
TOTAL TRIPS RESIDENTIAL			138	34	104	178	112	67	179	94	86

Table 6: *Trips Generated by the Proposed Residential Development.*

According to the ITE trip generation rates, it is estimated that the proposed residential development will generate a total of 69 trips during the morning peak hour, 89 trips during the afternoon peak hour and 90 trips during a typical Saturday peak hour for the year 2025.

By the year 2030 (full build-out), the proposed residential development will generate a total of 138 trips during the morning peak hour, 178 trips during the afternoon peak hour and 179 trips during a typical Saturday peak hour.

The estimated number of trips for the commercial development is shown in the following table:

ESTIMATED NUMBER OF TRIPS BY LAND USE - COMMERCIAL (YEAR 2025)											
ITE Code	ITE Land Use	Total Units	AM Peak Hr. of Adj. Street			PM Peak Hr. of Adj. Street			SAT Peak Hr. of Adj. Street		
			Trips	In	Out	Trips	In	Out	Trips	In	Out
710	General Office Building	15.8	18			18			8		
	Internal Trips		4			4			2		
			Total	In	Out	Total	In	Out	Total	In	Out
	Pass By Trips		0	0	0	0	0	0	0	0	0
	New Trips		15	13	2	15	2	12	7	4	3
	External Trips		15	13	2	15	2	12	7	4	3
720	Medical-Dental Office Building	25.76	72			89			80		
	Internal Trips		14			18			16		
			Total	In	Out	Total	In	Out	Total	In	Out
	Pass By Trips		0	0	0	0	0	0	0	0	0
	New Trips		57	45	13	71	20	51	64	36	27
	External Trips		57	45	13	71	20	51	64	36	27
850	Supermarket	26.59	102			246			275		
	Internal Trips		20			49			55		
			Total	In	Out	Total	In	Out	Total	In	Out
	Pass By Trips		33	16	16	71	35	35	57	29	29
	New Trips		49	29	20	126	64	62	163	83	80
	External Trips		81	46	36	197	100	97	220	112	108
934	Fast-Food Restaurant with Drive-Through Window	3.50	141			114			192		
	Internal Trips		28			23			38		
			Total	In	Out	Total	In	Out	Total	In	Out
	Pass By Trips		55	28	28	46	23	23	77	38	38
	New Trips		57	29	28	46	24	22	77	39	38
	External Trips		113	57	56	92	47	45	154	78	76
945	Gasoline/Service Station with Convenience Market	8.00	100			112			154		
	Internal Trips		20			22			31		
			Total	In	Out	Total	In	Out	Total	In	Out
	Pass By Trips		49	25	25	50	25	25	69	35	35
	New Trips		30	15	15	39	20	19	54	27	27
	External Trips		80	40	40	90	45	44	123	62	62

TOTAL TRIPS COMERCIAL	AM Peak Hr. of Adj. Street			PM Peak Hr. of Adj. Street			SAT Peak Hr. of Adj. Street		
	Trips	In	Out	Trips	In	Out	Trips	In	Out
TOTAL PASS BY TRIPS	137	69	69	167	83	83	203	102	102
TOTAL NEW TRIPS	208	131	77	297	130	166	365	189	175
TOTAL TRIPS AT DRIVEWAYS	346	200	146	463	214	250	568	291	277

Table 7: *Trips Generated by the Proposed Commercial Development.*

Based on the ITE trip generation rates, it is estimated that the proposed commercial development will generate a total of 346 trips during the morning peak hour, 463 trips during the afternoon peak hour and 568 trips during a typical Saturday peak hour for the year 2025 (full build-out).

According to the ITE Trip Generation Handbook, 3rd Edition, a key characteristic of a multi-use development is that trips among the various land uses can be made on site and these internal trips are not on the major street system. In multi-use developments, these internal trips can be made either by walking or by vehicles using internal roadways without using external streets. Internal trip reductions are noted as a percentage of the total calculated trips. A conservative 20% internal trip reduction is estimated for this site.

Pass-by trips is another phenomenon to consider. Pass-by trips are made as intermediate stops from an origin to a primary trip destination. These trips already exist on the link passing the site but they are attracted by the new development which offers a direct access to the site.

Based on the ITE Trip Generation Handbook, 3rd Edition, the average pass-by trips for the different land use type were taken into account. Trip reductions were applied to estimate the new external trips generated by the proposed development.

4.3 Trip Distribution/Assignment

The number of vehicles entering and leaving the site are distributed proportional to the existing directional traffic patterns. Directional traffic patterns were estimated from the traffic data report obtained from the County and from turning movement count reports included in the "Millbrook Development Phase 2 – Traffic Impact Study for the Tower Hill Developments Ltd." Prepared by JD Engineering.

The proportions of trips within the study area were independently distributed for the residential and the commercial development; the resulting new trips from each of these two developments were integrated to obtain the set of new trips (see process in the appendix); the total new trips are shown in the following figures:

