

PROPOSED STARBUCKS RESTAURANT TRAFFIC IMPACT STUDY

ROCHESTER HILLS, MICHIGAN

FEBRUARY 10, 2022

On sheet 3 of this TIS, number 5 of the Operational Analysis. More specifically, "Rochester HS Drive / Proposed Site Drive Back-to-Back Left-Turns = The results of the analysis indicate that the proposed Site Drive location has adequate spacing from the Rochester High School driveway to allow back-to-back left turn operations. However, the vehicles will decelerate in the through lane during the peak periods for the High School, as there is not expected to be adequate storage length to accommodate deceleration in the center lane without potential overlap. During the average peak hour operations, there will be adequate storage and deceleration for both uses."

Because of this we need Starbucks peak hour traffic times so we may further analyze the peak hour operations of the Rochester HS Drives left turn in verse the proposed Starbucks Drive left turn in operations as it pertains to the center left turn lane along Walton Blvd.

Attached please find the Rochester High School assumed peak hour times. The Applicant is requested to study the peak hours at Rochester High School to confirm these are accurate.

The Applicant is requested to offer a solution to this issue.

Location	Peak AM hours	Peak PM hours
Rochester High School	6:45AM-7:30AM	2:15PM-3:00PM
ITE Manual or assumed peak hours used in TIS	7:00AM-9:00AM	4:00PM-6:00PM
Starbucks typical peak hours used in TIS	?	?



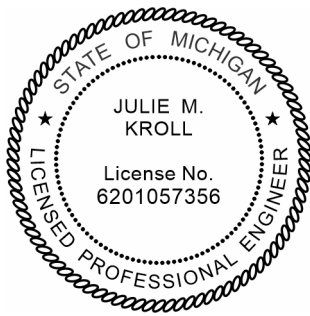
27725 STANSBURY BLVD., SUITE 195
FARMINGTON HILLS, MI 48334

The Applicant should prepare a queing study using comparable Starbucks data as there is still a concern that Traffic will back up onto Walton Blvd.

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I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Michigan.

A handwritten signature in blue ink that reads "Julie M. Kroll".

Digitally signed by Julie M. Kroll
Date: 2022.02.10 09:54:26 -05'00'

Agency Review	Date	Comments

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REFERENCES

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EXECUTIVE SUMMARY

This report presents the results of a Traffic Impact Study (TIS) for the proposed Starbucks Coffee Shop with drive-through on Walton Boulevard in Rochester Hills, Michigan. The project site is located at 1360 Walton Boulevard, at the location of a former Pizza Hut, as shown in **Figure E1**. Site access is proposed via one (1) driveway on Walton Boulevard, which is under the jurisdiction of the Road Commission for Oakland County (RCOC).

FIGURE E1: SITE LOCATION



The scope of this study was developed based on Fleis & VandenBrink's (F&V) knowledge of the study area, understanding of the development program, accepted traffic engineering practice and information published by the Institute of Transportation Engineers (ITE), and pursuant to the requirements of the City of Rochester Hills and the Road Commission for Oakland County (RCOC).

BACKGROUND DATA

The existing weekday turning movement volume data were collected by F&V subconsultant Traffic Data Collection, Inc. (TDC) on Thursday, November 4, 2021, during the AM (7:00 AM to 9:00 AM) and PM (4:00 PM to 6:00 PM) peak periods. Additional data collection was performed by F&V staff on Tuesday, November 9, 2021, at the Rochester High School driveway on Walton Boulevard. Due to the impact of COVID-19, the current traffic volume data is not representative of “typical” operations. Therefore, historical traffic volume data was obtained from SCATS for each study intersection approach and compared in order to determine COVID adjustment factors. Several approaches have higher volumes than the historical volumes; therefore, the 2021 volumes were utilized at these locations. The COVID adjustment factors are summarized in **Table E1** and were applied to the existing traffic volumes in order to determine baseline 2021 volumes for use in the study.

Table E1: COVID Adjustment Factors

Livernois Rd & Walton Blvd	AM	PM
Livernois Road (NB)	9%	0%
Livernois Road (SB)	31%	0%
Walton Blvd (EB)	1%	16%
Walton Blvd (WB)	42%	0%
Rochdale Dr & Walton Blvd	AM	PM
Rochdale Drive (NB)	15%	0%
Rochdale Drive (SB)	0%	0%
Walton Blvd (EB)	3%	23%
Walton Blvd (WB)	0%	0%

TRIP GENERATION

The number of peak hour (AM and PM), and daily vehicle trips that would be generated by the proposed development were forecast based on data published in the Institute of Transportation Engineers (ITE) *Trip Generation Manual 11th Edition*. The trip generation is summarized in **Table E2**.

Table E2: Trip Generation Summary

Land Use	ITE Code	Amount	Units	Average Daily Traffic (vpd)	AM Peak Hour (vph)			PM Peak Hour (vph)		
					In	Out	Total	In	Out	Total
Coffee Shop with Drive-Through	937	2,219	SF	1,184	97	94	191	44	43	87
<i>Pass-By</i>	50% AM, 55% PM			622	48	48	96	24	24	48
New Trips				562	49	46	95	20	19	39

SITE TRIP DISTRIBUTION

The vehicular trips that would be generated by the proposed development were assigned to the study roads based on existing peak hour traffic patterns in the adjacent roadway network and the methodologies published by ITE. The trip distributions used in this study is summarized in **Table E3**.

Table E3: Trip Distribution

New Trips			via	Pass-By Trips		
AM	PM	To/From		To/From	AM	PM
29%	19%	North	Livernois Road			
18%	20%	South	Livernois Road			
30%	33%	East	Walton Boulevard	Eastbound	39%	55%
23%	28%	West	Walton Boulevard	Westbound	61%	45%
100%	100%	Total			100%	100%

OPERATIONAL ANALYSIS SUMMARY

The existing peak hour vehicle delays and Levels of Service (LOS) were calculated at the study intersections using Synchro (Version 11) traffic analysis software. The results of the analysis are summarized below.

1. **Existing Conditions:** All study intersection approaches and movements currently operate acceptably at LOS D or better during both peak periods, with the following exceptions:
 - **Rochdale Drive & Walton Boulevard:** The SB left-turn movement is currently operating at LOS E during both peak periods. However, review of SimTraffic microsimulations indicates acceptable operations, with all vehicle queues observed to be serviced within each cycle length. The poor LOS and delay experienced at this intersection is the result of a long cycle length (120 seconds) and underutilization of this approach, resulting in a minimal percentage of vehicles arriving on a green.
2. **Background (2022) Conditions:** The proposed development is planned to be open and operational within a year; therefore, a growth rate was not applied to the 2021 volumes to reflect the buildout 2022 volumes. However, the following background developments were identified and included in the background volumes:
 - Andover Woods (Rochdale Drive) – 42 duplex units
 - MediLodge (Walton Boulevard) – 126-bed nursing home
3. **Background (2022) Conditions:** All study intersection approaches and movements are expected to operate acceptably, in a manner similar to existing conditions. SimTraffic network simulations also indicate acceptable operations, similar to those observed under the existing conditions analysis.
4. **Future Conditions:** The results of the future conditions analysis indicates that all study intersection approaches and movements are expected to continue operating acceptably, in a manner similar to existing and background conditions.
5. **Rochester HS Drive / Proposed Site Drive Back-to-Back Left-Turns:** The results of the analysis indicate that the proposed Site Drive location has adequate spacing from the Rochester High School driveway to allow back-to-back left turn operations. However, the vehicles will decelerate in the through lane during the peak periods for the High School, as there is not expected to be adequate storage length to accommodate deceleration in the center lane without potential overlap. During the average peak hour operations, there will be adequate storage and deceleration for both uses.
6. **Auxiliary Turn Lane Analysis:** The results of the auxiliary turn lane analysis indicates that a westbound right-turn deceleration taper is recommended on Walton Boulevard at the proposed site driveway.
7. **Site Circulation:** The vehicle queueing analysis indicates that there is adequate vehicle storage length to accommodate the projected operations.
8. **Crash Analysis:** The results of the crash analysis at the study intersections indicates a pattern of red-light running crashes are present. Therefore, mitigation measures were evaluated and indicate that increasing the yellow and all-red clearance intervals would help reduce this crash occurrence.

RECOMMENDATIONS

The recommendations of this TIS are summarized below.

Recommended Improvements	Existing (2021)	Background (2022)	Future (2022)
<ul style="list-style-type: none"> • Construct a westbound right-turn deceleration taper on Walton Boulevard at the proposed site driveway 			✓
<ul style="list-style-type: none"> • RCOC to consider increasing the clearance intervals at the signalized intersection of Walton Boulevard & Livernois Road to reduce red-light crashes. 	✓		

1 INTRODUCTION

This report presents the results of a Traffic Impact Study (TIS) for the proposed Starbucks restaurant with drive-through in Rochester Hills, Michigan, as shown in **Figure 1**. The proposed development is located at 1360 Walton Boulevard, at the location of a former Pizza Hut. Site access is proposed via one (1) driveway on Walton Boulevard, which is under the jurisdiction of the Road Commission for Oakland County (RCOC).

The City of Rochester Hills and RCOC has required a Traffic Impact Study (TIS) for the project as part of the site plan approval process. The purpose of this study is to identify the traffic related impacts, if any, from the proposed development project on the adjacent road network. F&V proposes to complete the scope of services for this project consistent with accepted traffic engineering practice and pursuant to the requirements of the City of Rochester Hills and RCOC. Specific tasks undertaken for this study include the following:

1. Study Area

- a. Provide a description of the study area including: intersection and roadway geometries, speed limits, functional classifications and traffic volume data (where available). In addition, a study area site map showing the site location and the study intersections will also be provided.

2. Proposed Land Use

- a. Obtain and review the proposed site plan which includes the proposed land uses, densities, and desired site access locations. A description of the current and proposed land use will be accompanied with a complete project site plan (with buildings identified as to proposed use). A schedule for construction of the development and proposed development stages (if any) will also be provided.

3. Existing Conditions

- a. Provide an analysis of the traffic-related impacts of the proposed development at the following study intersections:
 - Walton Blvd. & Livernois Rd.
 - Walton Blvd. & Rochdale Dr.
 - Walton Blvd. & Rochester High School Dr.
 - Walton Blvd. & Site Drive (proposed)
- b. Due to the impact of COVID-19, current traffic volume data is not representative of “typical” operations. Therefore, the data collection necessary for this study is proposed as follows:
 - Collect existing AM (7:00AM to 9:00 AM) and PM (4:00 to 6:00 PM) peak period turning movement count data at the study intersections.
 - Obtain existing available traffic count data from the Southeast Michigan Council of Governments (SEMCOG), Road Commission for Oakland County (RCOC), and Michigan Department of Transportation (MDOT) Traffic Data Management System (TDMS).
 - Review available historical traffic count data at the study intersections and adjacent roadways previously performed by MDOT, SEMCOG, RCOC, and others.
 - Compare the existing turning movement count data to historical traffic volumes collected in the area to determine the adjusted 2021 turning movement counts at the study intersections.
 - Existing traffic volumes at the proposed site driveways will be determined through balancing traffic volumes through the study network.
- c. Calculate the **Existing** vehicle delays, LOS, and vehicle queues at the study intersections during the AM and PM peak hours. Intersection analysis shall include LOS determination for all approaches and movements. The LOS will be based on the procedures outlined in the HCM 6th Edition, the latest edition of Transportation Research Board’s Highway Capacity Manual.

4. Background Conditions

- a. Calculate the future background traffic volumes based on an appropriate traffic growth determined from local or statewide data to the project build-out year and/or any applicable background developments in the vicinity of this project as identified by the City of Rochester Hills.
 - Andover Woods - Rochdale Drive
 - Medilodge - Waldon Blvd.



FIGURE 1 SITE LOCATION MAP

WALTON BLVD STARBUCKS TIS - ROCHESTER HILLS, MI

LEGEND

 SITE LOCATION



NORTH
SCALE: NOT TO SCALE

- b. Calculate the Background (without the proposed development) vehicle delays, LOS, and vehicle queues at the study intersections during the AM and PM peak periods. Intersection analysis shall include LOS determination for all approaches and movements. The LOS will be based on the procedures outlined in the HCM 6th Edition, the latest edition of Transportation Research Board's Highway Capacity Manual.
- c. Any state, local, or private transportation improvement projects in the project study area that will be underway in the build-out year as identified by the City of Rochester Hills or RCOC will be included as background conditions.

5. Trip Generation

- a. Forecast the number of Weekday AM and PM peak hour trips and daily trips that would be generated by the proposed development based on data published by the Institute of Transportation Engineers (ITE) in *Trip Generation, 11th Edition* and the ITE *Trip Generation Handbook, 3rd Edition*.
- b. A table will be provided in the report outlining the categories and quantities of land uses, with the corresponding trip generation rates or equations, and the resulting number of trips.

6. Trip Distribution and Traffic Assignment

- a. Assign the trips that would be generated by the proposed development to the adjacent road network based on the existing traffic patterns and methodologies outlined in the ITE Transportation and Land Development, 2nd Edition. Pass-by trips will be considered.
- b. The distribution percentages with the corresponding volumes will be provided in a graphical format to include in the report and the basis will be explained.
- c. Combine the site-generated traffic assignments with the background traffic forecasts to establish the Future AM and PM peak hour traffic volumes.

7. Future Conditions

- a. Calculate the **Future (with the proposed development)** vehicle delays, LOS, and vehicle queues at the study intersections. Intersection analysis shall include LOS determination for all approaches and movements. The LOS will be based on the procedures outlined in the HCM 6th Edition, the latest edition of Transportation Research Board's Highway Capacity Manual.
- b. Identify improvements (if any) for the study road network that would be required to accommodate the site-generated traffic volumes.

8. Access Management

- a. Evaluate the RCOC auxiliary lane criteria at the proposed site driveway location to determine the need for a right-turn lane at the site access driveway on Waldon Blvd.

9. Site Circulation

- a. Calculate the projected vehicle queue length for the site based on the peak operations of the site.

10. Crash Analysis

- a. Provide crash analysis for the most recent 3 years of available data at the study intersections.
- b. Perform a crash analysis in accordance with SEMCOG Crash Analysis Process.
- c. Provide recommendations for crash mitigation measures, as necessary.

The scope of this study was developed based on Fleis & VandenBrink's (F&V) knowledge of the study area, understanding of the development program, accepted traffic engineering practices and information published by the Institute of Transportation Engineers (ITE). The study analyses were completed using Synchro/SimTraffic (Version 11). Sources of data for this study include F&V subconsultant Traffic Data Collection, Inc. (TDC), Michigan Department of Transportation (MDOT), the Southeast Michigan Council of Governments (SEMCOG), and ITE. All background information is provided in **Appendix A**.

2 BACKGROUND DATA

2.1 EXISTING ROAD NETWORK

Vehicle transportation for the study area is provided via Walton Boulevard and Livernois Road. The lane uses and traffic control at the study intersections are shown on **Figure 2** and the study roadways are further described below. For the purposes of this study, all minor streets and driveways are assumed to have an operating speed of 25 miles per hour (mph), unless noted otherwise.

Walton Boulevard generally runs in the east and west directions, adjacent to the south side of the project site. The roadway is classified as *Other Principal Arterial* to the west of Livernois Road and classified as a *Minor Arterial* to the east of Livernois Road. Walton Boulevard is under the jurisdiction of the Road Commission for Oakland County (RCOC), has a posted speed limit of 40 mph, and has an Average Annual Daily Traffic (AADT) volume of approximately 24,800 vehicles per day (SEMCOG 2018). Walton Boulevard has a typical five-lane cross-section, with two lanes in each direction and a center two-way left-turn lane. Walton Blvd. widens to provide exclusive right-turn lanes at Livernois Road, however left-turns are prohibited at the intersection and are facilitated via median U-turns on Livernois Road both north and south of Walton Blvd.

Livernois Road generally runs in the north and south directions, approximately 500 feet east of the project site. The roadway is classified as *Other Principal Arterial* to the south of Walton Boulevard and classified as a *Minor Arterial* to the north of Walton Boulevard. Livernois Road is under the jurisdiction of the RCOC, has a posted speed limit of 40 mph, and an AADT volume of approximately 25,200 vehicles per day (SEMCOG 2018). Livernois Road has a median divided, four-lane cross-section with two lanes in each direction. At the intersection with Walton Boulevard, northbound Livernois Road widens to provide dual left-turn lanes and an exclusive right-turn lane. Southbound Livernois Road widens to provide an exclusive right-turn lane, however left-turns are prohibited and are facilitated via the median U-turn south of Walton Blvd.

Rochdale Drive generally runs in the north and south directions, approximately 900 feet west of the project site. The roadway is classified as a *Local Road* and is under the jurisdiction of the City of Rochester Hills. Rochdale Drive has a posted speed limit of 25 mph and an AADT volume of approximately 2,000 vehicles per day (SEMCOG 2018). Rochdale Drive has a typical two-lane cross-section, with one lane in each direction. At the intersection with Walton Boulevard, northbound Rochdale Drive widens to provide an exclusive left-turn lane and southbound Rochdale Drive widens to provide a median divided four-lane cross-section, with two lanes in each direction and an exclusive left-turn lane.

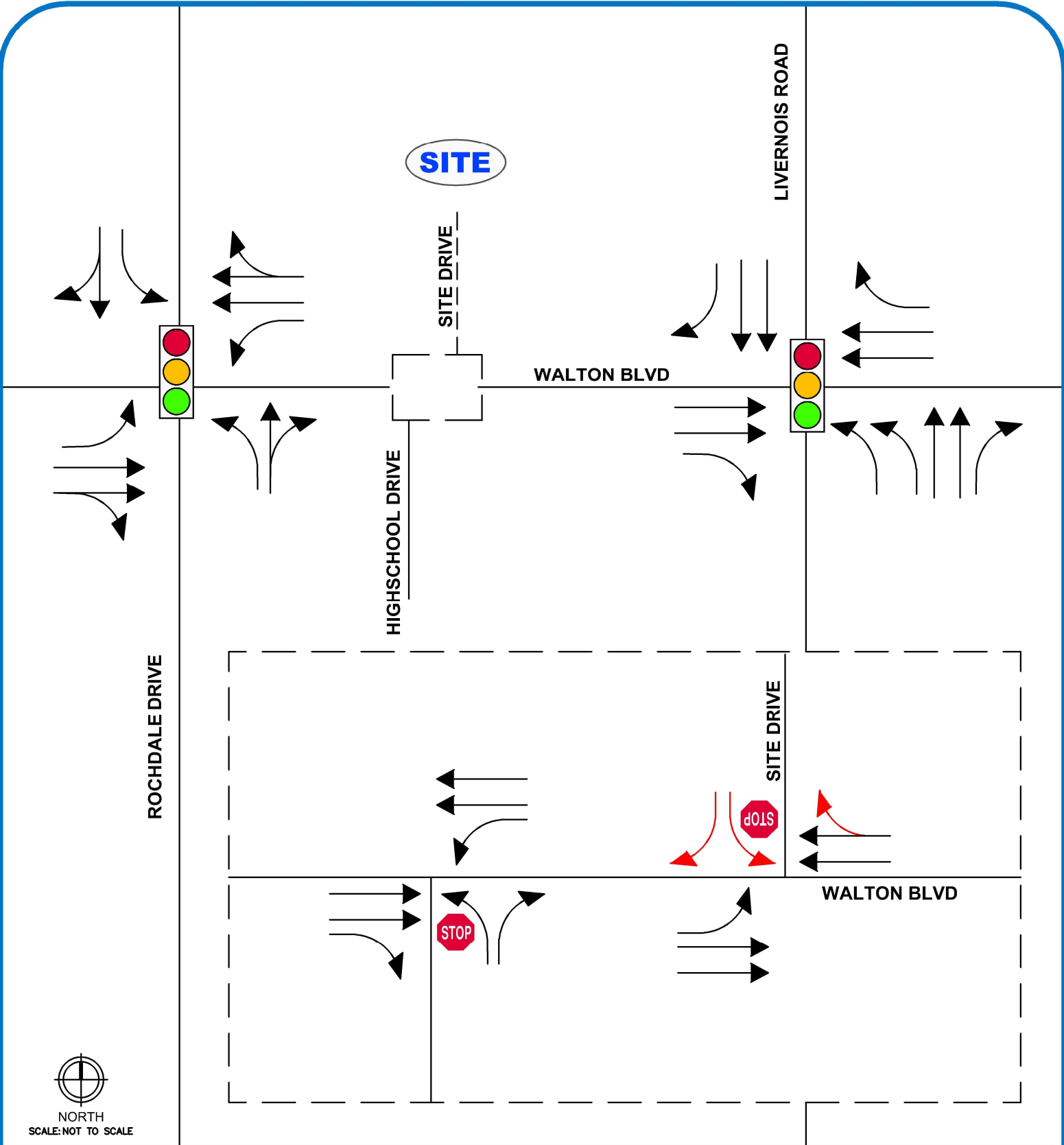
2.2 EXISTING TRAFFIC VOLUMES

Existing traffic volume data at the study intersections were collected by F&V subconsultant Traffic Data Collection, Inc. (TDC) on Thursday, November 4, 2021 and by F&V staff on Tuesday, November 9, 2021, during the weekday AM (7:00 AM to 9:00 AM) and PM (4:00 PM to 6:00 PM) peak periods. The data collection included Peak Hour Factors (PHFs), pedestrian volumes, and commercial truck percentages, which were used in the analysis in accordance with the MDOT Electronic Traffic Control Devices guidelines.

Due to the impact of COVID-19, current traffic volume data is not representative of “typical” operations. Therefore, historical traffic volume data collected by SCATS for each approach was reviewed, and adjustment factors were determined to calculate baseline existing 2021 traffic volumes. Several approaches has higher volumes than the historical volumes; therefore, the 2021 volumes were utilized. The COVID adjustment factors are summarized in **Table 1** and were applied to the study roadways; volumes were balanced upwards at the proposed site driveways and throughout the study intersections. The traffic volume data is included in **Appendix A** and the COVID adjusted baseline 2021 peak hour traffic volumes are shown on **Figure 3**.

Table 1: COVID Adjustment Factors

Livernois Road & Walton Boulevard	AM	PM	Rochdale Drive & Walton Boulevard	AM	PM
Livernois Road (NB)	9%	0%	Rochdale Drive (NB)	15%	0%
Livernois Road (SB)	31%	0%	Rochdale Drive (SB)	0%	0%
Walton Boulevard (EB)	1%	16%	Walton Boulevard (EB)	3%	23%
Walton Boulevard (WB)	42%	0%	Walton Boulevard (WB)	0%	0%



NORTH
SCALE: NOT TO SCALE



FIGURE 2 LANE USE AND TRAFFIC CONTROL

WALTON BLVD STARBUCKS TIS - ROCHESTER HILLS, MI

LEGEND

- ROADS
- PROPOSED ROADS
- LANE USE
- PROPOSED LANE USE
- SIGNALIZED INTERSECTION
- UNSIGNALIZED INTERSECTION
- ROUNDABOUT INTERSECTION

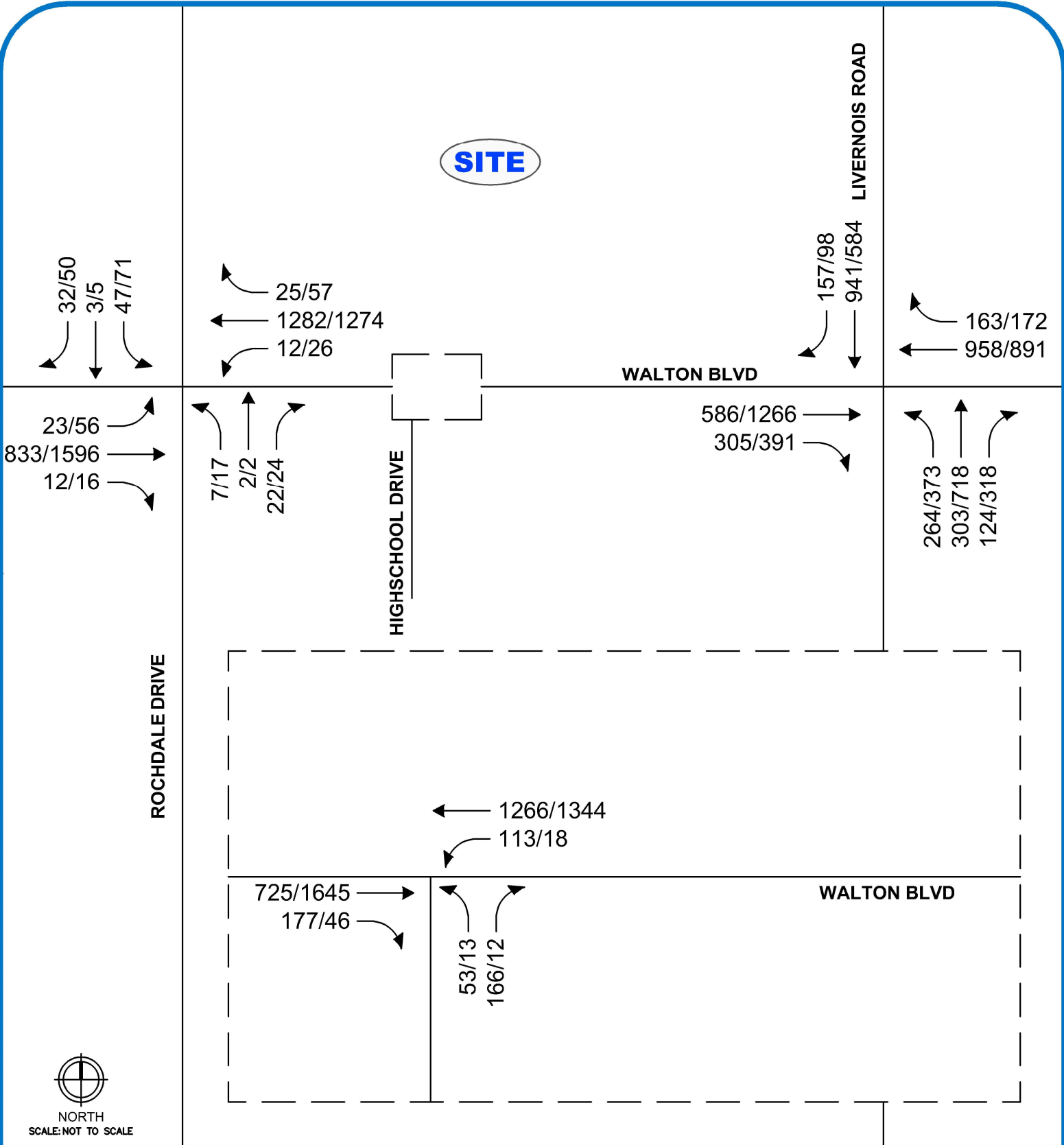


FIGURE 3
EXISTING TRAFFIC
VOLUMES

WALTON BLVD STARBUCKS TIS - ROCHESTER HILLS, MI



3 EXISTING CONDITIONS

3.1 EXISTING OPERATIONS

The existing AM and PM peak hour vehicle delays and Levels of Service (LOS) were calculated at the study intersections using Synchro (Version 11) traffic analysis software. The results of the analysis of existing conditions were based on the existing lane use and traffic control shown on **Figure 2**, the existing traffic volumes shown on **Figure 3**, and the methodologies presented in the Highway Capacity Manual 6th Edition (HCM6).

