

910 Veteran's Drive

City of Barrie

Traffic Impact Study for M-Star Developments (2528286 Ontario Inc.)

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Executive Summary

This report summarizes the traffic impact study prepared for the proposed residential development located at 910 Veteran's Drive, in the City of Barrie [City]. The report assesses the impact of traffic related to the development on the adjacent roadway and provides recommendations to accommodate this traffic in a safe and efficient manner.

The proposed development will include the construction of 52 townhouse units.

Access to the proposed development will be provided as follows:

- Extension of Lane 'T' from the adjacent H&H Capital Salem Subdivision [H&H Development] into the north side of the subject site;
- Access to Street 'M' within the adjacent H&H Development via the Municipal Lane; and
- Direct private driveway access to Street 'M' within the adjacent H&H Development.

Via the above noted connections, the proposed development will have access to McKay Road West from the internal H&H Development road network via Street 'A' and Street 'C' and will have access to Veteran's Drive from the internal H&H Development road network via Street 'H'. Only Street 'A' and Street 'C' are anticipated to be constructed as part of the first phase of the proposed development. Street 'H' is anticipated to be constructed by 2025.

Through consultation with the City, the following intersections are included in the Traffic Impact Study:

- Veteran's Drive / McKay Road West.

Conclusions

1. The proposed development is expected to generate a total of 26 AM and 33 PM peak hour trips.
2. Background traffic and pedestrian counts were completed at the existing intersection of Veteran's Drive / McKay Road West on Tuesday, November 27, 2018.
3. According to the City's MMATMP and Capital Budget (2018), the following transportation infrastructure improvements are planned for Veteran's Drive in the study area:

Veteran's Drive (within the study area)

- Road reconstruction to a 5-lane cross-section.

McKay Road West (within the study area)

- Road re-construction to a 7-lane cross section;
- It has been assumed that McKay Road West will be reconstructed to a 5-lane cross-section in the 2021 horizon year and a 7-lane cross section in the 2031 horizon year.

4. An estimate of the amount of traffic that would be generated by the Subject Site was prepared and assigned to the study area streets and intersection.
5. Total (2021 and 2025) traffic volumes were estimated by applying a background traffic growth (2%) and the various adjacent development traffic volumes.
6. Using a background growth rate of 3% and 8% for Veteran's Drive and McKay Drive West respectively, the total (2031) traffic volumes were estimated from the total (2025) traffic volumes.

7. An intersection operation analysis was completed under total (2021 and 2031) traffic volumes with the proposed development operational at the study area intersections. No additional infrastructure improvements are recommended.
8. In summary, the proposed development will not cause any operational issues and will not add significant delay or congestion to the local roadway network.

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1 Introduction

1.1 Background

M-Star Developments (2528286 Ontario Inc) [Developer] is proposing a residential townhouse development [subject site] located at 910 Veteran's Drive, in the City of Barrie [City]. The proposed development will include the construction of 52 townhouse units.

Access to the proposed development will be provided as follows:

- Extension of Lane 'T' from the adjacent H&H Capital Salem Subdivision [H&H Development] into the north side of the subject site;
- Access to Street 'M' within the adjacent H&H Development via the Municipal Lane; and
- Direct private driveway access to Street 'M' within the adjacent H&H Development.

Via the above noted connections, the proposed development will have access to McKay Road West from the internal H&H Development road network via Street 'A' and Street 'C' and will have access to Veteran's Drive from the internal H&H Development road network via Street 'H'. Only Street 'A' and Street 'C' are anticipated to be constructed as part of the first phase of the proposed development. Street 'H' is anticipated to be constructed by 2025.

The Developer has retained **JD Northcote Engineering Inc.** [JD Engineering] to prepare this traffic impact study in support of the proposed development.

1.2 Study Area

Figure 1 illustrates the location of the subject site and study area intersections in relation to the surrounding area. The Conceptual Site Plan by IPS Consulting Inc. is shown in **Appendix A**. The Draft Plan of Subdivision for the adjacent H&H Development is shown in **Appendix B**.

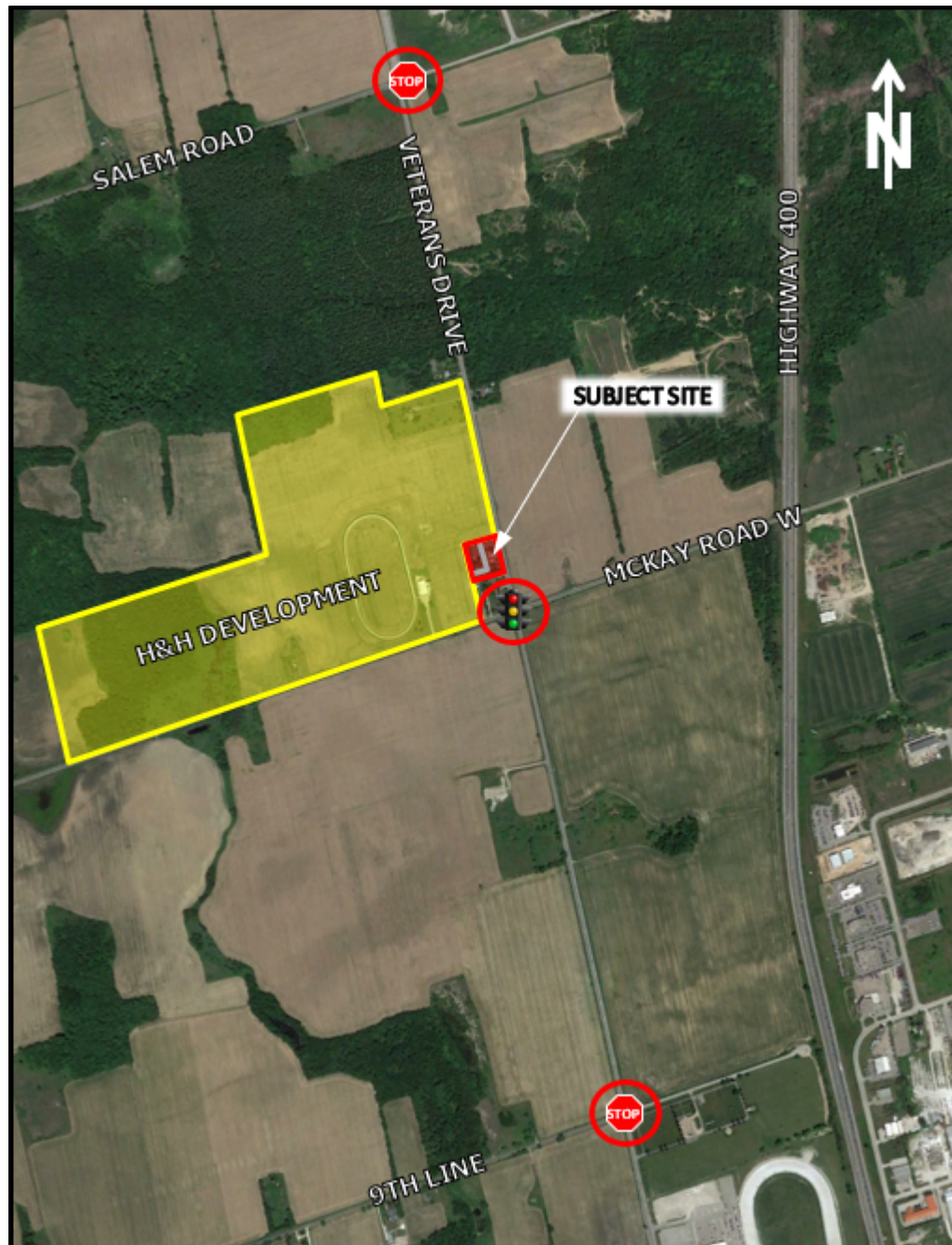
The subject site is bound by Veteran's Drive to the east, and lands designated for residential development to the west, south and north.

Through consultation with the City, the following intersections are included in the Traffic Impact Study¹:

1. Veteran's Drive / McKay Road West;

¹ Detailed review of the intersections of Street 'A' / McKay Drive West, Street 'C' / McKay Drive West and Street 'H' / Veteran's Drive have not been included in this study based on the satisfactory intersection operation analysis for these intersections in the February 2018 H&H Capital Salem Subdivision Residential Development Traffic Impact Study by C.F. Crozier & Associates Inc. for the 2031 horizon year. Furthermore, the additional traffic generated at these intersections by the proposed development is anticipated to be negligible as per Figures 9 and 10 in Section 3.

Figure 1 - Proposed Site Location and Study Area



1.3 Study Scope and Objectives

The purpose of the study is to identify the potential impacts to traffic flow on the surrounding roadway network. The study analysis includes the following tasks:

- Consult with the City to address any traffic-related issues or concerns they have with the proposed development;
- Determine existing traffic volumes and circulation patterns;
- Estimate future traffic volumes if the proposed development was not constructed, including the impact of additional proposed developments in the area;
- Estimate the amount of traffic that would be generated by the proposed development and assign to the roadway network;
- Complete level-of-service [LOS] analysis of horizon year (with the proposed development) traffic conditions and identify additional operational deficiencies;
- Identify improvement options to address operational deficiencies; and
- Calculate lane improvements for the the surrounding roadway network based on the Transportation Association of Canada and Ontario Ministry of Transportation guidelines;

1.4 Horizon Year and Analysis Periods

It has been assumed that, should all approvals be granted, occupancy for the proposed development will be completely built-out and occupied by 2021. Traffic scenarios for the build-out year (2021) and 10-year post-buildout (2031) horizon year were selected for analysis of traffic operations in the study area. The weekday morning [AM] and weekday afternoon [PM] peak hours have been selected as the analysis periods for this study.

2 Information Gathering

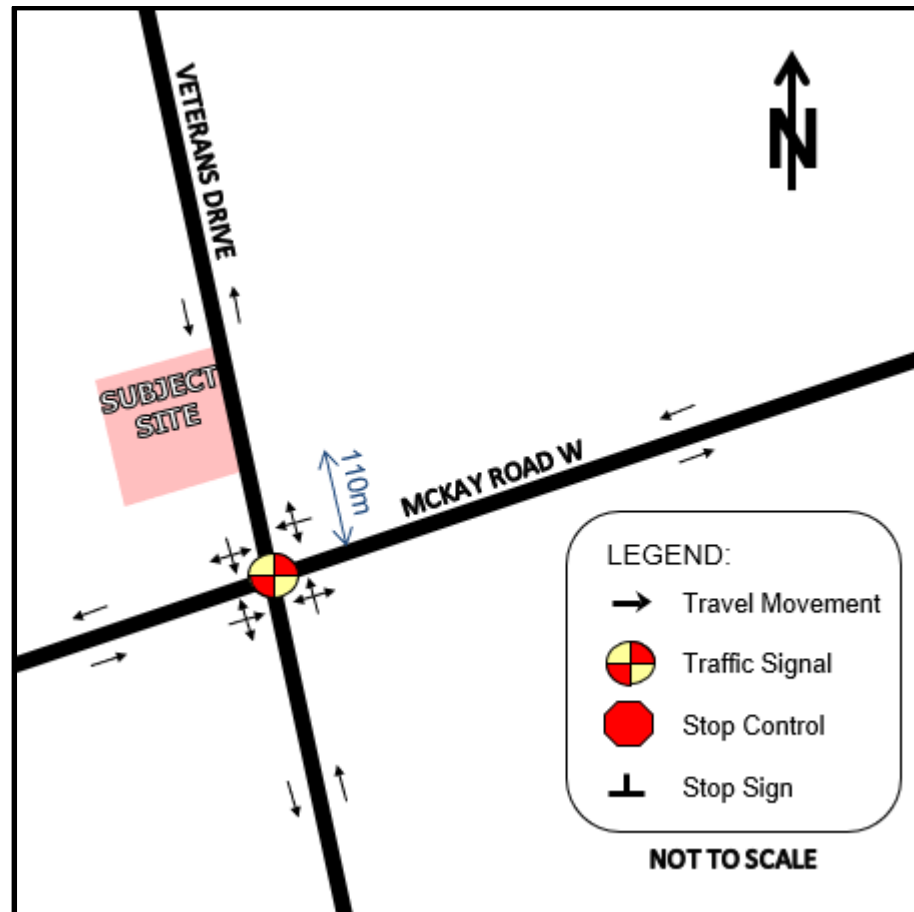
2.1 Street and Intersection Characteristics

Veteran's Drive is a two-lane arterial road with a rural cross-section. The posted speed limit on Veteran's Drive is 80 km/h within the study area. Veteran's Drive is under the jurisdiction of the City.

McKay Road West is a two-lane arterial road with a rural cross-section. The posted speed limit on McKay Road West is 80 km/h within the study area. McKay Road West is under the jurisdiction of the City.

The existing intersection spacing and lane configuration within the study are is illustrated in **Figure 2**.

Figure 2 – Existing Intersection Spacing and Lane Configuration with in Study Area



2.2 Local Transportation Infrastructure Improvements

Based on the City's Multi-Modal Active Transportation Master Plan (January 2014) [MMATMP], the following infrastructure improvements are anticipated to be completed prior to the 2021 horizon year.

- Veteran's Drive (within the study area)²
 - o Construction of a 5-lane cross section.
- McKay Road West (within the study area)
 - o Construction of a 7-lane cross section³

² According to the City's Capital Budget (2018), the Veteran's Drive improvements are planned to be completed by 2022. Since the road would be under construction at the build-out year (2021), we have based our analysis on the reconstructed configuration of the road.

³ The MMTAMP only identifies a 5-lane cross section on McKay Road West within the study area; however, based on discussions with the City, McKay Road West is now planned to have a 7-lane cross section from Highway 400 to the west side of Veteran's Drive. For the purpose of our analysis, it has been assumed that McKay Road West will operate with a 5-lane cross-section in the 2021 horizon year and a 7-lane cross section in the 2031 horizon year.

Based on the City's MMATMP and City's Capital Budget (2018), the following infrastructure improvements are anticipated to be completed prior to the 2031 horizon year.

- Salem Road (east of study area)
 - Construction of a new 5-lane Highway 400 crossing at Lockhart Road / Salem Road.
- McKay Road Interchange
 - Construction of a new Highway 400 interchange at McKay Road

The future (2021 and 2031) lane configurations within the study area are illustrated in **Figure 3** and **4**.