AM Peak Hour - Developments Trips - 2025

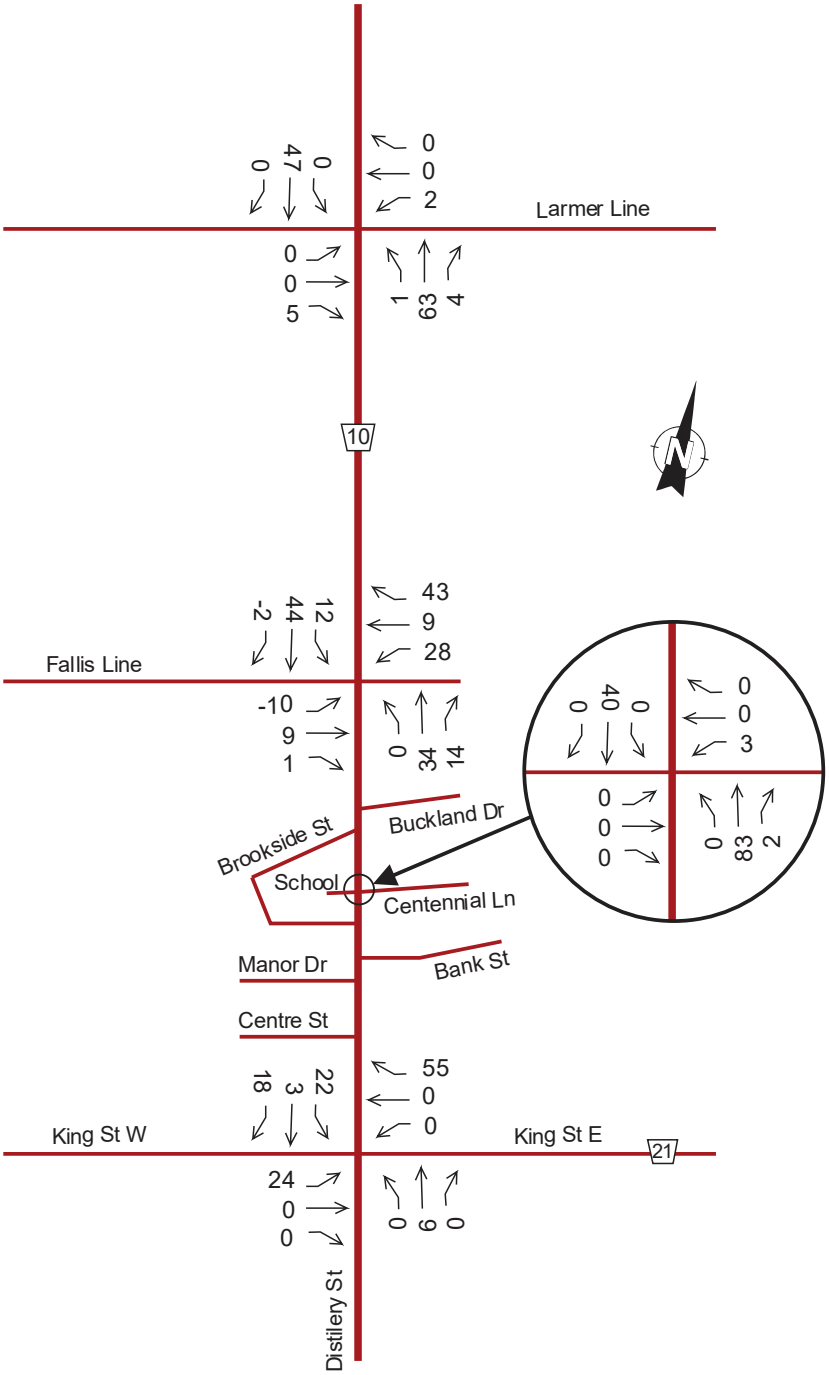

Exhibit 14: *AM Peak Hour Developments Trips - 2025.*

PM Peak Hour - Developments Trips - 2025

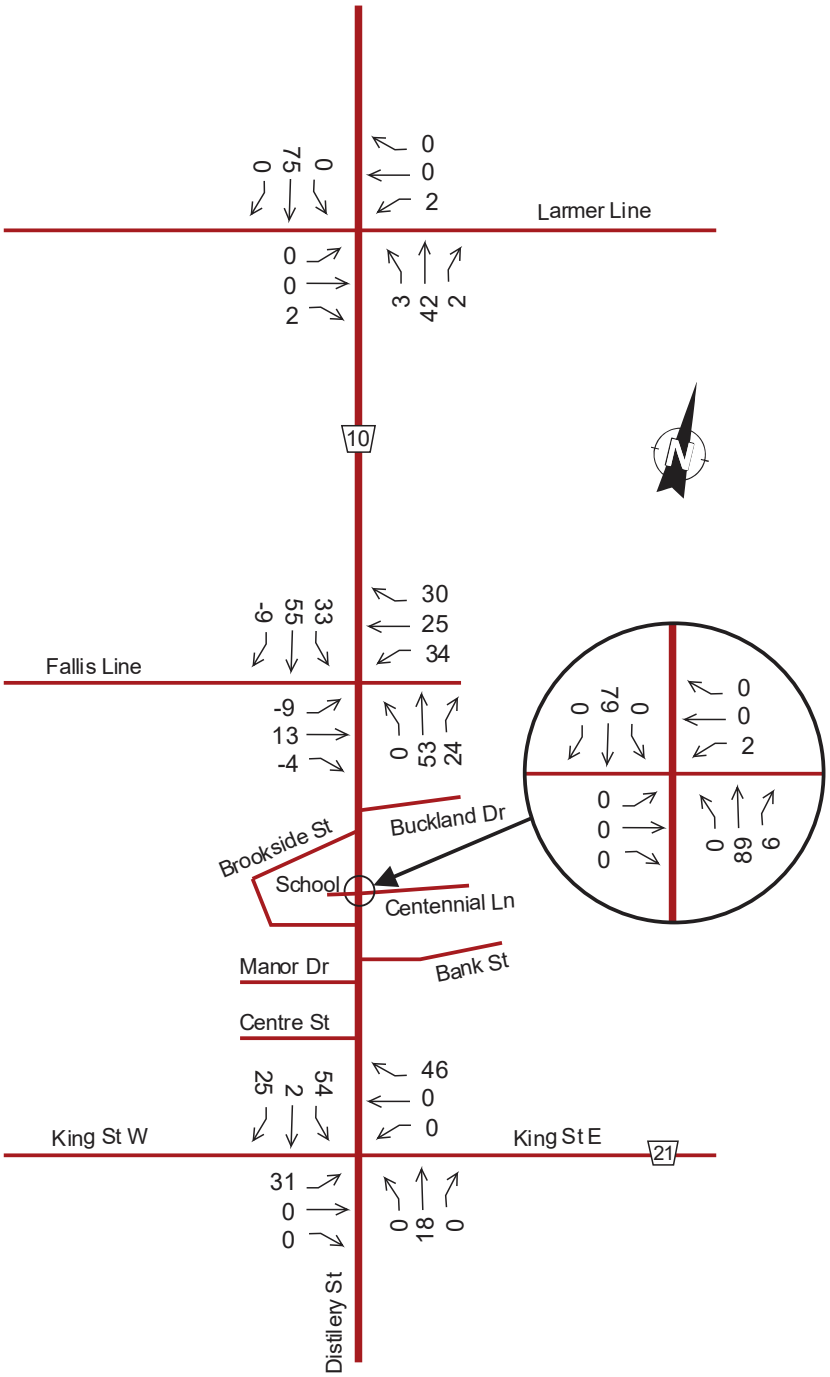

Exhibit 15: *PM Peak Hour Developments Trips - 2025.*

SAT Peak Hour - Developments Trips - 2025

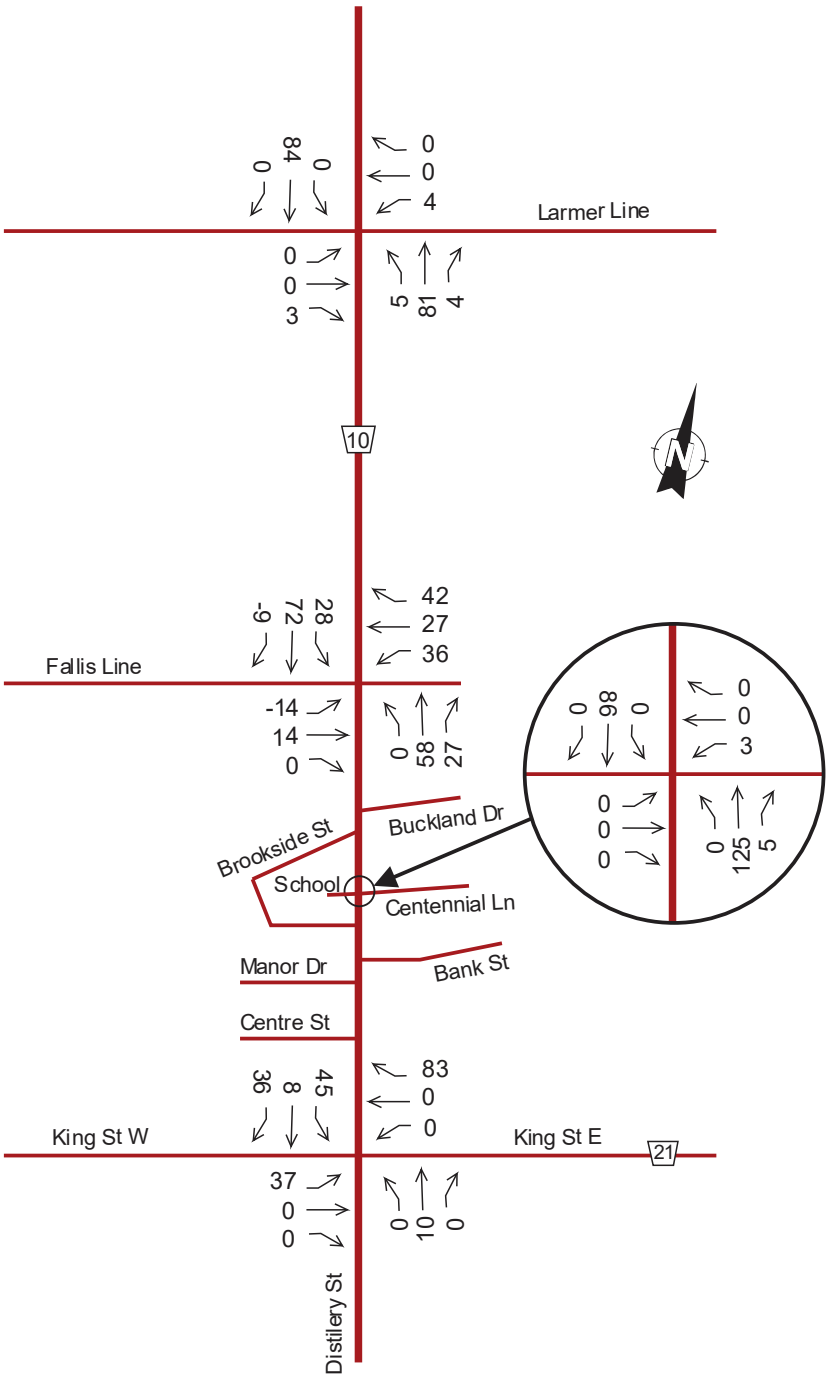

Exhibit 16: *SAT Peak Hour Developments Trips - 2025.*

AM Peak Hour - Developments Trips - 2030

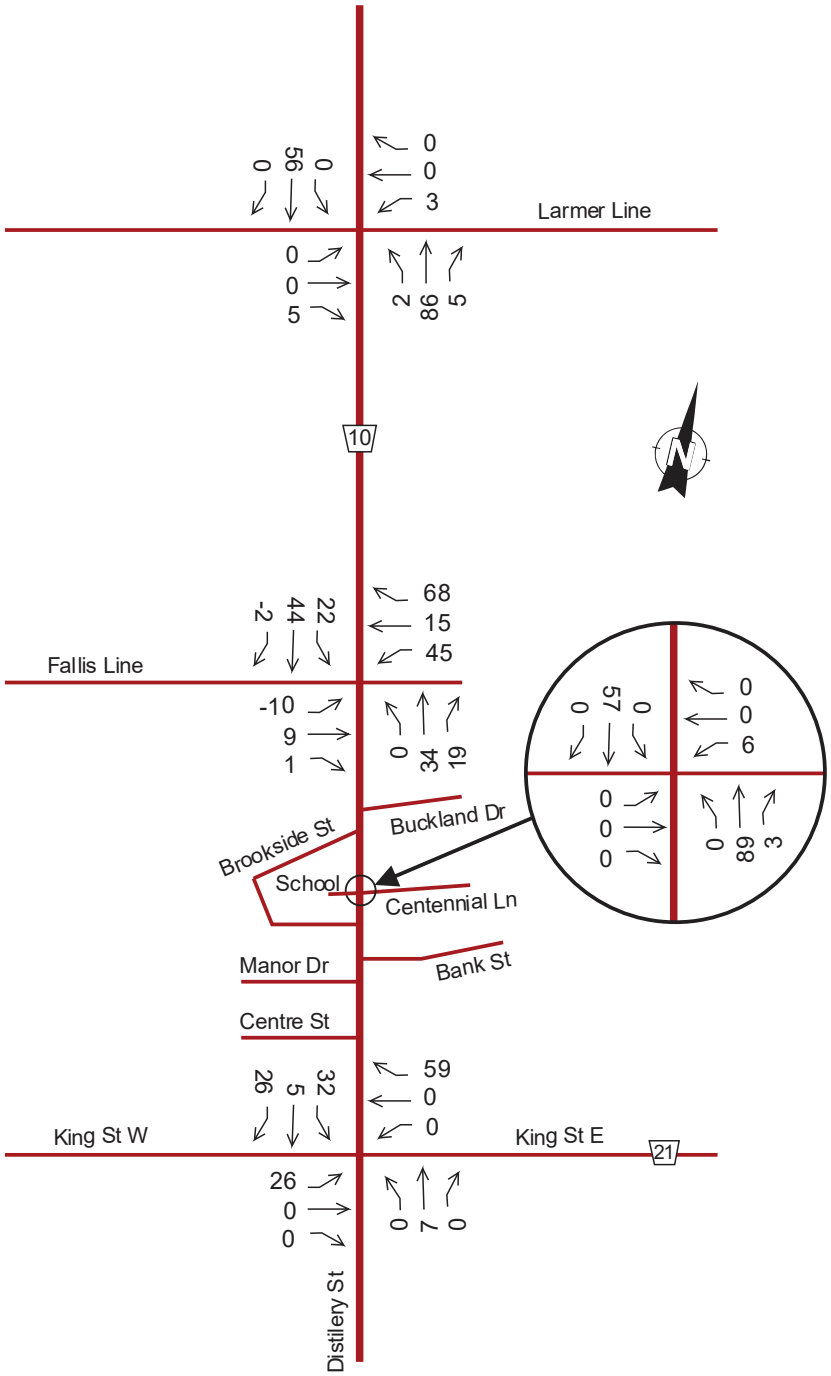

Exhibit 17: *AM Peak Hour Developments Trips - 2030.*

PM Peak Hour - Developments Trips - 2030

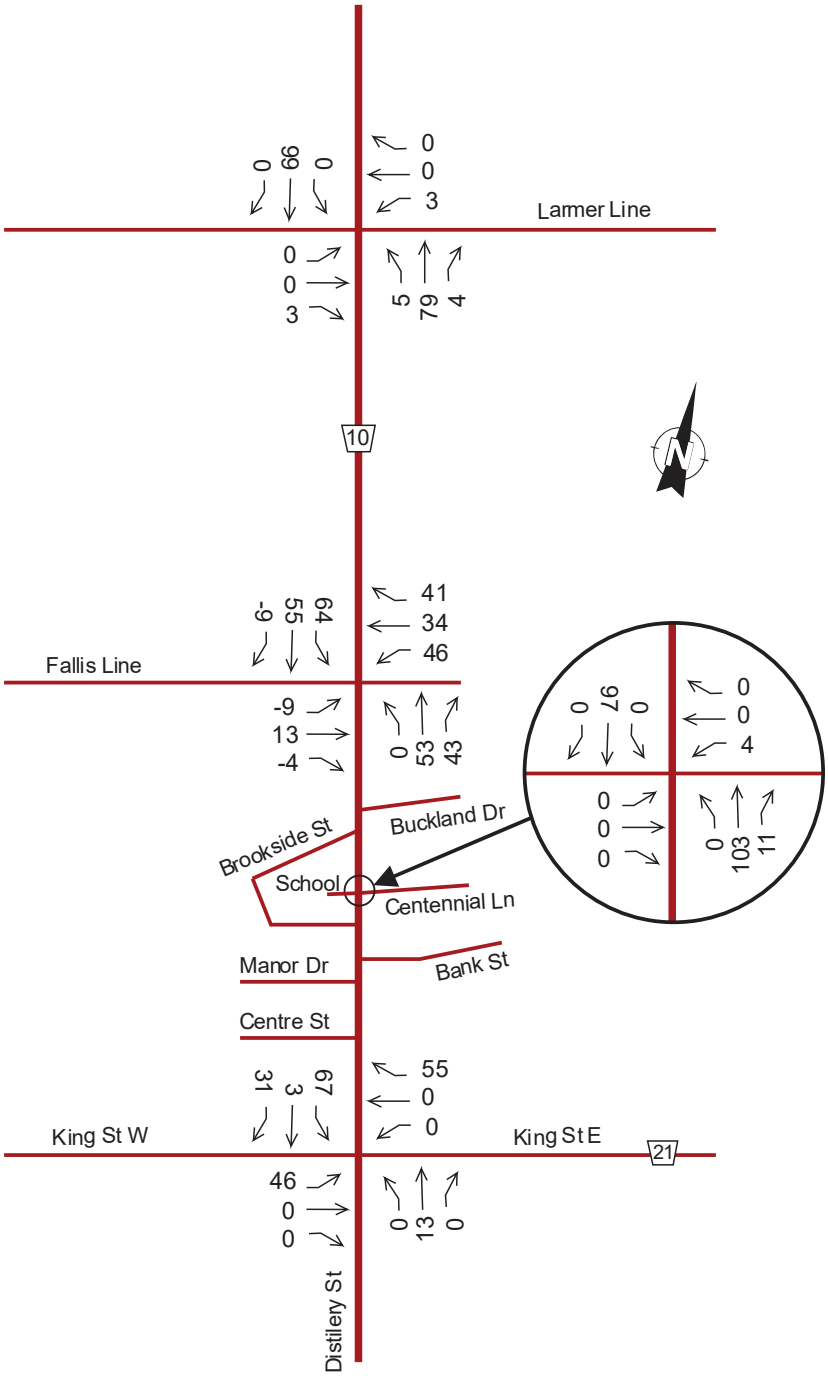

Exhibit 18: *PM Peak Hour Developments Trips - 2030.*

SAT Peak Hour - Developments Trips - 2030

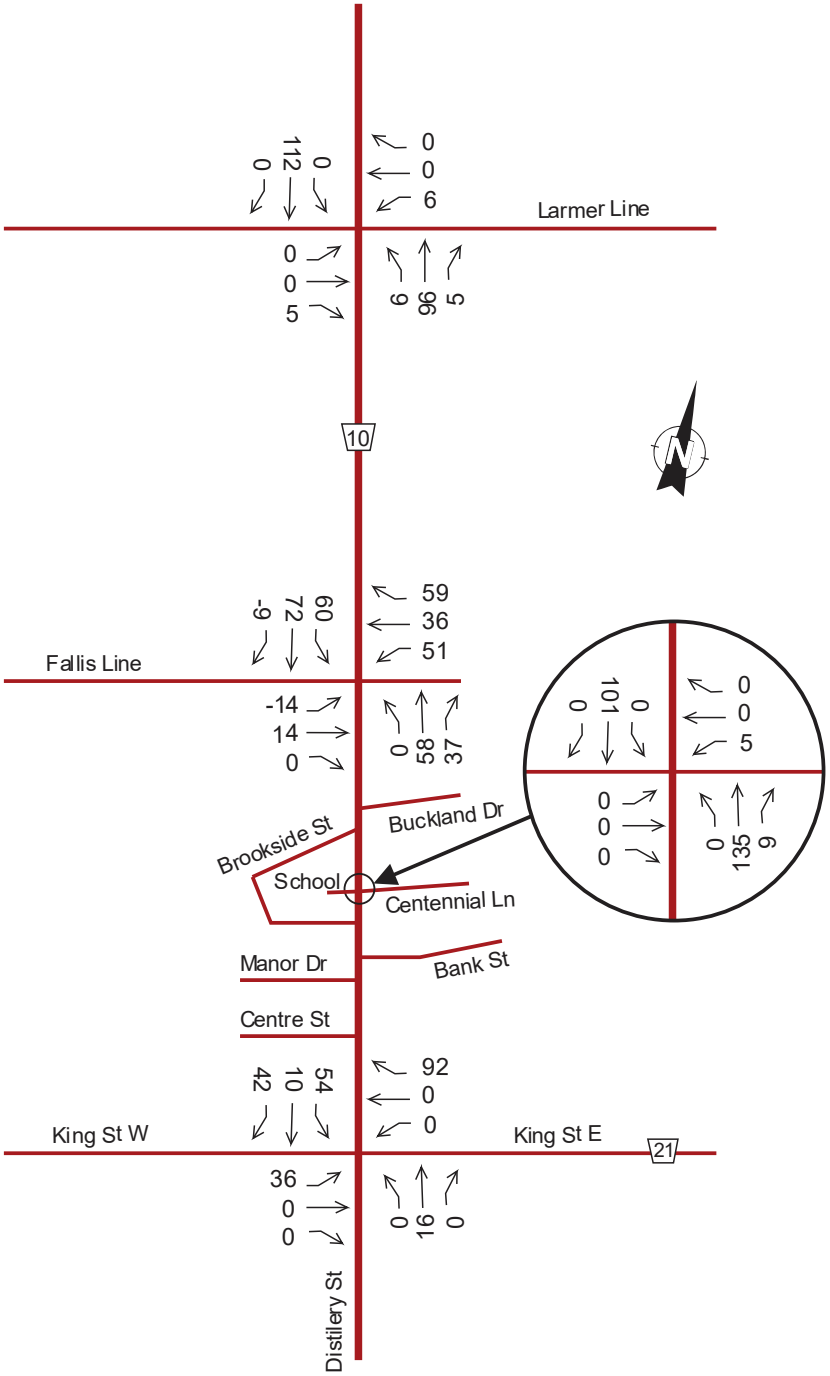

Exhibit 19: *SAT Peak Hour Developments Trips - 2030.*

The number of vehicles approaching to the CR10/Fallis Line intersection includes the new trips generated by the proposed developments (commercial and residential) as well as the number of pass by trips inherent of the commercial development. However, the other study intersections show the new generated trips only.