Descriptions of LOS “A” through “F”, as defined in the HCM, are provided in **Appendix B** for signalized and unsignalized intersections. Typically, LOS D is considered acceptable, with LOS A representing minimal delay, and LOS F indicating failing conditions. The results of the analysis of existing conditions are presented in **Appendix B** and are summarized in **Table 2**. Microsimulation was also conducted at the study intersections using SimTraffic to further evaluate the network performance.

Table 2: Existing Intersection Operations

Intersection	Control	Approach	Existing Conditions			
			AM Peak		PM Peak	
			Delay (s/veh)	LOS	Delay (s/veh)	LOS
1 Rochdale Drive & Walton Boulevard	Signalized	EBL	3.5	A	4.0	A
		EBT	5.8	A	9.6	A
		EBTR	5.8	A	9.6	A
		WBL	4.1	A	6.8	A
		WBT	1.3	A	1.4	A
		WBTR	1.3	A	1.4	A
		NBL	53.7	D	54.1	D
		NBTR	51.5	D	50.4	D
		SBL	56.8	E	56.5	E
		SBTR	52.8	D	52.0	D
		Overall	6.4	A	8.7	A
2 Rochester HS Drive & Walton Boulevard	Stop (Minor)	EB	Free			
		WBL	12.0	B	11.0	B
		NBL	30.3	D	19.9	C
		NBR	12.5	B	14.0	B
3 Livernois Road & Walton Boulevard	Signalized	EBT	27.1	C	47.1	D
		EBTR	17.2	B	19.2	B
		WBT	46.3	D	29.7	C
		WBR	30.1	C	24.2	C
		NBL	51.7	D	48.3	D
		NBT	13.4	B	20.4	C
		NBR	13.4	B	21.2	C
		SBT	39.6	D	41.8	D
		SBR	28.6	C	35.9	D
		Overall	34.5	C	34.2	C

The results of the existing conditions analysis indicates that all study intersection approaches and movements currently operate acceptably, at LOS D or better during both peak periods, with the following exceptions:

Rochdale Drive & Walton Boulevard

- During both peak periods: The SB left-turn movement is currently operating at LOS E.

Although the intersection LOS indicates poor operations for the southbound left-turn movement, review of SimTraffic network simulations indicate a 95th percentile queue length of approximately 120-feet (4-5 vehicles) or less during both peak periods, which is not significant. Additionally, microsimulation reviews indicate acceptable operations, with all vehicle queues observed to be service within each cycle length.

The poor LOS and delay at this intersection are due to an underutilization of this southbound left-turn movement. Low vehicle volumes for this approach and the random arrival of vehicles, in conjunction with the long cycle length (120 seconds) results in vehicles that will often arrive at the intersection on a red signal and have to wait throughout the majority of the cycle length to receive a green signal. Additionally, because the movement has a low volume of vehicles, each cycle may only serve a few vehicles, which does not facilitate efficient operations. It should be noted that this intersection runs on SCATS and performs real time optimizations for the cycle length and phase splits; therefore, during the off-peak periods, the cycle lengths (and subsequently the minor street delays) are likely reduced. A reduction of cycle length at this intersection during the peak periods would improve operations on this approach; however, this would impact the other movements at this intersection and other intersections along the corridor. Therefore, no improvements are recommended at this intersection.

4 BACKGROUND (2022) CONDITIONS

The proposed development is planned to be open and operational within the next year; therefore, the baseline 2021 volumes were assumed equal to 2022 volumes. Additionally, the City of Rochester Hills identified the following developments that are proposed to be completed within the next year and were included as background traffic volumes:

- Andover Woods (Rochdale Drive) – 42 duplex units
- MediLodge (Walton Boulevard) – 126-bed assisted living facility

In order to determine the traffic volumes for the buildout year of 2022, the trip generation from the background developments were projected and distributed onto the roadway network during the AM and PM peak periods. The background development trip generation was then added to the baseline 2021 traffic volumes; the background (2022) traffic volume **without the proposed development** is shown in **Figure 4**.

4.1 BACKGROUND OPERATIONS

The background peak hour vehicle delays and LOS **without the proposed development** were calculated based on the existing lane use and traffic control shown on **Figure 2**, the background traffic volumes shown on **Figure 4**, and the methodologies presented in the HCM6. The results of the analysis of background conditions are presented in **Appendix C** and are summarized in **Table 3**.

The results of the background conditions analysis indicates that all of the study intersection approaches and movements will continue to operate acceptably, in a manner similar to existing conditions analysis. Review of SimTraffic microsimulations also indicates acceptable operations for all study intersection approaches and movements similar to those observed under the existing conditions analysis. *Note: Several of the intersection movements improved with the addition of background traffic. This is due to the optimization of signal splits and increased lane utilization which decreased the delay on certain movements.*

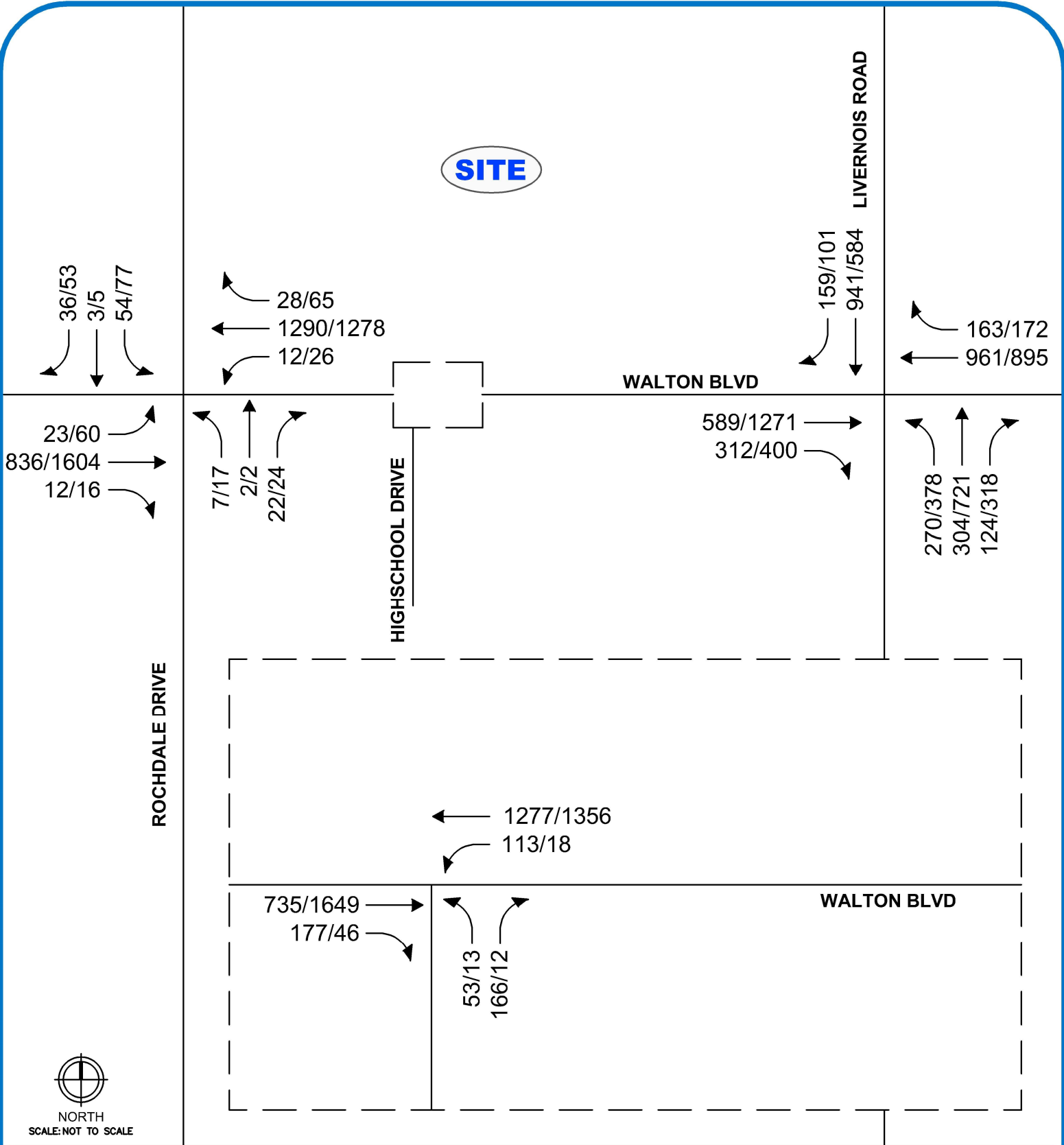


FIGURE 4 BACKGROUND TRAFFIC VOLUMES

WALTON BLVD STARBUCKS TIS - ROCHESTER HILLS, MI

LEGEND

- ROADS
- PROPOSED ROADS
- TRAFFIC VOLUMES (AM/PM)

Table 3: Background Intersection Operations

Intersection	Control	Approach	Existing Conditions				Background Conditions				Difference			
			AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
			Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
1 Rochdale Drive & Walton Boulevard	Signalized	EBL	3.5	A	4	A	3.8	A	4.2	A	0.3	-	0.2	-
		EBT	5.8	A	9.6	A	6.2	A	10.0	B	0.4	-	0.4	A→B
		EBTR	5.8	A	9.6	A	6.2	A	10.0	A	0.4	-	0.4	-
		WBL	4.1	A	6.8	A	4.4	A	7.1	A	0.3	-	0.3	-
		WBT	1.3	A	1.4	A	1.4	A	1.5	A	0.1	-	0.1	-
		WBTR	1.3	A	1.4	A	1.4	A	1.4	A	0.1	-	0.0	-
		NBL	53.7	D	54.1	D	53.2	D	53.7	D	-0.5	-	-0.4	-
		NBTR	51.5	D	50.4	D	50.5	D	49.7	D	-1.0	-	-0.7	-
		SBL	56.8	E	56.5	E	56.5	E	56.2	E	-0.3	-	-0.3	-
		SBTR	52.8	D	52	D	52.1	D	51.5	D	-0.7	-	-0.5	-
		Overall	6.4	A	8.7	A	6.8	A	9.0	A	0.4	-	0.3	-
2 Rochester HS Drive & Walton Boulevard	Stop (Minor)	EB	Free				Free				-			
		WBL	12.0	B	11.0	B	12.2	B	11.4	B	0.2	-	0.4	-
		NBL	30.3	D	19.9	C	23.3	C	20.8	C	-7.0	D→C	0.9	-
		NBR	12.5	B	14.0	B	12.5	B	14.6	B	0.0	-	0.6	-
3 Livernois Road & Walton Boulevard	Signalized	EBT	27.1	C	47.1	D	27.0	C	47.2	D	-0.1	-	0.1	-
		EBTR	17.2	B	19.2	B	17.3	B	19.4	B	0.1	-	0.2	-
		WBT	46.3	D	29.7	C	46.4	D	29.7	C	0.1	-	0.0	-
		WBR	30.1	C	24.2	C	30.0	C	24.1	C	-0.1	-	-0.1	-
		NBL	51.7	D	48.3	D	52.2	D	48.7	D	0.5	-	0.4	-
		NBT	13.4	B	20.4	C	13.4	B	20.5	C	0.0	-	0.1	-
		NBR	13.4	B	21.2	C	13.5	B	21.2	C	0.1	-	0.0	-
		SBT	39.6	D	41.8	D	39.6	D	41.8	D	0.0	-	0.0	-
		SBR	28.6	C	35.9	D	28.7	C	36.0	D	0.1	-	0.1	-
				Overall	34.5	C	34.2	C	34.6	C	34.3	C	0.1	-

5 SITE TRIP GENERATION

The number of peak hour (AM and PM), and daily vehicle trips that would be generated by the proposed development were forecast based on data published in the Institute of Transportation Engineers (ITE) *Trip Generation Manual 11th Edition*. The trip generation is summarized in **Table 4**.

Table 4: Trip Generation Summary

Land Use	ITE Code	Amount	Units	Average Daily Traffic (vpd)	AM Peak Hour (vph)			PM Peak Hour (vph)		
					In	Out	Total	In	Out	Total
Coffee Shop with Drive-Through	937	2,219	SF	1,184	97	94	191	44	43	87
<i>Pass-By</i>	50% AM, 55% PM			622	48	48	96	24	24	48
New Trips				562	49	46	95	20	19	39

As is typical of commercial developments, a portion of the trips generated are from vehicles on the adjacent roadway and will pass the site on the way from an origin to an ultimate destination. Therefore, not all traffic at the site driveways are necessarily new traffic added to the street system. This percentage of the trips generated by the development are considered “pass-by” trips and do not add new traffic to the adjacent street system. These trips are therefore reduced from the total external trips generated by a study site. The percentage of pass-by trips used in this analysis was determined based on the rates published by ITE in the *Trip Generation Manual, 11th Edition*.

6 SITE TRIP DISTRIBUTION

The vehicular trips that would be generated by the proposed development were assigned to the study roads based on the proposed site access plan, the existing peak hour traffic patterns in the adjacent roadway network, and the methodologies published by ITE. The adjacent street traffic volumes were used to develop the vehicular trip distribution; it was assumed that the traffic in the AM are home-to-work based trips and are work-to-home based trips in the PM. Therefore, the global trip distribution is based on vehicles entering the study network in the AM and exiting the study network in the PM. Additionally, ITE trip distribution methodology assumes that “new trips” will return to their direction of origin, whereas pass-by trips will enter and exit the development in their original direction of travel. The site trip distributions used in the analysis are summarized in **Table 5**.

Table 5: Site Trip Distribution

New Trips			via	Pass-By Trips		
AM	PM	To/From		To/From	AM	PM
29%	19%	North	Livernois Road			
18%	20%	South	Livernois Road			
30%	33%	East	Walton Boulevard	Eastbound	39%	55%
23%	28%	West	Walton Boulevard	Westbound	61%	45%
100%	100%	Total			100%	100%

The vehicular traffic volumes shown in **Table 4** were distributed to the roadway network according to the distribution shown in **Table 5**. The site generated trips are shown on **Figure 5** and were added to the background traffic volumes shown on **Figure 4**, in order to calculate the future peak hour traffic volumes **with the proposed development**, as shown on **Figure 6**.

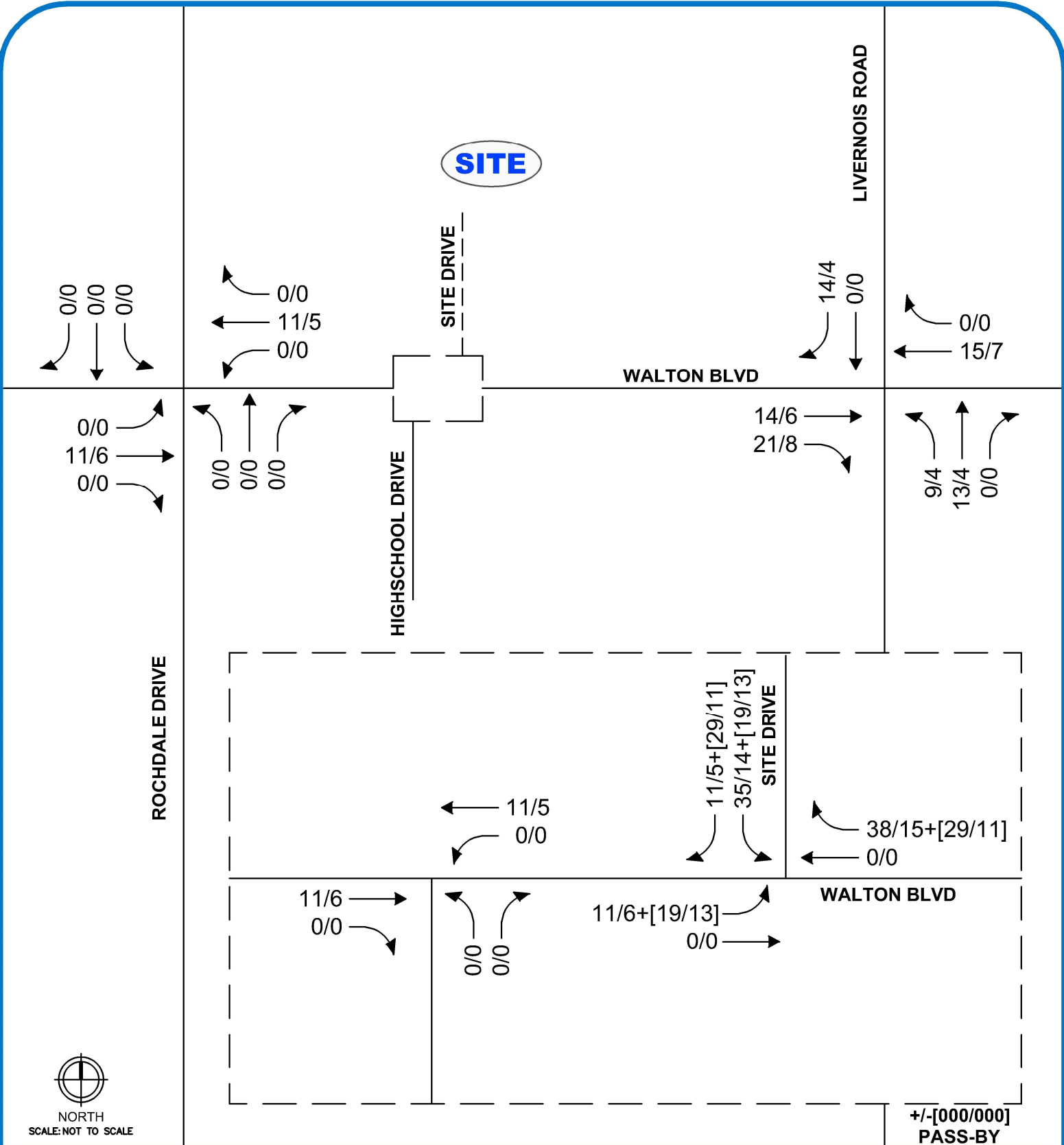


FIGURE 5
SITE-GENERATED
TRAFFIC VOLUMES

WALTON BLVD STARBUCKS TIS - ROCHESTER HILLS, MI

LEGEND
 ——— ROADS
 - - - PROPOSED ROADS
 [Arrows with numbers] TRAFFIC VOLUMES (AM/PM)

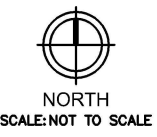
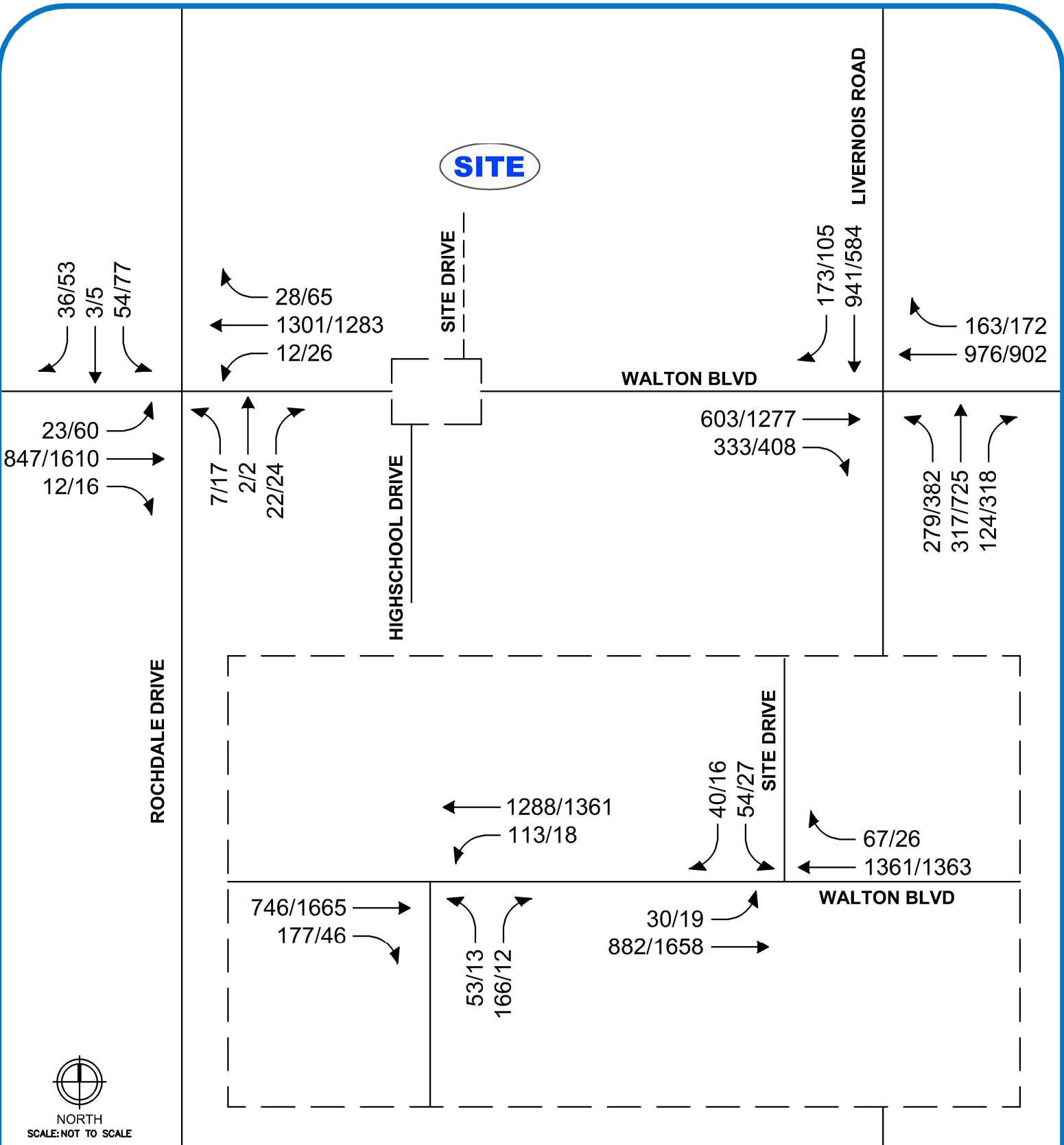


FIGURE 6 FUTURE TRAFFIC VOLUMES

WALTON BLVD STARBUCKS TIS - ROCHESTER HILLS, MI

LEGEND

	ROADS
	PROPOSED ROADS
	TRAFFIC VOLUMES (AM/PM)

7 FUTURE CONDITIONS

7.1 FUTURE OPERATIONS

Future peak hour vehicle delays and LOS *with the proposed development* were calculated based on the future lane use shown on **Figure 2**, the proposed site access plan, the future traffic volumes shown on **Figure 6**, and the methodologies presented in the HCM6. The results of the future conditions analysis are presented in **Appendix D** and are summarized in **Table 6**.

Table 6: Future Intersection Operations

Intersection	Control	Approach	Background Conditions				Future Conditions				Difference			
			AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
			Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
1 Rochdale Drive & Walton Boulevard	Signalized	EBL	3.8	A	4.2	A	3.8	A	4.2	A	0.0	-	0.0	-
		EBT	6.2	A	10.0	B	6.2	A	10.1	B	0.0	-	0.1	-
		EBTR	6.2	A	10.0	A	6.2	A	10.0	A	0.0	-	0.0	-
		WBL	4.4	A	7.1	A	4.4	A	7.1	A	0.0	-	0.0	-
		WBT	1.4	A	1.5	A	1.4	A	1.5	A	0.0	-	0.0	-
		WBTR	1.4	A	1.4	A	1.4	A	1.5	A	0.0	-	0.1	-
		NBL	53.2	D	53.7	D	53.2	D	53.7	D	0.0	-	0.0	-
		NBTR	50.5	D	49.7	D	50.5	D	49.7	D	0.0	-	0.0	-
		SBL	56.5	E	56.2	E	56.5	E	56.2	E	0.0	-	0.0	-
		SBTR	52.1	D	51.5	D	52.1	D	51.5	D	0.0	-	0.0	-
		Overall	6.8	A	9.0	A	6.8	A	9.1	A	0.0	-	0.1	-
2 Rochester HS Drive & Walton Boulevard	Stop (Minor)	EB	Free				Free				Free			
		WBL	12.2	B	11.4	B	12.5	B	11.4	B	0.3	-	0.0	-
		NBL	23.3	C	20.8	C	23.5	C	21.3	C	0.2	-	0.5	-
		NBR	12.5	B	14.6	B	12.5	B	14.6	B	0.0	-	0.0	-
3 Livernois Road & Walton Boulevard	Signalized	EBT	27.0	C	47.2	D	27.0	C	47.3	D	0.0	-	0.1	-
		EBTR	17.3	B	19.4	B	17.6	B	19.6	B	0.3	-	0.2	-
		WBT	46.4	D	29.7	C	47.0	D	29.7	C	0.6	-	0.0	-
		WBR	30.0	C	24.1	C	29.8	C	24.1	C	-0.2	-	0.0	-
		NBL	52.2	D	48.7	D	53.7	D	49.0	D	1.5	-	0.3	-
		NBT	13.4	B	20.5	C	13.6	B	20.6	C	0.2	-	0.1	-
		NBR	13.5	B	21.2	C	13.6	B	21.3	C	0.1	-	0.1	-
		SBT	39.6	D	41.8	D	39.6	D	41.8	D	0.0	-	0.0	-
		SBR	28.7	C	36.0	D	29.1	C	36.2	D	0.4	-	0.2	-
				Overall	34.6	C	34.3	C	34.8	C	34.4	C	0.2	-
4 Site Drive & Walton Boulevard	Stop (Minor)	EBL	N/A				10.1	B	9.8	A	N/A			
		WB					Free							
		SBL					17.6	C	22.2	C				
		SBR					12.6	B	12.3	B				

The results of the future conditions analysis indicates that, with the addition of site generated traffic, all study intersection approaches and movements will continue to operate acceptably, in a manner similar to existing and background conditions. Review of the proposed site driveway indicates that all movements are expected to operate at LOS D or better during both peak periods. Additionally, review of microsimulations indicates acceptable operations at all study intersections within the roadway network.