Figure 3 – Future (2021) Lane Configuration within the Study Area

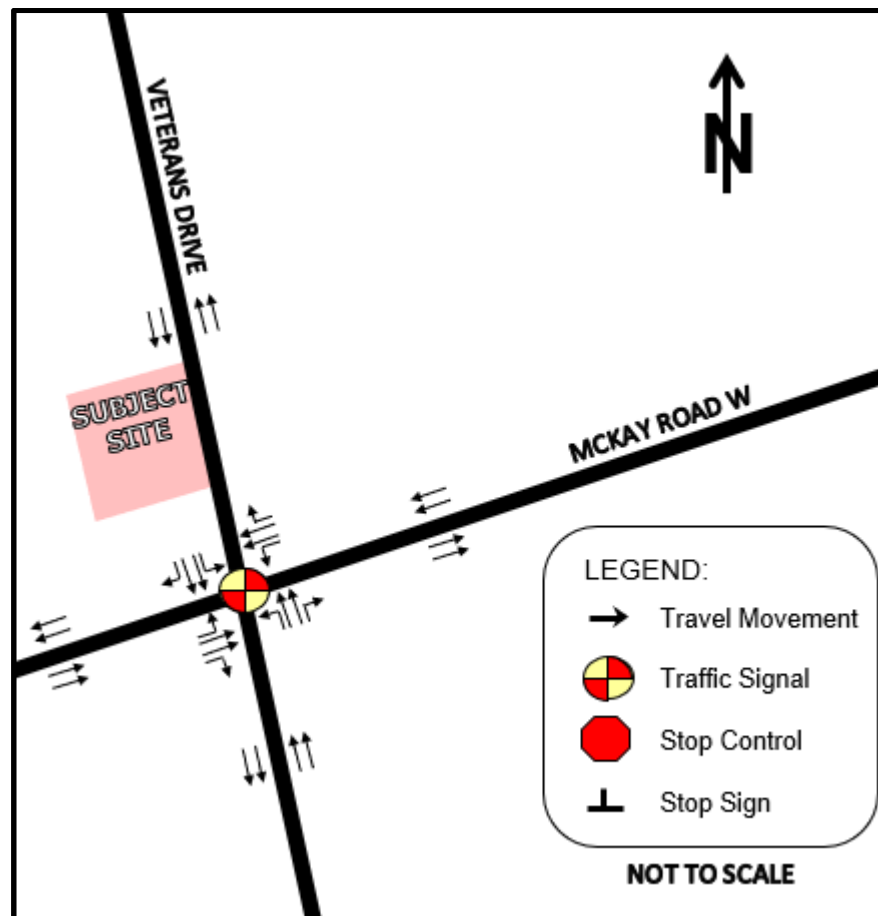
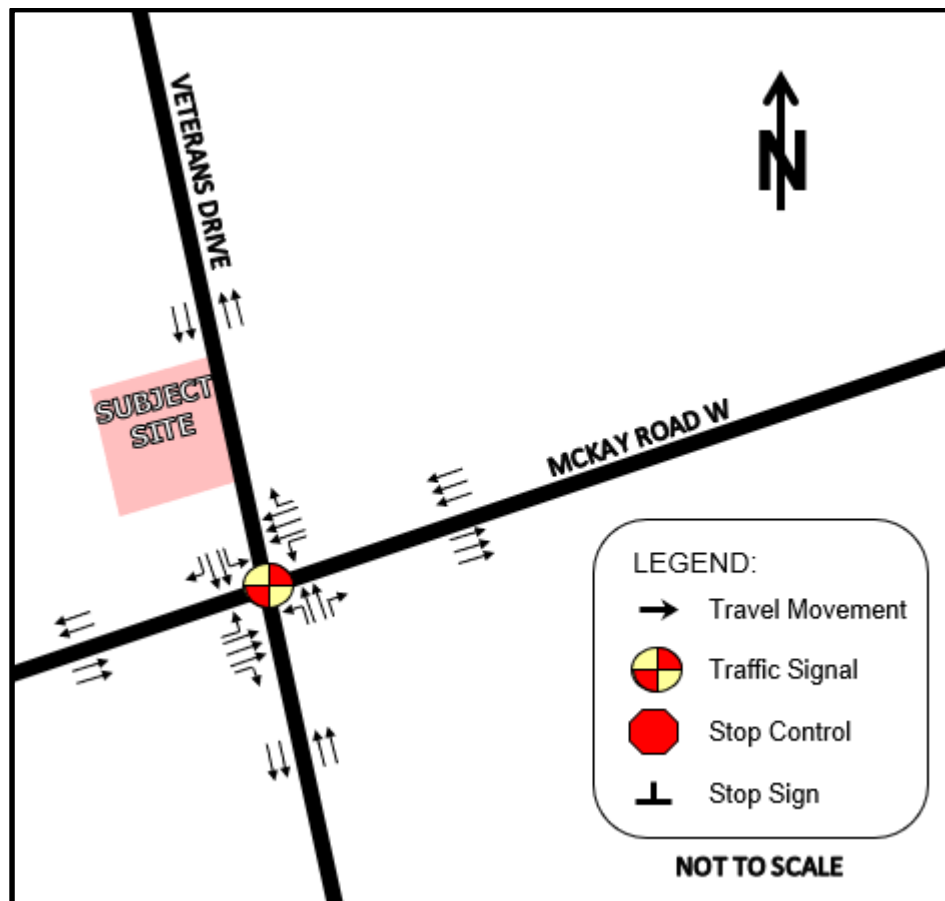


Figure 4 – Future (2031) Lane Configuration within the Study Area



2.3 Transit Access

Currently the City's transit system does not provide service within the study area. According to the City's MMATMP a new minor bus hub will be constructed near the McKay Road West / Veteran's Drive intersection, which will connect four bus routes to major hub points across the City. The timeline for extension of these routes will be dependent on the development and demand for transit in the surrounding area. Currently the closest transit route to the site is the No. 7A which travels along Veteran's Drive north of the study area. The closest existing bus stop is located at Commerce Park Drive at Norris Drive.

2.4 Other Developments within the Study Area

Based on discussions with the City, there are a number of developments in the area that will impact the traffic generation rates, specifically:

- Crisdawn;
- H&H;
- DiPoce; and
- Watersand Lands.

Figure 5 shows the location, land uses and latest unit count for Phase 1 of the above-noted adjacent developments, in relation to the subject site. Phase 1 of all developments are anticipated to be constructed by 2025. The specifics of Phase 2 and Phase 3 of the above noted developments are currently unknown.

Traffic generated by the above noted developments have been estimated based on the March 07, 2018 Watersand Development Traffic Analysis [Watersand TA] by JD Northcote Engineering Inc. (excerpts provided in **Appendix C**).

The Watersand TA calculated the 2025 traffic volumes for the above noted developments. It is anticipated that first occupancy will occur in 2020 with occupancy to continue linearly over the next 5 years. Consequently, we have assumed 20% of the Watersand TA 2025 traffic volumes to be within the study area during the 2021 horizon year.

Figure 6 illustrates the above noted development traffic during the 2021 horizon year within the study area. **Figure 7** illustrates the above noted development traffic during the 2031 horizon year within the study area.

An 80 unit townhouse development is also proposed at 844 Veteran's Drive; however, the traffic generation from this site is expected to have a negligible impact on the traffic volume in the study area. To stay consistent with the Watersand TA, we have assumed that the conservative traffic generation estimates used in this analysis for the large developments in the area (listed above), will account for the traffic generation from this and other small developments in and around the study area.

Figure 5 – Development Location and Statistics

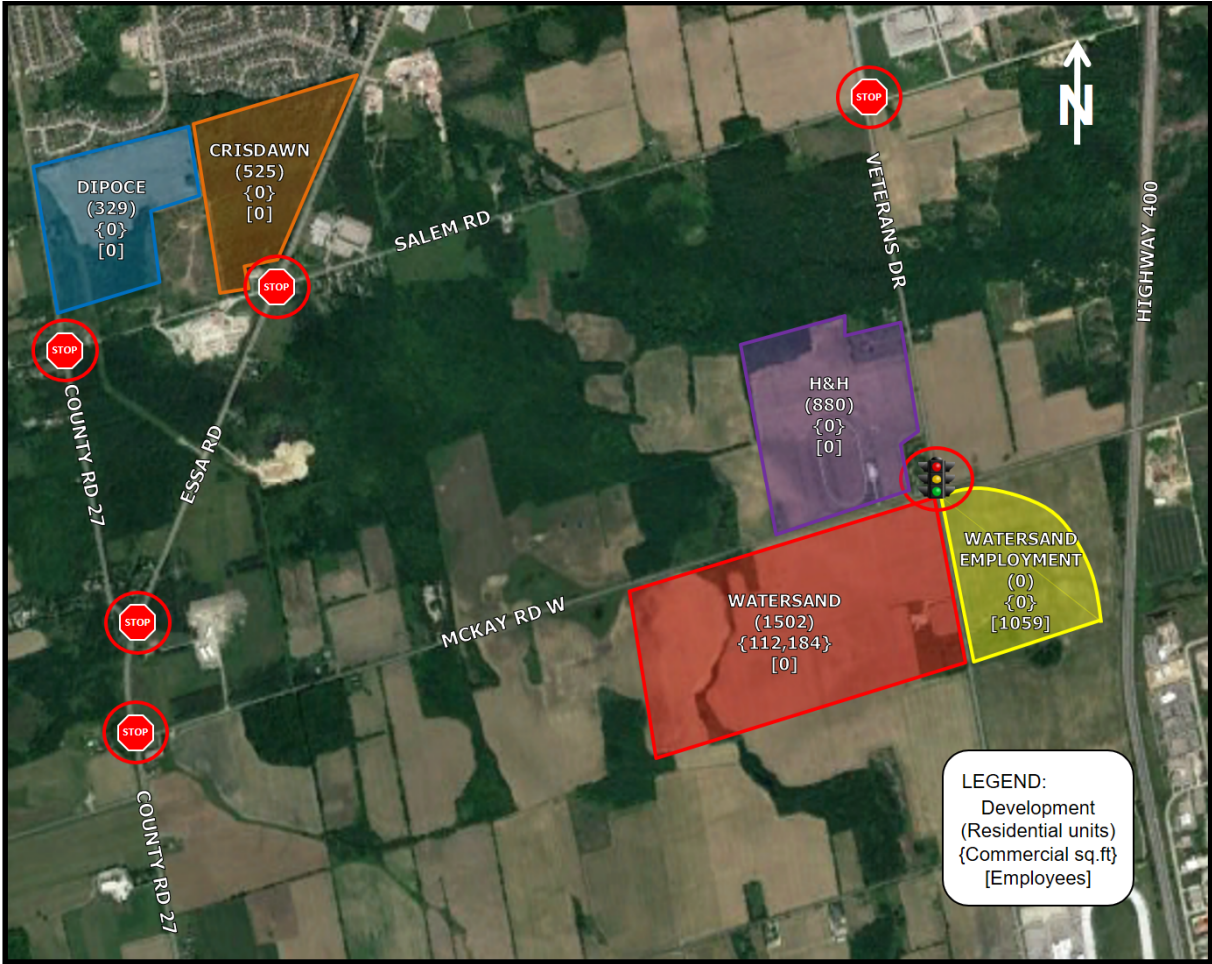


Figure 6 – Adjacent Development (2021 Horizon Year) Traffic Volumes within Study Area