More details about the distribution of the new and the pass-by trips are included in **Section 5.5 "Future Traffic Operations at Accesses"** of this report.

5 Future Traffic Operations

5.1 Future Traffic Volumes

Future total traffic volumes for the horizon years are obtained by adding the background traffic volumes plus the new trips generated by the proposed developments. The background traffic volumes and the total traffic volumes will be the base for comparisons to assess any impact for the future years.

5.2 Scenarios

The analysis will review the intersection operations for the following horizon years:

- Horizon Year 2025 – Morning, Afternoon and Saturday Peak Hour.
- Horizon year 2030 – Morning, Afternoon and Saturday Peak Hour.

5.3 Total Traffic Volumes for Horizon Years

Future total traffic volumes were obtained by adding the background traffic volumes and the new trips generated by the proposed development.

Total traffic volumes for the horizon year 2025 and 2030 for peak hours are shown in the exhibits below.

AM Peak Hour - Total Trips - 2025

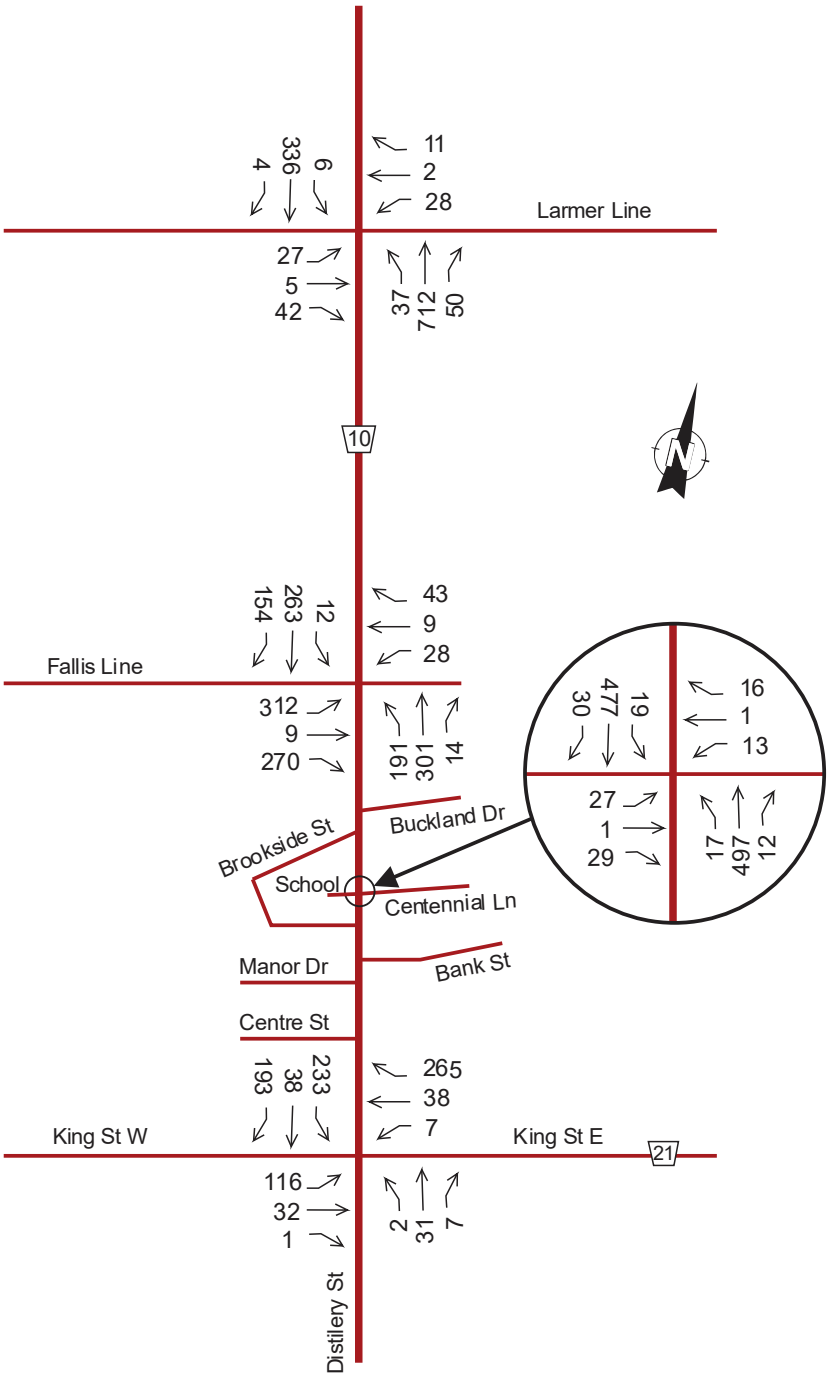

Exhibit 20: *AM Peak Hour Total Trips - 2025.*

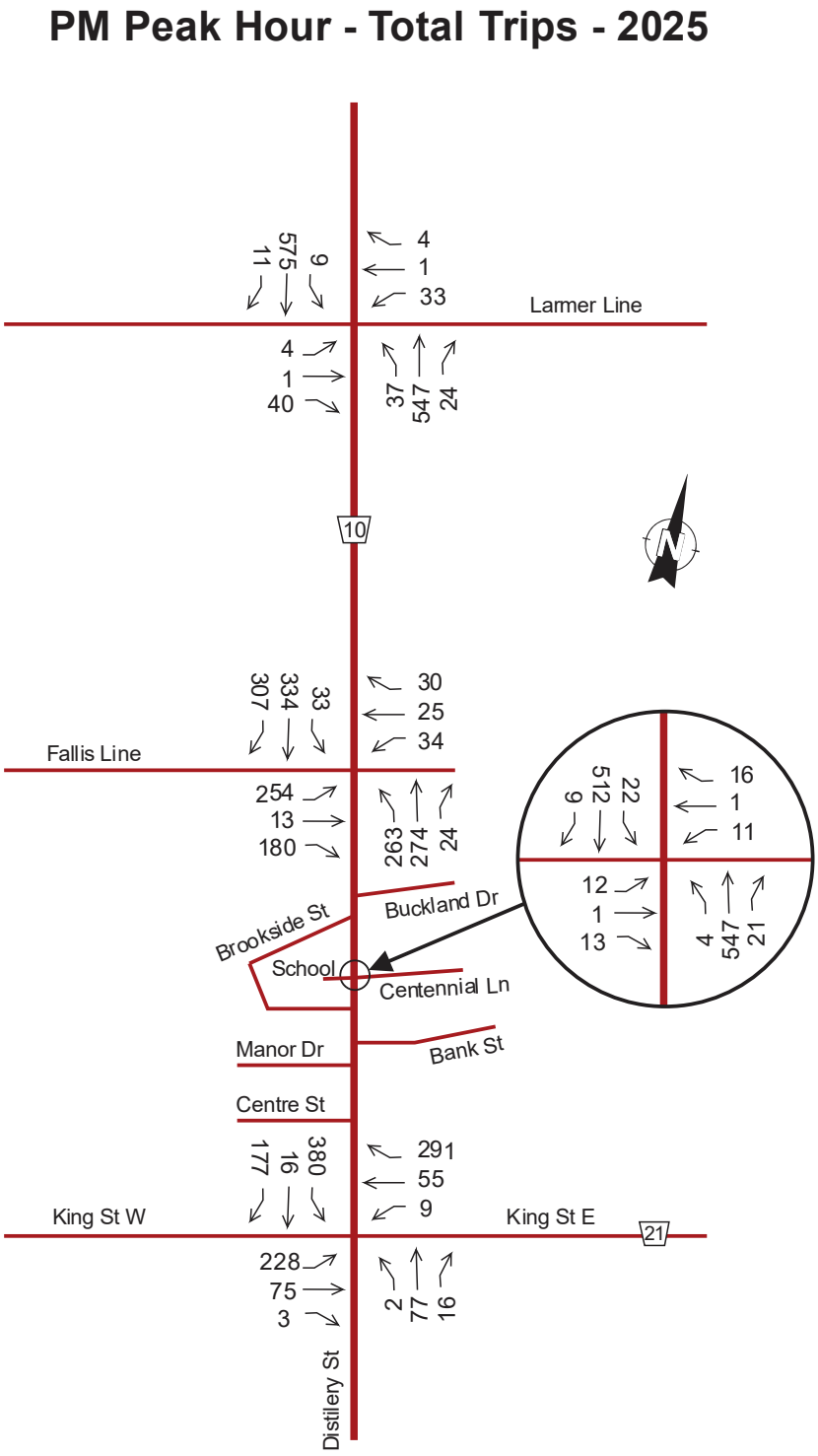

Exhibit 21: *PM Peak Hour Total Trips - 2025.*

SAT Peak Hour - Total Trips - 2025

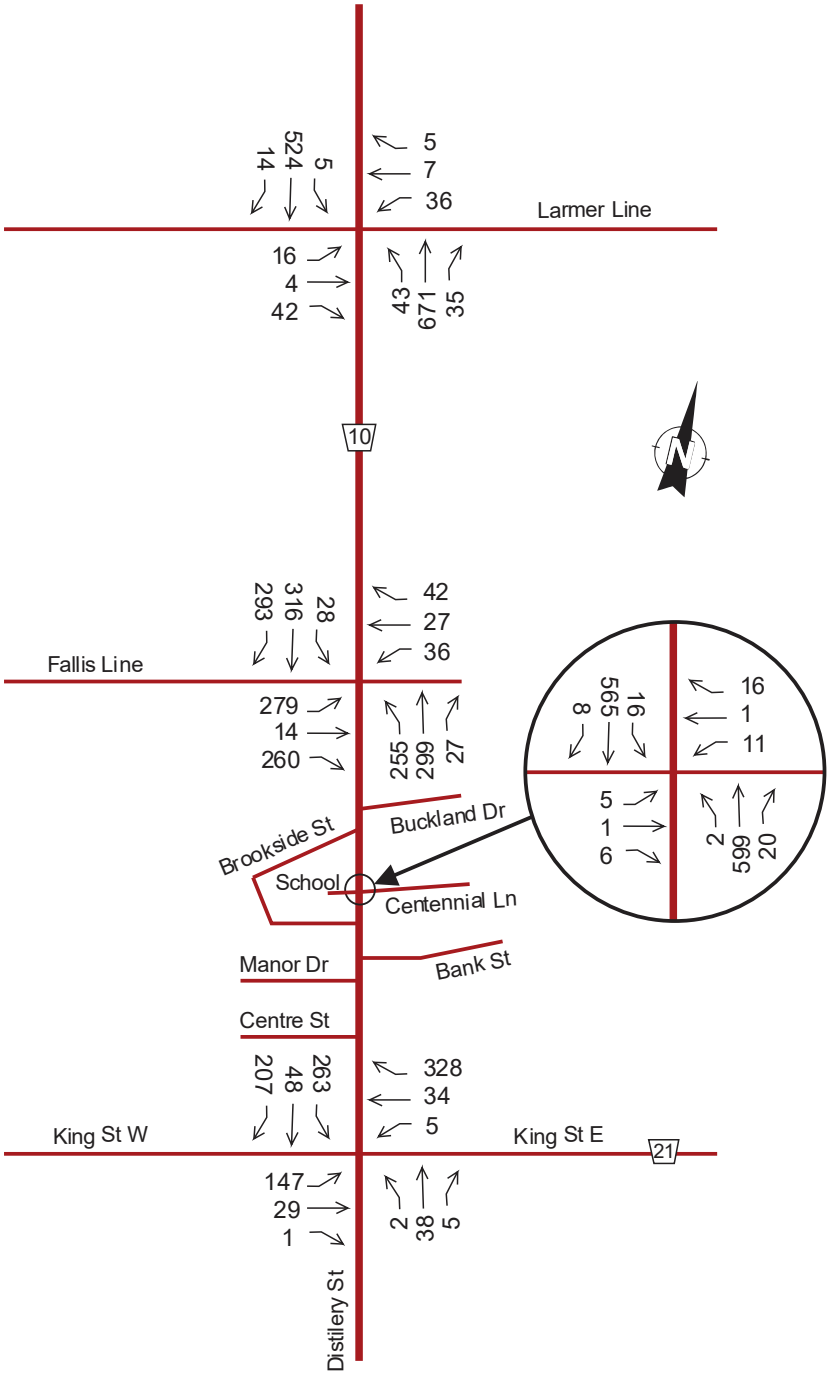

Exhibit 22: *SAT Peak Hour Total Trips - 2025.*

AM Peak Hour - Total Trips - 2030

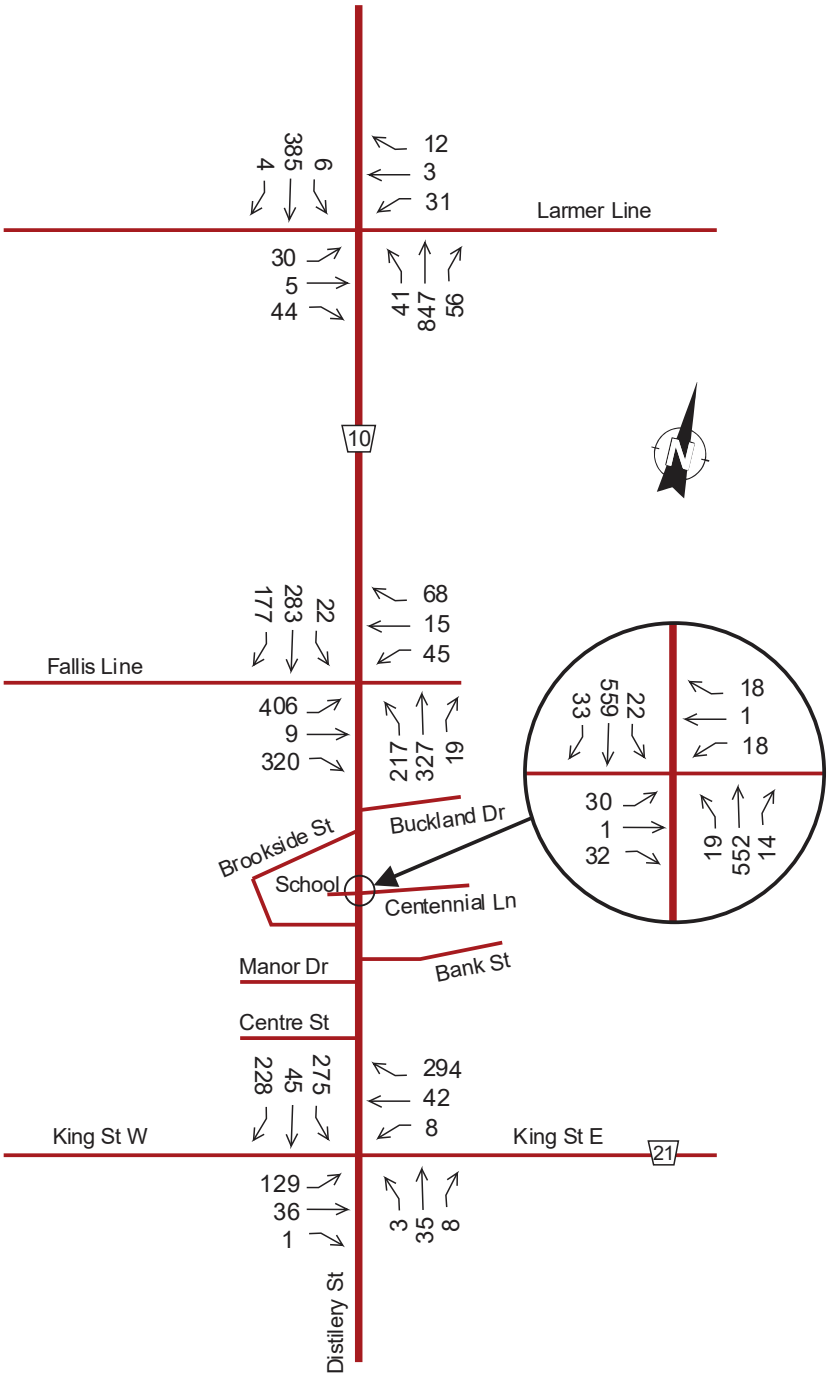

Exhibit 23: *AM Peak Hour Total Trips - 2030.*

PM Peak Hour - Total Trips - 2030

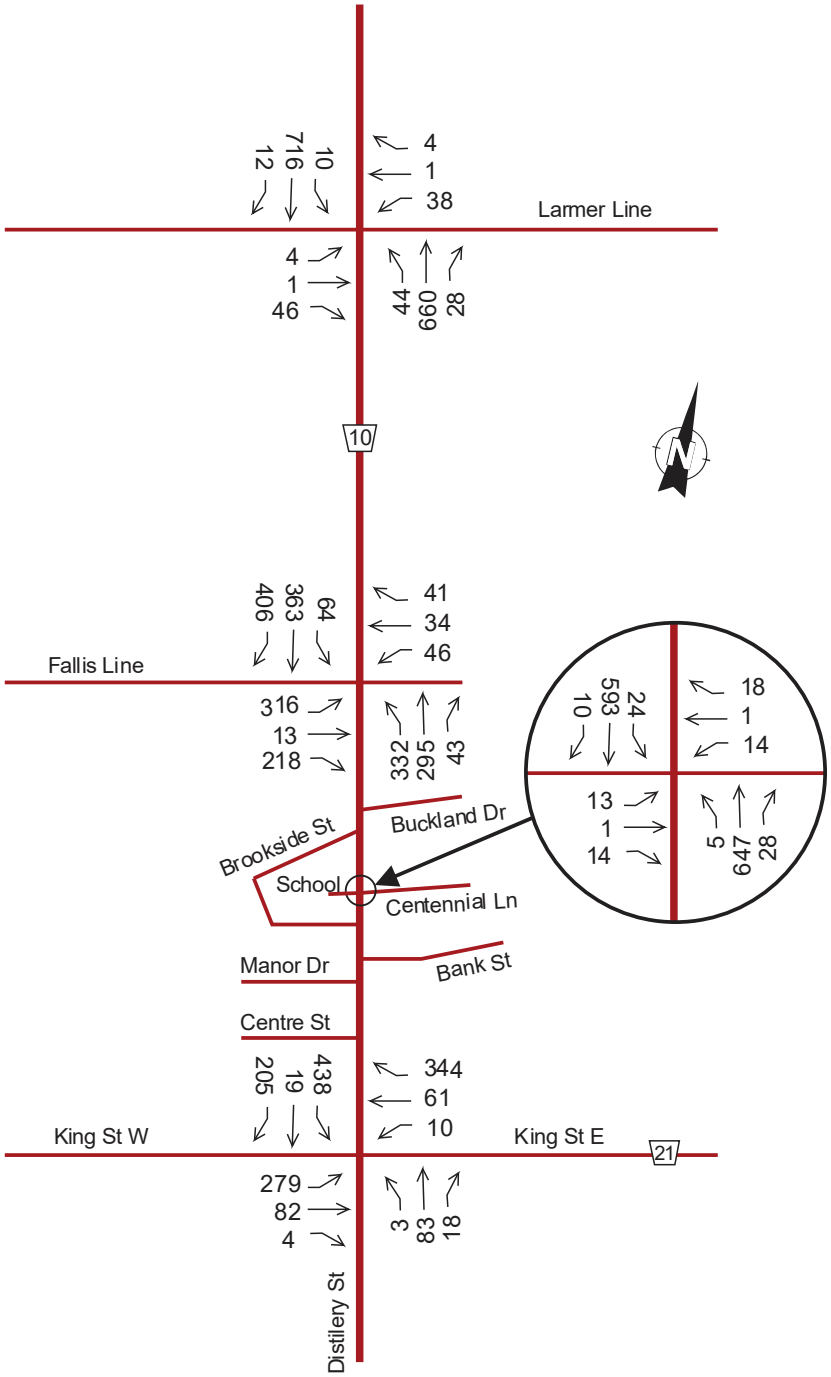

Exhibit 24: *PM Peak Hour Total Trips - 2030.*

SAT Peak Hour - Total Trips - 2030

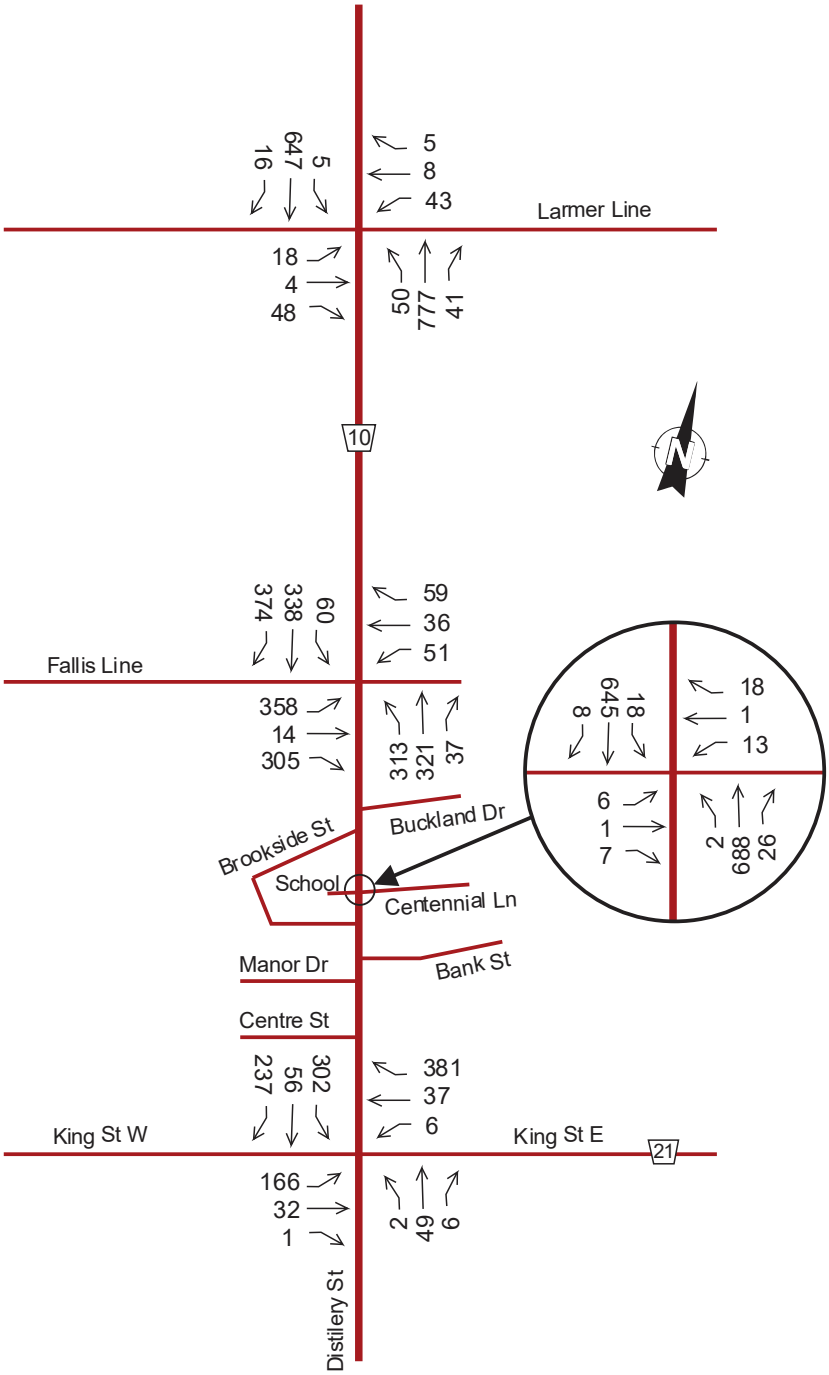

Exhibit 25: *SAT Peak Hour Total Trips - 2030.*

5.4 Future Traffic Operations at Intersections

Review of future traffic operations were done for the intersections under study, results are shown in the following tables:

		Total 2025											
		AM Peak Hour				PM Peak Hour				SAT Peak Hour			
		V/C	Delay (s)	Q_{95} (m)	LOS	V/C	Delay (s)	Q_{95} (m)	LOS	V/C	Delay (s)	Q_{95} (m)	LOS
CR10 / Larmer Line	EB-LTR	0.44	25.3	16.6	C	0.24	15.5	9.5	B	0.33	19.2	13.2	B
	WB-LTR	0.29	31.2	13.3	C	0.23	33.8	13.5	C	0.32	35.4	15.9	D
	NB-L	0.05	2.4	3.3	A	0.06	2.2	3.2	A	0.07	2.6	3.8	A
	NB-TR	0.55	5.0	73.3	A	0.38	3.0	39.1	A	0.50	4.4	58.1	A
	SB-L	0.01	2.5	1.1	A	0.01	2.2	1.2	A	0.01	2.4	0.8	A
	SB-TR	0.24	2.7	22.3	A	0.39	3.0	40.6	A	0.38	3.5	37.7	A
	Overall	0.55	6.4	-	A	0.39	4.3	-	A	0.50	5.7	-	A
CR10 / Fallis Line	EB-L	0.81	41.4	83.9	D	0.76	39.8	64.1	D	0.78	40.6	72.1	D
	EB-TR	0.43	5.2	17.5	A	0.36	6.1	15.6	A	0.44	5.7	18.0	A
	WB-L	0.12	21.0	9.7	C	0.13	22.3	11.0	C	0.17	22.8	11.9	C
	WB-TR	0.11	8.2	8.7	A	0.12	12.2	11.1	B	0.14	10.8	12.2	B
	NB-L	0.32	10.0	27.4	B	0.46	10.1	37.8	B	0.44	10.7	36.6	B
	NB-T	0.33	13.0	58.7	B	0.30	13.8	52.6	B	0.32	13.8	57.8	B
	NB-R	0.02	8.2	3.9	A	0.03	7.9	5.2	A	0.03	8.1	5.7	A
	SB-L	0.02	9.0	3.3	A	0.06	8.1	6.5	A	0.05	8.9	5.7	A
	SB-T	0.39	21.0	58.8	C	0.46	21.0	78.2	C	0.46	22.5	73.5	C
	SB-R	0.23	4.3	12.2	A	0.39	4.0	17.1	A	0.38	4.2	16.8	A
	Overall	0.81	17.2	-	B	0.76	15.7	-	B	0.78	16.1	-	B
CR10 / Centennial Rd	EB-LTR	0.25	24.4	7.3	C	0.12	23.2	3.2	C	0.06	24.1	1.6	C
	WB-LTR	0.13	21.9	3.4	C	0.12	21.8	3.2	C	0.14	24.0	3.6	C
	NB-LTR	0.02	0.5	0.5	A	0.00	0.1	0.1	A	0.00	0.1	0.1	A
	SB-LTR	0.02	0.6	0.5	A	0.02	0.7	0.6	A	0.02	0.5	0.4	A
CR10 / Kiing St / Distillery Rd	EB-LTR	0.27	11.3	21.0	B	0.67	23.7	27.2	C	0.34	12.6	26.6	B
	WB-LTR	0.48	12.8	23.3	B	0.70	23.5	39.2	C	0.59	15.8	33.4	C
	NB-LTR	0.07	9.6	15.5	A	0.23	13.5	19.7	B	0.09	10.4	14.0	B
	SB-L	0.46	13.7	24.6	B	0.89	46.2	33.0	E	0.54	16.4	25.6	C
	SB-TR	0.38	10.4	25.4	B	0.38	12.5	27.7	B	0.44	12.0	25.7	B

Table 8: *Total Traffic Volumes Operation Results – Horizon Year 2025.*

		Total 2030											
		AM Peak Hour				PM Peak Hour				SAT Peak Hour			
		V/C	Delay (s)	Q_{95} (m)	LOS	V/C	Delay (s)	Q_{95} (m)	LOS	V/C	Delay (s)	Q_{95} (m)	LOS
CR10 / Larmer Line	EB-LTR	0.45	25.5	17.7	C	0.26	14.5	10.0	B	0.35	18.7	14.2	B
	WB-LTR	0.32	32.1	14.6	C	0.26	34.0	14.4	C	0.37	36.7	17.9	D
	NB-L	0.06	2.5	3.8	A	0.09	2.6	3.9	A	0.10	3.0	4.6	A
	NB-TR	0.66	6.9	110.6	A	0.46	3.7	54.3	A	0.58	5.7	82.2	A
	SB-L	0.02	2.7	1.1	A	0.02	2.3	1.3	A	0.01	2.6	0.9	A
	SB-TR	0.28	3.0	26.8	A	0.48	3.9	59.9	A	0.47	4.4	55.2	A
	Overall	0.66	7.5	-	A	0.48	4.9	-	A	0.58	6.7	-	A
CR10 / Fallis Line	EB-L	0.89	47.0	121.6	D	0.84	46.8	91.4	D	0.90	53.9	112.2	D
	EB-TR	0.44	4.3	17.3	A	0.38	5.4	16.6	A	0.46	5.2	19.1	A
	WB-L	0.17	19.5	13.3	B	0.18	22.6	14.2	C	0.24	24.2	15.9	C
	WB-TR	0.14	6.6	10.5	A	0.15	11.7	13.5	B	0.17	10.1	14.9	B
	NB-L	0.43	14.0	34.7	B	0.63	14.9	48.8	B	0.60	15.0	45.6	B
	NB-T	0.42	18.9	70.0	B	0.35	16.7	56.9	B	0.40	18.2	62.3	B
	NB-R	0.03	10.9	5.3	B	0.06	7.8	7.4	A	0.05	8.5	7.0	A
	SB-L	0.05	11.4	5.5	B	0.12	9.6	10.7	A	0.12	10.1	10.1	B
	SB-T	0.51	27.9	70.8	C	0.55	25.7	86.3	C	0.53	26.4	79.2	C
	SB-R	0.29	5.1	14.4	A	0.50	4.5	19.0	A	0.48	4.5	18.5	A
	Overall	0.89	21.2	-	C	0.84	18.4	-	B	0.90	20.0	-	B
CR10 / Centennial Rd	EB-LTR	0.35	33.4	11.4	D	0.18	31.3	4.9	4.9	0.10	31.4	2.5	D
	WB-LTR	0.22	30.4	6.2	D	0.20	30.5	5.6	5.6	0.21	32.3	5.8	D
	NB-LTR	0.02	0.6	0.6	A	0.01	0.2	0.1	0.1	0.00	0.1	0.1	A
	SB-LTR	0.02	0.7	0.6	A	0.03	0.8	0.7	0.7	0.02	0.6	0.5	A
CR10 / Kiing St / Distillery Rd	EB-LTR	0.32	12.4	34.9	B	0.84	40.0	55.3	E	0.41	14.6	20.3	B
	WB-LTR	0.56	15.2	30.8	C	0.87	41.2	81.3	E	0.73	22.7	32.6	C
	NB-LTR	0.09	10.3	14.2	B	0.28	15.4	17.3	C	0.13	11.4	16.6	B
	SB-L	0.56	16.8	29.8	C	1.12	107.0	37.4	F	0.66	22.1	23.2	C
	SB-TR	0.47	12.3	26.3	B	0.49	15.9	35.5	C	0.54	15.1	26.3	C

Table 9: *Total Traffic Volumes Operation Results – Horizon Year 2030.*

It has been shown that traffic operation results with the background volumes have impacted the CR10/Larmer Line and CR10/Fallis Line intersections; some movements at these intersections are at the level of service “E” or “F”. The proposed developments generate additional number of trips to the noted intersections becoming critical if nothing is done.

Due to the above noted condition, traffic signals have been introduced in the analysis of traffic operations for total volumes (background plus site generated traffic volumes) to address the critical conditions at the CR10/Larmer Line and CR10/Fallis Line intersections.

Additional to traffic signals, new auxiliary lanes were included as following:

a. CR10/Larmer Line Intersection – An exclusive northbound and southbound left turn lane.
b. CR10/Fallis Line Intersection – An exclusive northbound and southbound left turn lane.
c. CR10/Fallis Line Intersection - A northbound right turn taper.
d. CR10/Fallis Line Intersection - An exclusive eastbound and westbound left turn lane.
e. CR10/Fallis Line Intersection – An eastbound and westbound shared thru/right lane.

With the introduction of traffic signals and auxiliary lanes, the intersections show substantial improvement bringing the intersections to acceptable operation conditions as shown in Table 8 and 9 for the horizon year 2025 and 2030, respectively.

5.5 Future Traffic Operations at Accesses

The following Exhibits show the number of trips generated by the proposed development at Access or Driveways. Notice that for the commercial accesses, the new trips and pass-by trips are included. For the Commercial development, it is expected that 70% of trips activity will happen at driveways Ac, Bc and Cc due to the location of the proposed gas station and supermarket (see details in Appendix I and J).