7.1.1 Rochester HS Drive / Proposed Site Drive Back-to-Back Left-Turns

The proposed site driveway is located east of the existing Rochester High School Drive, with an effective back-to-back left-turn storage length of approximately 150 feet. A review of the eastbound left-turn ingress traffic indicates that vehicles entering the proposed development have the potential to conflict with westbound left-turn ingress traffic entering the Rochester High School. Therefore, the potential for back-to-back left-turn conflicts exists and was further investigated to identify whether operational and safety concerns would arise from the proposed development. The SimTraffic microsimulation vehicle queueing reports are summarized in **Table 7**.

Table 7: Rochester HS Drive / Proposed Site Drive Back-to-Back Left-Turns

Peak Period	Rochester HS Ingress Left-turn		Site Drive Ingress Left-turn		Total		Effective Queue Length (ft)	Exceeds Queue Length
	Avg. Queue (ft)	95th % Queue (ft)	Avg. Queue (ft)	95th % Queue (ft)	Avg. Queue (ft)	95th % Queue (ft)		
AM	42	82	17	49	59	131	150	No
PM	14	41	13	44	27	85	150	No

The results of the analysis indicate that the proposed Site Drive location has adequate spacing from the Rochester High School driveway to allow back-to-back left turn operations. However, the vehicles will decelerate in the through lane during the peak periods for the High School, as there is not expected to be adequate storage length to accommodate deceleration in the center lane without potential overlap. During the average peak hour operations, there will be adequate storage and deceleration for both uses.

8 ACCESS MANAGEMENT

8.1 AUXILIARY LANE ANALYSIS

In order to determine the configuration of the proposed site driveway on Walton Boulevard, RCOC criteria for a right-turn treatments was evaluated. Walton Boulevard currently has an existing center two-way left-turn lane; therefore, the left-turn warrants were not evaluated. The results of the analysis are summarized in **Table 8** and presented in **Appendix E**. The results of the analysis indicate that a westbound right-turn deceleration taper is warranted on Walton Boulevard at the proposed site driveway.

Table 7: Auxiliary Lane Analysis Summary

Intersection	Movement	2022 Build-out		
		AM Peak	PM Peak	Recommendation
Site Drive & Walton Boulevard	WB Right-Turn	RT Taper	RT Taper	RT Taper

9 SITE CIRCULATION

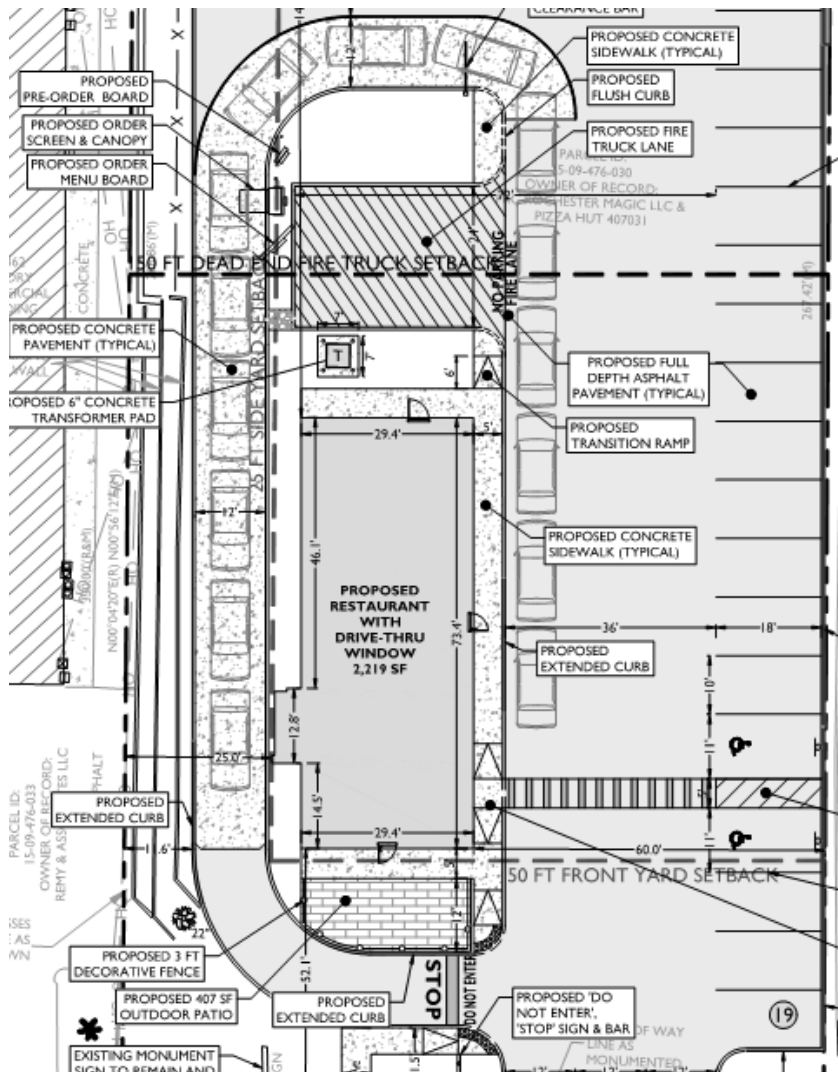
The projected drive-through vehicle queuing was reviewed to determine if the proposed on-site queue length for the drive-through is adequate to accommodate the projected operations. National data for Starbucks indicates a maximum service rate of 67 vehicle/hour. It is estimated by national restaurant consultants that approximately 70% of customers at Starbucks will utilize a drive-through. Therefore, it is estimated that approximately 68 vehicles per hour will use the Starbucks during the peak hour (AM) of operation. A queuing analysis was performed to determine if the demand exceeds the service rate and calculate the projected queuing as summarized in **Table 9**.

Table 9: Vehicle Queuing Analysis

STARBUCKS DRIVE-THRU STACKING SPACE CALCULATOR	
Number of Arrivals	68
Time per Vehicle (s)	54
Service Rate (veh/hr)	67
Peak Arrival (veh)	7
Vehicle Length	20
ORDER BOARD	
TOTAL QUEUE (ft)	140

The result of the analysis indicates that with a random arrival of 7 vehicles, the proposed development will require a total 12 stacking spaces (5 from the window to the order board and 7 past the order board). The proposed site plan provides storage for a total of 15 vehicles which will accommodate the projected vehicle queuing for this site without extending into the adjacent roadway.

Exhibit 1: Vehicle Queuing



10 CRASH ANALYSIS

A crash analysis was performed for the study intersections of Rochdale Drive & Walton Boulevard and Livernois Road & Walton Boulevard using the latest three (3) years of available data (2018-2020) obtained from the Michigan Traffic Crash Facts (MTCF) website. The crash results are summarized in **Table 10** and the detailed crash reports (UD-10s) are attached in **Appendix A**.

Table 10: Intersection Crash Summary

Crash Type	Livernois Road & Walton Boulevard		Rochdale Drive & Walton Boulevard	
	Crashes	Percentage	Crashes	Percentage
Single Motor Vehicle Crash	6	10.0%	2	10.5%
Head On Left-Turn	5	8.3%	1	5.3%
Angle	16	26.7%	5	26.3%
Rear End	25	41.7%	11	57.9%
Sideswipe-Same	8	13.3%	0	0.0%
Total	60	100%	19	100%

Rear-end crashes represented the majority of crashes at both intersections. This type of crash is typical for signalized intersections. Further analysis showed that, at the Livernois Road & Walton Boulevard intersection, a large number of the head-on left-turn and angle crashes were caused by drivers running through a red light and colliding with other drivers who had the right of way.

Mitigation measures were investigated in order to account for red light runners and the result of the evaluation indicates that increasing the yellow and all-red clearance phases on all approaches would help reduce red-light running. Therefore, it is recommended that RCOC consider increasing the clearance intervals at the signalized study intersections.

11 CONCLUSIONS

The conclusions of this TIS are as follows:

9. **Existing Conditions:** All study intersection approaches and movements currently operate acceptably at LOS D or better during both peak periods, with the following exceptions:
 - **Rochdale Drive & Walton Boulevard:** The SB left-turn movement is currently operating at LOS E during both peak periods. However, review of SimTraffic microsimulations indicates acceptable operations, with all vehicle queues observed to be serviced within each cycle length. The poor LOS and delay experienced at this intersection is the result of a long cycle length (120 seconds) and underutilization of this approach, resulting in a minimal percentage of vehicles arriving on a green.
10. **Background (2022) Conditions:** The proposed development is planned to be open and operational within a year; therefore, a growth rate was not applied to the 2021 volumes to reflect the buildout 2022 volumes. However, the following background developments were identified and included in the background volumes:
 - Andover Woods (Rochdale Drive) – 42 duplex units
 - MediLodge (Walton Boulevard) – 126-bed nursing home
11. **Background (2022) Conditions:** All study intersection approaches and movements are expected to operate acceptably, in a manner similar to existing conditions. SimTraffic network simulations also indicate acceptable operations, similar to those observed under the existing conditions analysis.
12. **Future Conditions:** The results of the future conditions analysis indicates that all study intersection approaches and movements are expected to continue operating acceptably, in a manner similar to existing and background conditions.
13. **Rochester HS Drive / Proposed Site Drive Back-to-Back Left-Turns:** The results of the analysis indicate that the proposed Site Drive location has adequate spacing from the Rochester High School driveway to allow back-to-back left turn operations. However, the vehicles will decelerate in the through lane during the peak periods for the High School, as there is not expected to be adequate storage length to accommodate deceleration in the center lane without potential overlap. During the average peak hour operations, there will be adequate storage and deceleration for both uses.
14. **Auxiliary Turn Lane Analysis:** The results of the auxiliary turn lane analysis indicates that a westbound right-turn deceleration taper is recommended on Walton Boulevard at the proposed site driveway.
15. **Site Circulation:** The vehicle queueing analysis indicates that there is adequate vehicle storage length to accommodate the projected operations.
16. **Crash Analysis:** The results of the crash analysis at the study intersections indicates a pattern of red-light running crashes are present. Therefore, mitigation measures were evaluated and indicate that increasing the yellow and all-red clearance intervals would help reduce this crash occurrence.

12 RECOMMENDATIONS

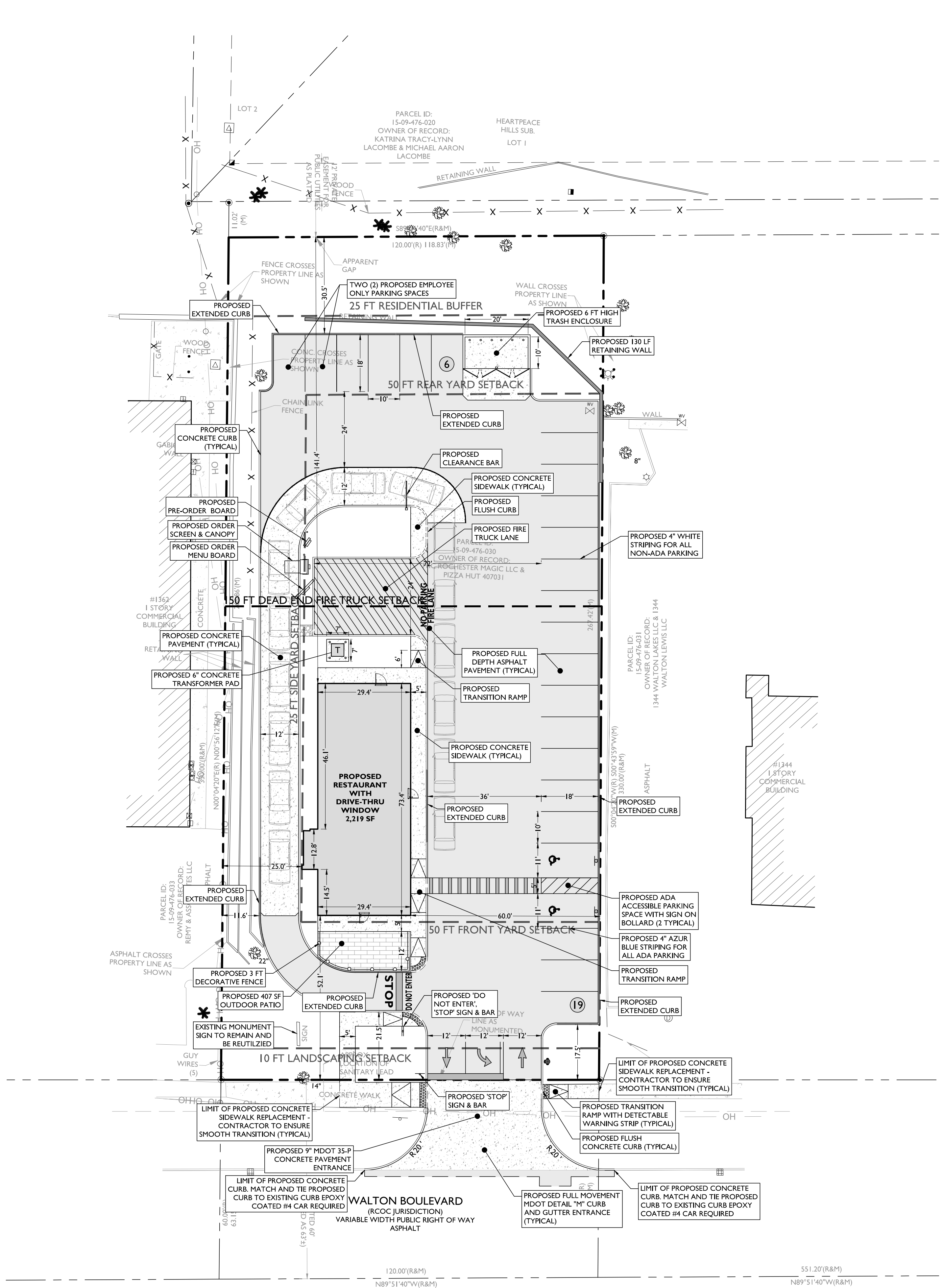
The recommendations of this TIS are as follows:

Recommended Improvements	Existing (2021)	Background (2022)	Future (2022)
<ul style="list-style-type: none"> • Construct a westbound right-turn deceleration taper on Walton Boulevard at the proposed site driveway 			✓
<ul style="list-style-type: none"> • RCOG to consider increasing the clearance intervals at the signalized intersection of Walton Boulevard & Livernois Road to reduce red-light crashes. 	✓		

Appendix A

BACKGROUND INFORMATION

NOT TO SCALE. DEVELOPMENT LOCATED AT 1360 WALTON BOULEVARD, ROCHESTER HILLS, MICHIGAN. DATE: 07/20/2024



LAND USE AND ZONING

PARCEL ID: 15-09-476-030
GENERAL BUSINESS (B-2) & FLEXIBLE BUSINESS OVERLAY (FB-2)

ZONING REQUIREMENT	REQUIRED	PROPOSED
RESTAURANT W/ DRIVE-THRU	CONDITIONAL USE	
MINIMUM LOT AREA	N/A	31,868 SF (0.73 AC)
MINIMUM LOT WIDTH	N/A	117.2 FT
MAXIMUM BUILDING HEIGHT	2 STORIES / 30 FT	1 STORY / <30 FT
MINIMUM FRONT YARD SETBACK	50 FT	50.0 FT
MINIMUM SIDE YARD SETBACK (ONE)	0 FT (1)	25.0 FT
MINIMUM SIDE YARD SETBACK (BOTH)	50 FT	85.0 FT
MINIMUM REAR YARD SETBACK	50 FT	141.4 FT
MINIMUM RESIDENTIAL LANDSCAPE BUFFER	25 FT	30.5 FT
MINIMUM DRIVE-THRU WINDOW SETBACK	10 FT FROM BUILDING FRONT	14.5 FT
MINIMUM FRONT PARKING SETBACK	10 FT LANDSCAPE BUFFER	17.5 FT

(1) 25 FT SETBACK IS REQUIRED FOR THE EXTERIOR SIDE OF PARCEL OR LOT ON THE EXTERIOR OF THE DISTRICT

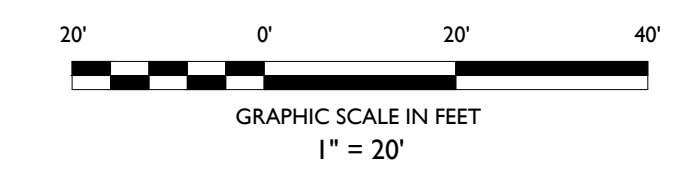
OFF-STREET PARKING REQUIREMENTS

CODE SECTION	REQUIRED	PROPOSED
§ 138-11.204	REQUIRED RESTAURANT PARKING: 1 SPACE PER 2 PERSONS AT MAX OCCUPANCY (50 PERSONS) (1 SPACE / 2 PERSONS) = 25 SPACES	25 SPACES
§ 138-11.204	REQUIRED DRIVE-THRU STACKING: 10 STACKING SPACES	15 SPACES
§ 138-11.302	DIMENSIONAL REQUIREMENTS: 75'-90": 18 FT X 10 FT W/ 24 FT TWO-WAY AISLE	18 FT X 10 FT W/ 24 FT AISLE

SYMBOL DESCRIPTION

---	PROPERTY LINE
---	SETBACK LINE
---	SAWCUT LINE
---	PROPOSED CURB
---	PROPOSED EXTENDED CURB
---	PROPOSED FLUSH CURB
---	PROPOSED SIGNS / BOLLARDS
---	PROPOSED BUILDING
---	PROPOSED CONCRETE
---	PROPOSED ASPHALT
---	PROPOSED AREA LIGHT
---	PROPOSED BUILDING DOORS
---	PROPOSED HANDRAIL

- GENERAL NOTES**
- THE CONTRACTOR SHALL VERIFY AND FAMILIARIZE THEMSELVES WITH THE EXISTING SITE CONDITIONS AND THE PROPOSED SCOPE OF WORK (INCLUDING DIMENSIONS, LAYOUT, ETC.) PRIOR TO INITIATING THE IMPROVEMENTS IDENTIFIED WITHIN THESE DOCUMENTS. SHOULD ANY DISCREPANCY BE FOUND BETWEEN THE EXISTING SITE CONDITIONS AND THE PROPOSED WORK, THE CONTRACTOR SHALL NOTIFY STONEFIELD ENGINEERING & DESIGN, LLC PRIOR TO THE START OF CONSTRUCTION.
 - THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS AND ENSURE THAT ALL REQUIRED APPROVALS HAVE BEEN OBTAINED PRIOR TO THE START OF CONSTRUCTION. COPIES OF ALL REQUIRED PERMITS AND APPROVALS SHALL BE KEPT ON SITE AT ALL TIMES DURING CONSTRUCTION.
 - ALL CONTRACTORS WILL, TO THE FULLEST EXTENT PERMITTED BY LAW, INDEMNIFY AND HOLD HARMLESS STONEFIELD ENGINEERING & DESIGN, LLC, AND ITS SUB-CONSULTANTS FROM AND AGAINST ANY DAMAGES AND LIABILITIES INCLUDING ATTORNEY'S FEES ARISING OUT OF CLAIMS BY EMPLOYEES OF THE CONTRACTOR IN ADDITION TO CLAIMS CONNECTED TO THE PROJECT AS A RESULT OF NOT CARRYING THE PROPER INSURANCE FOR WORKERS COMPENSATION, LIABILITY INSURANCE, AND LIMITS OF COMMERCIAL GENERAL LIABILITY INSURANCE.
 - THE CONTRACTOR SHALL NOT DEVIATE FROM THE PROPOSED IMPROVEMENTS IDENTIFIED WITHIN THIS PLAN SET UNLESS APPROVAL IS PROVIDED IN WRITING BY STONEFIELD ENGINEERING & DESIGN, LLC.
 - THE CONTRACTOR IS RESPONSIBLE TO DETERMINE THE MEANS AND METHODS OF CONSTRUCTION.
 - THE CONTRACTOR SHALL NOT PERFORM ANY WORK OR CAUSE DISTURBANCE ON A PRIVATE PROPERTY NOT CONTROLLED BY THE PERSON OR ENTITY WHO HAS AUTHORIZED THE WORK WITHOUT PRIOR WRITTEN CONSENT FROM THE OWNER OF THE PRIVATE PROPERTY.
 - THE CONTRACTOR IS RESPONSIBLE TO RESTORE ANY DAMAGED OR UNDERMINED STRUCTURE OR SITE FEATURE THAT IS IDENTIFIED TO REMAIN ON THE PLAN SET. ALL REPAIRS SHALL USE NEW MATERIALS TO RESTORE THE FEATURE TO ITS EXISTING CONDITION AT THE CONTRACTOR'S EXPENSE.
 - CONTRACTOR IS RESPONSIBLE TO PROVIDE THE APPROPRIATE SHOP DRAWINGS, PRODUCT DATA, AND OTHER REQUIRED SUBMITTALS FOR REVIEW. STONEFIELD ENGINEERING & DESIGN, LLC, WILL REVIEW THE SUBMITTALS IN ACCORDANCE WITH THE DESIGN INTENT AS REFLECTED WITHIN THE PLAN SET.
 - THE CONTRACTOR IS RESPONSIBLE FOR TRAFFIC CONTROL IN ACCORDANCE WITH MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES, LATEST EDITION.
 - THE CONTRACTOR IS REQUIRED TO PERFORM ALL WORK IN THE PUBLIC RIGHT-OF-WAY IN ACCORDANCE WITH THE APPROPRIATE GOVERNING AUTHORITY AND SHALL BE RESPONSIBLE FOR THE PROCUREMENT OF STREET OPENING PERMITS.
 - THE CONTRACTOR IS REQUIRED TO RETAIN AN OSHA CERTIFIED SAFETY INSPECTOR TO BE PRESENT ON SITE AT ALL TIMES DURING CONSTRUCTION & DEMOLITION ACTIVITIES.
 - SHOULD AN EMPLOYEE OF STONEFIELD ENGINEERING & DESIGN, LLC, BE PRESENT ON SITE AT ANY TIME DURING CONSTRUCTION, IT DOES NOT RELIEVE THE CONTRACTOR OF ANY OF THE RESPONSIBILITIES AND REQUIREMENTS LISTED IN THE NOTES WITHIN THIS PLAN SET.



REVISION	DATE	ISSUE	BY	DESCRIPTION
1	07/20/2024	JRC		SUBMISSION FOR PRE-APPLICATION MEETING
2	08/02/2024	ECM		REVISED PER CITY COMMENTS
3	08/20/2024	RAC		REVISED PER FIRE DEPARTMENT COMMENTS
4	09/03/2024	RAC / ECH		SUBMISSION FOR SITE PLAN APPROVAL
5	10/28/2024	JRC		REVISED PER CITY PLAN REVIEW

NOT APPROVED FOR CONSTRUCTION

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www.stonefielddesign.com

607 Shelby Suite 200, Detroit, MI 48226
Phone 248.247.1115

SITE DEVELOPMENT PLANS

1360 WALTON BLVD

PROPOSED STARBUCKS

PARCEL ID: 15-09-476-030
1360 WALTON BOULEVARD
CITY OF ROCHESTER HILLS
OAKLAND COUNTY, MICHIGAN

J. REID COOKSEY, P.E.
MICHIGAN LICENSE NO. 620105923
LICENSED PROFESSIONAL ENGINEER

STONEFIELD
engineering & design

CITY FILE #21-030 SECTION #9
SCALE: 1" = 20' PROJECT ID: DET-200412

TITLE:
SITE PLAN

DRAWING:
C-3

Traffic Data Collection, LLC

www.tdccounts.com

Phone: 586.786-5407

Traffic Study Performed For:

FIEIS & VANDENBRINK



Project: Rochester Hills Traffic Study
Study: 4 Hr. Video Turning Movement Count
Weather: Cldy, Dry Deg's 40s
Count By Miovision Video VCU 61E NW

File Name : TMC_1 Walton & Rochdale_11-4-21
Site Code : TMC_1
Start Date : 11/4/2021
Page No : 1

4 Hour video traffic study was conducted during typical weekday (Tuesday) from 7:00 AM - 9:00 AM morning & 4:00 PM - 6:00 PM afternoon peak hours, while school was in session & during COVID 19.