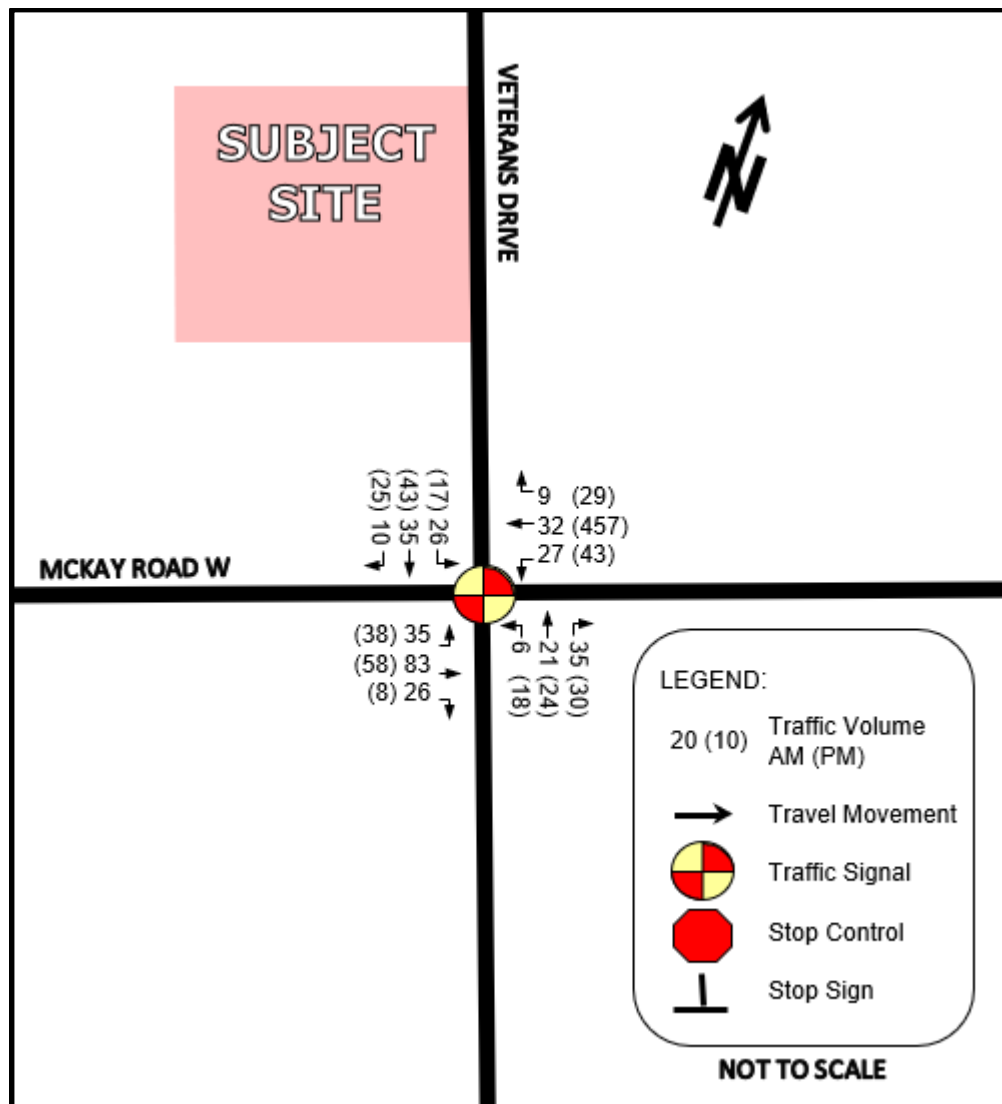
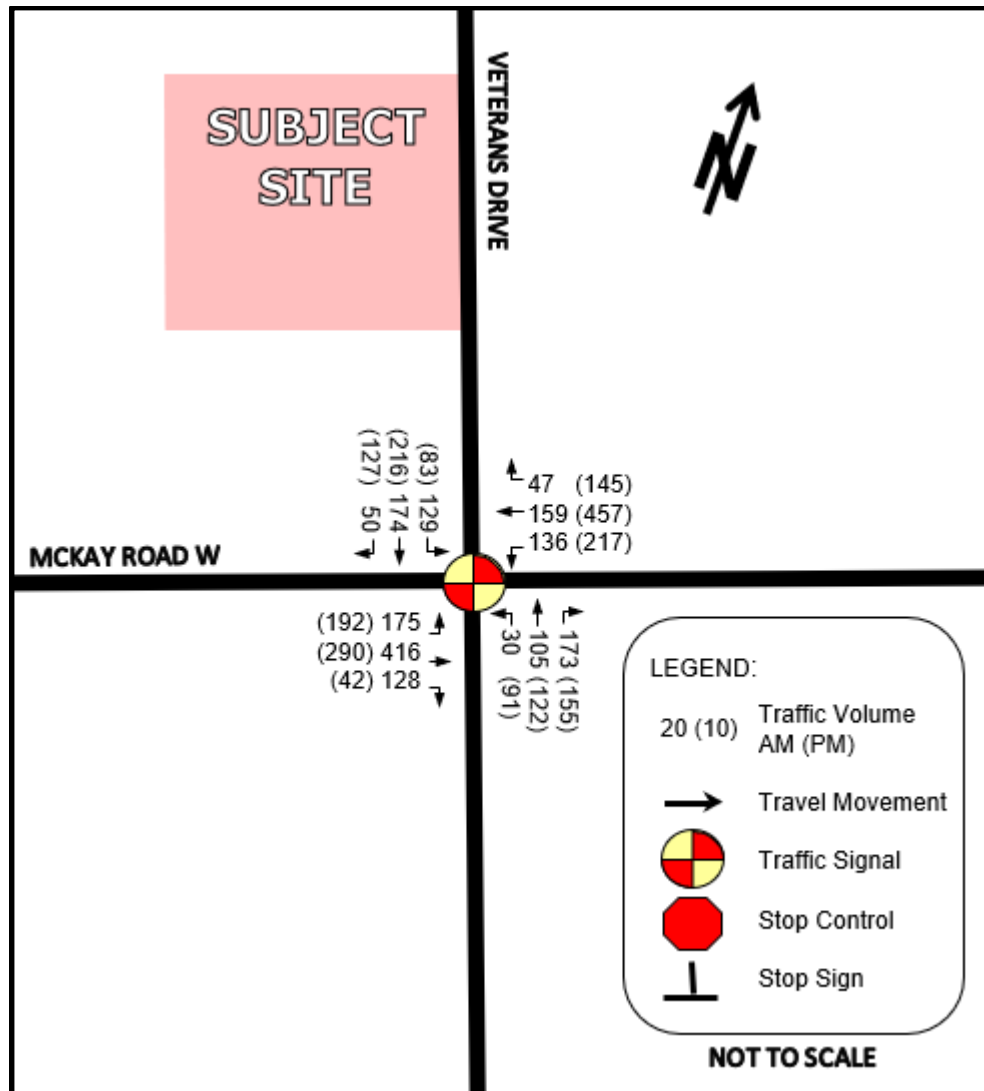


Figure 7 – Adjacent Development (2031 Horizon Year) Traffic Volumes within Study Area



2.5 Traffic Counts

Detailed turning movement traffic and pedestrian counts were completed for the intersection of Veteran's Drive / McKay Road West. **Table 1** summarizes the traffic count data collection information.

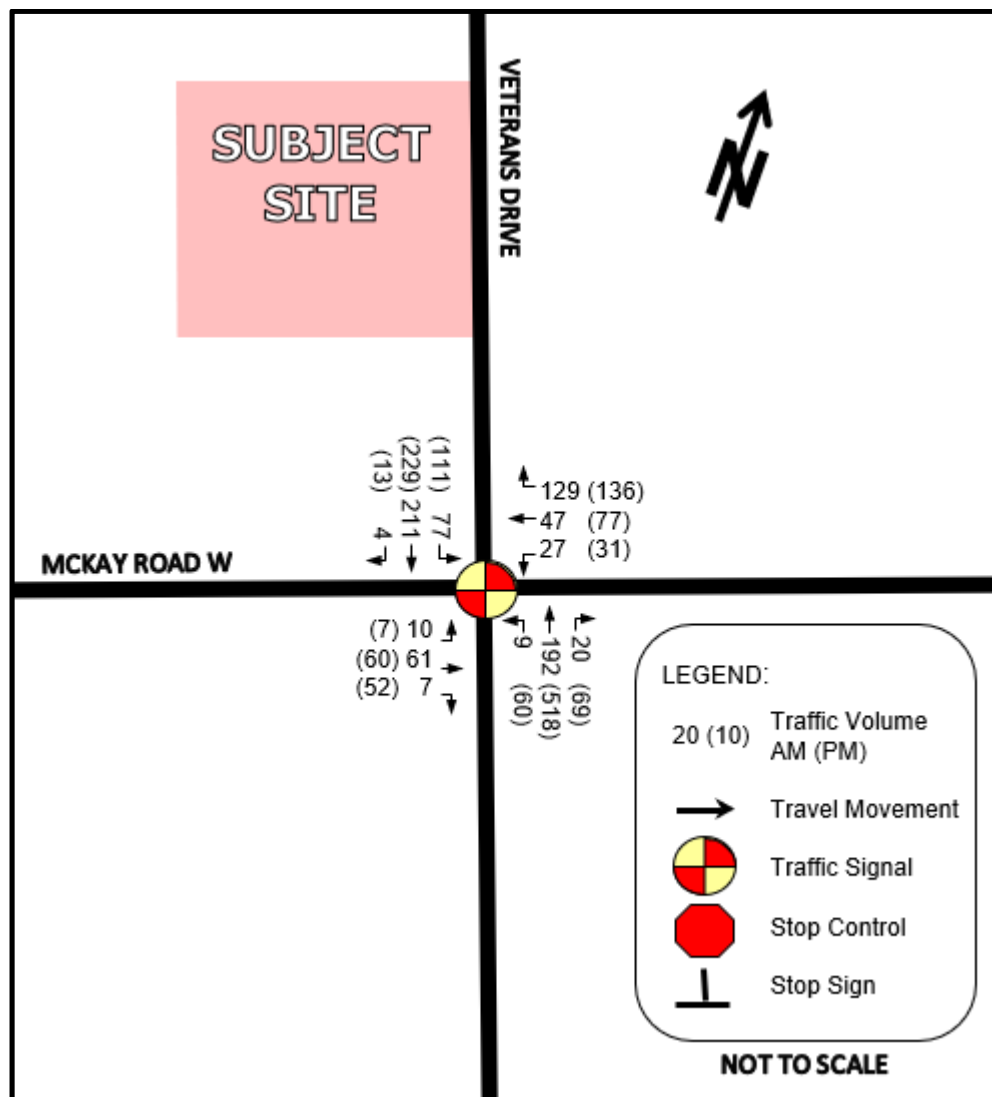
Table 1 – Traffic Count Data

Intersection (N-S Street / E-W Street)	Count Date	AM Peak Hour	PM Peak Hour
Veteran's Drive / McKay Road West	Tuesday, November 27, 2018	07:30 – 08:30	16:00 – 17:00

Detailed traffic count data can be found in **Appendix D**. The peak hours of traffic generation within the study area generally aligned with the anticipated peak hour of traffic generation by the proposed development.

Figure 8 illustrates the existing (2018) horizon year AM and PM peak hour traffic volumes in the study area.

Figure 8 – Existing (2018) Traffic Volumes



3 Proposed Development Traffic Generation and Assignment

3.1 Traffic Generation

The traffic generation for the subject site has been based on the ITE *Trip Generation* data. The following ITE land uses have been applied to estimate the traffic from the proposed development:

- ITE land use 220 (Multifamily Housing (Low-Rise))

The estimated trip generation of the proposed development is illustrated below in **Table 2**. The AM and PM peak traffic generation for the subject site generally aligns with the AM and PM peak hour in the traffic counts.

Table 2 – Estimated Traffic Generation from Proposed Development

Land Use	Size	AM Peak Hour			PM Peak Hour		
		IN	OUT	TOTAL	IN	OUT	TOTAL
Multifamily Housing (Low-Rise) ITE Land Use: 220	52 units	6	20	26	21	12	33

No transportation modal split has been applied to the above-noted traffic generation calculation.

3.2 Traffic Assignment

For the purposes of this study, it has been assumed that all traffic generated by the proposed development will be new traffic and would not be in the study area if the development was not constructed.

The distribution of traffic for the proposed development is assumed to follow the trip distribution calculated for the H&H Development in the February 2018 H&H Capital Salem Subdivision Residential Development Traffic Impact Study by C.F. Crozier & Associates Inc [H&H TIS]. For illustrative purposes, the traffic distribution can be seen below in **Table 3**.

Table 3 - Site Traffic Distribution

Travel Direction (to/from)	2021 Horizon Year	2031 Horizon Year
North on Veteran's Drive	55%	32%
South on Veteran's Drive	15%	-
East on McKay Road West	15%	55%
West on McKay Road West	15%	13%
Total	100%	100%

The assignment of the traffic generated by the proposed development during the 2021 and 2031 horizon years are provided in **Figures 9** and **10**. The variation in the 2021 and 2031 traffic distribution is due to the new road construction anticipated by 2031 per Section 2.2. More specifically, only Street 'A' and Street 'C' are anticipated to be constructed by the 2021 horizon year. Street 'H' is anticipated to be constructed by the 2031 horizon year. .

The distribution of traffic entering at each access location is based on our review of the internal site layout and road network, in conjunction with the external traffic distribution.

Figure 9 – Traffic Assignment for the Proposed Development (2021 Horizon Year)