AM Generated Trips at Accesses - 2025

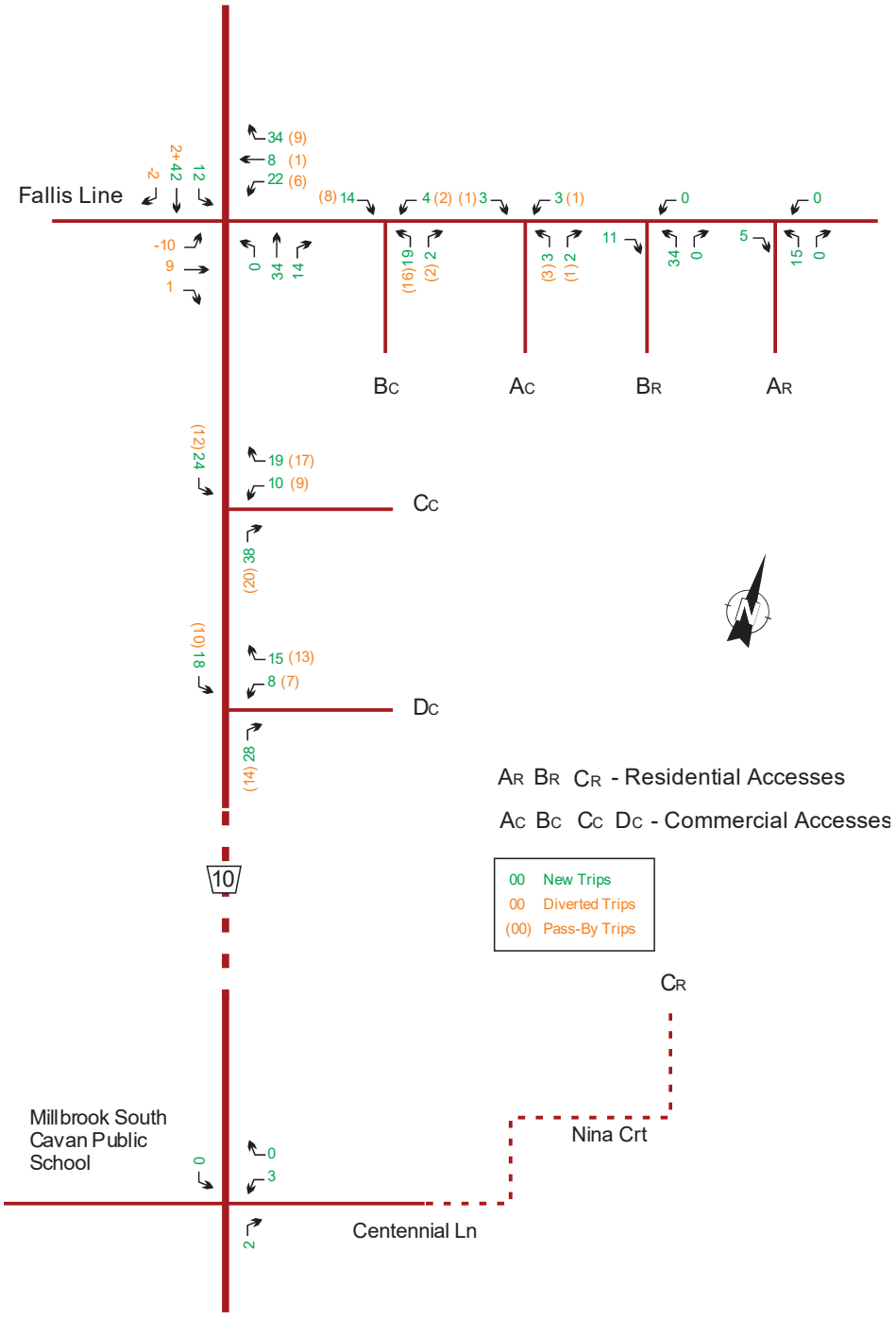

Exhibit 26: *AM Generated Trips at Accesses - 2025.*

PM Generated Trips at Accesses - 2025

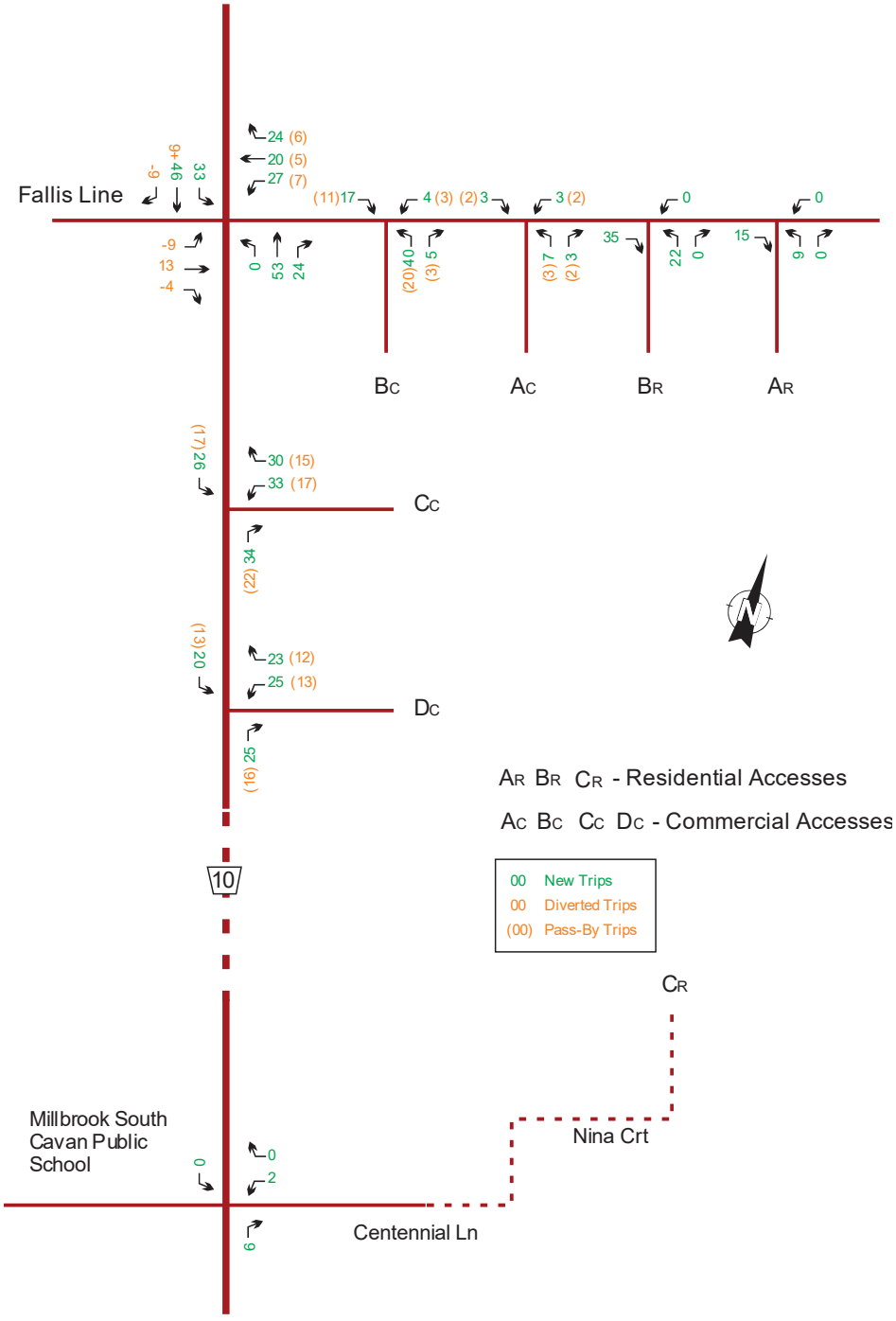

Exhibit 27: *PM Generated Trips at Accesses - 2025.*

SAT Generated Trips at Accesses - 2025

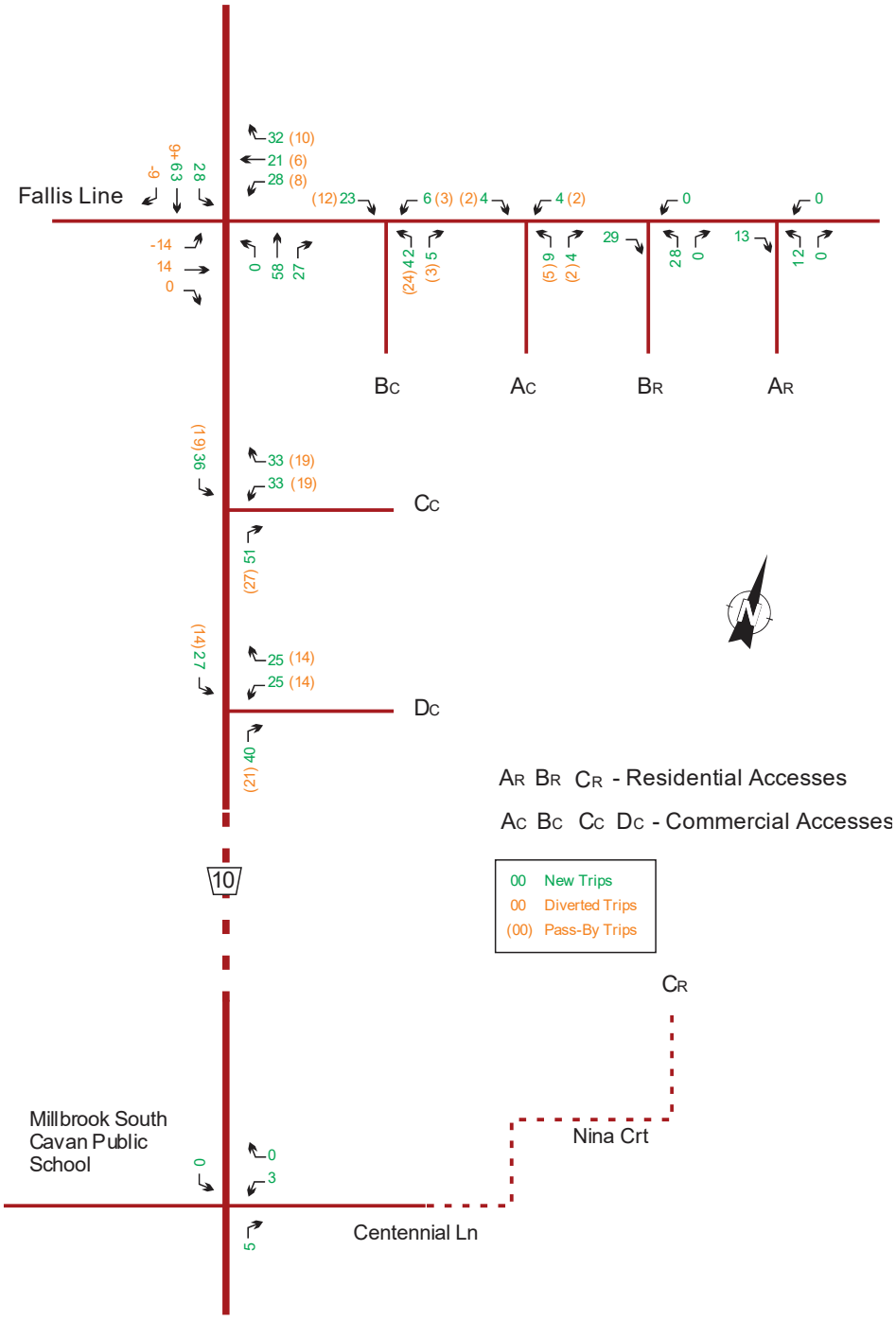

Exhibit 28: *SAT Generated Trips at Accesses - 2025.*

AM Generated Trips at Accesses - 2030

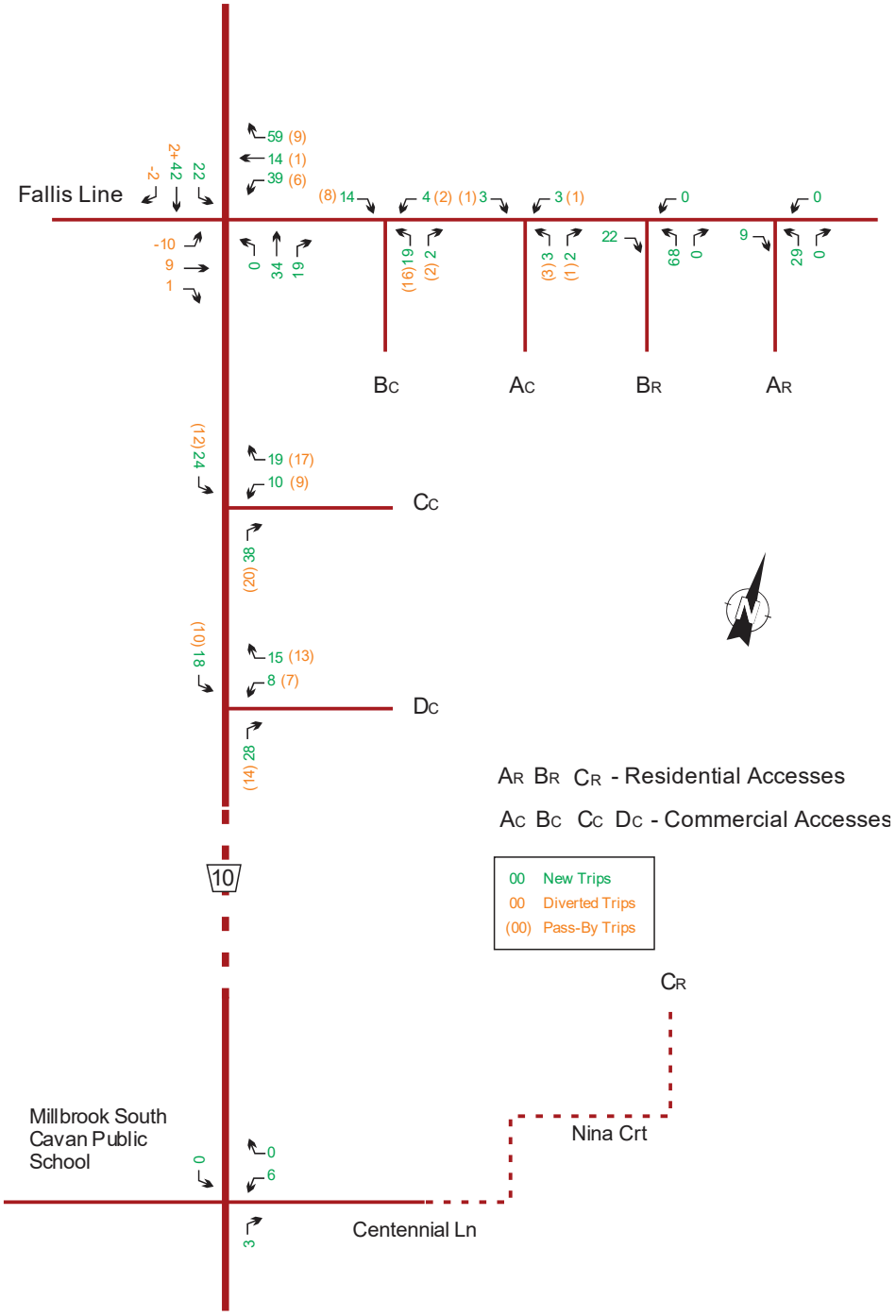

Exhibit 29: *AM Generated Trips at Accesses - 2030.*

PM Generated Trips at Accesses - 2030

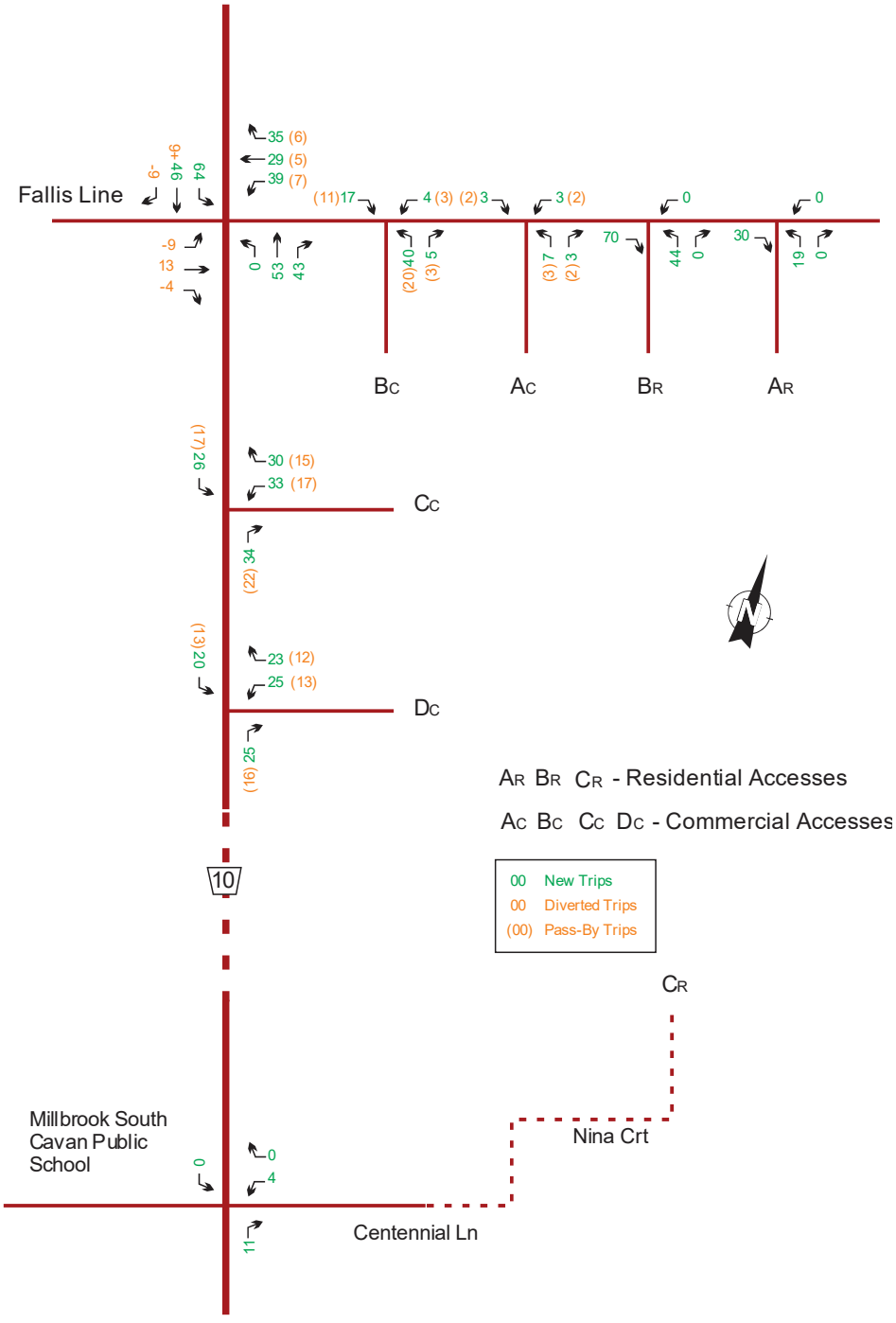

Exhibit 30: *PM Generated Trips at Accesses - 2030.*

SAT Generated Trips at Accesses - 2030

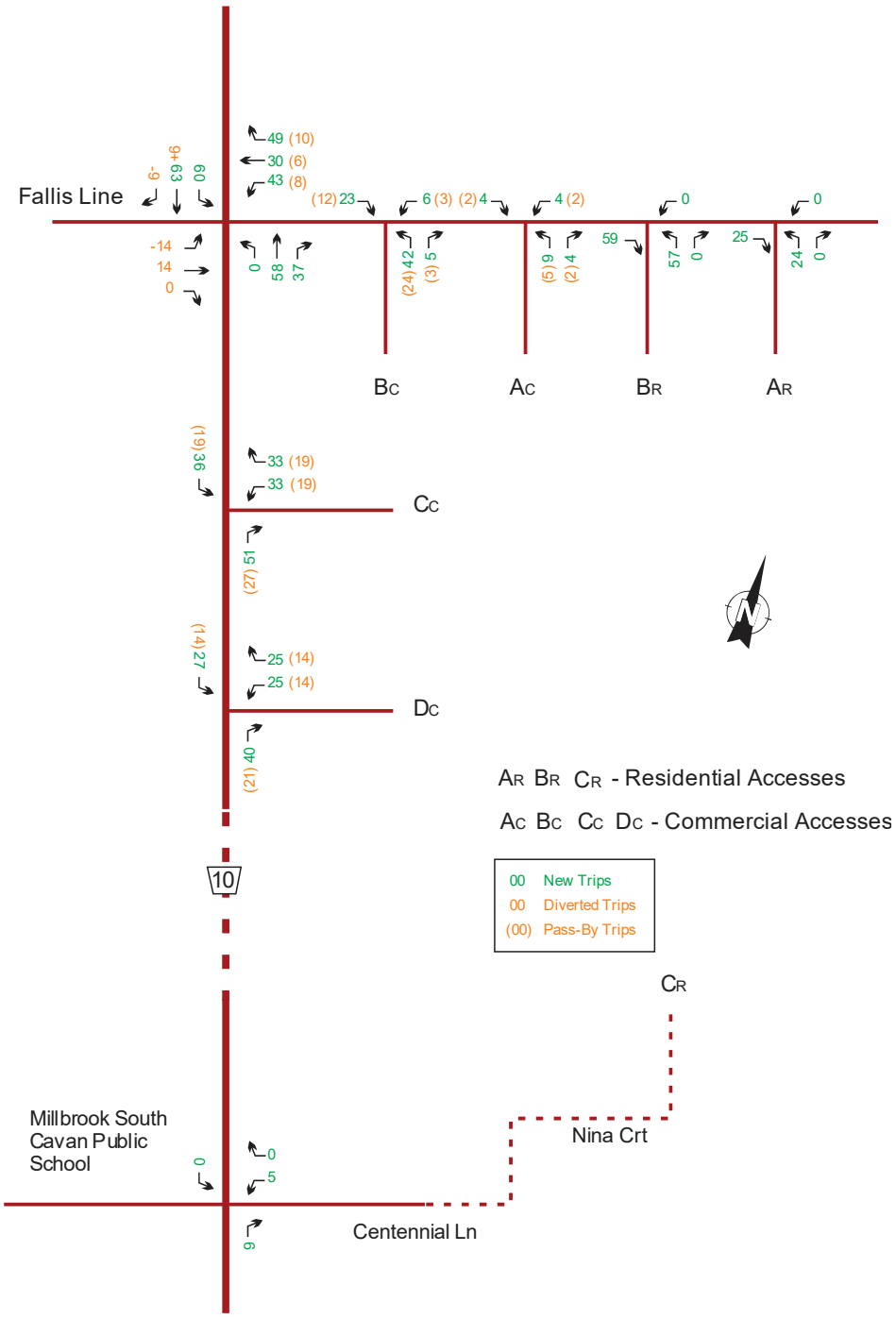

Exhibit 31: *SAT Generated Trips at Accesses - 2030.*

Summary of the traffic operations results for the horizon year 2025 and horizon year 2030 are shown in the following tables:

		Total Volumes at Accesses - Horizon Year 2025											
		AM Peak Hour				PM Peak Hour				SAT Peak Hour			
		V/C	Delay (s)	Q_{95} (m)	LOS	V/C	Delay (s)	Q_{95} (m)	LOS	V/C	Delay (s)	Q_{95} (m)	LOS
Fallis Line (A Residential Access)	EB-TR	0.00	0.0	0.0	A	0.01	0.0	0.0	A	0.01	0.0	0.0	A
	WB-TL	0.00	0.0	0.0	A	0.00	0.0	0.0	A	0.00	0.0	0.0	A
	NB-LR	0.02	8.6	0.4	A	0.01	8.6	0.2	A	0.01	8.6	0.3	A
Fallis Line (B Residential Access)	EB-TR	0.01	0.0	0.0	A	0.03	0.0	0.0	A	0.03	0.0	0.0	A
	WB-TL	0.00	0.0	0.0	A	0.00	0.0	0.0	A	0.00	0.0	0.0	A
	NB-LR	0.04	8.8	0.9	A	0.02	8.8	0.6	A	0.03	8.8	0.7	A
Fallis Line (A Commercial Access)	EB-TR	0.01	0.0	0.0	A	0.03	0.0	0.0	A	0.03	0.0	0.0	A
	WB-TL	0.00	0.6	0.1	A	0.00	1.2	0.1	A	0.00	1.1	0.4	A
	NB-LR	0.01	8.8	0.2	A	0.02	8.9	0.4	A	0.02	8.9	0.5	A
Fallis Line (B Commercial Access)	EB-TR	0.02	0.0	0.0	A	0.04	0.0	0.0	A	0.04	0.0	0.0	A
	WB-TL	0.00	0.9	0.1	A	0.00	1.5	0.1	A	0.01	1.4	0.1	A
	NB-LR	0.05	9.1	1.1	A	0.08	9.4	2.0	A	0.09	9.5	2.3	A
CR10 (C Commercial Access)	WB-LR	0.12	13.2	3.1	B	0.23	15.3	6.6	C	0.26	16.3	7.9	C
	NB-T	0.30	0.0	0.0	A	0.33	0.0	0.0	A	0.34	0.0	0.0	A
	NB-R	0.04	0.0	0.0	A	0.04	0.0	0.0	A	0.05	0.0	0.0	A
	SB-L	0.04	8.8	0.9	A	0.05	8.9	1.2	A	0.06	9.1	1.6	A
	SB-T	0.34	0.0	0.0	A	0.32	0.0	0.0	A	0.36	0.0	0.0	A
CR10 (D Commercial Access)	WB-LR	0.10	13.1	2.4	B	0.18	14.8	4.8	B	0.20	15.7	5.6	C
	NB-T	0.32	0.0	0.0	A	0.34	0.0	0.0	A	0.36	0.0	0.0	A
	NB-R	0.03	0.0	0.0	A	0.03	0.0	0.0	A	0.04	0.0	0.0	A
	SB-L	0.03	8.8	0.7	A	0.04	8.9	0.9	A	0.05	9.2	1.2	A
	SB-T	0.33	0.0	0.0	A	0.33	0.0	0.0	A	0.36	0.0	0.0	A

Table 10: *Traffic Operation Results at Accesses – Horizon Year 2025.*

		Total Volumes at Accesses - Horizon Year 2030											
		AM Peak Hour				PM Peak Hour				SAT Peak Hour			
		V/C	Delay (s)	Q_{95} (m)	LOS	V/C	Delay (s)	Q_{95} (m)	LOS	V/C	Delay (s)	Q_{95} (m)	LOS
Fallis Line (A Residential Access)	EB-TR	0.01	0.0	0.0	A	0.02	0.0	0.0	A	0.02	0.0	0.0	A
	WB-TL	0.00	0.0	0.0	A	0.00	0.0	0.0	A	0.00	0.0	0.0	A
	NB-LR	0.03	8.7	0.7	A	0.02	8.7	0.5	A	0.03	8.7	0.6	A
Fallis Line (B Residential Access)	EB-TR	0.02	0.0	0.0	A	0.06	0.0	0.0	A	0.05	0.0	0.0	A
	WB-TL	0.00	0.0	0.0	A	0.00	0.0	0.0	A	0.00	0.0	0.0	A
	NB-LR	0.08	9.1	1.9	A	0.05	9.2	1.3	A	0.07	9.2	1.7	A
Fallis Line (A Commercial Access)	EB-TR	0.02	0.0	0.0	A	0.06	0.0	0.0	A	0.05	0.0	0.0	A
	WB-TL	0.00	0.3	0.1	A	0.00	0.6	0.1	A	0.00	0.6	0.1	A
	NB-LR	0.01	9.0	0.2	A	0.02	9.3	0.4	A	0.03	9.4	0.6	A
Fallis Line (B Commercial Access)	EB-TR	0.03	0.0	0.0	A	0.08	0.0	0.0	A	0.07	0.0	0.0	A
	WB-TL	0.00	0.5	0.1	A	0.01	0.8	0.1	A	0.01	0.8	0.2	A
	NB-LR	0.05	9.5	1.2	A	0.09	9.9	2.3	A	0.10	10.1	2.6	B
CR10 (C Commercial Access)	WB-LR	0.13	14.1	3.4	B	0.27	17.5	8.0	C	0.30	18.7	9.5	C
	NB-T	0.34	0.0	0.0	A	0.40	0.0	0.0	A	0.40	0.0	0.0	A
	NB-R	0.04	0.0	0.0	A	0.04	0.0	0.0	A	0.05	0.0	0.0	A
	SB-L	0.04	9.0	1.0	A	0.05	9.4	1.3	A	0.07	9.5	1.7	A