Groups Printed- Pass Cars - Single Units - Heavy Trucks - Peds

Start Time	Rochdale Drive Southbound					Walton Blvd. Westbound					Rochdale Drive Northbound					Walton Blvd. Eastbound					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
07:00 AM	7	2	22	0	31	10	180	3	1	194	7	1	2	0	10	1	212	6	0	219	454
07:15 AM	8	0	11	0	19	5	257	3	0	265	6	0	1	1	8	2	247	7	0	256	548
07:30 AM	9	0	9	0	18	5	260	3	0	268	1	1	1	0	3	2	153	1	0	156	445
07:45 AM	8	1	5	0	14	5	230	3	0	238	5	0	2	1	8	7	196	8	0	211	471
Total	32	3	47	0	82	25	927	12	1	965	19	2	6	2	29	12	808	22	0	842	1918
08:00 AM	8	0	10	0	18	9	206	4	0	219	1	1	2	2	6	4	171	12	0	187	430
08:15 AM	4	1	7	0	12	11	187	5	0	203	8	1	1	0	10	3	205	14	0	222	447
08:30 AM	6	0	5	0	11	11	230	2	0	243	6	0	2	0	8	3	169	9	0	181	443
08:45 AM	9	0	19	0	28	12	227	8	0	247	13	3	2	1	19	15	216	8	0	239	533
Total	27	1	41	0	69	43	850	19	0	912	28	5	7	3	43	25	761	43	0	829	1853

*** BREAK ***

04:00 PM	15	2	14	0	31	12	280	3	0	295	9	0	6	0	15	5	297	10	0	312	653
04:15 PM	10	2	18	0	30	16	272	8	0	296	3	1	2	1	7	2	287	14	0	303	636
04:30 PM	6	1	19	0	26	15	280	6	0	301	4	0	4	0	8	2	349	12	0	363	698
04:45 PM	19	0	20	0	39	14	341	9	0	364	8	1	5	2	16	4	368	10	0	382	801
Total	50	5	71	0	126	57	1173	26	0	1256	24	2	17	3	46	13	1301	46	0	1360	2788
05:00 PM	16	0	21	0	37	15	356	12	0	383	19	2	3	0	24	5	343	15	0	363	807
05:15 PM	15	0	17	0	32	21	335	6	0	362	13	2	4	1	20	5	346	18	0	369	783
05:30 PM	10	1	21	0	32	14	283	6	0	303	8	1	1	1	11	5	305	19	0	329	675
05:45 PM	16	1	13	0	30	9	281	9	0	299	6	1	2	2	11	6	301	10	0	317	657
Total	57	2	72	0	131	59	1255	33	0	1347	46	6	10	4	66	21	1295	62	0	1378	2922
Grand Total	166	11	231	0	408	184	4205	90	1	4480	117	15	40	12	184	71	4165	173	0	4409	9481
Apprch %	40.7	2.7	56.6	0		4.1	93.9	2	0		63.6	8.2	21.7	6.5		1.6	94.5	3.9	0		
Total %	1.8	0.1	2.4	0	4.3	1.9	44.4	0.9	0	47.3	1.2	0.2	0.4	0.1	1.9	0.7	43.9	1.8	0	46.5	
Pass Cars	159	11	218	0	388	177	4139	89	0	4405	117	14	39	0	170	71	4092	167	0	4330	9293
% Pass Cars	95.8	100	94.4	0	95.1	96.2	98.4	98.9	0	98.3	100	93.3	97.5	0	92.4	100	98.2	96.5	0	98.2	98
Single Units	7	0	13	0	20	7	58	1	0	66	0	1	1	0	2	0	68	6	0	74	162
% Single Units	4.2	0	5.6	0	4.9	3.8	1.4	1.1	0	1.5	0	6.7	2.5	0	1.1	0	1.6	3.5	0	1.7	1.7
Heavy Trucks	0	0	0	0	0	0	8	0	0	8	0	0	0	0	0	0	5	0	0	5	13
% Heavy Trucks	0	0	0	0	0	0	0.2	0	0	0.2	0	0	0	0	0	0	0.1	0	0	0.1	0.1
Peds	0	0	0	0	0	0	0	0	1	1	0	0	0	12	12	0	0	0	0	0	13
% Peds	0	0	0	0	0	0	0	0	100	0	0	0	0	100	6.5	0	0	0	0	0	0.1

TDC Traffic Comments: SCATS Signalized controlled intersection, ped. signals for north & east legs. Push button for east leg only. Video VCU camera was located within NW intersection quadrant. Note: Peds. are excluded from peak hour reports. Traffic study was performed for Stonefield Engineering, Clty of Rochester Hills Traffic Impact Study for Fleis & Vandenbrink.

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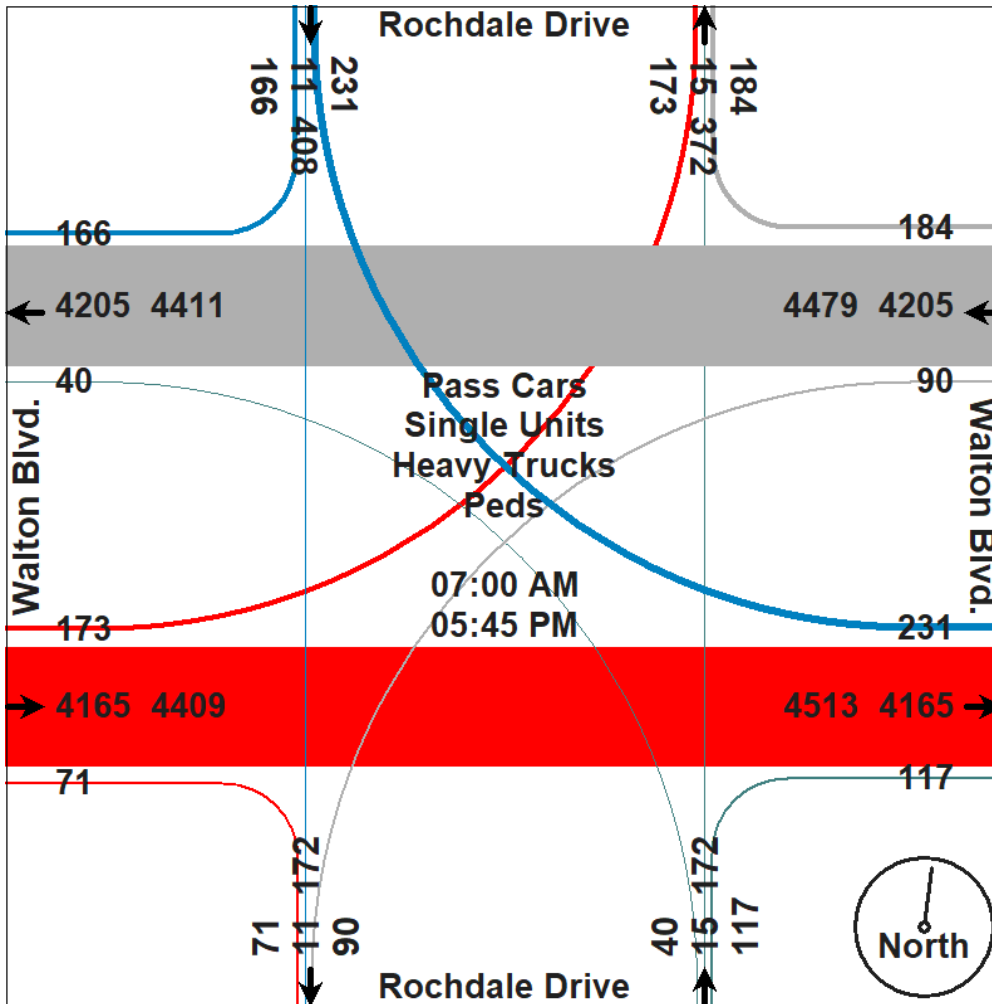
Traffic Study Performed For:

FIEIS & VANDENBRINK



Project: Rochester Hills Traffic Study
Study: 4 Hr. Video Turning Movement Count
Weather: Cldy, Dry Deg's 40s
Count By Miovision Video VCU 61E NW

File Name : TMC_1 Walton & Rochdale_11-4-21
Site Code : TMC_1
Start Date : 11/4/2021
Page No : 2



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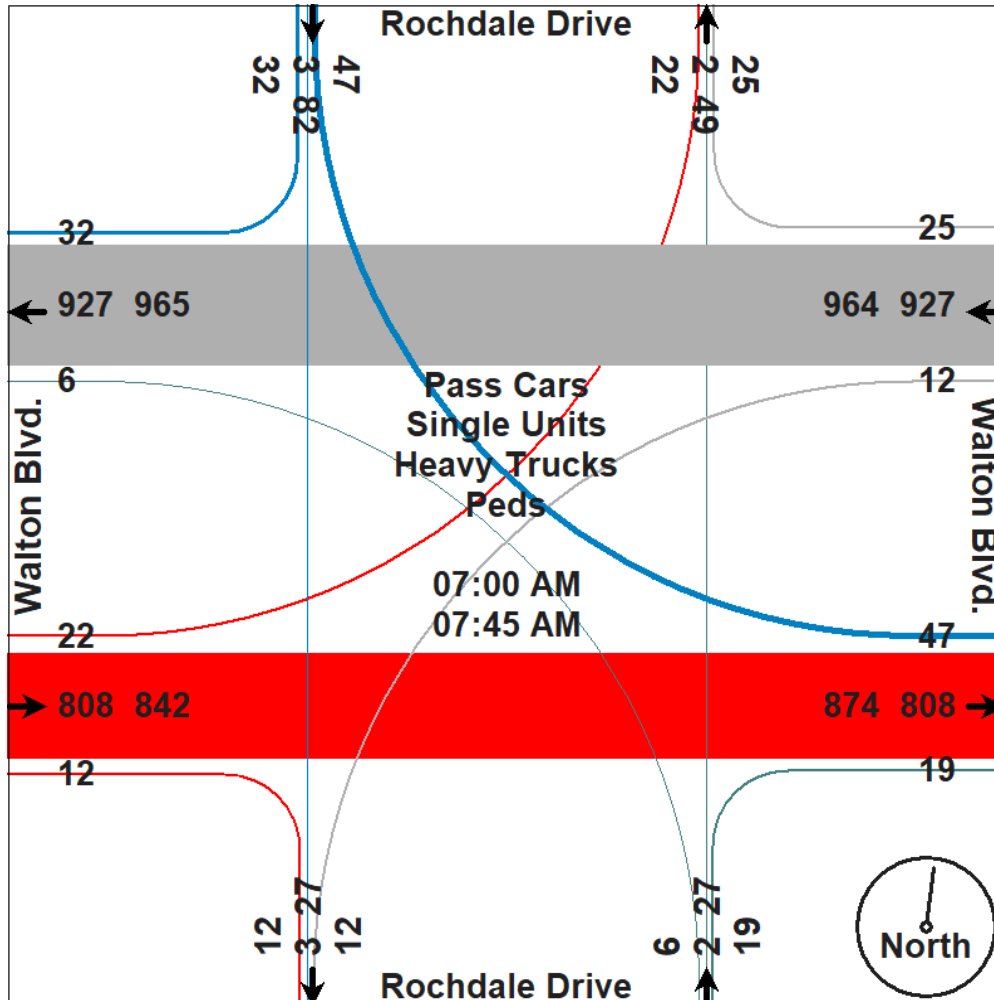
FIEIS & VANDENBRINK



Project: Rochester Hills Traffic Study
 Study: 4 Hr. Video Turning Movement Count
 Weather: Cldy, Dry Deg's 40s
 Count By Miovision Video VCU 61E NW

File Name : TMC_1 Walton & Rochdale_11-4-21
 Site Code : TMC_1
 Start Date : 11/4/2021
 Page No : 3

Start Time	Rochdale Drive Southbound				Walton Blvd. Westbound				Rochdale Drive Northbound				Walton Blvd. Eastbound				Int. Total
	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:00 AM																	
07:00 AM	7	2	22	31	10	180	3	193	7	1	2	10	1	212	6	219	453
07:15 AM	8	0	11	19	5	257	3	265	6	0	1	7	2	247	7	256	547
07:30 AM	9	0	9	18	5	260	3	268	1	1	1	3	2	153	1	156	445
07:45 AM	8	1	5	14	5	230	3	238	5	0	2	7	7	196	8	211	470
Total Volume	32	3	47	82	25	927	12	964	19	2	6	27	12	808	22	842	1915
% App. Total	39	3.7	57.3		2.6	96.2	1.2		70.4	7.4	22.2		1.4	96	2.6		
PHF	.889	.375	.534	.661	.625	.891	1.00	.899	.679	.500	.750	.675	.429	.818	.688	.822	.875
Pass Cars	31	3	45	79	25	906	11	942	19	2	6	27	12	793	21	826	1874
% Pass Cars	96.9	100	95.7	96.3	100	97.7	91.7	97.7	100	100	100	100	100	98.1	95.5	98.1	97.9
Single Units	1	0	2	3	0	15	1	16	0	0	0	0	0	15	1	16	35
% Single Units	3.1	0	4.3	3.7	0	1.6	8.3	1.7	0	0	0	0	0	1.9	4.5	1.9	1.8
Heavy Trucks	0	0	0	0	0	6	0	6	0	0	0	0	0	0	0	0	6
% Heavy Trucks	0	0	0	0	0	0.6	0	0.6	0	0	0	0	0	0	0	0	0.3
Peds	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Peds	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



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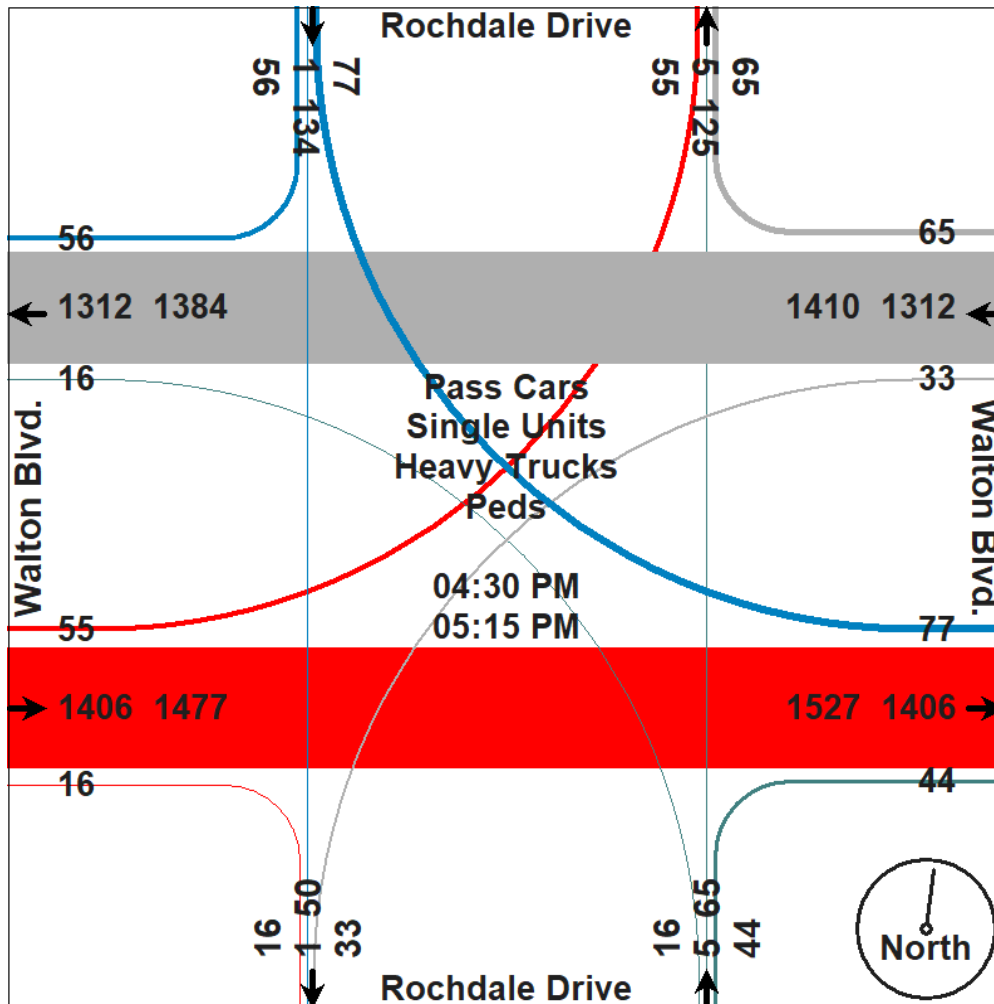
FIEIS & VANDENBRINK



Project: Rochester Hills Traffic Study
 Study: 4 Hr. Video Turning Movement Count
 Weather: Cldy, Dry Deg's 40s
 Count By Miovision Video VCU 61E NW

File Name : TMC_1 Walton & Rochdale_11-4-21
 Site Code : TMC_1
 Start Date : 11/4/2021
 Page No : 4

Start Time	Rochdale Drive Southbound				Walton Blvd. Westbound				Rochdale Drive Northbound				Walton Blvd. Eastbound				Int. Total
	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:30 PM																	
04:30 PM	6	1	19	26	15	280	6	301	4	0	4	8	2	349	12	363	698
04:45 PM	19	0	20	39	14	341	9	364	8	1	5	14	4	368	10	382	799
05:00 PM	16	0	21	37	15	356	12	383	19	2	3	24	5	343	15	363	807
05:15 PM	15	0	17	32	21	335	6	362	13	2	4	19	5	346	18	369	782
Total Volume	56	1	77	134	65	1312	33	1410	44	5	16	65	16	1406	55	1477	3086
% App. Total	41.8	0.7	57.5		4.6	93	2.3		67.7	7.7	24.6		1.1	95.2	3.7		
PHF	.737	.250	.917	.859	.774	.921	.688	.920	.579	.625	.800	.677	.800	.955	.764	.967	.956
Pass Cars	53	1	75	129	65	1305	33	1403	44	5	16	65	16	1387	55	1458	3055
% Pass Cars	94.6	100	97.4	96.3	100	99.5	100	99.5	100	100	100	100	100	98.6	100	98.7	99.0
Single Units	3	0	2	5	0	6	0	6	0	0	0	0	0	18	0	18	29
% Single Units	5.4	0	2.6	3.7	0	0.5	0	0.4	0	0	0	0	0	1.3	0	1.2	0.9
Heavy Trucks	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	1	2
% Heavy Trucks	0	0	0	0	0	0.1	0	0.1	0	0	0	0	0	0.1	0	0.1	0.1
Peds	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Peds	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



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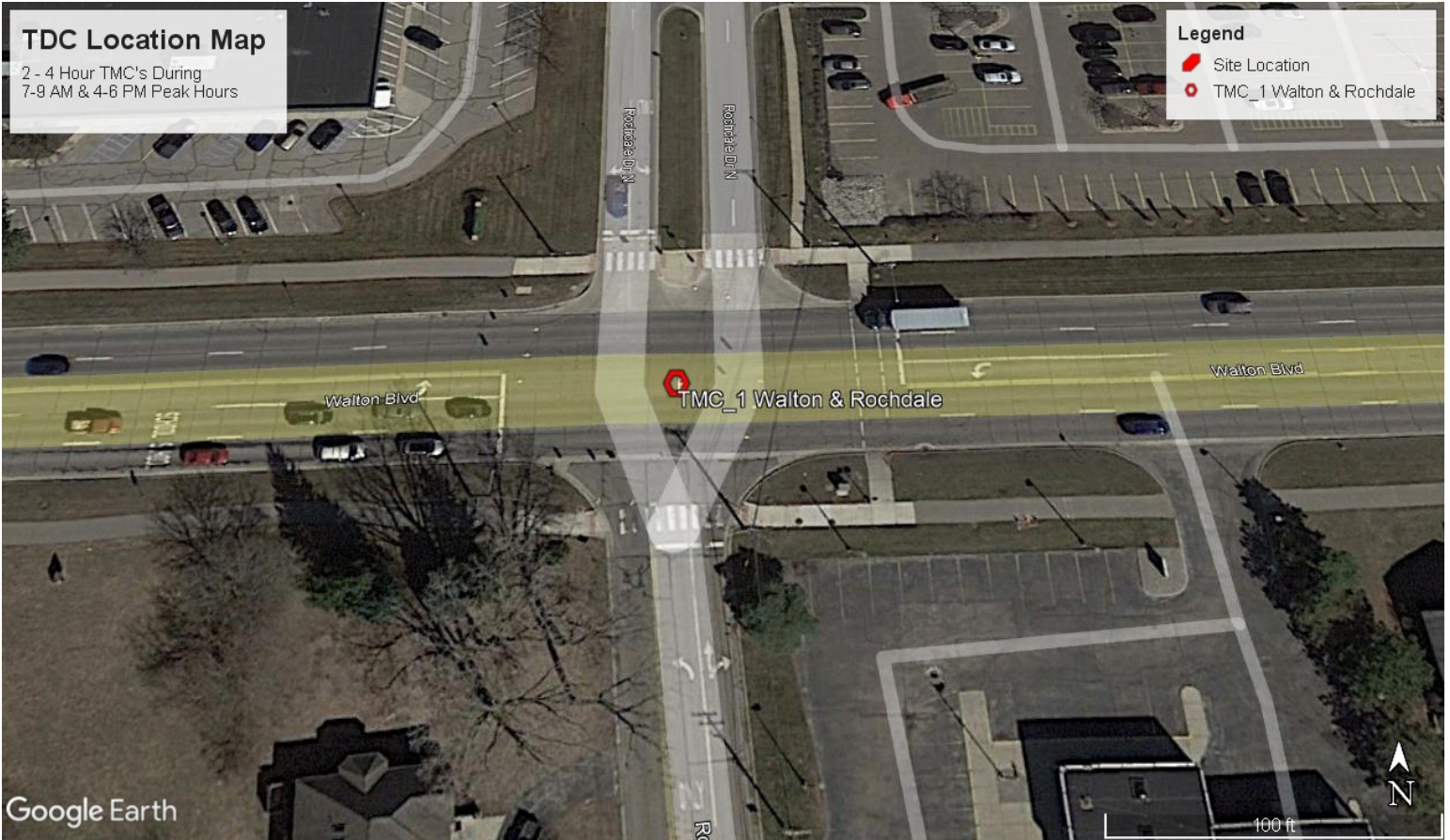
FIEIS & VANDENBRINK



Project: Rochester Hills Traffic Study
Study: 4 Hr. Video Turning Movement Count
Weather: Cldy, Dry Deg's 40s
Count By: Miovision Video VCU 61E NW

File Name : TMC_1 Walton & Rochdale_11-4-21
Site Code : TMC_1
Start Date : 11/4/2021
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Aerial Photo



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Traffic Study Performed For:

FIEIS & VANDENBRINK



Project: Rochester Hills Traffic Study
Study: 4 Hr. Video Turning Movement Count
Weather: Cldy, Dry Deg's 40s
Count By Miovision Video VCU 9HT & 61A

File Name : TMC_2 Walton & Livernois_11-4-21
Site Code : TMC_2
Start Date : 11/4/2021
Page No : 1

4 Hour video traffic study was conducted during typical weekday (Tuesday) from 7:00 AM - 9:00 AM morning & 4:00 PM - 6:00 PM afternoon peak hours, while school was in session & during COVID 19.

Groups Printed- Pass Cars - Single Units - Heavy Trucks - Peds

Start Time	Livernois Road Southbound					Walton Blvd. Westbound					Livernois Road Northbound					Walton Blvd. Eastbound					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
07:00 AM	43	134	0	0	177	22	133	0	0	155	18	57	53	0	128	106	91	0	0	197	657
07:15 AM	36	211	0	0	247	49	186	0	1	236	17	94	79	2	192	127	123	0	0	250	925
07:30 AM	31	154	0	0	185	12	183	0	0	195	23	69	54	0	146	60	114	0	0	174	700
07:45 AM	32	185	0	0	217	33	184	0	1	218	33	53	45	0	131	51	160	0	0	211	777
Total	142	684	0	0	826	116	686	0	2	804	91	273	231	2	597	344	488	0	0	832	3059
08:00 AM	21	171	0	0	192	21	124	0	1	146	41	63	65	1	170	41	141	0	0	182	690
08:15 AM	25	169	0	0	194	26	137	0	1	164	51	71	56	0	178	53	164	0	0	217	753
08:30 AM	27	157	0	0	184	29	170	0	0	199	42	88	48	0	178	51	133	0	0	184	745
08:45 AM	25	169	0	0	194	37	169	0	0	206	31	74	60	0	165	88	176	0	0	264	829
Total	98	666	0	0	764	113	600	0	2	715	165	296	229	1	691	233	614	0	0	847	3017
*** BREAK ***																					
04:00 PM	5	125	0	0	130	36	190	0	0	226	64	175	80	0	319	62	227	0	0	289	964
04:15 PM	7	137	0	0	144	50	194	0	0	244	59	203	83	1	346	71	250	1	0	322	1056
04:30 PM	7	161	0	1	169	33	191	0	0	224	65	166	89	1	321	68	232	0	2	302	1016
04:45 PM	12	160	0	0	172	47	221	0	1	269	79	165	101	0	345	93	254	0	0	347	1133
Total	31	583	0	1	615	166	796	0	1	963	267	709	353	2	1331	294	963	1	2	1260	4169
05:00 PM	30	145	0	0	175	37	257	0	0	294	86	190	98	0	374	79	297	0	0	376	1219
05:15 PM	25	148	0	0	173	47	220	0	1	268	95	179	95	0	369	78	261	0	0	339	1149
05:30 PM	31	131	0	0	162	41	193	0	1	235	58	184	79	0	321	84	273	0	0	357	1075
05:45 PM	25	134	0	2	161	45	200	0	0	245	79	171	83	0	333	77	261	0	1	339	1078
Total	111	558	0	2	671	170	870	0	2	1042	318	724	355	0	1397	318	1092	0	1	1411	4521
Grand Total	382	2491	0	3	2876	565	2952	0	7	3524	841	2002	1168	5	4016	1189	3157	1	3	4350	14766
Apprch %	13.3	86.6	0	0.1		16	83.8	0	0.2		20.9	49.9	29.1	0.1		27.3	72.6	0	0.1		
Total %	2.6	16.9	0	0	19.5	3.8	20	0	0	23.9	5.7	13.6	7.9	0	27.2	8.1	21.4	0	0	29.5	
Pass Cars	376	2416	0	0	2792	545	2914	0	0	3459	826	1960	1143	0	3929	1138	3119	0	0	4257	14437
% Pass Cars	98.4	97	0	0	97.1	96.5	98.7	0	0	98.2	98.2	97.9	97.9	0	97.8	95.7	98.8	0	0	97.9	97.8
Single Units	6	72	0	0	78	17	31	0	0	48	11	38	21	0	70	48	32	1	0	81	277
% Single Units	1.6	2.9	0	0	2.7	3	1.1	0	0	1.4	1.3	1.9	1.8	0	1.7	4	1	100	0	1.9	1.9
Heavy Trucks	0	3	0	0	3	3	7	0	0	10	4	4	4	0	12	3	6	0	0	9	34
% Heavy Trucks	0	0.1	0	0	0.1	0.5	0.2	0	0	0.3	0.5	0.2	0.3	0	0.3	0.3	0.2	0	0	0.2	0.2
Peds	0	0	0	3	3	0	0	0	7	7	0	0	0	5	5	0	0	0	3	3	18
% Peds	0	0	0	100	0.1	0	0	0	100	0.2	0	0	0	100	0.1	0	0	0	100	0.1	0.1

TDC Traffic Comments: SCATS signalized controlled intersection, push button ped. signals for all quadrants. Restricted NTOR signed for approach legs. Left turns prohibited for SB, EB & WB approach legs. Livernois is divided roadway, north of Walton Blvd. Video VCU cameras were located within SW & NE intersection quadrants. Note: Peds. are excluded from peak hour reports. Traffic study was performed for Stonefield Engineering, Clty of Rochester Hills Traffic Impact Study for Fleis & Vandenbrink.