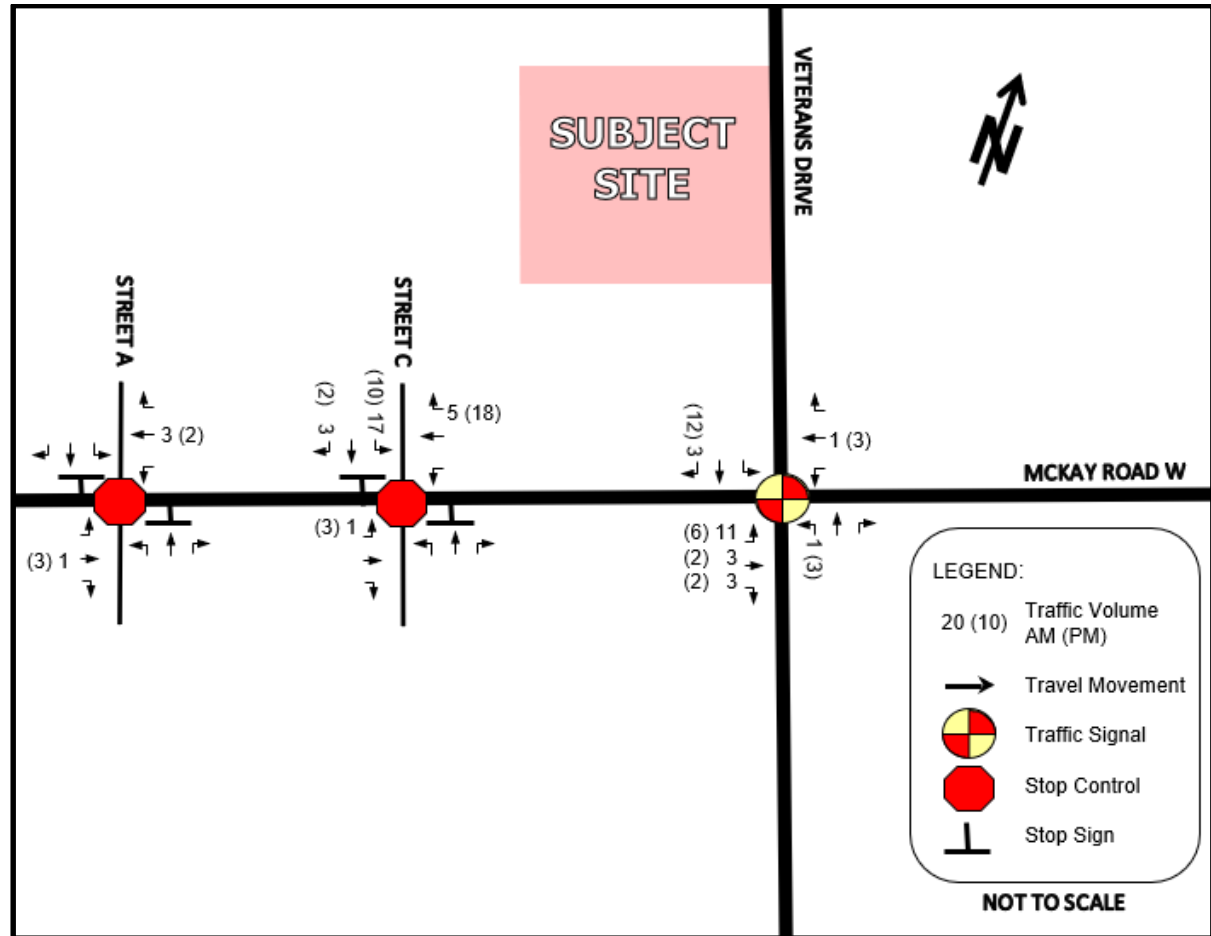
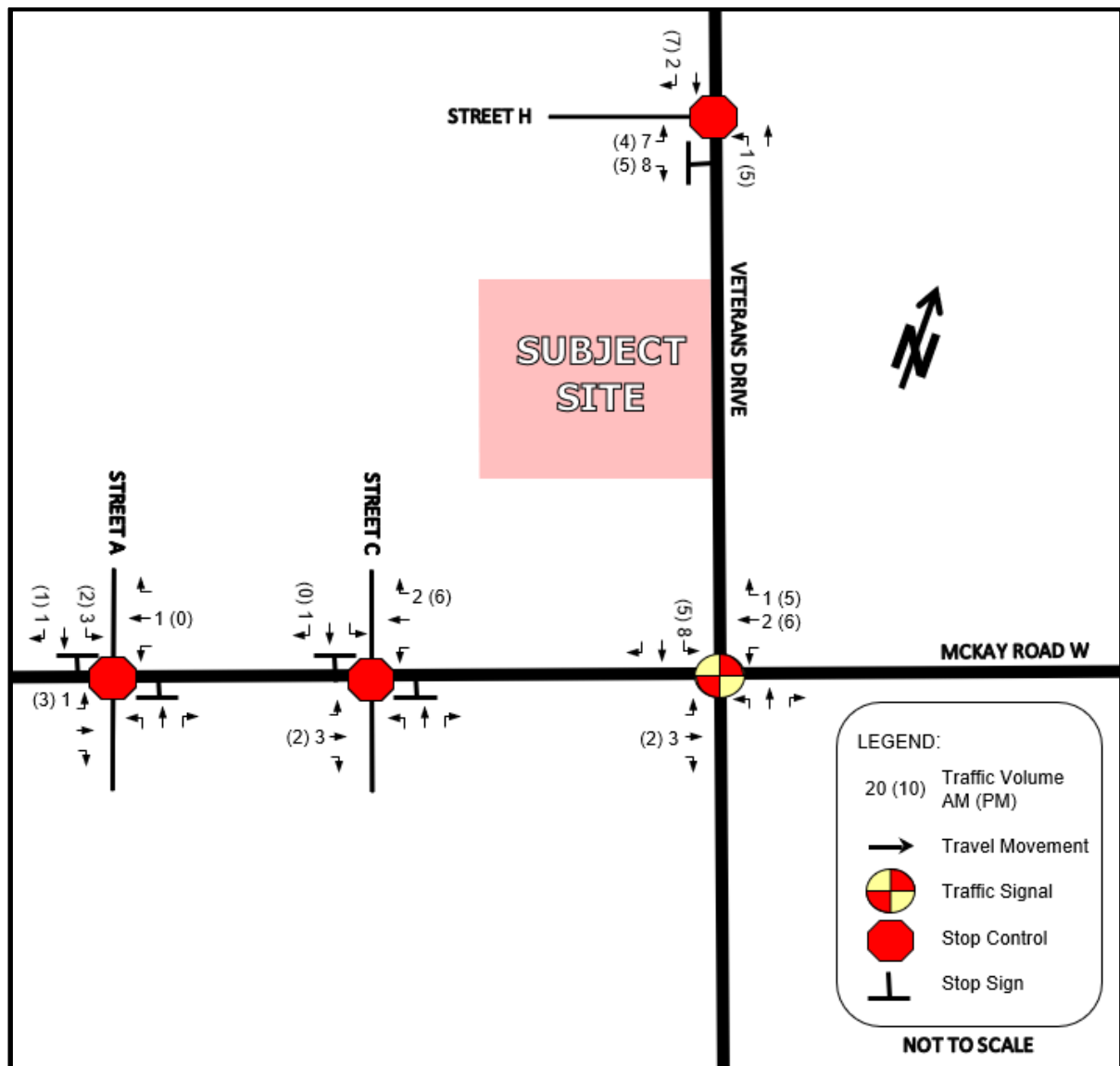


Figure 10 – Traffic Assignment for the Proposed Development (2031 Horizon Year)



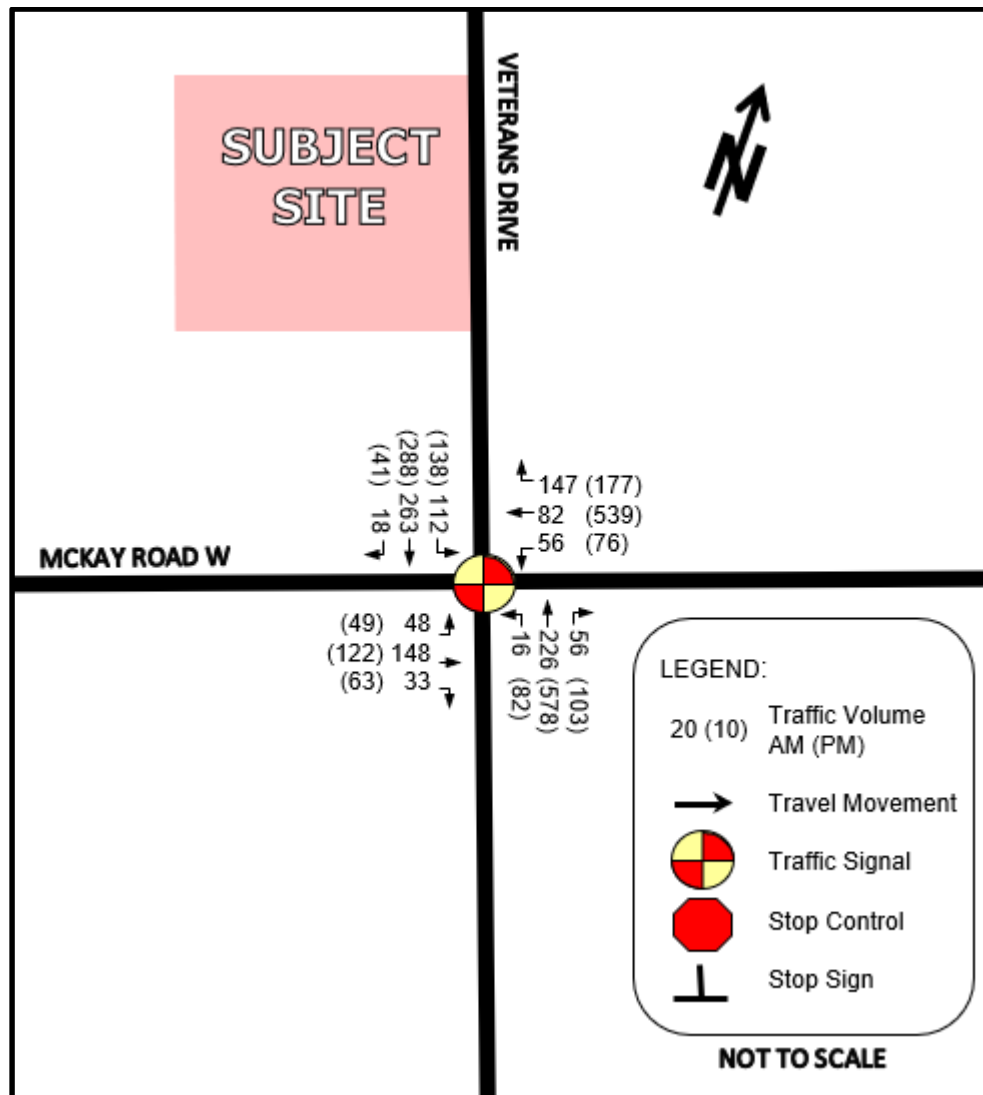
3.3 Total Horizon Year Traffic Volumes with the Proposed Development

3.3.1 Total (2021) Horizon Year Traffic Volumes

In addition to the various development traffic volumes outlined in Section 2.4 and the proposed development traffic volumes in Section 3.2, a background traffic growth rate of 2% / year (similar to recent studies within the study area) has also been applied to the existing (2018) traffic volumes to estimate the total (2021) horizon year traffic volumes.

Figure 11 illustrates the total (2021) horizon year AM and PM peak hour traffic volumes in the study area.

Figure 11 – Total (2021) Traffic Volumes



3.3.2 Total (2031) Horizon Year Traffic Volumes

In order to calculate the Total (2031) traffic volumes, the Total (2025) traffic volumes were first calculated using the various development traffic volumes outlined in Section 2.4, the proposed development traffic volumes outlined in Section 3.2 and a background traffic growth rate of 2% / year (similar to recent studies within the study area) applied to the existing (2018) traffic volumes.

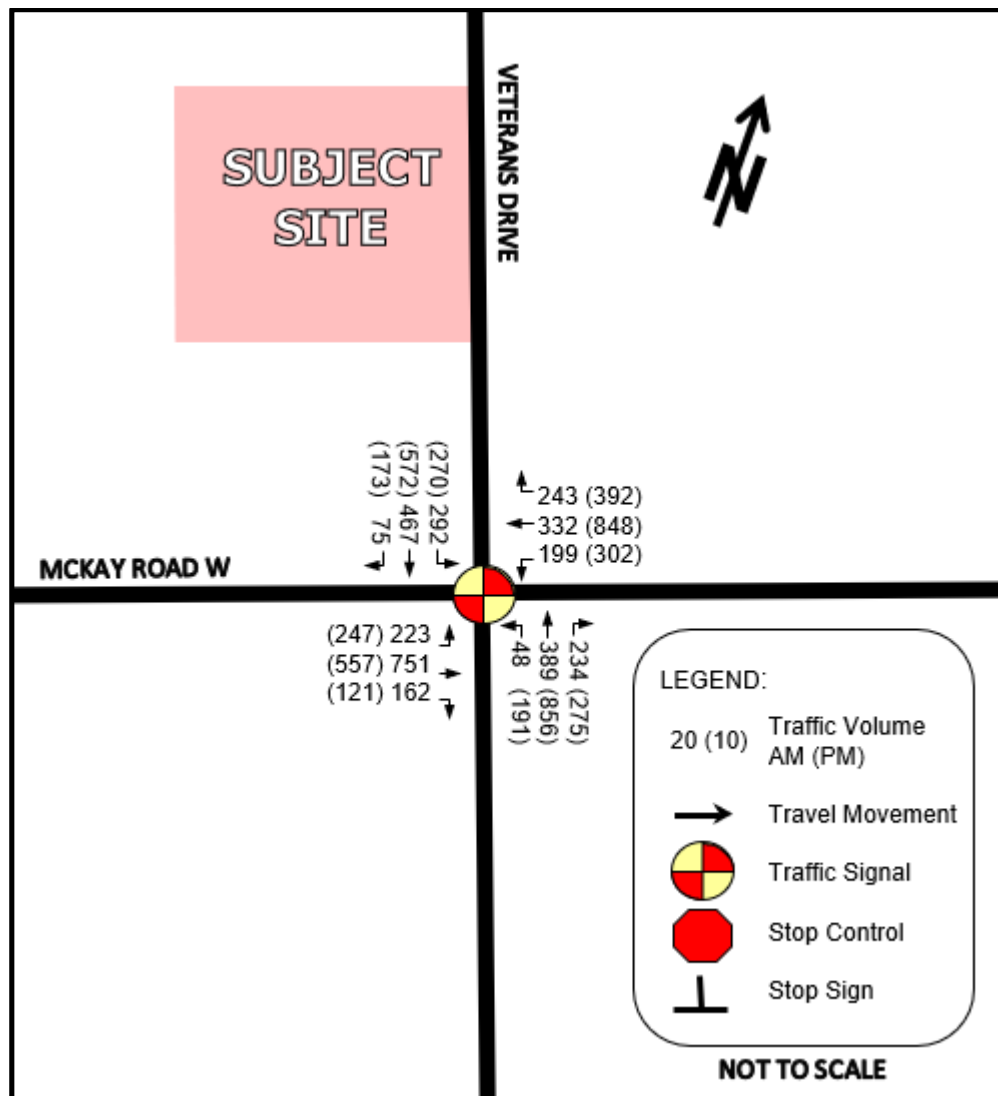
The Total (2031) traffic volumes were calculated by applying a background traffic growth rate of 3% / year on Veteran's Drive and 8% / year on McKay Road West to the Total (2025) traffic volumes. The background growth rate was applied to the Total (2025) traffic volumes, rather than the background (2025) traffic volumes, in order to account for the future development and intensification of these

corridors. While this methodology results in larger traffic volumes than the 2031 EMME model output, we believe this provides a reasonable, yet somewhat conservative estimate of the future traffic volume, based on our review of the Phase 1 traffic volumes and the planned future development in Phase 2 and 3 of the Salem Secondary Plan.

The annual background traffic growth rates outlined above have been calculated using the City's EMME transportation model output. The 2011 and 2031 EMME models were compared for Veteran's Drive and McKay Road West during AM and PM peak hour.

Figure 12 illustrates the total (2031) horizon year AM and PM peak hour traffic volumes in the study area.

Figure 12 – Total (2031) Traffic Volumes



4 Intersection Operation with Proposed Development

4.1 Introduction

The intersection performance was measured using the traffic analysis software, Synchro 10, a deterministic model that employs Highway Capacity Manual and Intersection Capacity Utilization methodologies for analyzing intersection operations. These procedures are accepted by provincial and municipal agencies throughout North America.

Synchro 10 enables the study area to be graphically defined in terms of streets and intersections, along with their geometric and traffic control characteristics. The user is able to evaluate both signalized and unsignalized intersections in relation to each other, thus not only providing level of service for the individual intersections, but also enabling an assessment of the impact the various intersections in a network have on each other in terms of spacing, traffic congestion, delay, and queuing.

Individual turning movements with a volume-to-capacity [V/C] ratio of 0.85 or greater are considered to be critical movements and would be highlighted in the LOS tables.

The intersection operations were also evaluated in terms of the LOS. LOS is a common measure of the quality of performance at an intersection and is defined in terms of vehicular delay. This delay includes deceleration delay, queue move-up time, stopped delay, and acceleration delay. LOS is expressed on a scale of A through F, where LOS A represents very little delay (i.e. less than 10 seconds per vehicle) and LOS F represents very high delay (i.e. greater than 50 seconds per vehicle for a stop sign controlled intersection and greater than 80 seconds per vehicle for a signalized intersection).