	SB-T	0.39	0.0	0.0	A	0.37	0.0	0.0	A	0.41	0.0	0.0	A
CR10 (D Commercial Access)	WB-LR	0.10	14.0	2.7	B	0.21	16.8	5.8	C	0.23	17.7	6.6	C
	NB-T	0.36	0.0	0.0	A	0.41	0.0	0.0	A	0.42	0.0	0.0	A
	NB-R	0.03	0.0	0.0	A	0.03	0.0	0.0	A	0.04	0.0	0.0	A
	SB-L	0.03	9.0	0.8	A	0.04	9.4	1.0	A	0.05	9.5	1.3	A
	SB-T	0.39	0.0	0.0	A	0.38	0.0	0.0	A	0.42	0.0	0.0	A

Table 11: *Traffic Operation Results at Accesses – Horizon Year 2030.*

All accesses (residential and commercial accesses) show acceptable operations with level of service “C“ or better for the horizon years 2025 and 2030.

6 Roadway Geometry Review

6.1 Auxiliary Lanes Review

The need for auxiliary lanes (right turn taper and left turn lane) on (CR10) at the commercial site driveway locations were reviewed.

The MTO Design Supplement for the Geometric Design Guide for Canadian Roads (TAC Manual) was consulted to evaluate the need for a left turn lane. The methodology is based on the advancing volume, opposed volume and percentage of left turns from the advancing volumes; based on a design speed of 70 km/h and the total volumes for the horizon year 2025 and horizon year 2030, it was determined that a left turn lane on CR10 at each of the commercial driveways is warranted (see Appendix K for procedure).

he MTO Design Supplement for the Geometric Design Guide for Canadian Roads (TAC Manual) was consulted to evaluate the need for a right turn taper. According to the TAC Manual, if the right turn volume of 60 vehicles per hour is observed, geometric options for accommodation of the right turning traffic is required. Based on the noted criteria, it was determined that a right turn taper on CR10 at each of the commercial driveways is warranted.

6.2 Stopping Sight Distance at Entrance

In general, driveways provide physical transition between the site and the abutting roadway. Driveways should be located and designed to minimize impacts on traffic while providing a safe entry and exit from the served development. In order to provide a safe entry and exit, adequate sight

distance is to be provided. Sight distance is the distance needed by a driver on a roadway, or a driver exiting a driveway or street, to verify that the road is clear and avoid conflicts with other vehicles. Sight lines must be kept free of object which might interfere with the ability of the driver to see incoming vehicles.

Sight distance was reviewed based on the design speed of the roadways. When the road vertical or horizontal curve do not constrain the design speed, as general practice has been assumed the following design speed:

- For low posted speeds of 60 km/h or less, increase of 10 km/h.
- For high posted speeds of 70 km/h or greater, increase of 20 km/h.

Since CR10 within the proposed commercial area is posted to 60 km/h, a 70 km/h design speed was adopted; the stopping sight distance for a 70 km/h is 105 m. Reviewing the Geometric Design Guide for Canadian Road (TAC Manual), the stopping sight distance considers an object of 0.6 m above the pavement to represent the tail light height of a vehicle and to the other end, a height of 1.05 m above the pavement to represent the driver height eye. The stopping sight distance was measured in the field with the following results:

<u>Cc – CR10 North Commercial Access</u>

- To the north, the minimum stopping sight distance is just meet – measured 105 m
- To the south, the stopping sight distance exceed substantially the 105 m

<u>Dc – CR10 South Commercial Access</u>

- To the north, the minimum stopping sight distance is meet – measured 115 m
- To the south, the stopping sight distance exceed substantially the 105 m

Therefore, the stopping sight distance from the proposed entrance locations meet or exceed the minimum required as per the TAC Manual.