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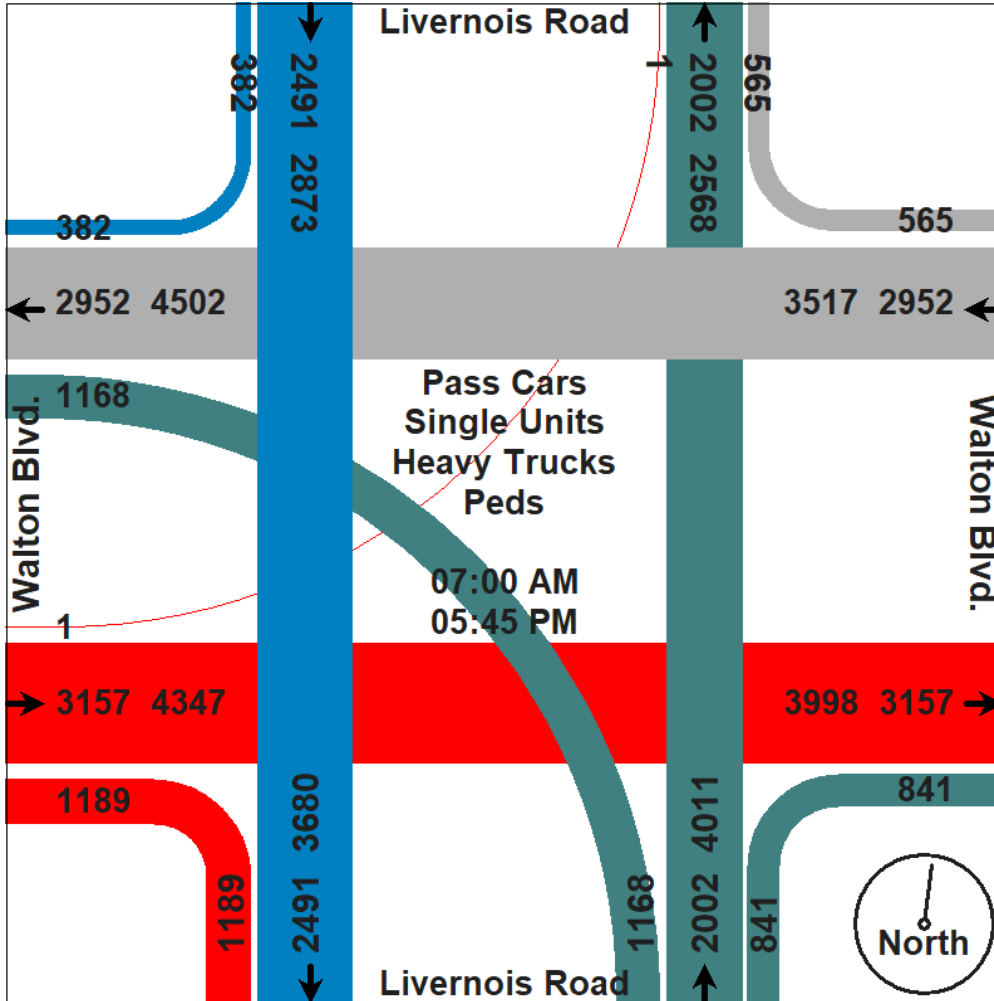
Traffic Study Performed For:

FIEIS & VANDENBRINK



Project: Rochester Hills Traffic Study
Study: 4 Hr. Video Turning Movement Count
Weather: Cldy, Dry Deg's 40s
Count By Miovision Video VCU 9HT & 61A

File Name : TMC_2 Walton & Livernois_11-4-21
Site Code : TMC_2
Start Date : 11/4/2021
Page No : 2



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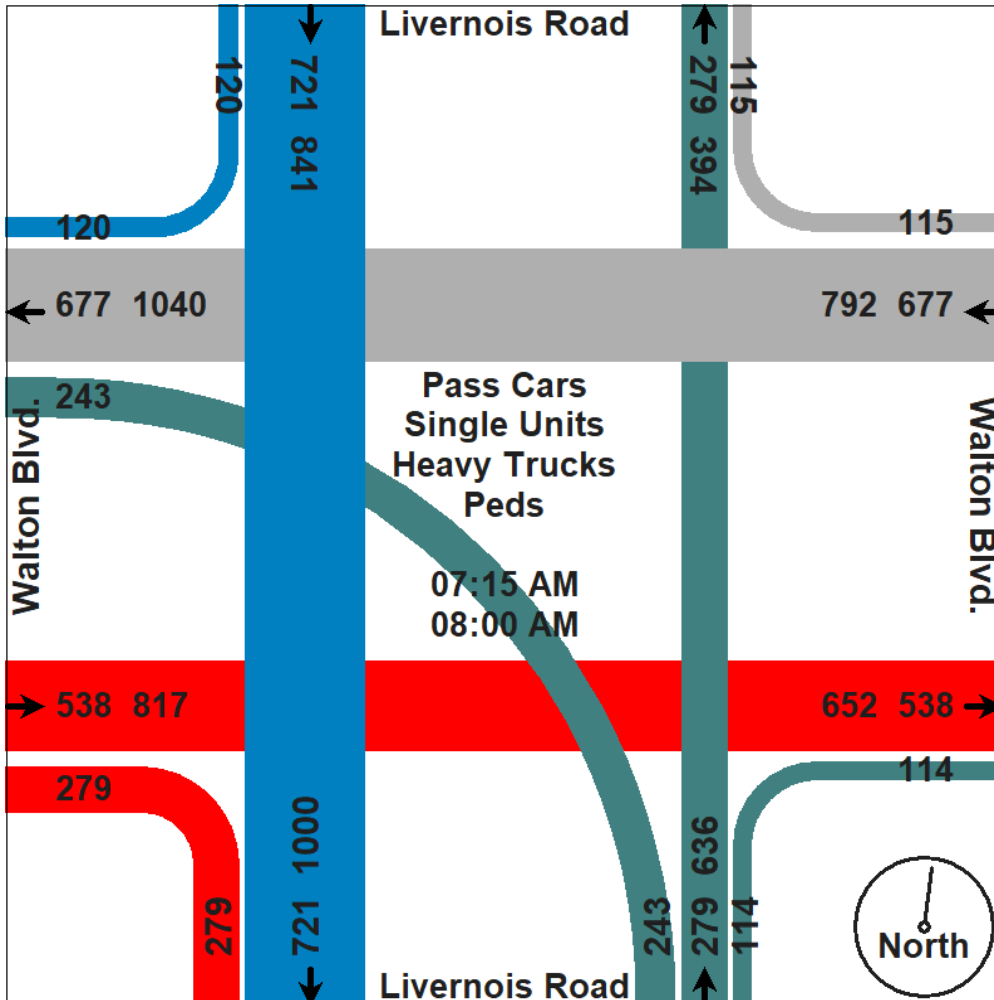
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 Weather: Cldy, Dry Deg's 40s
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File Name : TMC_2 Walton & Livernois_11-4-21
 Site Code : TMC_2
 Start Date : 11/4/2021
 Page No : 3

Start Time	Livernois Road Southbound				Walton Blvd. Westbound				Livernois Road Northbound				Walton Blvd. Eastbound				Int. Total
	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:15 AM																	
07:15 AM	36	211	0	247	49	186	0	235	17	94	79	190	127	123	0	250	922
07:30 AM	31	154	0	185	12	183	0	195	23	69	54	146	60	114	0	174	700
07:45 AM	32	185	0	217	33	184	0	217	33	53	45	131	51	160	0	211	776
08:00 AM	21	171	0	192	21	124	0	145	41	63	65	169	41	141	0	182	688
Total Volume	120	721	0	841	115	677	0	792	114	279	243	636	279	538	0	817	3086
% App. Total	14.3	85.7	0		14.5	85.5	0		17.9	43.9	38.2		34.1	65.9	0		
PHF	.833	.854	.000	.851	.587	.910	.000	.843	.695	.742	.769	.837	.549	.841	.000	.817	.837
Pass Cars	119	716	0	835	111	662	0	773	112	267	233	612	267	526	0	793	3013
% Pass Cars	99.2	99.3	0	99.3	96.5	97.8	0	97.6	98.2	95.7	95.9	96.2	95.7	97.8	0	97.1	97.6
Single Units	1	5	0	6	2	10	0	12	1	10	8	19	11	10	0	21	58
% Single Units	0.8	0.7	0	0.7	1.7	1.5	0	1.5	0.9	3.6	3.3	3.0	3.9	1.9	0	2.6	1.9
Heavy Trucks	0	0	0	0	2	5	0	7	1	2	2	5	1	2	0	3	15
% Heavy Trucks	0	0	0	0	1.7	0.7	0	0.9	0.9	0.7	0.8	0.8	0.4	0.4	0	0.4	0.5
Peds	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Peds	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



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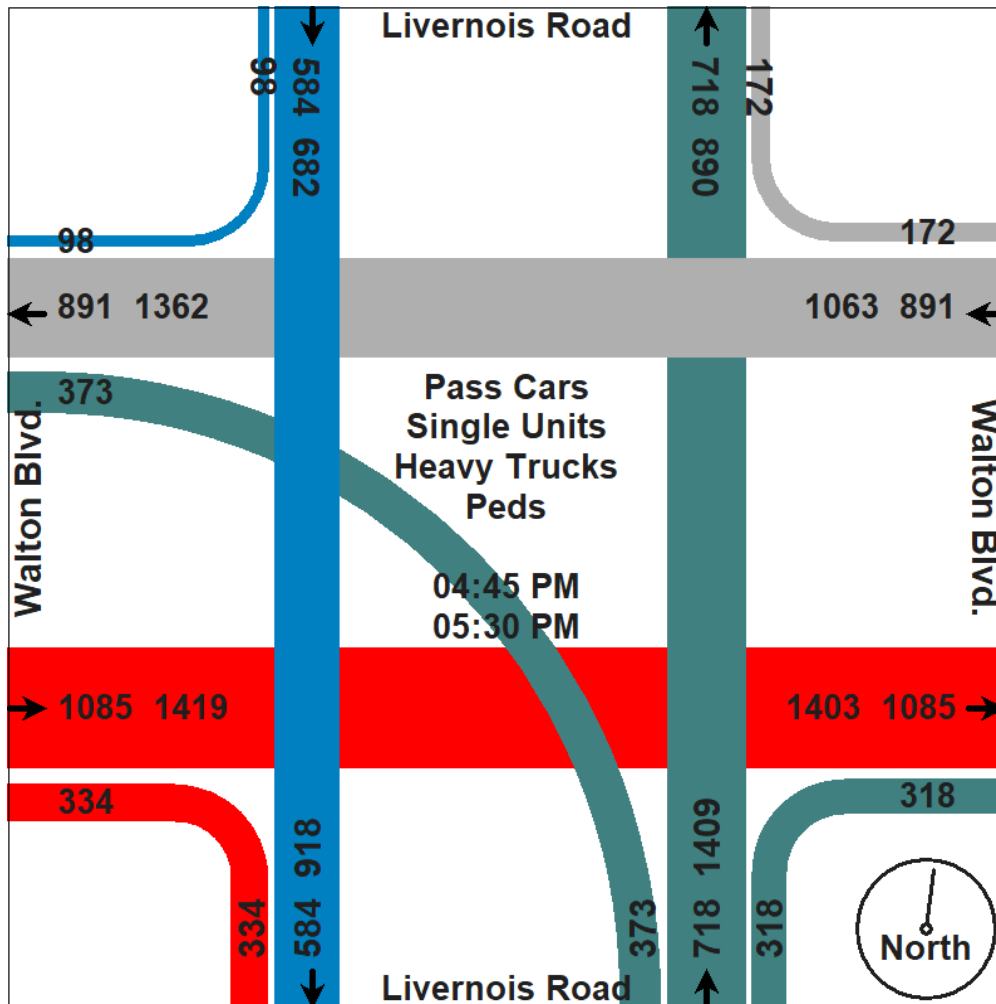
FIEIS & VANDENBRINK



Project: Rochester Hills Traffic Study
Study: 4 Hr. Video Turning Movement Count
Weather: Cldy, Dry Deg's 40s
Count By Miovision Video VCU 9HT & 61A

File Name : TMC_2 Walton & Livernois_11-4-21
Site Code : TMC_2
Start Date : 11/4/2021
Page No : 4

Start Time	Livernois Road Southbound				Walton Blvd. Westbound				Livernois Road Northbound				Walton Blvd. Eastbound				Int. Total
	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:45 PM																	
04:45 PM	12	160	0	172	47	221	0	268	79	165	101	345	93	254	0	347	1132
05:00 PM	30	145	0	175	37	257	0	294	86	190	98	374	79	297	0	376	1219
05:15 PM	25	148	0	173	47	220	0	267	95	179	95	369	78	261	0	339	1148
05:30 PM	31	131	0	162	41	193	0	234	58	184	79	321	84	273	0	357	1074
Total Volume	98	584	0	682	172	891	0	1063	318	718	373	1409	334	1085	0	1419	4573
% App. Total	14.4	85.6	0		16.2	83.8	0		22.6	51	26.5		23.5	76.5	0		
PHF	.790	.913	.000	.974	.915	.867	.000	.904	.837	.945	.923	.942	.898	.913	.000	.943	.938
Pass Cars	98	578	0	676	171	886	0	1057	317	712	369	1398	331	1079	0	1410	4541
% Pass Cars	100	99.0	0	99.1	99.4	99.4	0	99.4	99.7	99.2	98.9	99.2	99.1	99.4	0	99.4	99.3
Single Units	0	6	0	6	1	4	0	5	1	6	4	11	3	5	0	8	30
% Single Units	0	1.0	0	0.9	0.6	0.4	0	0.5	0.3	0.8	1.1	0.8	0.9	0.5	0	0.6	0.7
Heavy Trucks	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	1	2
% Heavy Trucks	0	0	0	0	0	0.1	0	0.1	0	0	0	0	0	0.1	0	0.1	0.0
Peds	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Peds	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



Fleis & VandenBrink Engineering, Inc.

27725 Stansbury Boulevard, Suite 195

Farmington Hills, MI 48334

Project: Starbucks TIS

Weather: Dusk AM 40's Cloudy PM 50's

Location: Walton Blvd & Rochester HS Dri

File Name : Walton & HS Drive

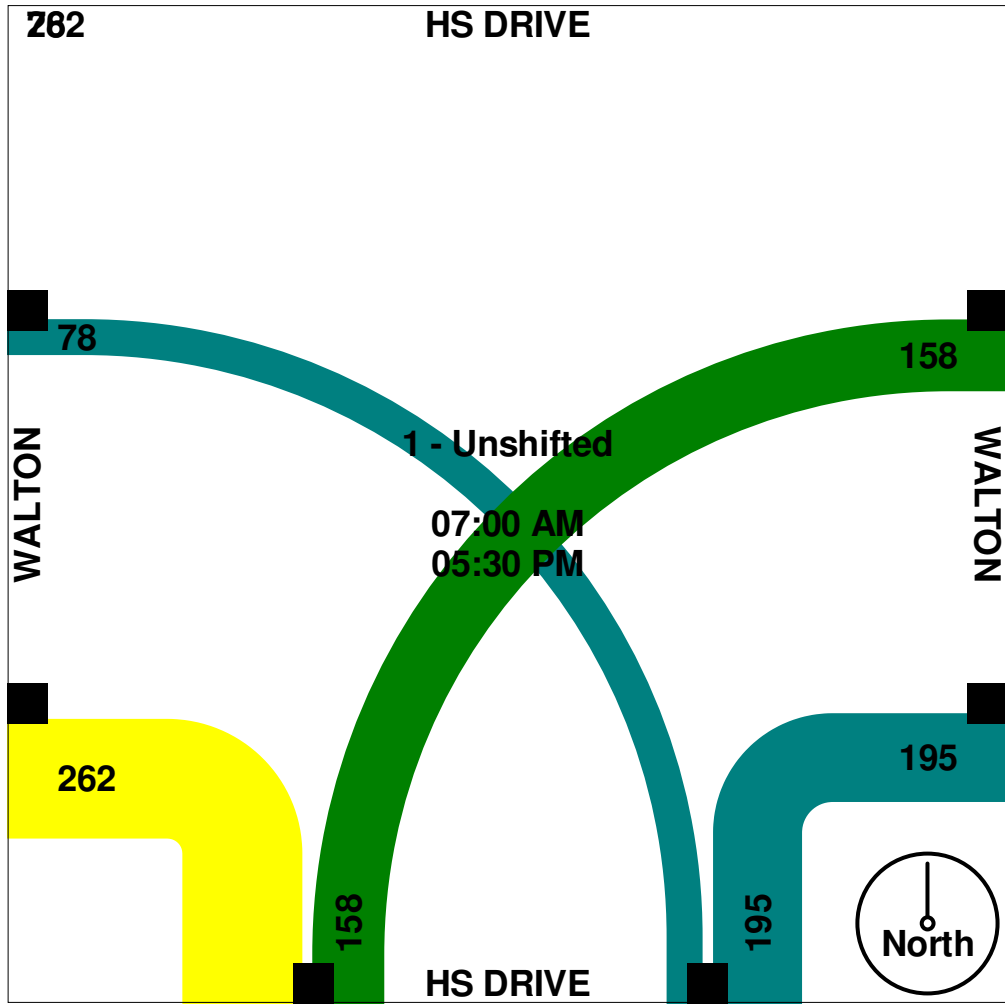
Site Code : 00000000

Start Date : 11/9/2021

Page No : 1

Groups Printed- Unshifted

Start Time	HS DRIVE Southbound			WALTON Westbound			HS DRIVE Northbound			WALTON Eastbound			Int. Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:00 AM	0	0	0	50	0	0	18	0	65	0	0	94	227
07:15 AM	0	0	0	47	0	0	22	0	84	0	0	63	216
07:30 AM	0	0	0	11	0	0	13	0	15	0	0	16	55
07:45 AM	0	0	0	5	0	0	0	0	2	0	0	4	11
Total	0	0	0	113	0	0	53	0	166	0	0	177	509
08:00 AM	0	0	0	3	0	0	0	0	3	0	0	2	8
08:15 AM	0	0	0	2	0	0	1	0	1	0	0	3	7
08:30 AM	0	0	0	3	0	0	2	0	5	0	0	4	14
08:45 AM	0	0	0	2	0	0	1	0	1	0	0	5	9
Total	0	0	0	10	0	0	4	0	10	0	0	14	38
*** BREAK ***													
03:45 PM	0	0	0	3	0	0	1	0	3	0	0	2	9
Total	0	0	0	3	0	0	1	0	3	0	0	2	9
04:00 PM	0	0	0	2	0	0	3	0	2	0	0	2	9
04:15 PM	0	0	0	5	0	0	3	0	2	0	0	5	15
04:30 PM	0	0	0	7	0	0	3	0	3	0	0	19	32
04:45 PM	0	0	0	4	0	0	4	0	5	0	0	8	21
Total	0	0	0	18	0	0	13	0	12	0	0	34	77
05:00 PM	0	0	0	2	0	0	1	0	2	0	0	7	12
05:15 PM	0	0	0	5	0	0	5	0	2	0	0	12	24
05:30 PM	0	0	0	7	0	0	1	0	0	0	0	16	24
Grand Total	0	0	0	158	0	0	78	0	195	0	0	262	693
Apprch %	0.0	0.0	0.0	100.0	0.0	0.0	28.6	0.0	71.4	0.0	0.0	100.0	
Total %	0.0	0.0	0.0	22.8	0.0	0.0	11.3	0.0	28.1	0.0	0.0	37.8	



Fleis & VandenBrink Engineering, Inc.

27725 Stansbury Boulevard, Suite 195

Farmington Hills, MI 48334

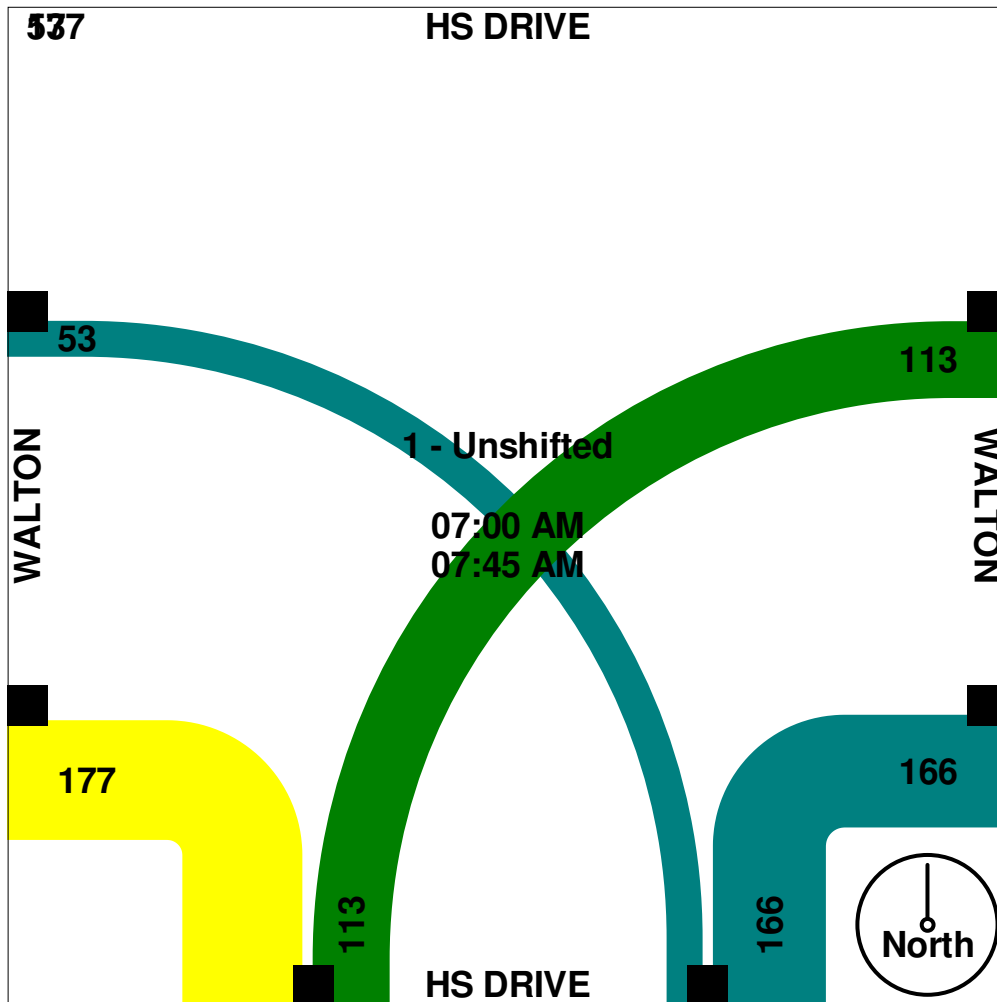
File Name : Walton & HS Drive

Site Code : 00000000

Start Date : 11/9/2021

Page No : 3

Start Time	HS DRIVE Southbound				WALTON Westbound				HS DRIVE Northbound				WALTON Eastbound				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour From	07:00 AM to 11:45 AM - Peak 1 of 1																
Intersection	07:00 AM																
Volume	0	0	0	0	113	0	0	113	53	0	166	219	0	0	177	177	509
Percent	0.0	0.0	0.0	0	100.0	0.0	0.0	113	24.2	0.0	75.8	219	0.0	0.0	100.0	177	227
07:00 Volume	0	0	0	0	50	0	0	50	18	0	65	83	0	0	94	94	227
Peak Factor	0.561																
High Int.	6:45:00 AM				07:00 AM				07:15 AM				07:00 AM				
Volume	0	0	0	0	50	0	0	50	22	0	84	106	0	0	94	94	94
Peak Factor					0.565				0.517				0.471				



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27725 Stansbury Boulevard, Suite 195

Farmington Hills, MI 48334

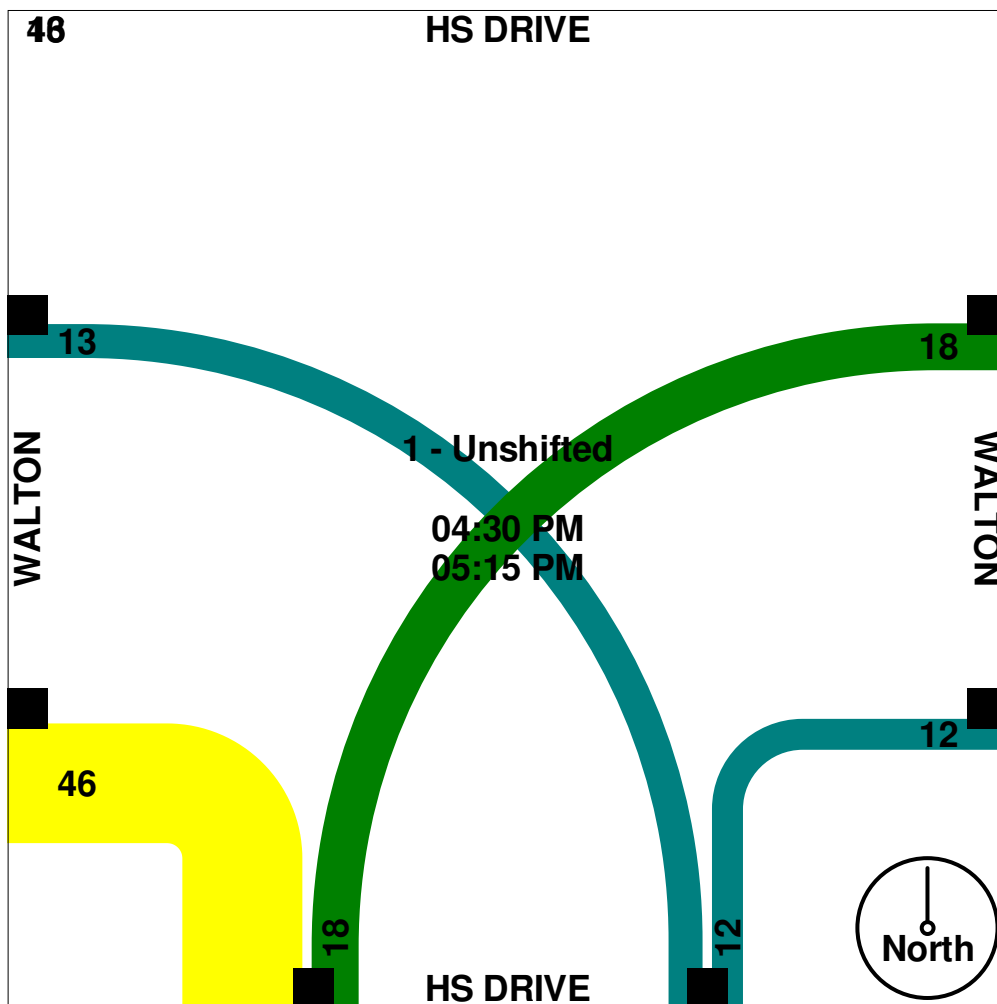
File Name : Walton & HS Drive

Site Code : 00000000

Start Date : 11/9/2021

Page No : 4

Start Time	HS DRIVE Southbound				WALTON Westbound				HS DRIVE Northbound				WALTON Eastbound				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour From 12:00 PM to 05:30 PM - Peak 1 of 1																	
Intersection	04:30 PM																
Volume	0	0	0	0	18	0	0	18	13	0	12	25	0	0	46	46	89
Percent	0.0	0.0	0.0	0.0	100.0	0.0	0.0	100.0	52.0	0.0	48.0	100.0	0.0	0.0	100.0	100.0	
04:30 Volume	0	0	0	0	7	0	0	7	3	0	3	6	0	0	19	19	32
Peak Factor	0.695																
High Int.	04:30 PM																
Volume	0	0	0	0	7	0	0	7	4	0	5	9	0	0	19	19	
Peak Factor					0.643				0.694				0.605				