The LOS criteria for signalized and stop sign controlled intersections are shown in **Table 4**. A description of traffic performance characteristics is included for each LOS.

Table 4 - Level of Service Criteria for Intersections

LOS	LOS Description	Control Delay (seconds per vehicle)	
		Signalized Intersections	Stop Controlled Intersections
A	Very low delay; most vehicles do not stop (Excellent)	less than 10.0	less than 10.0
B	Higher delay; more vehicles stop (Very Good)	between 10.0 and 20.0	between 10.0 and 15.0
C	Higher level of congestion; number of vehicles stopping is significant, although many still pass through intersection without stopping (Good)	between 20.0 and 35.0	between 15.0 and 25.0
D	Congestion becomes noticeable; vehicles must sometimes wait through more than one red light; many vehicles stop (Satisfactory)	between 35.0 and 55.0	between 25.0 and 35.0
E	Vehicles must often wait through more than one red light; considered by many agencies to be the limit of acceptable delay	between 55.0 and 80.0	between 35.0 and 50.0
F	This level is considered to be unacceptable to most drivers; occurs when arrival flow rates exceed the capacity of the intersection (Unacceptable)	greater than 80.0	greater than 50.0

4.2 Intersection Operation for Total (2021) Traffic Volume

The results of the LOS analysis under total (2021) traffic volumes during the AM and PM peak hour can be found below in **Table 5**. The intersection geometry and traffic control identified in Section 2.2 has been utilized for this scenario with signal timing optimization. Detailed output of the Synchro analysis can be found in **Appendix E**.

Table 5 – Total (2021) LOS

Location (E-W Street / N-S Street)	Weekday AM Peak Hour			Weekday PM Peak Hour		
	V/C	Delay (s)	LOS	V/C	Delay (s)	LOS
McKay Rd W / Veteran's Drive (signalized)	0.22	18.7	B	0.34	19.3	B
EBL	0.22	27.1	C	0.22	32.0	C
EBT	0.40	33.2	C	0.38	38.1	D
EBR	0.02	31.2	C	0.04	36.3	D
WBL	0.22	27.2	C	0.31	31.4	C
WBT	0.22	32.3	C	0.39	37.5	D
WBR	0.10	31.8	C	0.12	36.1	D
NBL	0.03	9.4	A	0.14	7.9	A
NBT	0.14	10.7	B	0.34	12.8	B
NBR	0.04	10.1	B	0.07	10.7	B
SBL	0.17	6.4	A	0.27	6.7	A
SBT	0.14	8.3	A	0.16	10.1	B
EBL	0.01	7.6	A	0.03	9.3	A

The results of the LOS analysis indicate that the McKay Road West / Veteran's Drive intersection is operating within the typical design limits noted in Section 4.1.

The existing storage length for all auxiliary turn lanes, which are discussed further in Section 5, can accommodate the anticipated 95th percentile queue length for the associated turning movement.

No infrastructure improvements are recommended within the study area for this analysis scenario.

4.3 Intersection Operation for Total (2031) Traffic Volume

The results of the LOS analysis under total (2031) traffic volumes during the AM and PM peak hour can be found below in **Table 6**. The intersection geometry and traffic control identified in Section 2.2 has been utilized for this scenario with signal timing optimization. Detailed output of the Synchro analysis can be found in **Appendix E**.

Table 6 – Total (2031) LOS

Location (E-W Street / N-S Street)	Weekday AM Peak Hour			Weekday PM Peak Hour		
	V/C	Delay (s)	LOS	V/C	Delay (s)	LOS
McKay Rd W / Veteran's Drive (signalized)	0.64	28.8	C	0.85	37.1	D
EBL	0.52	24.0	C	0.79	46.3	D
EBT	0.72	37.4	D	0.84	55.9	E
EBR	0.20	31.1	C	0.08	42.1	D
WBL	0.68	29.8	C	0.84	44.8	D
WBT	0.32	32.4	C	0.63	43.2	D
WBR	0.16	31.2	C	0.54	42.9	D
NBL	0.15	21.4	C	0.48	18.7	B
NBT	0.40	28.8	C	0.70	32.9	C
NBR	0.16	26.4	C	0.29	26.0	C
SBL	0.56	17.7	B	0.79	30.4	C
SBT	0.38	22.2	C	0.42	24.4	C
EBL	0.04	18.6	B	0.16	21.3	C

The results of the LOS analysis indicate that the McKay Road West / Veteran's Drive intersection is operating within the typical design limits noted in Section 4.1.

The existing storage length for all auxiliary turn lanes, which are discussed further in Section 5, can accommodate the anticipated 95th percentile queue length for the associated turning movement.

No infrastructure improvements are recommended within the study area for this analysis scenario.

4.4 Construction Parking

Based on our correspondence with the design team for this project, the Developer is committed to the following arrangement for construction parking:

The parking of construction vehicles and vehicles owned by staff and subcontractors employed by the Developer will be formally directed (in writing where possible) to avoid parking on municipal streets surrounding the subject site and avoid parking within private parking lots surrounding the subject site, without consent from the owner of the parking lots.

5 Proposed Lane Geometry and Traffic Control

5.1 McKay Road West / Veteran's Drive – 2021 Horizon Year

Based on the intersection operation analysis completed in Section 4.2, a five-lane cross section with auxiliary right turn lanes on Veteran's Drive and a five-lane cross section with auxiliary right turn lanes on McKay Road West will provide the necessary capacity to convey the 2021 traffic volumes. **Table 7** illustrates the storage and taper lengths required for each auxiliary turn lane. Transportation Association of Canada *Design Guide for Canadian Roads* (2011) [TAC Guidelines] have been taken into consideration when determining the auxiliary taper lengths.

Table 7 – McKay Road West / Veteran's Drive Storage and Taper Lengths – 2021 Horizon Year

Movement	Storage Length	Taper Length
EBL	20	70
EBR	10	70
WBL	25	70
WBR	20	70
NBL	15	70
NBR	10	70
SBL	20	70
SBR	10	70

5.2 McKay Road West / Veteran's Drive – 2031 Horizon Year

Based on the intersection operation analysis completed in Section 4.3, a five-lane cross section with auxiliary right turn lanes on Veteran's Drive and a seven-lane cross section with auxiliary right turn lanes on McKay Road West will provide the necessary capacity to convey the 2031 traffic volumes. **Table 8** illustrates the storage and taper lengths required for each auxiliary turn lane. TAC Guidelines have been taken into consideration when determining the auxiliary taper lengths

Table 8 – McKay Road West / Veteran's Drive Storage and Taper Lengths – 2031 Horizon Year

Movement	Storage Length	Taper Length
EBL	90	70
EBR	25	70
WBL	90	70
WBR	65	70
NBL	40	70
NBR	50	70
SBL	95	70
SBR	30	70

The storage lengths recommended in Table 8 are at a minimum the required lengths identified in the Watersand TA. Some of the storage lengths recommended in Table 8 are longer than the required lengths in the Watersand TA. It is noted that this is not a result of the proposed development, but is a result of the variance in the existing traffic count data used in each study.

6 Interaction Between the Proposed Development and H&H Development

As outlined in Section 1.1, access to the proposed development will be provided via the proposed road network within the H&H Development. The following sections analyse the impact of the traffic generated by the subject site and the impact of the internal connection provided by the proposed link between Lane 'T' and Street 'M', through the subject site.

6.1 Ultimate Buildout of the Proposed Development & Phase 1A of the H&H Development

The proposed development is anticipated to be fully built and occupied by 2021. At this time, it is anticipated that Phase 1A of the H&H Development will be occupied per the H&H TIS. In this scenario, the H&H Development will only have access to McKay Road West via Street 'A' and Street 'C'. All proposed development traffic will utilize these streets as reflected in Figure 9. Based on the satisfactory intersection operation (LOS D) and the corresponding excess capacity at these intersections, as identified in the H&H TIS, the additional traffic at these intersections generated by the proposed development will have a negligible impact on the anticipated intersection operation. There are no changes to the conclusion of the H&H TIS as a result of the proposed development.

6.2 Ultimate Buildout of the Proposed Development & Phase 1 of the H&H Development

Phase 1 of the H&H Development is anticipated to be fully occupied by 2025 per the H&H TIS. This will include access to Veteran's Drive via Street 'H' and access to McKay Road West via Street 'A' and Street 'C'. All proposed development traffic will utilize these streets as reflected in Figure 10. Based on the satisfactory intersection operation (LOS D) and the corresponding excess capacity at these intersections, as identified in the H&H TIS, the additional traffic at these intersections generated by the proposed development will have a negligible impact on the anticipated intersection operation. There are no changes to the conclusion of the H&H TIS as a result of the proposed development.

6.3 Ultimate Buildout of the Proposed Development & H&H Development

Based on our review of the internal site layout and road network within the H&H Development, the proposed development traffic generated is not anticipated to travel on any additional roads constructed by subsequent phases of the H&H Development.

7 Summary

M-Star Developments (2528286 Ontario Inc) retained **JD Engineering** to prepare this traffic impact study in support of the residential townhouse development on 910 Veteran's Drive located in the City of Barrie. The proposed Site Plan is shown in **Appendix A**. This chapter summarizes the conclusions and recommendations from the study.

The proposed development includes 52 residential townhouse units.

1. The proposed development is expected to generate a total of 26 AM and 33 PM peak hour trips.
2. Background traffic and pedestrian counts were completed at the existing intersection of Veteran's Drive / McKay Road West on Tuesday, November 27, 2018.
3. According to the City's MMATMP and Capital Budget (2018), the following transportation infrastructure improvements are planned for Veteran's Drive in the study area:

Veteran's Drive (within the study area)

- Road reconstruction to a 5-lane cross-section.

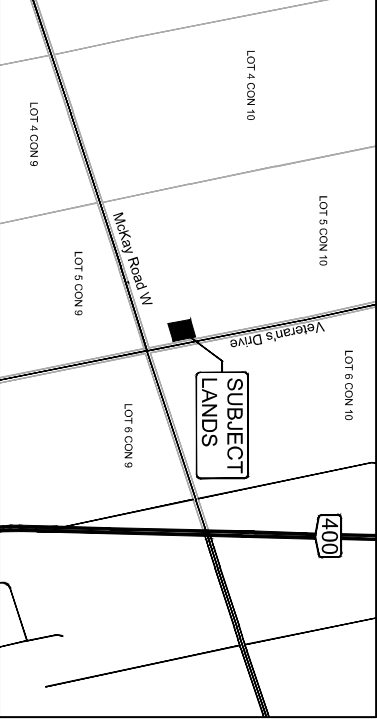
McKay Road West (within the study area)

- Road re-construction to a 7-lane cross section;
 - It has been assumed that McKay Road West will be reconstructed to a 5-lane cross-section in the 2021 horizon year and a 7-lane cross section in the 2031 horizon year.
4. An estimate of the amount of traffic that would be generated by the Subject Site was prepared and assigned to the study area streets and intersection.
 5. Total (2021 and 2025) traffic volumes were estimated by applying a background traffic growth (2%) and the various adjacent development traffic volumes.
 6. Using a background growth rate of 3% and 8% for Veteran's Drive and McKay Drive West respectively, the total (2031) traffic volumes were estimated from the total (2025) traffic volumes.
 7. An intersection operation analysis was completed under total (2021 and 2031) traffic volumes with the proposed development operational at the study area intersections. No additional infrastructure improvements are recommended.
 8. In summary, the proposed development will not cause any operational issues and will not add significant delay or congestion to the local roadway network.

Appendix A – Site Plan

CONCEPT PLAN - 52 UNITS

910 Veterans Drive, Barrie



Key Map
910 Veterans Drive, City of Barrie

Scale 1:30,000

LEGEND

- Subject Lands
- Proposed Back-to-back townhouse units
- Road Widening

PROVISION	REQUIRED RM3	PROVIDED
Lot Area	n/a	7,352.6m ²
Developable Area	n/a	6,712.7m ²
Lot Frontage	5.5m	4.5m
Setbacks		
Front Yard	3.0m	3.0m
To Garage	5.5m	5.9m
Interior Side Yard	1.2m	1.2m
Exterior Side Yard	2.0m	2.0m
Rear Yard	5.0m	6.1m
Dwelling Unit Floor Area	35m ²	±108m ²
GFA % of Lot	250%	151%
Height	3 storeys	4 storeys
Parking	78 (1.5 / unit)	104 (2 / unit)
Density	100 u/ha	77.5 u/ha

Note: This drawing is for discussion purposes only.
Property boundary to be verified by an O.L.S.



Date:	January 17, 2019	Scale:	1 : 600
File:	18-7-69	Drawn By:	AM

**INNOVATIVE PLANNING SOLUTIONS**

PLANNERS • PROJECT MANAGERS • LAND DEVELOPERS

190 DUNDAS STREET EAST, SUITE 201, BARRIE, ONTARIO L4M 1B1

tel: 705 • 812 • 3281 fax: 705 • 812 • 3438 e: info@ipsconsultinginc.com www.ipsconsultinginc.com

Appendix B – H&H Development Excerpts

I HEREBY AUTHORIZE INNOVATIVE PLANNING SOLUTIONS TO PREPARE AND
SUBMIT THIS DRAFT PLAN OF SUBDIVISION FOR APPROVAL.

Sept 06, 2018

DATE _____

Qi Zhu
H&H CAPITAL GROUP LTD

I CERTIFY THAT THE BOUNDARIES OF THE LANDS TO BE SUBDIVIDED AND THEIR
RELATIONSHIP TO ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN.

SEPT 04, 2018

DATE _____

Gary Vanderveen, O.L.S.
HOLDING JONES VANDERVEEN INC.