7 Drive-Through Window – Vehicle Storage

7.1 The Restaurant with Drive-Through Window

As discussed in this report, the proposed development will include a restaurant with a drive-through window service.

Location of the drive-through window needs to be designed in order to avoid the estimated queue in line conflicts with the normal site circulation and to avoid blockage of parking stalls within the site.

7.2 Review of Ontario Municipal Zoning By-Law Requirements

Municipalities across southern Ontario have developed minimum zoning by-law requirements for drive-through restaurants. A survey of fourteen Municipal zoning by-laws has indicated that storage requirements for drive-thru lanes range from 6 to 15 vehicles. ***Table 12*** summarizes the various municipal zoning by-law requirements. The average storage noted by municipalities for a drive through lane requires a space to accommodate 12 vehicles, some of these municipalities requiring storage for 15 vehicles.

Municipality	Zoning By-Law Requirements
Ajax	15
Brampton	10
Brandford	13
Caledon	8
Durham	15
Hamilton	12
Kitchener	13
London	15
Markham	10
Milton	10
Mississuaga	12
Niagara Falls	12
Oakville	10
Sarnia	6

Table 12: *Various Ontario Municipal Zoning By-Law Requirements.*

It is expected the subject site to provide storage for at least 12 vehicles for the drive-thru window service.

8 Conclusions/Recommendations

For purposes of this study, it is estimated that the build-out of the commercial development is for the year 2025; by the same year, it is expected the residential development is 50% developed/occupied, and for the 2030 is already fully developed/occupied.

As part of the background volumes, the study includes those major proposed developments within the study area that are approved or in construction. The traffic volumes of these developments were obtained from the "Millbrook Development Phase 2 – Traffic Impact Study for the Tower Hill Developments Ltd." Prepared by JD Engineering.

Background traffic capacity results for the horizon years 2025 and horizon year 2030 are very similar with acceptable traffic operations. Under the existing geometry, some of the movements reach their capacity; this is the case for the westbound movement at the CR10/Larmer Line which shows level of service "E" for 2025 and becomes "F" for 2030. For the CR10/Fallis Line intersection, the most critical is the eastbound movement which shows level of service "F" for the year 2025 and 2030.

The additional trips generated by the proposed developments will degrade even more traffic operations; therefore, the use for traffic signals at CR10/Larmer Line and at CR10/Fallis Line intersections is required to improve operations.

Based on the Book 12 of the Ontario Traffic Manual, traffic signal timing and signal timing offsets have been introduced for both intersections.

While the signal timing design for the year 2025 is recommended as an initial setup, the signal timing for the year 2030 is only a reference to demonstrate that signals can handle the intersection; however, the traffic signal timing design for the year 2030 will need to be revisited and evaluated with updated traffic volumes.

There is also some indication that the CR10/King St/Distillery Rd intersection might require traffic signals by the year 2030; however, there are many variables that can change over the long run and preclude to make an accurate forecast; the noted intersection will require some attention after the year 2025 (after full build out of the commercial development) to review the new traffic volumes and to identify if traffic signals are warranted.

The study has also identified the need for auxiliary lanes at CR10/Larmer Line and at CR10/Fallis Line intersections. There will also be required auxiliary lanes on CR10 at the commercial driveways (see next exhibits with sketch of improvements). Details for auxiliary lanes are as following:

<u>CR10/Fallis Line Intersection</u>

a. Provide an exclusive eastbound left turn lane with 30 m storage lane, 90 m parallel lane and taper length according to Table 9.17.1 of the TAC for 70 km/h design speed.

b. Provide an exclusive westbound left turn lane with 15 m storage lane, 40 m parallel lane and taper length according to Table 9.17.1 of the TAC for 70 km/h design speed.

c. Provide an exclusive southbound left turn lane with 15 m storage lane, 40 m parallel lane and taper length according to Table 9.17.1 of the TAC for 70 km/h design speed.

d. Provide an exclusive northbound left turn lane with 40 m storage lane. This northbound left turn lane will need to be designed in conjunction with the southbound left turn lane on CR10 into the commercial access (north access), as a back-to-back left turn lane

(see the ***Exhibit 32***). The southbound left turn lane should have the minimum 15 m storage lane.

e. Provide a 60 m northbound right turn taper.

CR10/Larmer Line Intersection

a. Provide an exclusive northbound left turn lane with 15 m storage lane, 60 m parallel lane and taper length according to Table 9.17.1 of the TAC for 90 km/h design speed.

b. Provide an exclusive southbound left turn lane with 15 m storage lane, 60 m parallel lane and taper length according to Table 9.17.1 of the TAC for 90 km/h design speed.

On CR10 at Commercial Accesses

a. Provide a southbound left turn lane on CR10 at the north access location with the minimum 15 m storage lane. The design of this southbound left turn lane is to be designed in conjunction to the northbound left turn lane for the CR10/Fallis Line intersection, as a back-to-back left turn lane (see the ***Exhibit 32***).

b. Provide a southbound left turn lane on CR10 at the south access location with the minimum 15 m storage lane (see the ***Exhibit 32***).

c. Provide a 60 m northbound right turn taper on CR10 at each of the two commercial accesses.

Therefore, from the traffic point of view and with the inclusion of the recommended improvements, the proposed developments can take place without significant impacts to traffic operations.

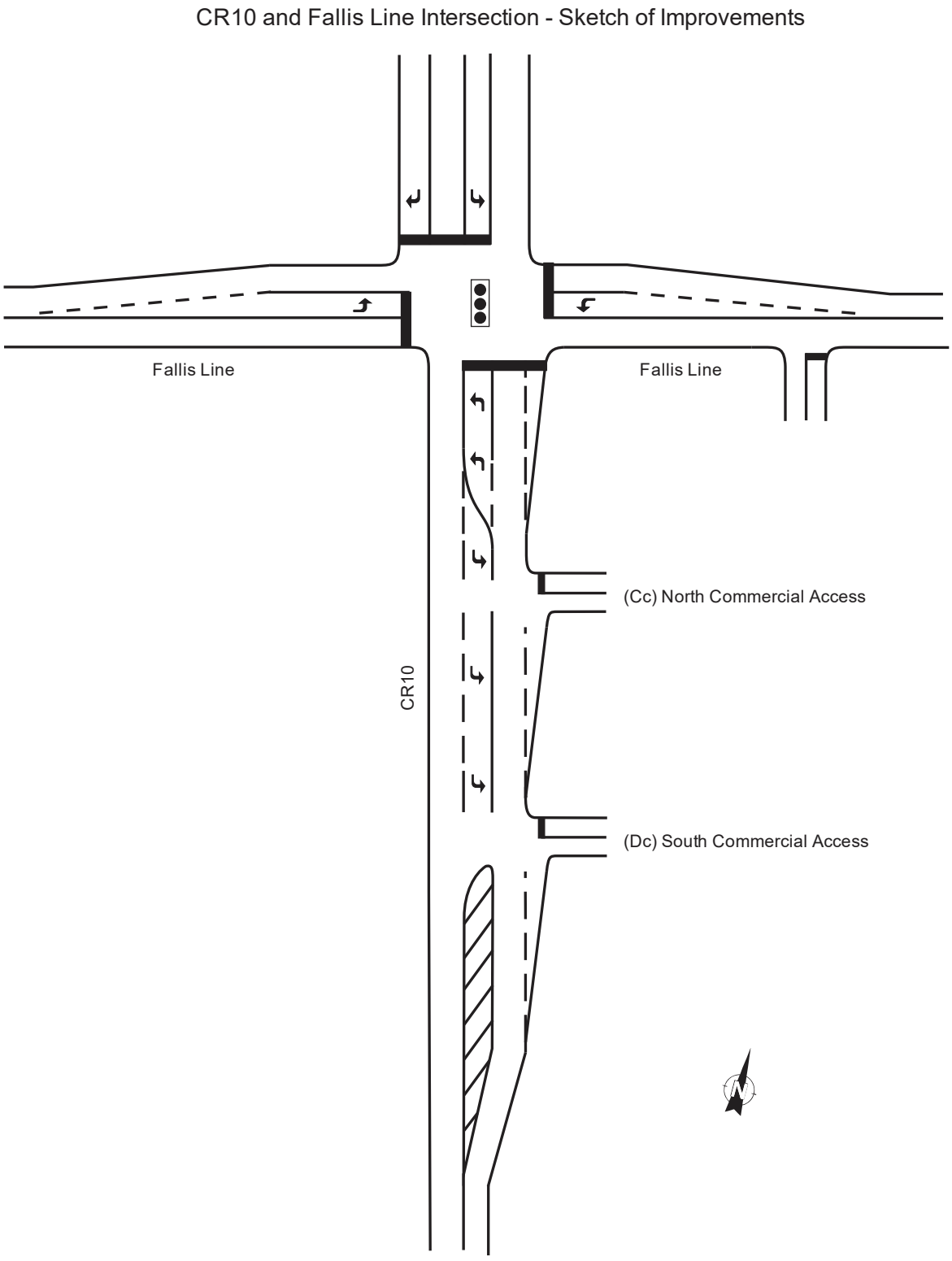

Exhibit 32: *CR10/Fallis Line Intersection – Sketch of Improvements.*

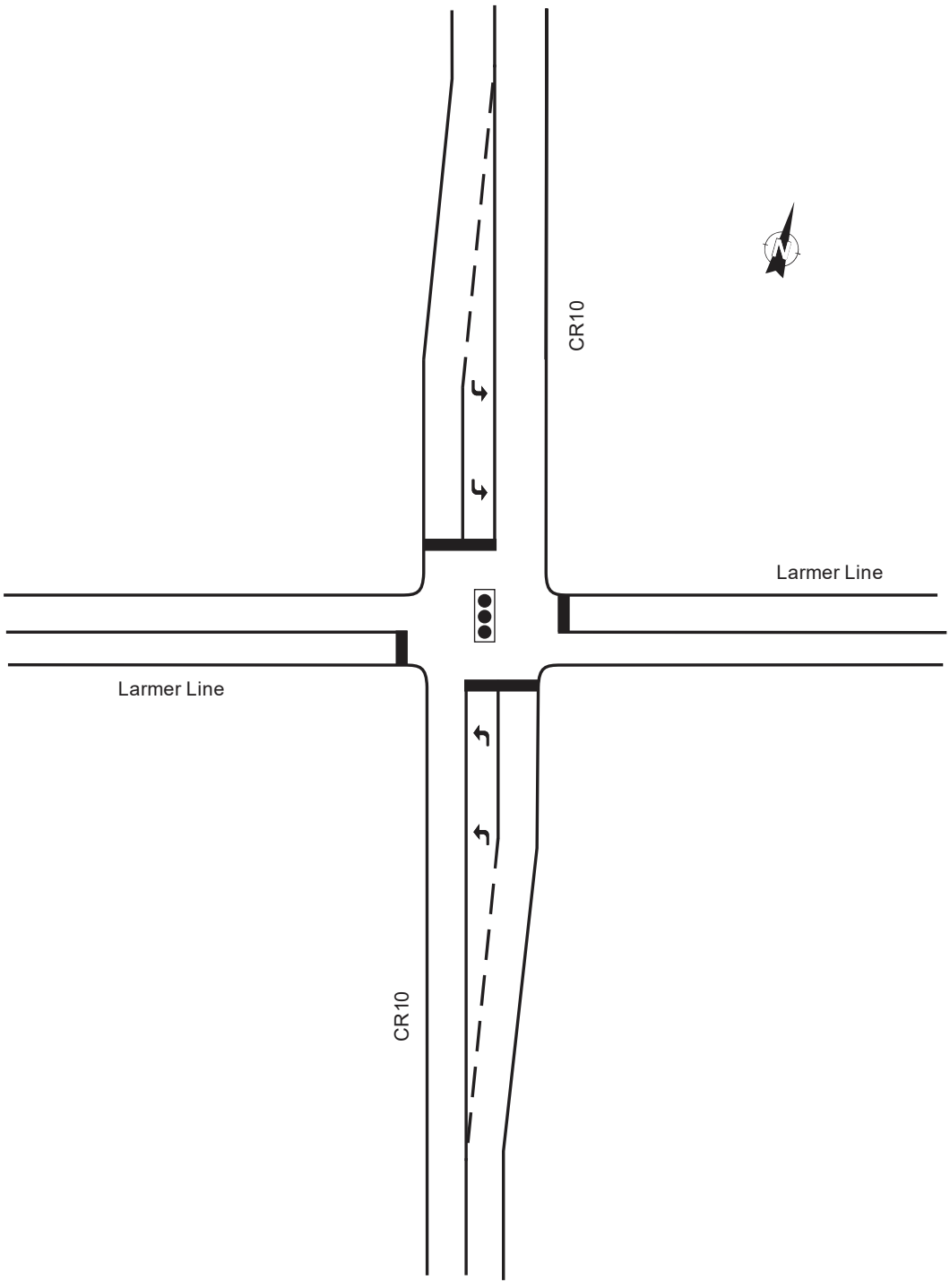

Exhibit 33: *CR10/Larmer Line Intersection – Sketch of Improvements.*