Volume Count Report

LOCATION INFO	
Location ID	122_NB
Type	SPOT
Funct'l Class	-
Located On	LIVERNOS
SOUTH OF	WALTON BLVD
Direction	NB
County	Oakland
Community	-
MPO ID	
HPMS ID	
Agency	Oakland County - SCATS

INTERVAL:15-MIN					
Time	15-min Interval				Hourly Count
	1st	2nd	3rd	4th	
0:00-1:00	18	21	13	9	61
1:00-2:00	8	7	6	10	31
2:00-3:00	12	5	4	16	37
3:00-4:00	4	6	9	6	25
4:00-5:00	5	7	9	13	34
5:00-6:00	4	18	18	31	71
6:00-7:00	54	88	84	105	331
7:00-8:00	114	171	127	160	572
8:00-9:00	159	191	153	178	681
9:00-10:00	178	170	190	189	727
10:00-11:00	160	180	198	219	757
11:00-12:00	188	223	237	279	927
12:00-13:00	275	229	216	271	991
13:00-14:00	237	234	225	261	957
14:00-15:00	255	240	296	300	1,091
15:00-16:00	297	303	329	338	1,267
16:00-17:00	324	341	351	365	1,381
17:00-18:00	359	326	350	340	1,375
18:00-19:00	364	289	323	304	1,280
19:00-20:00	229	242	223	214	908
20:00-21:00	200	183	149	149	681
21:00-22:00	128	125	102	87	442
22:00-23:00	82	47	48	48	225
23:00-24:00	35	33	36	17	121
Total					14,973
AADT					
AM Peak					11:30-12:30 1,020
PM Peak					16:15-17:15 1,416

COUNT DATA INFO	
Count Status	Accepted
Start Date	Tue 10/9/2018
End Date	Wed 10/10/2018
Start Time	12:00:00 AM
End Time	12:00:00 AM
Direction	NB
Notes	
Station	122
Study	
Speed Limit	
Description	
Sensor Type	
Source	CombineVolumeCountsIncremental
Latitude,Longitude	



Volume Count Report

LOCATION INFO	
Location ID	122_SB
Type	SPOT
Funct'l Class	-
Located On	LIVERNOS
NORTH OF	WALTON BLVD
Direction	SB
County	Oakland
Community	-
MPO ID	
HPMS ID	
Agency	Oakland County - SCATS

INTERVAL:15-MIN						
Time	15-min Interval				Hourly Count	
	1st	2nd	3rd	4th		
0:00-1:00	6	7	6	7	26	
1:00-2:00	7	7	6	4	24	
2:00-3:00	5	5	0	5	15	
3:00-4:00	4	6	4	11	25	
4:00-5:00	6	5	11	29	51	
5:00-6:00	26	64	66	95	251	
6:00-7:00	103	150	176	235	664	
7:00-8:00	166	116	246	257	785	
8:00-9:00	241	262	255	324	1,082	
9:00-10:00	246	184	156	185	771	
10:00-11:00	136	138	122	168	564	
11:00-12:00	158	133	140	146	577	
12:00-13:00	153	179	162	156	650	
13:00-14:00	156	134	160	167	617	
14:00-15:00	127	150	153	155	585	
15:00-16:00	149	135	141	167	592	
16:00-17:00	164	175	157	142	638	
17:00-18:00	148	129	140	135	552	
18:00-19:00	164	176	132	120	592	
19:00-20:00	118	108	102	110	438	
20:00-21:00	70	82	74	47	273	
21:00-22:00	68	70	65	33	236	
22:00-23:00	41	28	22	19	110	
23:00-24:00	21	18	12	11	62	
Total					10,180	
AADT						
AM Peak					08:15-09:15 1,087	
PM Peak					15:45-16:45 663	

COUNT DATA INFO	
Count Status	Accepted
Start Date	Tue 10/9/2018
End Date	Wed 10/10/2018
Start Time	12:00:00 AM
End Time	12:00:00 AM
Direction	SB
Notes	
Station	122
Study	
Speed Limit	
Description	
Sensor Type	
Source	CombineVolumeCountsIncremental
Latitude,Longitude	



Volume Count Report

LOCATION INFO	
Location ID	379_NB
Type	SPOT
Funct'l Class	-
Located On	ROCHDALE
SOUTH OF	WALTON BLVD
Direction	NB
County	Oakland
Community	-
MPO ID	
HPMS ID	
Agency	Oakland County - SCATS

INTERVAL:15-MIN					
Time	15-min Interval				Hourly Count
	1st	2nd	3rd	4th	
▶ 0:00-1:00	2	3	1	3	9
1:00-2:00	1	2	2	1	6
2:00-3:00	2	1	1	0	4
3:00-4:00	0	0	2	0	2
4:00-5:00	0	1	0	1	2
5:00-6:00	1	2	3	2	8
6:00-7:00	5	7	13	12	37
7:00-8:00	14	3	1	10	28
8:00-9:00	7	9	2	13	31
9:00-10:00	9	10	8	7	34
10:00-11:00	4	10	4	9	27
11:00-12:00	9	13	5	12	39
12:00-13:00	5	7	4	5	21
13:00-14:00	12	9	5	8	34
14:00-15:00	8	5	4	10	27
15:00-16:00	8	11	4	8	31
16:00-17:00	7	4	5	8	24
17:00-18:00	7	7	2	6	22
18:00-19:00	6	4	3	3	16
19:00-20:00	5	25	87	67	184
20:00-21:00	53	51	38	41	183
21:00-22:00	45	37	32	24	138
22:00-23:00	23	17	11	10	61
23:00-24:00	11	9	6	6	32
Total					1,000
AADT					
AM Peak					06:15-07:15 46
PM Peak					19:30-20:30 258

COUNT DATA INFO	
Count Status	Accepted
Start Date	Tue 10/9/2018
End Date	Wed 10/10/2018
Start Time	12:00:00 AM
End Time	12:00:00 AM
Direction	NB
Notes	
Station	379
Study	
Speed Limit	
Description	
Sensor Type	
Source	CombineVolumeCountsIncremental
Latitude,Longitude	



Volume Count Report

LOCATION INFO	
Location ID	379_SB
Type	SPOT
Funct'l Class	-
Located On	ROCHDALE
NORTH OF	WALTON BLVD
Direction	SB
County	Oakland
Community	-
MPO ID	
HPMS ID	
Agency	Oakland County - SCATS

INTERVAL:15-MIN					
Time	15-min Interval				Hourly Count
	1st	2nd	3rd	4th	
▶ 0:00-1:00	0	0	0	0	0
1:00-2:00	0	0	0	0	0
2:00-3:00	0	0	0	0	0
3:00-4:00	0	0	0	0	0
4:00-5:00	0	1	0	2	3
5:00-6:00	0	1	1	4	6
6:00-7:00	9	2	9	20	40
7:00-8:00	11	22	17	16	66
8:00-9:00	23	20	14	13	70
9:00-10:00	14	14	20	18	66
10:00-11:00	23	15	18	21	77
11:00-12:00	22	22	21	16	81
12:00-13:00	28	18	19	21	86
13:00-14:00	18	17	13	12	60
14:00-15:00	9	17	23	13	62
15:00-16:00	22	15	15	10	62
16:00-17:00	15	19	22	14	70
17:00-18:00	19	17	21	13	70
18:00-19:00	16	14	16	15	61
19:00-20:00	9	9	9	12	39
20:00-21:00	7	5	9	4	25
21:00-22:00	7	3	2	2	14
22:00-23:00	0	1	1	1	3
23:00-24:00	0	3	0	0	3
Total					964
AADT					
AM Peak					11:15-12:15 87
PM Peak					12:00-13:00 86

COUNT DATA INFO	
Count Status	Accepted
Start Date	Tue 10/9/2018
End Date	Wed 10/10/2018
Start Time	12:00:00 AM
End Time	12:00:00 AM
Direction	SB
Notes	
Station	379
Study	
Speed Limit	
Description	
Sensor Type	
Source	CombineVolumeCountsIncremental
Latitude,Longitude	



Volume Count Report

LOCATION INFO	
Location ID	122_EB
Type	SPOT
Funct'l Class	-
Located On	WALTON BLVD
WEST OF	LIVERNOIS
Direction	EB
County	Oakland
Community	-
MPO ID	
HPMS ID	
Agency	Oakland County - SCATS

INTERVAL:15-MIN						
Time	15-min Interval				Hourly Count	
	1st	2nd	3rd	4th		
▶ 0:00-1:00	20	15	7	6	48	
1:00-2:00	9	8	7	8	32	
2:00-3:00	8	5	5	6	24	
3:00-4:00	6	3	7	7	23	
4:00-5:00	5	11	10	24	50	
5:00-6:00	21	32	38	57	148	
6:00-7:00	56	71	100	133	360	
7:00-8:00	167	203	191	158	719	
8:00-9:00	212	217	164	227	820	
9:00-10:00	211	189	210	210	820	
10:00-11:00	179	185	178	196	738	
11:00-12:00	214	222	266	241	943	
12:00-13:00	238	254	203	240	935	
13:00-14:00	224	203	241	226	894	
14:00-15:00	221	246	296	356	1,119	
15:00-16:00	294	331	325	297	1,247	
16:00-17:00	364	333	347	366	1,410	
17:00-18:00	390	398	417	419	1,624	
18:00-19:00	356	286	225	273	1,140	
19:00-20:00	257	229	204	174	864	
20:00-21:00	162	130	136	138	566	
21:00-22:00	130	131	90	69	420	
22:00-23:00	55	43	50	38	186	
23:00-24:00	◻ 33	29	23	13	98	
Total					15,228	
AADT						
AM Peak					11:30-12:30 999	
PM Peak					17:00-18:00 1,624	

COUNT DATA INFO	
Count Status	Accepted
Start Date	Tue 10/9/2018
End Date	Wed 10/10/2018
Start Time	12:00:00 AM
End Time	12:00:00 AM
Direction	EB
Notes	
Station	122
Study	
Speed Limit	
Description	
Sensor Type	
Source	CombineVolumeCountsIncremental
Latitude,Longitude	



Volume Count Report

LOCATION INFO	
Location ID	379_EB
Type	SPOT
Funct'l Class	-
Located On	WALTON BLVD
WEST OF	ROCHDALE
Direction	EB
County	Oakland
Community	-
MPO ID	
HPMS ID	
Agency	Oakland County - SCATS

INTERVAL:15-MIN						
Time	15-min Interval				Hourly Count	
	1st	2nd	3rd	4th		
▶ 0:00-1:00	25	19	7	8	59	
1:00-2:00	8	10	3	8	29	
2:00-3:00	5	4	7	3	19	
3:00-4:00	5	2	4	5	16	
4:00-5:00	3	8	7	18	36	
5:00-6:00	18	39	38	39	134	
6:00-7:00	56	86	75	185	402	
7:00-8:00	239	259	167	182	847	
8:00-9:00	217	205	180	253	855	
9:00-10:00	218	186	210	230	844	
10:00-11:00	189	197	198	200	784	
11:00-12:00	204	226	236	238	904	
12:00-13:00	232	209	204	183	828	
13:00-14:00	153	171	232	222	778	
14:00-15:00	232	248	296	322	1,098	
15:00-16:00	291	316	322	318	1,247	
16:00-17:00	338	345	362	381	1,426	
17:00-18:00	380	397	455	411	1,643	
18:00-19:00	329	281	269	256	1,135	
19:00-20:00	232	241	222	183	878	
20:00-21:00	162	144	139	137	582	
21:00-22:00	155	144	105	78	482	
22:00-23:00	47	52	44	43	186	
23:00-24:00	◻ 31	40	18	15	104	
Total					15,316	
AADT						
AM Peak					11:15-12:15 932	
PM Peak					17:00-18:00 1,643	

COUNT DATA INFO	
Count Status	Accepted
Start Date	Tue 10/9/2018
End Date	Wed 10/10/2018
Start Time	12:00:00 AM
End Time	12:00:00 AM
Direction	EB
Notes	
Station	379
Study	
Speed Limit	
Description	
Sensor Type	
Source	CombineVolumeCountsIncremental
Latitude,Longitude	



Volume Count Report

LOCATION INFO	
Location ID	122_WB
Type	SPOT
Funct'l Class	-
Located On	WALTON BLVD
EAST OF	LIVERNOIS
Direction	WB
County	Oakland
Community	-
MPO ID	
HPMS ID	
Agency	Oakland County - SCATS

INTERVAL:15-MIN					
Time	15-min Interval				Hourly Count
	1st	2nd	3rd	4th	
0:00-1:00	12	12	8	10	42
1:00-2:00	10	7	11	5	33
2:00-3:00	7	6	8	2	23
3:00-4:00	6	4	8	4	22
4:00-5:00	5	7	11	24	47
5:00-6:00	20	33	39	38	130
6:00-7:00	51	78	88	306	523
7:00-8:00	263	147	370	324	1,104
8:00-9:00	268	310	235	180	993
9:00-10:00	160	191	176	143	670
10:00-11:00	164	139	145	168	616
11:00-12:00	181	192	178	186	737
12:00-13:00	213	237	212	173	835
13:00-14:00	203	178	160	197	738
14:00-15:00	211	221	206	235	873
15:00-16:00	227	212	211	205	855
16:00-17:00	274	217	220	232	943
17:00-18:00	265	211	201	240	917
18:00-19:00	213	230	166	177	786
19:00-20:00	181	169	186	163	699
20:00-21:00	151	104	102	114	471
21:00-22:00	121	109	85	56	371
22:00-23:00	52	41	36	28	157
23:00-24:00	34	30	22	20	106
Total					12,691
AADT					
AM Peak					07:30-08:30 1,272
PM Peak					16:00-17:00 943

COUNT DATA INFO	
Count Status	Accepted
Start Date	Tue 10/9/2018
End Date	Wed 10/10/2018
Start Time	12:00:00 AM
End Time	12:00:00 AM
Direction	WB
Notes	
Station	122
Study	
Speed Limit	
Description	
Sensor Type	
Source	CombineVolumeCountsIncremental
Latitude,Longitude	



Volume Count Report

LOCATION INFO	
Location ID	379_WB
Type	SPOT
Funct'l Class	-
Located On	WALTON BLVD
EAST OF	ROCHDALE
Direction	WB
County	Oakland
Community	-
MPO ID	
HPMS ID	
Agency	Oakland County - SCATS

INTERVAL:15-MIN					
Time	15-min Interval				Hourly Count
	1st	2nd	3rd	4th	
▶ 0:00-1:00	8	8	7	7	30
1:00-2:00	4	2	3	2	11
2:00-3:00	8	4	5	1	18
3:00-4:00	3	2	5	4	14
4:00-5:00	1	6	8	14	29
5:00-6:00	6	27	35	19	87
6:00-7:00	51	85	110	168	414
7:00-8:00	172	122	202	159	655
8:00-9:00	138	180	136	147	601
9:00-10:00	140	122	128	122	512
10:00-11:00	98	118	112	148	476
11:00-12:00	129	158	126	164	577
12:00-13:00	141	165	152	150	608
13:00-14:00	151	160	122	142	575
14:00-15:00	151	151	179	171	652
15:00-16:00	149	152	139	159	599
16:00-17:00	183	167	152	190	692
17:00-18:00	171	156	148	170	645
18:00-19:00	167	169	122	142	600
19:00-20:00	135	157	196	166	654
20:00-21:00	153	122	101	104	480
21:00-22:00	113	116	76	66	371
22:00-23:00	55	35	31	28	149
23:00-24:00	◻ 23	24	19	14	80
Total					9,529
AADT					
AM Peak					07:30-08:30 679
PM Peak					16:00-17:00 692

COUNT DATA INFO	
Count Status	Accepted
Start Date	Tue 10/9/2018
End Date	Wed 10/10/2018
Start Time	12:00:00 AM
End Time	12:00:00 AM
Direction	WB
Notes	
Station	379
Study	
Speed Limit	
Description	
Sensor Type	
Source	CombineVolumeCountsIncremental
Latitude,Longitude	

OAKLAND COUNTY ROAD COMMISSION
TRAFFIC - SAFETY DEPARTMENT
SIGNAL WORK ORDER

LOCATION: Walton Blvd & Livernois DATE: 1-10-20

CITY/TOWNSHIP: Rochester Hills BY: T CREECH

COUNTY#: 122 STATE#: — CHARGES: 54281 E

PLEASE PERFORM THE FOLLOWING:

ELECTRICAL DEVICE: INSTALL MODERNIZE MAINTENANCE

UNDERGROUND: _____

EDISON OK: YES NO JOB#: _____

COORDINATE W/DISTRICT 7: _____

DIAL..	1	1	1	1		2	2	2	2		3	3	3	3		4	4	4	4
SPLIT.	1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4
<input type="checkbox"/> CHANGE TIMING.....																			
<input type="checkbox"/> CHANGE OFFSET.....																			
<input type="checkbox"/> CHANGE CYCLE LENGTH.....																			
<input type="checkbox"/> ADD DIAL/SPLIT.....																			

CHANGE BREAKOUT OR EPROM: _____

CHANGE HOURS OF OPERATION:

ROAD COMMISSION FOR
OAKLAND COUNTY

OLD: _____

MAR 3 2020

NEW: _____

REPROGRAM TBC

TRAFFIC OPERATIONS

INSTALL INTERCONNECT: TBC MINITROL TONE

MBT OK: YES NO

NO CHANGE - RECORD CORRECTION

OTHER: Build TS2 P44-16 cabinet for contractor w/ MOD 60 SCATS controller, loop rack, existing DIGI, and CCTV cam.

APPROVED BY: 

DATE: 1/10/20

DATE INSTALLED: 1-30-20

INSTALLED BY: Rachon/Alexander

INTERSECTION :- 122 WALTON BLVD & LIVERNOIS
DESCRIPTION PROMS :- X00122 / F3805
CONTROLLER TYPE :- STANDARD PERSONALITY CONTROLLER
SOFTWARE TYPE :- MOD 60 SCATS S30

INPUTS :-

1. SB LIVERNOIS L (LK)
 2. SB LIVERNOIS C (LK)
 3. SB LIVERNOIS R (LK)
 4. EB WALTON L (LK)
 5. EB WALTON C (LK)
 6. EB WALTON R (LK)
 7. NB LIVERNOIS LT L (LK)
 8. NB LIVERNOIS LT L ADV (LK)
 9. NB LIVERNOIS LT R (LK)
 10. NB LIVERNOIS LT R ADV (LK)
 11. NB LIVERNOIS L (LK)
 12. NB LIVERNOIS C (LK)
 13. NB LIVERNOIS R (LK)
 14. WB WALTON L (LK)
 15. WB WALTON C (LK)
 16. WB WALTON R (LK)
- Note: All detectors are loops.

PED 2: NB LIVERNOIS PED (EAST LEG) P.B.
PED 4: WB WALTON PED (NORTH LEG) P.B.
PED 6: SB LIVERNOIS PED (WEST LEG) P.B.
PED 8: EB WALTON PED (SOUTH LEG) P.B.

APPROACHES :-

A APP 1 : SB LIVERNOIS L,C,R A APP 2 : NB LIVERNOIS L,C,R
B APP 1 : NB LIVERNOIS LT L,L ADV,R,R ADV
C APP 1 : EB WALTON L,C,R C APP 2 : WB WALTON L,C,R

FLEXIDATA :-

SEQUENCE	A,B,C	A,B,C
AUTO REL		
R- REL	A	A
R+ REL	B	B
Q- REL	C	C
Q+ REL		

PEDESTRIANS :-

1. -
2. NB LIVERNOIS PED (EAST LEG) (P-)
3. -
4. WB WALTON PED (NORTH LEG) (P-)
5. -
6. SB LIVERNOIS PED (WEST LEG) (P+)
7. -
8. EB WALTON PED (SOUTH LEG) (P+)

SPECIAL FEATURES :-

Personality revision is 1 (=A).

A STAGE HAS PERMANENT DEMAND.

DEMAND FOR STAGES B AND C IN FLEXI AND ISOLATED, SET ZNEG TO DISABLE.

Pedestrians have automatic introduction using SCATS Y-.

Ped NB LIVERNOIS PED (EAST LEG) has walk/clearance overlap from AB to AB stages.

BACKPANEL :- SIZE P44-16 TS2 CABINET

LOAD SWITCH 2	- NB LIVERNOIS	A	FLR
LOAD SWITCH 4	- WB WALTON	B	FLR
LOAD SWITCH 5	- NB LIVERNOIS LT & EB WALTON RT	AL & DR	FLR
LOAD SWITCH 6	- SB LIVERNOIS	C	FLR
LOAD SWITCH 8	- EB WALTON	D	FLR
LOAD SWITCH 9	- NB LIVERNOIS PED (EAST LEG)	WA	
LOAD SWITCH 10	- WB WALTON PED (NORTH LEG)	WB	
LOAD SWITCH 11	- SB LIVERNOIS PED (WEST LEG)	WC	
LOAD SWITCH 12	- EB WALTON PED (SOUTH LEG)	WD	

MMU 2 :- (MENU : SET/VIEW CONFIG)

Field Check Enable Channel 2: G, Y, R
 Channel 4: G, Y, R
 Channel 5: G, Y, R
 Channel 6: G, Y, R
 Channel 8: G, Y, R

Dual Indication Enable: R+G: Channel 2,4,5,6,8,9,10,11,12
 R+Y: Channel 2,4,5,6,8
 G+Y: Channel 2,4,5,6,8

Red Fail Enable: Enable: Channel 2,4,5,6,8

Unit Options: All OFF except:
 Recurrent pulse
 LED Guard
 Program Memory Card

Y & R Clearance Disable: Channel 2,4,5,6,8 Enabled

Flashing Yellow Arrow: None

Program Card: Compatible Channels: 2-5,2-6,2-9,2-11,
 4-8,4-10,4-12,5-9,6-9,6-11,8-10,8-12,
 9-11,10-12.

 Min Flash Time : 4+2+1
 Min Yellow Change Disable: 9,10,11,12
 Voltage Monitor Latch: None

Note :- Add Jumper 16 MMU Flash - 116 Monitor ST Out

*****	CHECKSUMS
* CONTROLLER INFORMATION SHEET *	TIMES C3 / 303
* FOR SITE NO. 122 *	PERS F1 / 361
* T CREECH *	TOTAL 32 / 062
* 10-Jan-2020 *	

FLEXILINK PLAN DATA

Intersection # 122 State # _____ Date: 01/10/20 Prepared By: T. Creech

Intersection: Livernois & Walton City: Rochester Hills

Hours of Operation: 7 Days: 24 Hours Approved By: R. Jones

Hours of Flashing: None

		PL0	PL1	PL2	PL3	PL4	PL5	PL6	PL7	PL8
0	CL	0	80	120	120					
1	A		0	0	0					
2	B		30	45	40					
3	C		45	60	60					
4	D									
5	E									
6	F									
7	G									
8	R-									
9	R+									
10	Of (Y-)		61	34	70					
11	Y+	C								
12	Z-									
13	Z+									
14	Q-									
15	Q+									
16	XH									
17	XL									

NOTE: Stages with 1 second of phase time are skipped. Blank entries are default values equal to 0. Except for an AWA controller, entries #8 to #15 (=254) and 'C' entry means continuous (=255).