PLAN 51R-35241

58100-0056

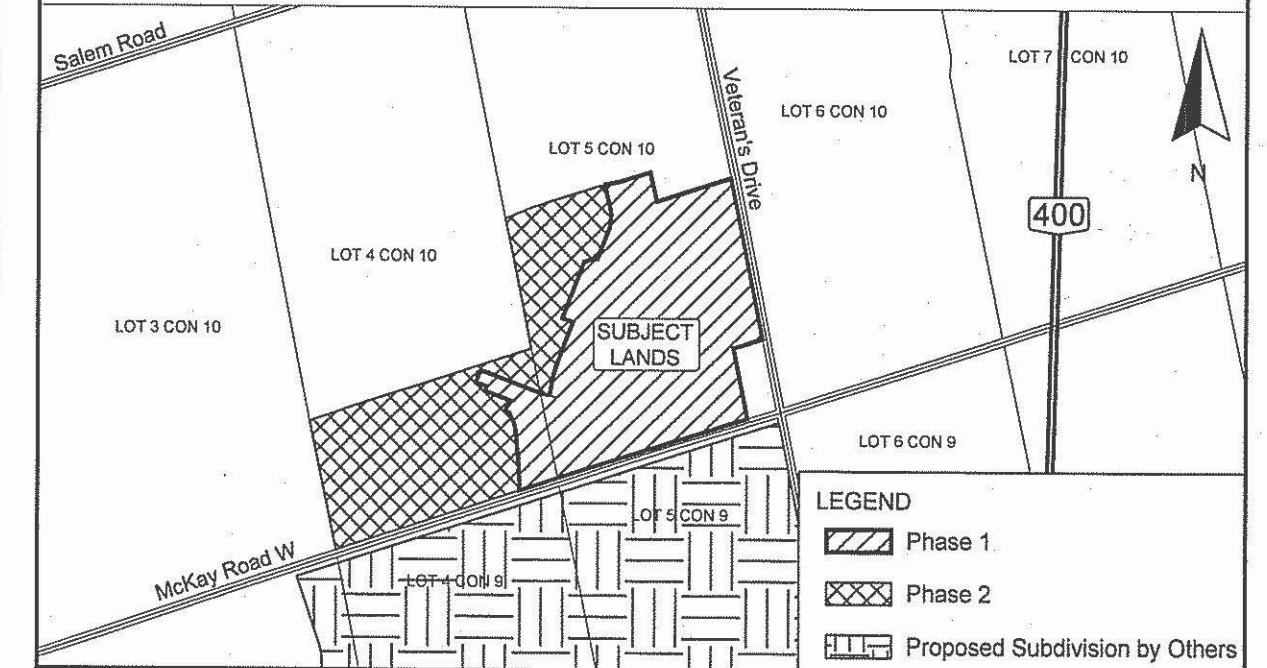
4 , CONCESSION 10

NORTH HALF LOT 5 CONCESSION 10

FUTURE

KEY MAP

Scale 1:20,000



PART OF LOTS 4 & 5, CONCESSION 10

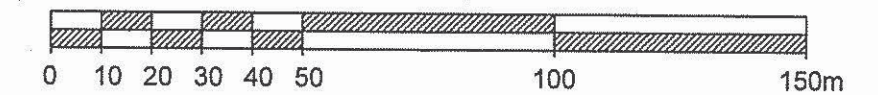
(124, 180, & 228 MCKAY ROAD WEST)

IN THE FORMER TOWNSHIP OF INNISFIL

NOW IN THE

CITY OF BARRIE
COUNTY OF SIMCOE

Scale 1:1,500



100

SUBJECT LANDS

--- PHASE 1 LANDS

	LOTS / BLOCKS / STREETS	Units	ha	AREA ac	%
RESIDENTIAL LOTS (10.0m)	Lots 36-39, 63-85, 137-139, 214-221, 272-274, 334-336	23	0.670	1.65	1.93
RESIDENTIAL LOTS (11.6m)	Lots 2-13, 16, 19-33, 41-56, 59-61, 64-80, 88-106, 109-111, 114-134, 141-164, 167-187, 191-211, 224, 227-237, 239-242, 244-255, 261-270, 276-285, 288-298, 300-301, 303-316, 319-353	268	8.836	21.83	25.49
RESIDENTIAL LOTS (12.0m)	Lots 35, 39, 40, 82, 86, 87, 196, 140, 213, 222, 271, 275, 337	13	0.469	1.15	1.35
RESIDENTIAL LOTS (13.0m)	Lots 1, 14, 15, 17, 18, 34, 57, 62, 63, 81, 107, 108, 112, 113, 135, 167, 168, 186, 189, 190, 212, 223, 225, 226, 243, 259, 260, 286, 287, 299, 302, 317, 316	33	1.613	3.98	4.65
TOWNHOUSE UNITS (6.0m)	Blocks 1-21, 26-41	270	5.200	12.85	15.00
TOWNHOUSE UNITS (4.5m)	Blocks 22-25, 42-46	64	0.914	2.26	2.84
HIGH DENSITY RESIDENTIAL	Block 51	100	1.000	2.47	2.88
INSTITUTIONAL	Block 52		2.004	4.95	5.78
PARKLAND	Block 53		2.016	4.98	5.82
WALKWAY	Blocks 54		0.032	0.08	0.09
STORMWATER MANAGEMENT	Block 50		1.849	4.57	5.33
ROAD WIDENING	Block 48, 49		0.873	2.16	2.52
FUTURE ROAD	Block 47		0.062	0.20	0.24
STREETS AND LANES	Streets 'A'-M' & Lanes 'O'-U'		9.111	22.54	28.28
TOTAL		771	34.669	85.67	100

Note: Phase 1 density is 22.2 units / ha

a) SHOWN ON PLAN	b) SHOWN ON PLAN	c) SHOWN ON PLAN	d) RESIDENTIAL, INSTITUTIONAL, PARKLAND, STORMWATER MANAGEMENT
e) SHOWN ON PLAN	f) SHOWN ON PLAN	f) NONE	
g) SHOWN ON PLAN	h) MUNICIPAL WATER	i) TIGGA LOAMY SAND & BONDHEAD SANDY LOAM	
j) SHOWN ON PLAN	k) ALL MUNICIPAL SERVICES	i) NONE	

No.	Date	Description	By

IPS

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PLANNERS • PROJECT MANAGERS • LAND DEVELOPERS
150 DUNLOP STREET EAST, SUITE 201, BARRIE, ONTARIO L4M 1B1

tel: 705 • 812 • 3281 fax: 705 • 812 • 3434 e: info@ipsconsultinginc.com www.ipsconsultinginc.com

Date: August 15, 2018

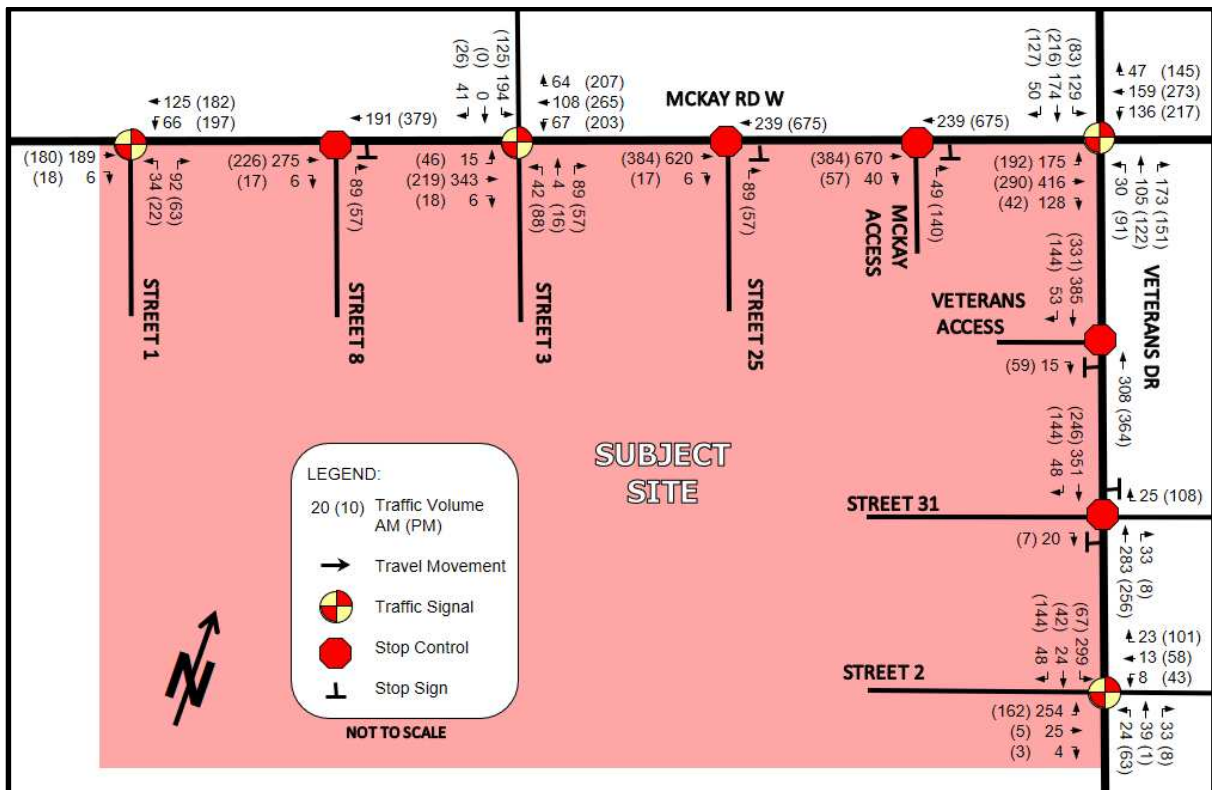
Drawn By: VS

File:

Checked By: DV

Appendix C – Watersand Development Excerpts

Figure 5 – Total Development Traffic Volumes within Study Area



3.4 Total Horizon Year Traffic Volumes with the Proposed Development

Peak Hour traffic volumes projections at the McKay Road West / Veteran's Drive intersection for horizon year 2016 are provided in the BA Study (excerpt provided in the **Appendix C**). The 2016 traffic projections were generated by applying a 2% / year background traffic growth rate to the traffic count data collected at the intersection of McKay Road West / Veteran's Drive, on Thursday April 30, 2015.

3.4.1 Total (2025) Horizon Year Traffic Volumes

In addition to the various development traffic volumes outlined in Section 3.2, a background traffic growth rate of 2% / year (consistent with the BA Study) has also been applied to the 2016 BA Study traffic volumes to estimate the total (2025) horizon year traffic volumes.

The volume of traffic on the Reid Drive extension at McKay Road West, opposite Street 3, has been estimated assuming all the anticipated traffic generated from the H&H Development will use one of the two proposed accesses onto McKay Road West (Reid Drive is one of these accesses).

Figure 6 illustrates the total (2025) horizon year AM and PM peak hour traffic volumes in the study area.

Appendix D – Traffic Counts

Accu-Traffic Inc

Morning Peak Diagram

Specified Period

From: 7:00:00

To: 9:00:00

One Hour Peak

From: 7:30:00

To: 8:30:00

Municipality: Barrie

Site #: 1815300001

Intersection: Veteran's Dr & McKay Rd

TFR File #: 1

Count date: 27-Nov-18

Weather conditions:

Person counted:

Person prepared:

Person checked:

** Signalized Intersection **

Major Road: Veteran's Dr runs N/S

North Leg Total: 623

North Entering: 292

North Peds: 0

Peds Cross: 

Heavys	1	4	0	5
Trucks	0	4	1	5
Cars	3	203	76	282
Totals	4	211	77	



Heavys 4

Trucks 7

Cars 320

Totals 331

East Leg Total: 361

East Entering: 203

East Peds: 0

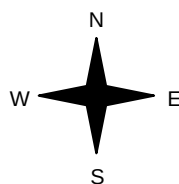
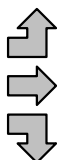
Peds Cross: 

Heavys	Trucks	Cars	Totals
3	0	57	60



McKay Rd

Heavys	Trucks	Cars	Totals
0	0	10	10
0	0	61	61
2	0	5	7
2	0	76	



Veteran's Dr



Cars	Trucks	Heavys	Totals
126	2	1	129
46	0	1	47
25	1	1	27
197	3	3	

McKay Rd



Cars	Trucks	Heavys	Totals
156	1	1	158

Peds Cross: 

West Peds: 0

West Entering: 78

West Leg Total: 138

Cars 233

Trucks 5

Heavys 7

Totals 245



Cars	8	184	19	211
Trucks	0	5	0	5
Heavys	1	3	1	5
Totals	9	192	20	

Peds Cross: 

South Peds: 0

South Entering: 221

South Leg Total: 466

Comments

Accu-Traffic Inc

Afternoon Peak Diagram

Specified Period

From: 16:00:00

To: 19:00:00

One Hour Peak

From: 16:00:00

To: 17:00:00

Municipality: Barrie

Site #: 1815300001

Intersection: Veteran's Dr & McKay Rd

TFR File #: 1

Count date: 27-Nov-18

Weather conditions:

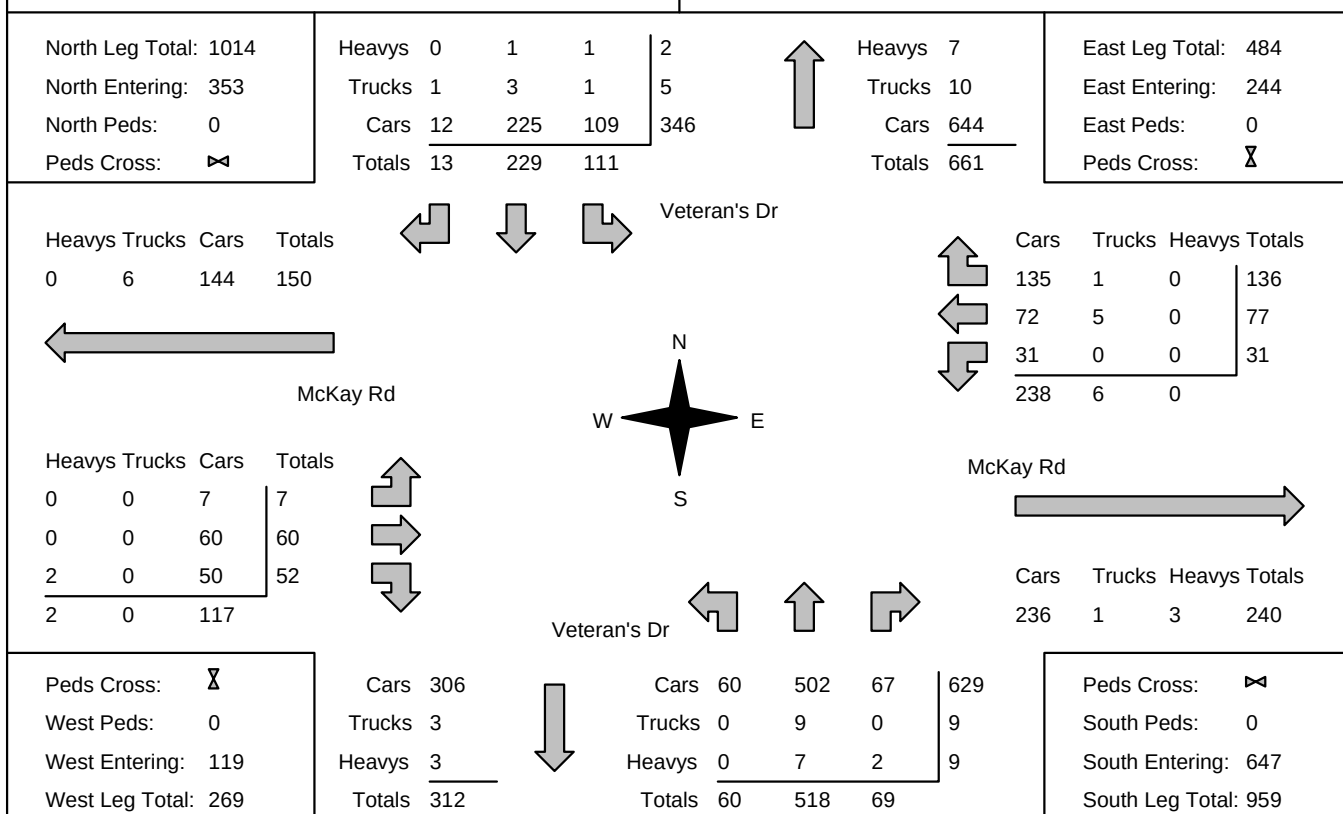
Person counted:

Person prepared:

Person checked:

** Signalized Intersection **

Major Road: Veteran's Dr runs N/S



Comments

Accu-Traffic Inc

Total Count Diagram

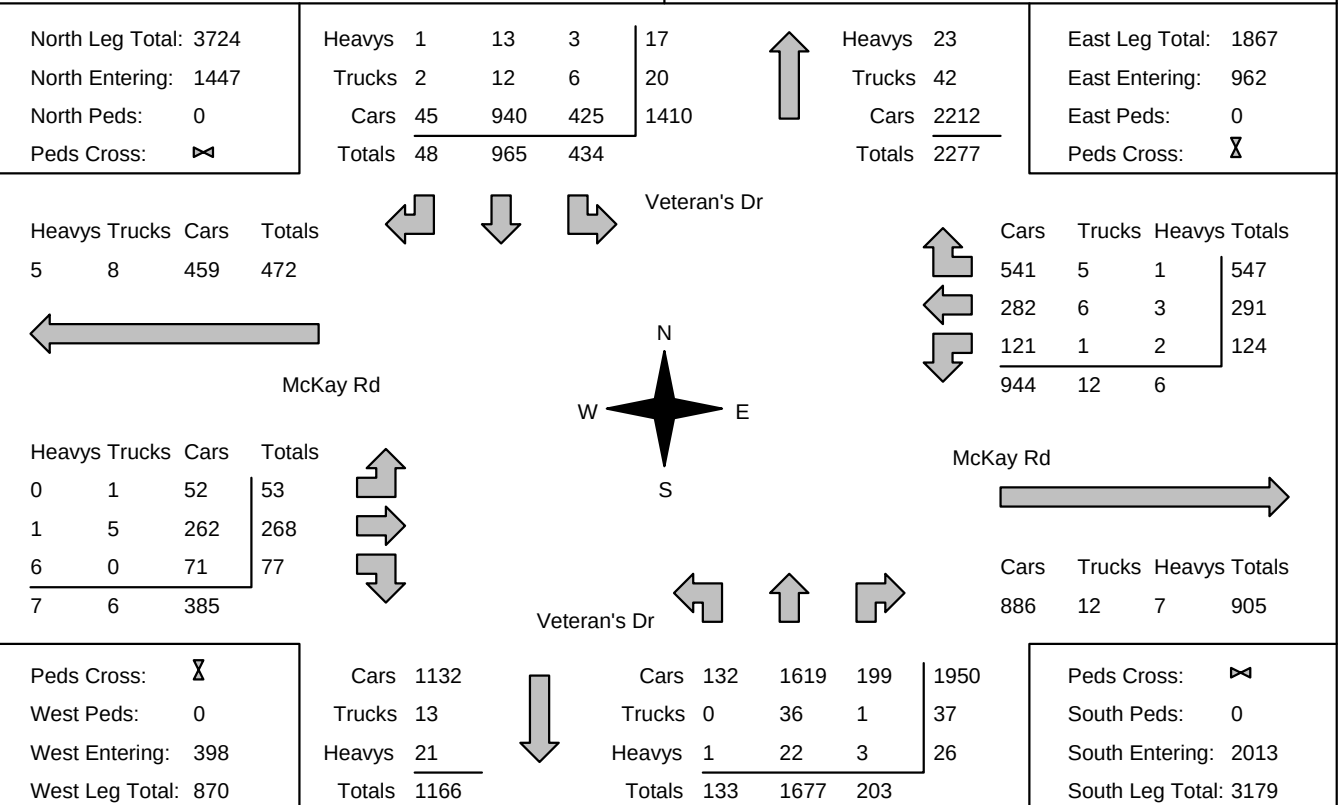
Municipality: Barrie
Site #: 1815300001
Intersection: Veteran's Dr & McKay Rd
TFR File #: 1
Count date: 27-Nov-18

Weather conditions:

Person counted:
Person prepared:
Person checked:

**** Signalized Intersection ****

Major Road: Veteran's Dr runs N/S



Comments

Accu-Traffic Inc

Traffic Count Summary

Intersection: Veteran's Dr & McKay Rd					Count Date: 27-Nov-18		Municipality: Barrie					
North Approach Totals						North/South Total Approaches	South Approach Totals					
Hour Ending	Includes Cars, Trucks, & Heavys				Total Peds		Hour Ending	Includes Cars, Trucks, & Heavys				Total Peds
	Left	Thru	Right	Grand Total				Left	Thru	Right	Grand Total	
7:00:00	0	0	0	0	0	0	7:00:00	0	0	0	0	0
8:00:00	65	224	5	294	0	481	8:00:00	10	162	15	187	0
9:00:00	56	193	6	255	0	480	9:00:00	5	201	19	225	0
16:00:00	0	0	0	0	0	0	16:00:00	0	0	0	0	0
17:00:00	111	229	13	353	0	1000	17:00:00	60	518	69	647	0
18:00:00	130	167	14	311	0	948	18:00:00	35	519	83	637	0
19:00:00	72	152	10	234	0	551	19:00:00	23	277	17	317	0

[illegible]

[illegible]

[illegible]

[illegible]

Appendix E – Synchro Analysis Output – Total Traffic Volumes

910 Veterans
6: Veterans Dr & Mckay Rd W

Queues
Total (2021) AM Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	57	151	36	56	83	146	17	225	56	108	259	17
Future Volume (vph)	57	151	36	56	83	146	17	225	56	108	259	17
Lane Group Flow (vph)	62	164	39	61	90	159	18	245	61	117	282	18
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Minimum Split (s)	11.0	22.0	22.0	12.0	22.0	22.0	11.0	22.0	22.0	11.0	22.0	22.0
Total Split (s)	17.0	39.0	39.0	18.0	40.0	40.0	13.0	39.0	39.0	24.0	50.0	50.0
Total Split (%)	14.2%	32.5%	32.5%	15.0%	33.3%	33.3%	10.8%	32.5%	32.5%	20.0%	41.7%	41.7%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	Max	Max	None	Max	Max
v/c Ratio	0.17	0.39	0.14	0.18	0.22	0.49	0.03	0.14	0.07	0.16	0.14	0.02
Control Delay	22.1	35.3	1.0	22.2	33.8	11.8	6.3	12.9	0.8	6.7	8.9	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.1	35.3	1.0	22.2	33.8	11.8	6.3	12.9	0.8	6.7	8.9	0.1
Queue Length 50th (m)	6.7	12.1	0.0	6.6	6.5	0.0	0.9	11.0	0.0	6.2	9.0	0.0
Queue Length 95th (m)	17.8	24.6	0.0	17.5	15.1	17.7	3.6	20.6	1.9	14.4	22.1	0.0
Internal Link Dist (m)		660.7			374.3			304.1			199.8	
Turn Bay Length (m)	20.0		10.0	25.0		20.0	15.0		10.0	20.0		10.0
Base Capacity (vph)	454	1552	755	458	1599	802	780	1760	842	878	2077	963
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.11	0.05	0.13	0.06	0.20	0.02	0.14	0.07	0.13	0.14	0.02

Intersection Summary

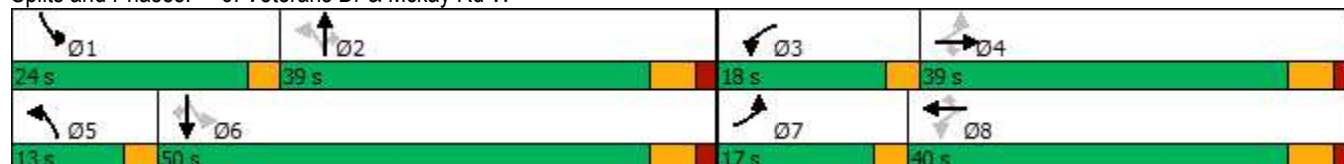
Cycle Length: 120

Actuated Cycle Length: 76.2

Natural Cycle: 70

Control Type: Semi Act-Uncoord

Splits and Phases: 6: Veterans Dr & Mckay Rd W



910 Veterans
6: Veterans Dr & Mckay Rd W

HCM Signalized Intersection Capacity Analysis

Total (2021) AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	57	151	36	56	83	146	17	225	56	108	259	17
Future Volume (vph)	57	151	36	56	83	146	17	225	56	108	259	17
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.69	1.00	1.00	0.65	1.00	1.00	0.58	1.00	1.00	0.56	1.00	1.00
Satd. Flow (perm)	1282	3539	1583	1207	3539	1583	1078	3539	1583	1039	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	62	164	39	61	90	159	18	245	61	117	282	18
RTOR Reduction (vph)	0	0	35	0	0	141	0	0	30	0	0	8
Lane Group Flow (vph)	62	164	4	61	90	18	18	245	31	117	282	10
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	15.4	9.1	9.1	15.2	9.0	9.0	41.0	39.8	39.8	49.0	44.8	44.8
Effective Green, g (s)	15.4	9.1	9.1	15.2	9.0	9.0	41.0	39.8	39.8	49.0	44.8	44.8
Actuated g/C Ratio	0.19	0.11	0.11	0.19	0.11	0.11	0.52	0.50	0.50	0.62	0.56	0.56
Clearance Time (s)	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	287	406	181	275	401	179	567	1776	794	699	1999	894
v/s Ratio Prot	0.02	c0.05		c0.02	0.03		0.00	0.07		c0.01	0.08	
v/s Ratio Perm	0.02		0.00	0.03		0.01	0.02		0.02	c0.09		0.01
v/c Ratio	0.22	0.40	0.02	0.22	0.22	0.10	0.03	0.14	0.04	0.17	0.14	0.01
Uniform Delay, d1	26.7	32.6	31.2	26.8	32.0	31.5	9.3	10.6	10.0	6.3	8.2	7.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.7	0.1	0.4	0.3	0.2	0.0	0.2	0.1	0.1	0.1	0.0
Delay (s)	27.1	33.2	31.2	27.2	32.3	31.8	9.4	10.7	10.1	6.4	8.3	7.6
Level of Service	C	C	C	C	C	C	A	B	B	A	A	A
Approach Delay (s)		31.5			31.0			10.5			7.7	
Approach LOS		C			C			B			A	
Intersection Summary												
HCM 2000 Control Delay			18.7			HCM 2000 Level of Service				B		
HCM 2000 Volume to Capacity ratio			0.22									
Actuated Cycle Length (s)			79.3			Sum of lost time (s)			18.0			
Intersection Capacity Utilization			41.3%			ICU Level of Service			A			
Analysis Period (min)			15									
c Critical Lane Group												

910 Veterans
6: Veterans Dr & Mckay Rd W

Queues
Total (2021) PM Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	51	124	65	76	140	173	85	574	103	135	286	51
Future Volume (vph)	51	124	65	76	140	173	85	574	103	135	286	51
Lane Group Flow (vph)	55	135	71	83	152	188	92	624	112	147	311	55
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Minimum Split (s)	11.0	22.0	22.0	12.0	22.0	22.0	11.0	22.0	22.0	11.0	22.0	22.0
Total Split (s)	13.0	40.0	40.0	14.0	41.0	41.0	13.0	48.0	48.0	18.0	53.0	53.0
Total Split (%)	10.8%	33.3%	33.3%	11.7%	34.2%	34.2%	10.8%	40.0%	40.0%	15.0%	44.2%	44.2%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	Max	Max	None	Max	Max
v/c Ratio	0.18	0.38	0.27	0.26	0.39	0.55	0.12	0.34	0.13	0.26	0.16	0.06
Control Delay	26.9	41.5	5.7	28.0	40.6	12.7	6.2	13.9	3.4	7.0	11.7	1.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.9	41.5	5.7	28.0	40.6	12.7	6.2	13.9	3.4	7.0	11.7	1.6
Queue Length 50th (m)	7.6	12.3	0.0	11.7	13.7	0.0	5.1	33.3	0.3	8.4	14.7	0.0
Queue Length 95th (m)	17.4	22.5	5.6	24.0	24.4	19.6	11.7	53.1	9.2	17.6	25.5	3.5
Internal Link Dist (m)		660.7			374.3			304.1			199.8	
Turn Bay Length (m)	20.0		10.0	25.0		20.0	15.0		10.0	20.0		10.0
Base Capacity (vph)	336	1390	687	354	1430	752	788	1847	878	657	1971	918
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.16	0.10	0.10	0.23	0.11	0.25	0.12	0.34	0.13	0.22	0.16	0.06