Phase	Direction	Min	Max	ECO	Amber	All Red	Timers		
							Gap	Hdwy	Waste
A	Livernois	10.0	20.0		3.9	2.5	3.0	1.2	10.0
B	NB Livernois LT/Thru	5.0	20.0		3.9	2.5	3.5	1.2	10.0
C	Walton	10.0	45.0		3.9	2.5	3.0	1.2	10.0
D									
E									
F									
G									

	Day	Hours	Plan#
SC1	14	0:00	1
SC2	8	6:00	2
SC3	8	9:00	1
SC4	8	14:00	3
SC5	8	19:00	1
SC6			
SC7			
SC8			
SC9			
SC10			

Pedestrian Crossing Times

Direction	Walk	CL 1	CL 2
NB Livernois Ped East (Ped 2)	7.0	16.0	3.4
WB Walton Ped North (Ped 4)	7.0	5.0	3.4
SB Livernois Ped West (Ped 6)	7.0	23.0	3.4
EB Walton Ped South (Ped 8)	7.0	23.0	3.4

Normal Operating Mode

Isolated	Flexilink	Masterlink	Master Isolated	Flexi Isolated
		X		

DAY OF WEEK CODE NUMBER

0	End of Schedule	4	WED	8	MON-FRI	12	MON,FRI,SAT
1	SUN	5	THUR	9	MON-SAT	13	SAT,SUN
2	MON	6	FRI	10	TUE,WED,THU	14	EVERY DAY
3	TUE	7	SAT	11	MON,FRI	15	NEVER

TS2 LOOP DETECTORS BIU #1

CO#122 - Walton Blvd & Livernois

Detector # on print	Description	Phase	Output
1	SB LIVERNOIS L	6	1
2	SB LIVERNOIS C	6	2
3	SB LIVERNOIS R	6	3
4	EB WALTON L	8	4
5	EB WALTON C	8	5
6	EB WALTON R	8	6
7	NB LIVERNOIS LT L	5	7
8	NB LIVERNOIS LT L ADV	5	8
9	NB LIVERNOIS LT R	5	9
10	NB LIVERNOIS LT R ADV	5	10
11	NB LIVERNOIS L	2	11
12	NB LIVERNOIS C	2	12
13	NB LIVERNOIS R	2	13
14	WB WALTON L	4	14
15	WB WALTON C	4	15
16	WB WALTON R	4	16

OAKLAND COUNTY ROAD COMMISSION
TRAFFIC - SAFETY DEPARTMENT
SIGNAL WORK ORDER

LOCATION: Walton & Rochdale DATE: 6-10-13

CITY/TOWNSHIP: Rochester Hills BY: T. Creech

COUNTY#: 379 STATE#: — CHARGES: 7860379 0

PLEASE PERFORM THE FOLLOWING:

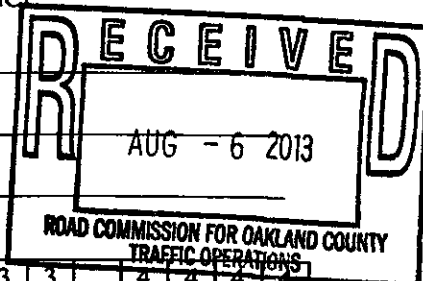
ELECTRICAL DEVICE: INSTALL MODERNIZE MAINTENANCE

UNDERGROUND: _____

EDISON OK: YES NO

JOB#: _____

COORDINATE W/DISTRICT 7: _____



DIAL..	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4
SPLIT.	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
CHANGE TIMING.....																
CHANGE OFFSET.....																
CHANGE CYCLE LENGTH.....																
ADD DIAL/SPLIT.....																

CHANGE BREAKOUT OR EPROM: Change Pcs → Rev 2
 CHANGE HOURS OF OPERATION: (Added xSF bits for LT demands, Pen time, All Real)

OLD: _____

NEW: _____

REPROGRAM TBC

INSTALL INTERCONNECT: TBC MINITROL TONE

MBT OK: YES NO

NO CHANGE - RECORD CORRECTION

OTHER: Requires a checksum change.

APPROVED BY: [Signature]

DATE: 7 / 26 / 13

DATE INSTALLED: 8-2-13

INSTALLED BY: Dave Williams

INTERSECTION :- 379 Walton and Rochdale
DESCRIPTION PROMS :- X00020R / F4808
CONTROLLER TYPE :- STANDARD PERSONALITY CONTROLLER
SOFTWARE :- MOD 52 SCATS w/fya (Version s15)

PHYSICAL INPUTS :-

1. WB WALTON LT (NL)
2. WB WALTON LT ADV (NL)
3. WB WALTON L (LK)
4. WB WALTON R (LK)
5. SB ROCHDALE L (LK)
6. SB ROCHDALE R (LK)
7. EB WALTON LT (NL)
8. EB WALTON LT ADV (NL)
9. EB WALTON L (LK)
10. EB WALTON R (LK)
11. NB ROCHDALE R (LK)
12. NB ROCHDALE R (LK)

NOTE: ALL DETECTORS ARE AUTOSCOPE
(TERRA CAMERAS).

PED 2: WB WALTON PED NORTH (WA) WFG.
PED 6: EB WALTON PED SOUTH (WC) WFG.
PED 8: NB ROCHDALE PED EAST (WD) P.B.

APPROACHES :-

A APPR 1 : EB WALTON	A APPR 2 : WB WALTON
B APPR 1 : SB ROCHDALE	B APPR 2 : NB ROCHDALE
C APPR 1 : EB WALTON LT	C APPR 2 : WB WALTON LT
C APPR 3 : WB WALTON	C APPR 4 : EB WALTON

FLEXIDATA:-

SEQUENCE	A,B,C	A,B,C
AUTO REL		
R- REL	A	A
R+ REL	B	B
Q- REL	C	C
Q+ REL		
LOOKAHEAD		

PEDESTRIANS:-

1. P1
2. P2 (WB WALTON NORTH)
3. P3
4. P4
5. P5
6. P6 (EB WALTON SOUTH)
7. P7
8. P8 (NB ROCHDALE EAST)

SPECIAL FEATURES :-

Controller Software must be 2070/M52 S15 or later (VC=5)
The personality revision number is currently 2 (=B).

Ped outputs mapped to phases as follows: ped 2 = 18, ped 4 = 20,
ped 6 = 22 and ped 8 = 24. VC5 software reports them as mapped.

Left turns are permissive to NCHRP flashing yellow recommendation.
Signal groups 9 and 11 provide flashing yellow (green aspect), yellow
and red, i.e. upper aspects of 4 section turn display. Signal
groups 1 and 5 provide the green (bottom) aspect, i.e. turn arrow.

A STAGE HAS A PERMANENT DEMAND
DEMAND FOR STAGES B AND C IN FLEXI AND ISOLATED. SET ZNEG TO DISABLE.

Signal Group 1 and 5 non-locked detectors will not call stage C directly.
If XSF7 is set signal Group 1 and 5 detectors will call stage B and then
stage C.

XSF1 (XL VALUE = 1) WILL CALL EB LT IN B STAGE.
 XSF5 (XL VALUE = 10) WILL CALL WB LT IN B STAGE.

Flash rate for FYA is set with Timesettings 28 and 29.
 TSM28=0.6 (on rate), TSM29=0.4 (off rate)

Backpanel for size P44-12 cabinet:

Load Switch 1:	EB WALTON LT (G: green arrow)	CL	-
Load Switch 2:	WB WALTON	A	FLA
Load Switch 4:	SB ROCHDALE	B	FLR
Load Switch 5:	WB WALTON LT (G: green arrow)	AL	-
Load Switch 6:	EB WALTON	C	FLA
Load Switch 7:	NB ROCHDALE Ped East (Ped 8)	WD	-
Load Switch 8:	NB ROCHDALE	D	FLR
Load Switch 9:	EB WALTON LT	CL	FLA
(OLA)	G: flashing yellow arrow, Y: yellow arrow, R: red arrow		
Load Switch 10:	WB WALTON Ped North (Ped 2)	WA	-
Load Switch 11:	WB WALTON LT	AL	FLA
(OLC)	G: flashing yellow arrow, Y: yellow arrow, R: red arrow		
Load Switch 12:	EB WALTON Ped South (Ped 6)	WC	-

Jumpers:

193-194, 195-196, 197-198, 199-200, 201-224, 202-203, 205-206, 207-230, 208-209,
 217-218, 219-220, 221-222, 237-238, 239-240, 241-242, 243-244, 245-268, 246-247,
 249-250, 251-274, 252-253, 256-267, 260-273, 261-262, 263-264, 265-266, 325-326,
 327-328, 329-330, 331-332, 333-334, 335-356, 343-PB1, 347-348, 349-350, 351-PB1,
 369-370, 371-372, 373-374, 375-376, 377-378, 379-400, 387-PB1, 391-392, 393-394,
 395-PB1, 298-302.

Signal Monitor: 1-5, 1-6, 1-9, 1-11, 2-5, 2-6, 2-9, 2-11, 4-8, 5-9, 5-11, 6-9,
 6-11, 9-11.

Remove 7G from conflict monitor and tape it. Hook 7G to CH 8W (401).

All switches OFF EXCEPT: Dual Select A&B; G&Y Enable;

FYA 1-9, 5-11 Enable; SSM 2, 4, 6, 8, 9, 11.

Minimum Flash = 4 + 2 + 1.

 * CONTROLLER INFORMATION SHEET *
 * FOR SITE NO. 379 *
 * T. CREECH *
 * DATE : 10-Jun-2013 *

Checksums: Times F1 / 361
 Pers 12 / 022
 Total E3 / 343

FLEXILINK PLAN DATA

Intersection # 379 State # _____ Date: 06/10/13 Prepared By: T. Creech

Intersection: Walton & Rochdale City: Rochester Hills

Hours of Operation: M-F: 6am - 10pm; S&S: 7am - 10pm Approved By: R. Jones

Hours of Flashing: M-F: 10pm - 6am; S&S: 10pm - 7am

		PL0	PL1	PL2	PL3	PL4	PL5	PL6	PL7	PL8
0	CL		80	120	120					
1	A		0	0	0					
2	B		30	58	61					
3	C		66	104	104					
4	D									
5	E									
6	F									
7	G									
8	R-									
9	R+		C	C	C					
10	Y-		50	113	109					
11	Y+	C								
12	Z-									
13	Z+									
14	Q-									
15	Q+									
16	XH									
17	XL									

NOTE: Stages with 1 second of phase time are skipped. Blank entries are default values equal to 0. Except for an AWA controller, entries #8 to #15 (=254) and 'C' entry means continuous (=255).

Phase	Direction	Min	Max	ECO	Amber	All Red	Timers		
							Gap	Hdwy	Waste
A	Walton	10.0	40.0	15.0	3.9	2.0	3.0	1.2	10.0
B	Rochdale	5.0	20.0		3.5	2.5	3.0	1.2	10.0
C	Walton LT	4.0	15.0		3.9	2.0	3.0	1.2	10.0
D									
E									
F									
G									

	Day	Hours	Plan#
SC1	8	6:00	2
SC2	8	9:00	1
SC3	8	15:00	3
SC4	8	19:00	1
SC5	13	7:00	1
SC6	14	0:00	0
SC7	14	22:00	0
SC8			
SC9			
SC10			

Pedestrian Crossing Times

Direction	Walk	CL 1	CL 2
WB Walton Ped (N Leg) (P2)	7.0	15.0	2.9
EB Walton Ped (S Leg) (P6)	7.0	15.0	2.9
NB Rochdale Ped (E Leg) (P8)	7.0	13.0	3.0

Flash rate Timesettings TSM28=0.6 (on rate); TSM29=0.4 (off rate)

Normal Operating Mode

Isolated	Flexilink	Masterlink	Master Isolated	Flexi Isolated
		X		

DAY OF WEEK CODE NUMBER

0	End of Schedule	4	WED	8	MON-FRI	12	MON,FRI,SAT
1	SUN	5	THUR	9	MON-SAT	13	SAT,SUN
2	MON	6	FRI	10	TUE,WED,THU	14	EVERY DAY
3	TUE	7	SAT	11	MON,FRI	15	NEVER

Autoscope Solo Terra (Terra Access Point)

CO# 379

Camera #	TAP I/O Connector	Description	D-Connector		Detector # on Print	Phase
			Terminal #	Description		
1	Output 1	WB WALTON LT	1	Det 9	1	5
1	Output 2	WB WALTON LT ADV	2	Det 10	2	5
1	Output 3	WB WALTON L	3	Det 11	3	2
1	Output 4	WB WALTON R	4	Det 12	4	2
2	Output 5	SB ROCHESTER L	5	Det 13	5	4
2	Output 6	SB ROCHESTER R	6	Det 14	6	4
3	Output 7	EB WALTON LT	7	Det 15	7	1
3	Output 8	EB WALTON LT ADV	8	Det 16	8	1
3	Output 9	EB WALTON L	9	Det 17	9	6
3	Output 10	EB WALTON R	10	Det 18	10	6
4	Output 11	NB ROCHESTER L	11	Det 19	11	8
4	Output 12	NB ROCHESTER R	12	Det 20	12	8
	Output 13		13	Det 21		
	Output 14		14	Det 22		
	Output 15		15	Det 23		
	Output 16		16	Det 24		
	Output 17		Backpanel VD1 (101)			
	Output 18		Backpanel VD2 (109)			
	Output 19		Backpanel VD3 (123)			
	Output 20		Backpanel VD4 (131)			
	Output 21		Backpanel VD5 (145)			
	Output 22		Backpanel VD6 (153)			
	Output 23		Backpanel VD7 (167)			
	Output 24		Backpanel VD8 (175)			

TAP I/O Connector	Description
Input 1	LS1-9 RED (203)
Input 2	LS2 RED (195)
Input 3	
Input 4	LS4 RED (217)
Input 5	LS5-11 RED (247)
Input 6	LS6 RED (239)
Input 7	
Input 8	LS8 RED (261)
Input 9	
Input 10	
Input 11	
Input 12	
Input 13	
Input 14	
Input 15	
Input 16	

Terra Access Point - (Selector Switch in I/O Position) Input / Output Indicators

- Rotary Dial Position 7 = Outputs 17 through 24
- Rotary Dial Position 8 = Outputs 1 through 16
- Rotary Dial Position 9 = Inputs 1 through 16

MVP Status LEDs - (Selector Switch in MVP Position)

- Rotary Dial Position 1-4 - Cameras 1-4 (Camera on monitor for viewing)
- Rotary Dial Position 5-8 - Cameras 5-8 (Camera on monitor for viewing)

Appendix B

EXISTING TRAFFIC CONDITIONS

Level of Service for Signalized Intersections

Level of service for signalized intersections is defined in terms of delay, which is a measure of driver discomfort and frustration, fuel consumption, and lost travel time. LOS can be characterized for the entire intersection, each intersection approach, and each lane group. Specifically, level-of-service (LOS) criteria are stated in terms of the average stopped delay per vehicle. The criteria are given in Exhibit 19-8. Delay may be measured in the field or estimated using procedures presented later in this chapter. Delay is a complex measure and is dependent on a number of variables, including the quality of progression, the cycle length, the green ratio, and the v/c ratio for the lane group in question.

LOS A describes operations with a control delay of 10 s/veh or less. This level is typically assigned when the volume-to-capacity ratio is low and either progression is extremely favorable or the cycle length is very short. If LOS A is the result of favorable progression, most vehicles arrive during a green indication and travel through the intersection without stopping.

LOS B describes operations with control delay between 10 and 20 s/veh. This level is typically assigned when the volume-to-capacity ratio is low and either progression is highly favorable or the cycle length is short. More vehicles stop than with LOS A.

Exhibit 19.8. Level-of-Service Criteria for Signalized Intersections (Motorized Vehicles)

LEVEL OF SERVICE	STOPPED DELAY PER VEHICLE (SEC)
A	≤ 10.0
B	> 10.0 and ≤ 20.0
C	> 20.0 and ≤ 35.0
D	> 35.0 and ≤ 55.0
E	> 55.0 and ≤ 80.0
F	> 80.0

1. If the v/c ratio for a lane group exceeds 1.0, a LOS F is assigned to the individual lane group. LOS for approach-based and intersection-wide assessments are determined solely by the control delay.

LOS C describes operations with control delay between 20 and 35 s/veh. This level is typically assigned when progression is favorable or the cycle length is moderate. Individual *cycle failures* (i.e. one or more queued vehicles are not able to depart as a result of insufficient capacity during the cycle) may begin to appear at this level. The number of vehicle stopping is significant, although many vehicles still pass through the intersection without stopping.

LOS D describes operations with control delay between 35 and 55 s/veh. This level is typically assigned when when the volume-to-capacity ratio is high and either progression is ineffective or the cycle length is long. Many vehicles stop and individual cycle failures are noticeable.

LOS E describes operations with control delay between 55 and 80 s/veh. This level is typically assigned when when the volume-to-capacity ratio is high, progression is unfavorable, and the cycle length is long. Individual cycle failures are frequent.

LOS F describes operations with control delay exceeding 80 s/veh or a volume-to-capacity ratio greater than 1.0. This level, considered to be unacceptable to most drivers, often occurs with over-saturation, that is, when arrival flow rates exceed the capacity of the intersection. This level is typically assigned when the volume-to-capacity ratio is high, progression is very poor, and the cycle length is long. Most cycles fail to clear the queue.

Source: Highway Capacity Manual, 6th Edition. Transportation Research Board, National Research Council

HCM 6th Signalized Intersection Summary
1: Rochdale Drive & Walton Boulevard

Existing Conditions
AM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↗		↖	↗	
Traffic Volume (veh/h)	23	833	12	12	1282	25	7	2	22	47	3	32
Future Volume (veh/h)	23	833	12	12	1282	25	7	2	22	47	3	32
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	0.99		0.99	0.99		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1969	1969	1969	1969	1969	1969	2000	2000	2000	1938	1938	1938
Adj Flow Rate, veh/h	28	1016	15	13	1424	28	10	3	32	71	5	48
Peak Hour Factor	0.82	0.82	0.82	0.90	0.90	0.90	0.68	0.68	0.68	0.66	0.66	0.66
Percent Heavy Veh, %	2	2	2	2	2	2	0	0	0	4	4	4
Cap, veh/h	370	2831	42	442	2783	55	141	13	140	155	14	134
Arrive On Green	0.02	0.75	0.75	0.02	1.00	1.00	0.09	0.09	0.09	0.09	0.09	0.09
Sat Flow, veh/h	1875	3773	56	1875	3752	74	1366	146	1560	1344	156	1500
Grp Volume(v), veh/h	28	504	527	13	709	743	10	0	35	71	0	53
Grp Sat Flow(s),veh/h/ln	1875	1870	1959	1875	1870	1955	1366	0	1707	1344	0	1656
Q Serve(g_s), s	0.4	11.0	11.0	0.2	0.0	0.0	0.8	0.0	2.3	6.2	0.0	3.6
Cycle Q Clear(g_c), s	0.4	11.0	11.0	0.2	0.0	0.0	4.4	0.0	2.3	8.5	0.0	3.6
Prop In Lane	1.00		0.03	1.00		0.04	1.00		0.91	1.00		0.91
Lane Grp Cap(c), veh/h	370	1403	1470	442	1387	1451	141	0	153	155	0	148
V/C Ratio(X)	0.08	0.36	0.36	0.03	0.51	0.51	0.07	0.00	0.23	0.46	0.00	0.36
Avail Cap(c_a), veh/h	427	1403	1470	515	1387	1451	246	0	284	258	0	276
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	3.4	5.1	5.1	4.0	0.0	0.0	53.5	0.0	50.8	54.7	0.0	51.4
Incr Delay (d2), s/veh	0.1	0.7	0.7	0.0	1.3	1.3	0.2	0.0	0.8	2.1	0.0	1.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	3.7	3.9	0.1	0.5	0.5	0.3	0.0	1.0	2.2	0.0	1.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	3.5	5.8	5.8	4.1	1.3	1.3	53.7	0.0	51.5	56.8	0.0	52.8
LnGrp LOS	A	A	A	A	A	A	D	A	D	E	A	D
Approach Vol, veh/h		1059			1465			45			124	
Approach Delay, s/veh		5.8			1.3			52.0			55.1	
Approach LOS		A			A			D			E	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	7.3	95.9		16.8	8.3	94.9		16.8				
Change Period (Y+Rc), s	5.9	5.9		6.0	5.9	5.9		6.0				
Max Green Setting (Gmax), s	6.1	76.1		20.0	6.1	76.1		20.0				
Max Q Clear Time (g_c+I1), s	2.2	13.0		10.5	2.4	2.0		6.4				
Green Ext Time (p_c), s	0.0	7.8		0.3	0.0	14.5		0.1				
Intersection Summary												
HCM 6th Ctrl Delay				6.4								
HCM 6th LOS				A								

Intersection						
Int Delay, s/veh	2.3					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↑	↑	↑↑	↑	↑
Traffic Vol, veh/h	725	177	113	1266	53	166
Future Vol, veh/h	725	177	113	1266	53	166
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	300	500	-	0	75
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	82	47	60	57	52	52
Heavy Vehicles, %	3	0	0	2	1	1
Mvmt Flow	884	377	188	2221	102	319

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	1261	0	2371 442
Stage 1	-	-	-	-	884 -
Stage 2	-	-	-	-	1487 -
Critical Hdwy	-	-	4.1	-	6.82 6.92
Critical Hdwy Stg 1	-	-	-	-	5.82 -
Critical Hdwy Stg 2	-	-	-	-	5.82 -
Follow-up Hdwy	-	-	2.2	-	3.51 3.31
Pot Cap-1 Maneuver	-	-	704	-	116 *799
Stage 1	-	-	-	-	656 -
Stage 2	-	-	-	-	473 -
Platoon blocked, %	-	-	1	-	1 1
Mov Cap-1 Maneuver	-	-	704	-	~ 85 *799
Mov Cap-2 Maneuver	-	-	-	-	242 -
Stage 1	-	-	-	-	656 -
Stage 2	-	-	-	-	347 -

Approach	EB	WB	NB
HCM Control Delay, s	0	0.9	16.8
HCM LOS			C













Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	242	799	-	-	704	-
HCM Lane V/C Ratio	0.421	0.4	-	-	0.268	-
HCM Control Delay (s)	30.3	12.5	-	-	12	-
HCM Lane LOS	D	B	-	-	B	-
HCM 95th %tile Q(veh)	2	1.9	-	-	1.1	-

Notes
 ~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

HCM 6th Signalized Intersection Summary

3: Livernois Road & Walton Boulevard

Existing Conditions
AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↗		↑↑	↗	↘↘	↑↑	↗		↑↑	↗
Traffic Volume (veh/h)	0	586	305	0	958	163	264	303	124	0	941	157
Future Volume (veh/h)	0	586	305	0	958	163	264	303	124	0	941	157
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	0	1953	1953	0	1969	1969	1938	1938	1938	0	1984	1984
Adj Flow Rate, veh/h	0	715	372	0	1140	194	314	361	148	0	1107	185
Peak Hour Factor	0.82	0.82	0.82	0.84	0.84	0.84	0.84	0.84	0.84	0.85	0.85	0.85
Percent Heavy Veh, %	0	3	3	0	2	2	4	4	4	0	1	1
Cap, veh/h	0	1255	788	0	1265	564	495	2043	910	0	1370	611
Arrive On Green	0.00	0.45	0.45	0.00	0.34	0.34	0.14	0.56	0.56	0.00	0.36	0.36
Sat Flow, veh/h	0	3809	1651	0	3839	1668	3580	3681	1639	0	3870	1682
Grp Volume(v), veh/h	0	715	372	0	1140	194	314	361	148	0	1107	185
Grp Sat Flow(s),veh/h/ln	0	1856	1651	0	1870	1668	1790	1841	1639	0	1885	1682
Q Serve(g_s), s	0.0	17.1	0.0	0.0	34.8	10.4	9.9	5.8	5.3	0.0	31.8	9.4
Cycle Q Clear(g_c), s	0.0	17.1	0.0	0.0	34.8	10.4	9.9	5.8	5.3	0.0	31.8	9.4
Prop In Lane	0.00		1.00	0.00		1.00	1.00		1.00	0.00		1.00
Lane Grp Cap(c), veh/h	0	1255	788	0	1265	564	495	2043	910	0	1370	611
V/C Ratio(X)	0.00	0.57	0.47	0.00	0.90	0.34	0.63	0.18	0.16	0.00	0.81	0.30
Avail Cap(c_a), veh/h	0	1317	815	0	1328	592	495	2043	910	0	1370	611
HCM Platoon Ratio	1.00	1.33	1.33	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	0.0	26.5	16.8	0.0	37.8	29.7	48.8	13.2	13.1	0.0	34.4	27.3
Incr Delay (d2), s/veh	0.0	0.5	0.4	0.0	8.5	0.4	2.8	0.2	0.4	0.0	5.2	1.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	6.8	12.5	0.0	17.0	4.2	4.6	2.4	2.0	0.0	15.0	3.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	0.0	27.1	17.2	0.0	46.3	30.1	51.7	13.4	13.4	0.0	39.6	28.6
LnGrp LOS	A	C	B	A	D	C	D	B	B	A	D	C
Approach Vol, veh/h		1087			1334			823			1292	
Approach Delay, s/veh		23.7			43.9			28.0			38.1	
Approach LOS		C			D			C			D	
Timer - Assigned Phs		2		4	5	6		8				
Phs Duration (G+Y+Rc), s		73.0		47.0	23.0	50.0		47.0				
Change Period (Y+Rc), s		6.4		6.4	6.4	6.4		6.4				
Max Green Setting (Gmax), s		64.6		42.6	14.6	43.6		42.6				
Max Q Clear Time (g_c+I1), s		7.8		19.1	11.9	33.8		36.8				
Green Ext Time (p_c), s		3.6		6.3	0.4	5.4		3.8				
Intersection Summary												
HCM 6th Ctrl Delay			34.5									
HCM 6th LOS			C									

HCM 6th Signalized Intersection Summary
1: Rochdale Drive & Walton Boulevard

Existing Conditions
PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	56	1596	16	26	1274	57	17	2	24	71	5	50
Future Volume (veh/h)	56	1596	16	26	1274	57	17	2	24	71	5	50
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1984	1984	1984	1984	1984	1984	2000	2000	2000	1938	1938	1938
Adj Flow Rate, veh/h	59	1680	17	28	1385	62	25	3	35	83	6	58
Peak Hour Factor	0.95	0.95	0.95	0.92	0.92	0.92	0.68	0.68	0.68	0.86	0.86	0.86
Percent Heavy Veh, %	1	1	1	1	1	1	0	0	0	4	4	4
Cap, veh/h	382	2797	28	250	2658	119	147	14	158	167	16	151
Arrive On Green	0.03	0.73	0.73	0.04	1.00	1.00	0.10	0.10	0.10	0.10	0.10	0.10
Sat Flow, veh/h	1890	3824	39	1890	3675	164	1359	135	1580	1348	156	1510
Grp Volume(v), veh/h	59	827	870	28	709	738	25	0	38	83	0	64
Grp Sat Flow(s),veh/h/ln	1890	1885	1977	1890	1885	1955	1359	0	1716	1348	0	1666
Q Serve(g_s), s	1.0	25.2	25.3	0.5	0.0	0.0	2.1	0.0	2.4	7.2	0.0	4.3
Cycle Q Clear(g_c), s	1.0	25.2	25.3	0.5	0.0	0.0	6.4	0.0	2.4	9.7	0.0	4.3
Prop In Lane	1.00		0.02	1.00		0.08	1.00		0.92	1.00		0.91
Lane Grp Cap(c), veh/h	382	1379	1447	250	1363	1413	147	0	171	167	0	166
V/C Ratio(X)	0.15	0.60	0.60	0.11	0.52	0.52	0.17	0.00	0.22	0.50	0.00	0.38
Avail Cap(c_a), veh/h	440	1379	1447	324	1363	1413	226	0	272	246	0	264
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	3.8	7.7	7.7	6.6	0.0	0.0	53.6	0.0	49.7	54.2	0.0	50.6
Incr Delay (d2), s/veh	0.2	1.9	1.9	0.2	1.4	1.4	0.5	0.0	0.6	2.3	0.0	1.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	9.0	9.5	0.2	0.5	0.5	0.7	0.0	1.1	2.6	0.0	1.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	4.0	9.6	9.6	6.8	1.4	1.4	54.1	0.0	50.4	56.5	0.0	52.0
LnGrp LOS	A	A	A	A	A	A	D	A	D	E	A	D
Approach Vol, veh/h		1756			1475			63			147	
Approach Delay, s/veh		9.4			1.5			51.8			54.5	
Approach LOS		A			A			D			D	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.3	93.7		18.0	9.3	92.7		18.0				
Change Period (Y+Rc), s	5.9	5.9		6.0	5.9	5.9		6.0				
Max Green Setting (Gmax), s	7.1	76.1		19.0	7.1	76.1		19.0				
Max Q Clear Time (g_c+I1), s	2.5	27.3		11.7	3.0	2.0		8.4				
Green Ext Time (p_c), s	0.0	18.6		0.3	0.0	14.4		0.1				
Intersection Summary												
HCM 6th Ctrl Delay				8.7								
HCM 6th LOS				A								