Intersection Summary

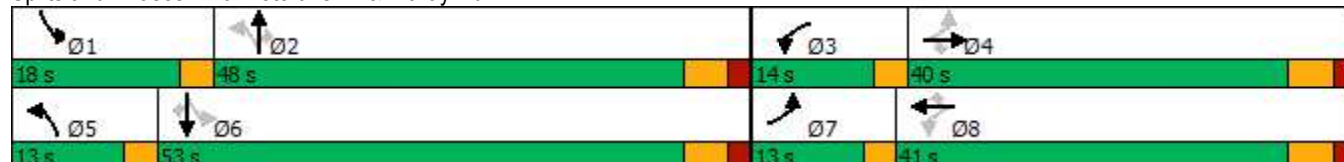
Cycle Length: 120

Actuated Cycle Length: 87.6

Natural Cycle: 70

Control Type: Semi Act-Uncoord

Splits and Phases: 6: Veterans Dr & Mckay Rd W



910 Veterans
6: Veterans Dr & Mckay Rd W

HCM Signalized Intersection Capacity Analysis

Total (2021) PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 			 			 	
Traffic Volume (vph)	51	124	65	76	140	173	85	574	103	135	286	51
Future Volume (vph)	51	124	65	76	140	173	85	574	103	135	286	51
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.66	1.00	1.00	0.61	1.00	1.00	0.56	1.00	1.00	0.37	1.00	1.00
Satd. Flow (perm)	1221	3539	1583	1139	3539	1583	1048	3539	1583	682	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	55	135	71	83	152	188	92	624	112	147	311	55
RTOR Reduction (vph)	0	0	64	0	0	167	0	0	52	0	0	25
Lane Group Flow (vph)	55	135	7	83	152	21	92	624	60	147	311	30
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	15.2	8.9	8.9	16.8	9.7	9.7	52.6	46.5	46.5	57.2	48.8	48.8
Effective Green, g (s)	15.2	8.9	8.9	16.8	9.7	9.7	52.6	46.5	46.5	57.2	48.8	48.8
Actuated g/C Ratio	0.17	0.10	0.10	0.19	0.11	0.11	0.59	0.52	0.52	0.64	0.55	0.55
Clearance Time (s)	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	247	354	158	265	386	172	669	1851	828	541	1942	868
v/s Ratio Prot	0.02	0.04		c0.02	c0.04		0.01	c0.18		c0.03	0.09	
v/s Ratio Perm	0.02		0.00	0.03		0.01	0.07		0.04	0.15		0.02
v/c Ratio	0.22	0.38	0.04	0.31	0.39	0.12	0.14	0.34	0.07	0.27	0.16	0.03
Uniform Delay, d1	31.5	37.4	36.2	30.7	36.9	35.7	7.8	12.3	10.5	6.4	9.9	9.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.5	0.7	0.1	0.7	0.7	0.3	0.1	0.5	0.2	0.3	0.2	0.1
Delay (s)	32.0	38.1	36.3	31.4	37.5	36.1	7.9	12.8	10.7	6.7	10.1	9.3
Level of Service	C	D	D	C	D	D	A	B	B	A	B	A
Approach Delay (s)		36.3			35.7			11.9			9.0	
Approach LOS		D			D			B			A	

Intersection Summary

HCM 2000 Control Delay	19.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.34		
Actuated Cycle Length (s)	88.9	Sum of lost time (s)	18.0
Intersection Capacity Utilization	51.7%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

910 Veterans
6: Veterans Dr & Mckay Rd W

Queues
Total (2031) AM Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		  			  			 			 	
Traffic Volume (vph)	223	776	162	199	341	234	48	389	234	269	497	65
Future Volume (vph)	223	776	162	199	341	234	48	389	234	269	497	65
Lane Group Flow (vph)	242	843	176	216	371	254	52	423	254	292	540	71
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Minimum Split (s)	11.0	22.0	22.0	12.0	22.0	22.0	11.0	22.0	22.0	11.0	22.0	22.0
Total Split (s)	19.0	38.0	38.0	26.0	45.0	45.0	11.0	32.0	32.0	24.0	45.0	45.0
Total Split (%)	15.8%	31.7%	31.7%	21.7%	37.5%	37.5%	9.2%	26.7%	26.7%	20.0%	37.5%	37.5%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	Max	Max	None	Max	Max
v/c Ratio	0.49	0.72	0.37	0.66	0.32	0.46	0.13	0.41	0.39	0.54	0.38	0.10
Control Delay	22.5	39.3	12.0	28.6	32.9	6.9	16.2	31.9	6.4	19.9	24.3	2.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.5	39.3	12.0	28.6	32.9	6.9	16.2	31.9	6.4	19.9	24.3	2.0
Queue Length 50th (m)	32.5	58.9	6.6	28.5	23.8	0.0	5.1	36.2	0.0	33.4	41.7	0.0
Queue Length 95th (m)	50.9	78.6	25.2	45.5	33.4	19.1	14.0	63.0	21.0	64.6	68.2	3.9
Internal Link Dist (m)		660.7			374.3			304.1			199.8	
Turn Bay Length (m)	90.0		25.0	90.0		65.0	40.0		50.0	95.0		30.0
Base Capacity (vph)	524	1664	609	484	2028	783	418	1043	645	600	1411	696
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.46	0.51	0.29	0.45	0.18	0.32	0.12	0.41	0.39	0.49	0.38	0.10

Intersection Summary

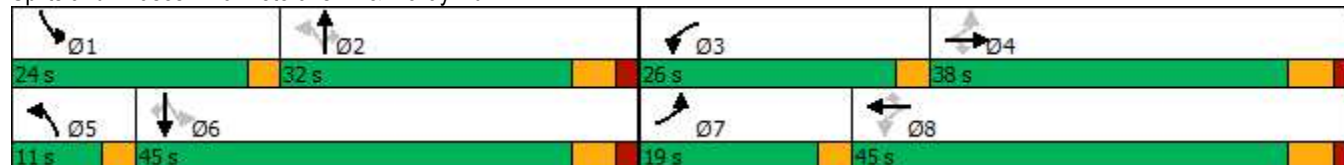
Cycle Length: 120

Actuated Cycle Length: 99.3

Natural Cycle: 70

Control Type: Semi Act-Uncoord

Splits and Phases: 6: Veterans Dr & Mckay Rd W



910 Veterans
6: Veterans Dr & Mckay Rd W

HCM Signalized Intersection Capacity Analysis

Total (2031) AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		  			  			 			 	
Traffic Volume (vph)	223	776	162	199	341	234	48	389	234	269	497	65
Future Volume (vph)	223	776	162	199	341	234	48	389	234	269	497	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	1770	5085	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.50	1.00	1.00	0.19	1.00	1.00	0.45	1.00	1.00	0.40	1.00	1.00
Satd. Flow (perm)	940	5085	1583	352	5085	1583	840	3539	1583	745	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	242	843	176	216	371	254	52	423	254	292	540	71
RTOR Reduction (vph)	0	0	105	0	0	196	0	0	178	0	0	43
Lane Group Flow (vph)	242	843	71	216	371	58	52	423	76	292	540	28
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	37.0	23.1	23.1	36.0	22.6	22.6	35.7	30.0	30.0	48.3	39.6	39.6
Effective Green, g (s)	37.0	23.1	23.1	36.0	22.6	22.6	35.7	30.0	30.0	48.3	39.6	39.6
Actuated g/C Ratio	0.37	0.23	0.23	0.36	0.23	0.23	0.36	0.30	0.30	0.48	0.40	0.40
Clearance Time (s)	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	464	1176	366	317	1151	358	353	1063	475	517	1404	628
v/s Ratio Prot	0.07	c0.17		c0.09	0.07		0.01	0.12		c0.09	0.15	
v/s Ratio Perm	0.12		0.05	0.15		0.04	0.04		0.05	c0.19		0.02
v/c Ratio	0.52	0.72	0.20	0.68	0.32	0.16	0.15	0.40	0.16	0.56	0.38	0.04
Uniform Delay, d1	22.9	35.3	30.9	23.9	32.2	31.0	21.2	27.7	25.6	16.3	21.4	18.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.1	2.1	0.3	5.9	0.2	0.2	0.2	1.1	0.7	1.4	0.8	0.1
Delay (s)	24.0	37.4	31.1	29.8	32.4	31.2	21.4	28.8	26.4	17.7	22.2	18.6
Level of Service	C	D	C	C	C	C	C	C	C	B	C	B
Approach Delay (s)		34.0			31.4			27.4			20.5	
Approach LOS		C			C			C			C	
Intersection Summary												
HCM 2000 Control Delay			28.8			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.64									
Actuated Cycle Length (s)			99.8			Sum of lost time (s)			18.0			
Intersection Capacity Utilization			68.3%			ICU Level of Service			C			
Analysis Period (min)			15									
c Critical Lane Group												

910 Veterans
6: Veterans Dr & Mckay Rd W

Queues
Total (2031) PM Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		  			  			 			 	
Traffic Volume (vph)	239	573	121	302	583	366	191	856	275	257	572	169
Future Volume (vph)	239	573	121	302	583	366	191	856	275	257	572	169
Lane Group Flow (vph)	260	623	132	328	634	398	208	930	299	279	622	184
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Minimum Split (s)	11.0	22.0	22.0	12.0	22.0	22.0	11.0	22.0	22.0	11.0	22.0	22.0
Total Split (s)	19.0	23.0	23.0	29.0	33.0	33.0	15.0	47.0	47.0	21.0	53.0	53.0
Total Split (%)	15.8%	19.2%	19.2%	24.2%	27.5%	27.5%	12.5%	39.2%	39.2%	17.5%	44.2%	44.2%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	Max	Max	None	Max	Max
v/c Ratio	0.74	0.84	0.38	0.82	0.63	0.74	0.46	0.70	0.41	0.78	0.42	0.25
Control Delay	40.8	59.3	10.7	45.0	45.1	21.3	17.0	34.7	11.4	33.3	25.6	8.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	40.8	59.3	10.7	45.0	45.1	21.3	17.0	34.7	11.4	33.3	25.6	8.6
Queue Length 50th (m)	44.1	53.5	0.0	58.1	51.3	23.8	23.4	100.5	15.6	32.8	55.2	7.5
Queue Length 95th (m)	#69.0	#76.1	17.2	89.2	64.7	61.7	40.0	133.6	41.9	#73.4	76.1	23.7
Internal Link Dist (m)		660.7			374.3			304.1			199.8	
Turn Bay Length (m)	90.0		25.0	90.0		65.0	40.0		50.0	95.0		30.0
Base Capacity (vph)	365	763	353	464	1212	595	468	1331	721	394	1469	734
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.71	0.82	0.37	0.71	0.52	0.67	0.44	0.70	0.41	0.71	0.42	0.25

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 113.6

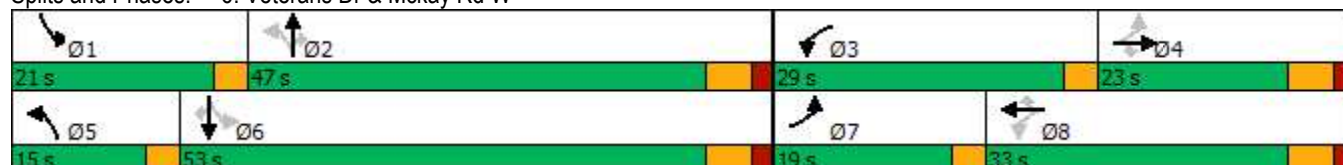
Natural Cycle: 75

Control Type: Semi Act-Uncoord

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

Queue shown is maximum after two cycles.

Splits and Phases: 6: Veterans Dr & Mckay Rd W



910 Veterans
6: Veterans Dr & Mckay Rd W

HCM Signalized Intersection Capacity Analysis

Total (2031) PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		  			  			 			 	
Traffic Volume (vph)	239	573	121	302	583	366	191	856	275	257	572	169
Future Volume (vph)	239	573	121	302	583	366	191	856	275	257	572	169
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	1770	5085	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.36	1.00	1.00	0.21	1.00	1.00	0.37	1.00	1.00	0.15	1.00	1.00
Satd. Flow (perm)	668	5085	1583	382	5085	1583	696	3539	1583	280	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	260	623	132	328	634	398	208	930	299	279	622	184
RTOR Reduction (vph)	0	0	113	0	0	230	0	0	126	0	0	77
Lane Group Flow (vph)	260	623	19	328	634	168	208	930	173	279	622	107
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	31.5	16.5	16.5	40.3	22.3	22.3	53.8	42.8	42.8	61.2	47.2	47.2
Effective Green, g (s)	31.5	16.5	16.5	40.3	22.3	22.3	53.8	42.8	42.8	61.2	47.2	47.2
Actuated g/C Ratio	0.28	0.15	0.15	0.36	0.20	0.20	0.47	0.38	0.38	0.54	0.42	0.42
Clearance Time (s)	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	331	739	230	390	999	311	433	1334	596	353	1471	658
v/s Ratio Prot	0.10	0.12		c0.15	0.12		0.05	0.26		c0.11	0.18	
v/s Ratio Perm	0.11		0.01	c0.14		0.11	0.18		0.11	c0.32		0.07
v/c Ratio	0.79	0.84	0.08	0.84	0.63	0.54	0.48	0.70	0.29	0.79	0.42	0.16
Uniform Delay, d1	34.7	47.2	42.0	29.8	41.9	41.0	17.9	29.9	24.7	19.0	23.5	20.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	11.6	8.7	0.2	15.0	1.3	1.9	0.8	3.0	1.2	11.4	0.9	0.5
Delay (s)	46.3	55.9	42.1	44.8	43.2	42.9	18.7	32.9	26.0	30.4	24.4	21.3
Level of Service	D	E	D	D	D	D	B	C	C	C	C	C
Approach Delay (s)		51.7			43.5			29.4			25.4	
Approach LOS		D			D			C			C	

Intersection Summary

HCM 2000 Control Delay	37.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	113.5	Sum of lost time (s)	18.0
Intersection Capacity Utilization	82.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group