HCM 6th TWSC
2: HS Drive & Walton Boulevard

Existing Conditions
PM Peak Hour

Intersection						
Int Delay, s/veh	0.5					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↑	↓	↑↑	↓	↑
Traffic Vol, veh/h	1645	46	18	1344	13	12
Future Vol, veh/h	1645	46	18	1344	13	12
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	300	500	-	0	75
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	73	61	64	72	69	69
Heavy Vehicles, %	2	0	0	2	0	0
Mvmt Flow	2253	75	28	1867	19	17

Major/Minor	Major1	Major2	Minor1	Minor2	Minor3
Conflicting Flow All	0	0	2328	0	3243
Stage 1	-	-	-	-	2253
Stage 2	-	-	-	-	990
Critical Hdwy	-	-	4.1	-	6.8
Critical Hdwy Stg 1	-	-	-	-	5.8
Critical Hdwy Stg 2	-	-	-	-	5.8
Follow-up Hdwy	-	-	2.2	-	3.5
Pot Cap-1 Maneuver	-	-	217	-	*~0
Stage 1	-	-	-	-	*116
Stage 2	-	-	-	-	*514
Platoon blocked, %	-	-	1	-	1
Mov Cap-1 Maneuver	-	-	217	-	*0
Mov Cap-2 Maneuver	-	-	-	-	*84
Stage 1	-	-	-	-	*116
Stage 2	-	-	-	-	*448

Approach	EB	WB	NB
HCM Control Delay, s	0	0.4	37.8
HCM LOS			E

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	84	417	-	-	217	-
HCM Lane V/C Ratio	0.224	0.042	-	-	0.13	-
HCM Control Delay (s)	59.8	14	-	-	24	-
HCM Lane LOS	F	B	-	-	C	-
HCM 95th %tile Q(veh)	0.8	0.1	-	-	0.4	-

Notes
~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

HCM 6th Signalized Intersection Summary

3: Livernois Road & Walton Boulevard

Existing Conditions
PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↗		↑↑	↗	↗↗	↑↑	↗		↑↑	↗
Traffic Volume (veh/h)	0	1266	391	0	891	172	373	718	318	0	584	98
Future Volume (veh/h)	0	1266	391	0	891	172	373	718	318	0	584	98
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	0	1984	1984	0	1984	1984	1984	1984	1984	0	1984	1984
Adj Flow Rate, veh/h	0	1347	416	0	990	191	397	764	338	0	615	103
Peak Hour Factor	0.94	0.94	0.94	0.90	0.90	0.90	0.94	0.94	0.94	0.95	0.95	0.95
Percent Heavy Veh, %	0	1	1	0	1	1	1	1	1	0	1	1
Cap, veh/h	0	1526	970	0	1526	681	630	1842	820	0	993	443
Arrive On Green	0.00	0.27	0.27	0.00	0.40	0.40	0.17	0.49	0.49	0.00	0.26	0.26
Sat Flow, veh/h	0	3870	1682	0	3870	1682	3666	3770	1679	0	3870	1682
Grp Volume(v), veh/h	0	1347	416	0	990	191	397	764	338	0	615	103
Grp Sat Flow(s),veh/h/ln	0	1885	1682	0	1885	1682	1833	1885	1679	0	1885	1682
Q Serve(g_s), s	0.0	41.1	1.2	0.0	25.4	9.2	12.1	15.6	15.5	0.0	17.2	5.8
Cycle Q Clear(g_c), s	0.0	41.1	1.2	0.0	25.4	9.2	12.1	15.6	15.5	0.0	17.2	5.8
Prop In Lane	0.00		1.00	0.00		1.00	1.00		1.00	0.00		1.00
Lane Grp Cap(c), veh/h	0	1526	970	0	1526	681	630	1842	820	0	993	443
V/C Ratio(X)	0.00	0.88	0.43	0.00	0.65	0.28	0.63	0.41	0.41	0.00	0.62	0.23
Avail Cap(c_a), veh/h	0	1590	998	0	1590	709	630	1842	820	0	993	443
HCM Platoon Ratio	1.00	0.67	0.67	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	0.0	41.0	18.9	0.0	28.8	24.0	46.1	19.7	19.6	0.0	38.9	34.7
Incr Delay (d2), s/veh	0.0	6.1	0.3	0.0	0.9	0.2	2.2	0.7	1.5	0.0	2.9	1.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	20.8	14.4	0.0	11.4	3.6	5.6	6.7	6.2	0.0	8.2	2.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	0.0	47.1	19.2	0.0	29.7	24.2	48.3	20.4	21.2	0.0	41.8	35.9
LnGrp LOS	A	D	B	A	C	C	D	C	C	A	D	D
Approach Vol, veh/h		1763			1181			1499			718	
Approach Delay, s/veh		40.5			28.8			28.0			41.0	
Approach LOS		D			C			C			D	
Timer - Assigned Phs		2		4	5	6		8				
Phs Duration (G+Y+Rc), s		65.0		55.0	27.0	38.0		55.0				
Change Period (Y+Rc), s		6.4		6.4	6.4	6.4		6.4				
Max Green Setting (Gmax), s		56.6		50.6	18.6	31.6		50.6				
Max Q Clear Time (g_c+I1), s		17.6		43.1	14.1	19.2		27.4				
Green Ext Time (p_c), s		9.1		5.5	0.7	3.4		8.1				
Intersection Summary												
HCM 6th Ctrl Delay					34.2							
HCM 6th LOS					C							

Intersection: 1: Rochdale Drive & Walton Boulevard

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	TR	L	TR
Maximum Queue (ft)	56	125	160	28	71	103	35	53	116	66
Average Queue (ft)	15	28	46	5	16	26	8	19	43	24
95th Queue (ft)	43	80	122	20	51	71	29	48	90	58
Link Distance (ft)		2092	2092		680	680		893		621
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (ft)	500			500			125		500	
Storage Blk Time (%)										
Queuing Penalty (veh)										

Intersection: 2: Livernois Road & Walton Boulevard

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	NB	NB	SB
Directions Served	T	T	R	T	T	R	L	L	T	T	R	T
Maximum Queue (ft)	249	296	200	440	479	225	198	202	106	105	110	405
Average Queue (ft)	132	146	123	268	286	144	88	113	51	37	36	227
95th Queue (ft)	212	246	211	410	442	282	163	176	98	82	84	340
Link Distance (ft)	657	657		2662	2662				1979	1979		1651
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)			150			100	225	225				500
Storage Blk Time (%)		8	5		41	8	0	0				
Queuing Penalty (veh)		26	14		68	40	0	0				

Intersection: 2: Livernois Road & Walton Boulevard

Movement	SB	SB
Directions Served	T	R
Maximum Queue (ft)	389	280
Average Queue (ft)	217	83
95th Queue (ft)	334	181
Link Distance (ft)	1651	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		400
Storage Blk Time (%)	0	
Queuing Penalty (veh)	1	

Intersection: 91: HS Drive & Walton Boulevard

Movement	EB	WB	NB	NB
Directions Served	T	L	L	R
Maximum Queue (ft)	4	106	111	107
Average Queue (ft)	0	40	35	40
95th Queue (ft)	3	78	87	83
Link Distance (ft)	680		431	
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)		500		75
Storage Blk Time (%)			2	1
Queuing Penalty (veh)			4	1

Zone Summary

Zone wide Queuing Penalty: 155

Intersection: 1: Rochdale Drive & Walton Boulevard

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	TR	L	TR
Maximum Queue (ft)	113	220	234	59	98	116	60	65	145	108
Average Queue (ft)	33	78	92	14	30	29	17	23	62	37
95th Queue (ft)	77	160	181	40	74	80	49	53	117	78
Link Distance (ft)		2092	2092		680	680		893		621
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (ft)	500			500			125		500	
Storage Blk Time (%)										
Queuing Penalty (veh)										

Intersection: 2: Livernois Road & Walton Boulevard

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	NB	NB	SB
Directions Served	T	T	R	T	T	R	L	L	T	T	R	T
Maximum Queue (ft)	653	656	200	339	370	225	212	230	248	230	227	278
Average Queue (ft)	402	433	182	194	207	105	122	144	130	126	114	168
95th Queue (ft)	619	648	250	283	311	229	195	210	201	202	202	236
Link Distance (ft)	657	657		2662	2662				1979	1979		1651
Upstream Blk Time (%)	1	2										
Queuing Penalty (veh)	11	15										
Storage Bay Dist (ft)			150			100	225	225			500	
Storage Blk Time (%)		39	8		32	5	0	1	0			
Queuing Penalty (veh)		152	51		55	22	0	3	1			

Intersection: 2: Livernois Road & Walton Boulevard

Movement	SB	SB
Directions Served	T	R
Maximum Queue (ft)	264	130
Average Queue (ft)	149	51
95th Queue (ft)	223	107
Link Distance (ft)	1651	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)	400	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 91: HS Drive & Walton Boulevard

Movement	EB	EB	EB	WB	NB	NB
Directions Served	T	T	R	L	L	R
Maximum Queue (ft)	334	364	74	56	59	34
Average Queue (ft)	28	31	5	15	16	9
95th Queue (ft)	187	199	76	44	47	29
Link Distance (ft)	680	680			431	
Upstream Blk Time (%)	0	0				
Queuing Penalty (veh)	0	0				
Storage Bay Dist (ft)			300	500		75
Storage Blk Time (%)		1			0	0
Queuing Penalty (veh)		0			0	0

Zone Summary

Zone wide Queuing Penalty: 311

Appendix C

BACKGROUND TRAFFIC CONDITIONS

HCM 6th Signalized Intersection Summary
1: Rochdale Drive & Walton Boulevard

Background Conditions
AM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	23	836	12	12	1290	28	7	2	22	54	3	36
Future Volume (veh/h)	23	836	12	12	1290	28	7	2	22	54	3	36
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.99	0.99		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1969	1969	1969	1969	1969	1969	2000	2000	2000	1938	1938	1938
Adj Flow Rate, veh/h	28	1020	15	13	1433	31	10	3	32	82	5	55
Peak Hour Factor	0.82	0.82	0.82	0.90	0.90	0.90	0.68	0.68	0.68	0.66	0.66	0.66
Percent Heavy Veh, %	2	2	2	2	2	2	0	0	0	4	4	4
Cap, veh/h	364	2800	41	434	2746	59	147	14	153	166	13	148
Arrive On Green	0.02	0.74	0.74	0.02	1.00	1.00	0.10	0.10	0.10	0.10	0.10	0.10
Sat Flow, veh/h	1875	3774	55	1875	3744	81	1358	146	1561	1345	138	1516
Grp Volume(v), veh/h	28	506	529	13	715	749	10	0	35	82	0	60
Grp Sat Flow(s),veh/h/ln	1875	1870	1959	1875	1870	1954	1358	0	1708	1345	0	1654
Q Serve(g_s), s	0.4	11.5	11.5	0.2	0.0	0.0	0.8	0.0	2.3	7.2	0.0	4.1
Cycle Q Clear(g_c), s	0.4	11.5	11.5	0.2	0.0	0.0	4.9	0.0	2.3	9.4	0.0	4.1
Prop In Lane	1.00		0.03	1.00		0.04	1.00		0.91	1.00		0.92
Lane Grp Cap(c), veh/h	364	1388	1454	434	1372	1434	147	0	167	166	0	162
V/C Ratio(X)	0.08	0.36	0.36	0.03	0.52	0.52	0.07	0.00	0.21	0.49	0.00	0.37
Avail Cap(c_a), veh/h	421	1388	1454	508	1372	1434	240	0	285	259	0	276
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	3.7	5.5	5.5	4.3	0.0	0.0	53.0	0.0	49.9	54.2	0.0	50.7
Incr Delay (d2), s/veh	0.1	0.7	0.7	0.0	1.4	1.4	0.2	0.0	0.6	2.3	0.0	1.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	3.9	4.1	0.1	0.5	0.5	0.3	0.0	1.0	2.6	0.0	1.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	3.8	6.2	6.2	4.4	1.4	1.4	53.2	0.0	50.5	56.5	0.0	52.1
LnGrp LOS	A	A	A	A	A	A	D	A	D	E	A	D
Approach Vol, veh/h		1063			1477			45				142
Approach Delay, s/veh		6.1			1.4			51.1				54.6
Approach LOS		A			A			D				D
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	7.3	95.0		17.7	8.3	93.9		17.7				
Change Period (Y+Rc), s	5.9	5.9		6.0	5.9	5.9		6.0				
Max Green Setting (Gmax), s	6.1	76.1		20.0	6.1	76.1		20.0				
Max Q Clear Time (g_c+I1), s	2.2	13.5		11.4	2.4	2.0		6.9				
Green Ext Time (p_c), s	0.0	7.8		0.3	0.0	14.7		0.1				
Intersection Summary												
HCM 6th Ctrl Delay			6.8									
HCM 6th LOS			A									

Intersection						
Int Delay, s/veh	2.7					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↑	↑	↑↑	↑	↑
Traffic Vol, veh/h	735	177	113	1277	53	166
Future Vol, veh/h	735	177	113	1277	53	166
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	300	500	-	0	75
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	82	47	57	90	52	52
Heavy Vehicles, %	3	0	0	2	1	1
Mvmt Flow	896	377	198	1419	102	319

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	1273	0	2002 448
Stage 1	-	-	-	-	896 -
Stage 2	-	-	-	-	1106 -
Critical Hdwy	-	-	4.1	-	6.82 6.92
Critical Hdwy Stg 1	-	-	-	-	5.82 -
Critical Hdwy Stg 2	-	-	-	-	5.82 -
Follow-up Hdwy	-	-	2.2	-	3.51 3.31
Pot Cap-1 Maneuver	-	-	694	-	*266 *799
Stage 1	-	-	-	-	*643 -
Stage 2	-	-	-	-	*537 -
Platoon blocked, %	-	-	1	-	1 1
Mov Cap-1 Maneuver	-	-	694	-	*190 *799
Mov Cap-2 Maneuver	-	-	-	-	*297 -
Stage 1	-	-	-	-	*643 -
Stage 2	-	-	-	-	*384 -

Approach	EB	WB	NB
HCM Control Delay, s	0	1.5	15.1
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	297	799	-	-	694	-
HCM Lane V/C Ratio	0.343	0.4	-	-	0.286	-
HCM Control Delay (s)	23.3	12.5	-	-	12.2	-
HCM Lane LOS	C	B	-	-	B	-
HCM 95th %tile Q(veh)	1.5	1.9	-	-	1.2	-

Notes
 ~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

HCM 6th Signalized Intersection Summary

3: Livernois Road & Walton Boulevard

Background Conditions
AM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↗		↑↑	↗	↘↘	↑↑	↗		↑↑	↗
Traffic Volume (veh/h)	0	589	312	0	961	163	270	304	124	0	941	159
Future Volume (veh/h)	0	589	312	0	961	163	270	304	124	0	941	159
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	0	1953	1953	0	1969	1969	1938	1938	1938	0	1984	1984
Adj Flow Rate, veh/h	0	718	380	0	1144	194	321	362	148	0	1107	187
Peak Hour Factor	0.82	0.82	0.82	0.84	0.84	0.84	0.84	0.84	0.84	0.85	0.85	0.85
Percent Heavy Veh, %	0	3	3	0	2	2	4	4	4	0	1	1
Cap, veh/h	0	1258	788	0	1268	565	493	2041	909	0	1370	611
Arrive On Green	0.00	0.45	0.45	0.00	0.34	0.34	0.14	0.55	0.55	0.00	0.36	0.36
Sat Flow, veh/h	0	3809	1651	0	3839	1668	3580	3681	1639	0	3870	1682
Grp Volume(v), veh/h	0	718	380	0	1144	194	321	362	148	0	1107	187
Grp Sat Flow(s),veh/h/ln	0	1856	1651	0	1870	1668	1790	1841	1639	0	1885	1682
Q Serve(g_s), s	0.0	17.2	0.0	0.0	35.0	10.4	10.2	5.8	5.3	0.0	31.8	9.6
Cycle Q Clear(g_c), s	0.0	17.2	0.0	0.0	35.0	10.4	10.2	5.8	5.3	0.0	31.8	9.6
Prop In Lane	0.00		1.00	0.00		1.00	1.00		1.00	0.00		1.00
Lane Grp Cap(c), veh/h	0	1258	788	0	1268	565	493	2041	909	0	1370	611
V/C Ratio(X)	0.00	0.57	0.48	0.00	0.90	0.34	0.65	0.18	0.16	0.00	0.81	0.31
Avail Cap(c_a), veh/h	0	1317	814	0	1328	592	493	2041	909	0	1370	611
HCM Platoon Ratio	1.00	1.33	1.33	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(l)	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	0.0	26.5	16.9	0.0	37.8	29.7	49.0	13.2	13.1	0.0	34.4	27.4
Incr Delay (d2), s/veh	0.0	0.5	0.5	0.0	8.6	0.4	3.2	0.2	0.4	0.0	5.2	1.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	6.8	12.8	0.0	17.1	4.2	4.7	2.4	2.0	0.0	15.0	4.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	0.0	27.0	17.3	0.0	46.4	30.0	52.2	13.4	13.5	0.0	39.6	28.7
LnGrp LOS	A	C	B	A	D	C	D	B	B	A	D	C
Approach Vol, veh/h		1098			1338			831			1294	
Approach Delay, s/veh		23.7			44.0			28.4			38.1	
Approach LOS		C			D			C			D	
Timer - Assigned Phs		2		4	5	6		8				
Phs Duration (G+Y+Rc), s		72.9		47.1	22.9	50.0		47.1				
Change Period (Y+Rc), s		6.4		6.4	6.4	6.4		6.4				
Max Green Setting (Gmax), s		64.6		42.6	14.6	43.6		42.6				
Max Q Clear Time (g_c+I1), s		7.8		19.2	12.2	33.8		37.0				
Green Ext Time (p_c), s		3.6		6.3	0.3	5.4		3.7				
Intersection Summary												
HCM 6th Ctrl Delay			34.6									
HCM 6th LOS			C									

HCM 6th Signalized Intersection Summary
1: Rochdale Drive & Walton Boulevard

Background Conditions
PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	60	1604	16	26	1278	65	17	2	24	77	5	53
Future Volume (veh/h)	60	1604	16	26	1278	65	17	2	24	77	5	53
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1984	1984	1984	1984	1984	1984	2000	2000	2000	1938	1938	1938
Adj Flow Rate, veh/h	63	1688	17	28	1389	71	25	3	35	90	6	62
Peak Hour Factor	0.95	0.95	0.95	0.92	0.92	0.92	0.68	0.68	0.68	0.86	0.86	0.86
Percent Heavy Veh, %	1	1	1	1	1	1	0	0	0	4	4	4
Cap, veh/h	378	2778	28	246	2618	134	150	14	166	174	15	159
Arrive On Green	0.03	0.73	0.73	0.04	1.00	1.00	0.10	0.10	0.10	0.10	0.10	0.10
Sat Flow, veh/h	1890	3824	38	1890	3650	186	1354	135	1580	1348	147	1518
Grp Volume(v), veh/h	63	831	874	28	716	744	25	0	38	90	0	68
Grp Sat Flow(s),veh/h/ln	1890	1885	1977	1890	1885	1951	1354	0	1716	1348	0	1664
Q Serve(g_s), s	1.0	25.9	26.0	0.5	0.0	0.0	2.1	0.0	2.4	7.9	0.0	4.6
Cycle Q Clear(g_c), s	1.0	25.9	26.0	0.5	0.0	0.0	6.7	0.0	2.4	10.3	0.0	4.6
Prop In Lane	1.00		0.02	1.00		0.10	1.00		0.92	1.00		0.91
Lane Grp Cap(c), veh/h	378	1370	1437	246	1353	1399	150	0	180	174	0	175
V/C Ratio(X)	0.17	0.61	0.61	0.11	0.53	0.53	0.17	0.00	0.21	0.52	0.00	0.39
Avail Cap(c_a), veh/h	435	1370	1437	319	1353	1399	223	0	272	246	0	264
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	4.0	8.0	8.0	6.9	0.0	0.0	53.2	0.0	49.2	53.9	0.0	50.1
Incr Delay (d2), s/veh	0.2	2.0	1.9	0.2	1.5	1.4	0.5	0.0	0.6	2.4	0.0	1.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	9.4	9.8	0.2	0.6	0.6	0.7	0.0	1.1	2.8	0.0	2.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	4.2	10.0	10.0	7.1	1.5	1.4	53.7	0.0	49.7	56.2	0.0	51.5
LnGrp LOS	A	B	A	A	A	A	D	A	D	E	A	D
Approach Vol, veh/h		1768			1488			63				158
Approach Delay, s/veh		9.8			1.6			51.3				54.2
Approach LOS		A			A			D				D
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.3	93.1		18.6	9.4	92.0		18.6				
Change Period (Y+Rc), s	5.9	5.9		6.0	5.9	5.9		6.0				
Max Green Setting (Gmax), s	7.1	76.1		19.0	7.1	76.1		19.0				
Max Q Clear Time (g_c+I1), s	2.5	28.0		12.3	3.0	2.0		8.7				
Green Ext Time (p_c), s	0.0	18.7		0.3	0.0	14.7		0.1				
Intersection Summary												
HCM 6th Ctrl Delay				9.0								
HCM 6th LOS				A								

HCM 6th TWSC
2: HS Drive & Walton Boulevard

Background Conditions
PM Peak Hour

Intersection						
Int Delay, s/veh	0.5					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↑	↑	↑↑	↑	↑
Traffic Vol, veh/h	1659	46	18	1356	13	12
Future Vol, veh/h	1659	46	18	1356	13	12
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	300	500	-	0	75
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	73	61	64	72	69	69
Heavy Vehicles, %	2	0	0	2	0	0
Mvmt Flow	2273	75	28	1883	19	17

Major/Minor	Major1	Major2	Minor1	Minor2	Minor3
Conflicting Flow All	0	0	2348	0	3271
Stage 1	-	-	-	-	2273
Stage 2	-	-	-	-	998
Critical Hdwy	-	-	4.1	-	6.8
Critical Hdwy Stg 1	-	-	-	-	5.8
Critical Hdwy Stg 2	-	-	-	-	5.8
Follow-up Hdwy	-	-	2.2	-	3.5
Pot Cap-1 Maneuver	-	-	214	-	*0
Stage 1	-	-	-	-	*119
Stage 2	-	-	-	-	*490
Platoon blocked, %	-	-	1	-	1
Mov Cap-1 Maneuver	-	-	214	-	*0
Mov Cap-2 Maneuver	-	-	-	-	*85
Stage 1	-	-	-	-	*119
Stage 2	-	-	-	-	*426

Approach	EB	WB	NB
HCM Control Delay, s	0	0.4	37.7
HCM LOS			E

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	85	391	-	-	214	-
HCM Lane V/C Ratio	0.222	0.044	-	-	0.131	-
HCM Control Delay (s)	59	14.6	-	-	24.4	-
HCM Lane LOS	F	B	-	-	C	-
HCM 95th %tile Q(veh)	0.8	0.1	-	-	0.4	-

Notes
 ~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

HCM 6th Signalized Intersection Summary

3: Livernois Road & Walton Boulevard

Background Conditions
PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↗		↑↑	↗	↗↗	↑↑	↗		↑↑	↗
Traffic Volume (veh/h)	0	1271	400	0	895	172	378	721	318	0	584	101
Future Volume (veh/h)	0	1271	400	0	895	172	378	721	318	0	584	101
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	0	1984	1984	0	1984	1984	1984	1984	1984	0	1984	1984
Adj Flow Rate, veh/h	0	1352	426	0	994	191	402	767	338	0	615	106
Peak Hour Factor	0.94	0.94	0.94	0.90	0.90	0.90	0.94	0.94	0.94	0.95	0.95	0.95
Percent Heavy Veh, %	0	1	1	0	1	1	1	1	1	0	1	1
Cap, veh/h	0	1529	970	0	1529	682	628	1839	819	0	993	443
Arrive On Green	0.00	0.27	0.27	0.00	0.41	0.41	0.17	0.49	0.49	0.00	0.26	0.26
Sat Flow, veh/h	0	3870	1682	0	3870	1682	3666	3770	1679	0	3870	1682
Grp Volume(v), veh/h	0	1352	426	0	994	191	402	767	338	0	615	106
Grp Sat Flow(s),veh/h/ln	0	1885	1682	0	1885	1682	1833	1885	1679	0	1885	1682
Q Serve(g_s), s	0.0	41.3	1.9	0.0	25.5	9.1	12.2	15.7	15.5	0.0	17.2	5.9
Cycle Q Clear(g_c), s	0.0	41.3	1.9	0.0	25.5	9.1	12.2	15.7	15.5	0.0	17.2	5.9
Prop In Lane	0.00		1.00	0.00		1.00	1.00		1.00	0.00		1.00
Lane Grp Cap(c), veh/h	0	1529	970	0	1529	682	628	1839	819	0	993	443
V/C Ratio(X)	0.00	0.88	0.44	0.00	0.65	0.28	0.64	0.42	0.41	0.00	0.62	0.24
Avail Cap(c_a), veh/h	0	1590	997	0	1590	709	628	1839	819	0	993	443
HCM Platoon Ratio	1.00	0.67	0.67	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	0.0	41.0	19.1	0.0	28.8	23.9	46.3	19.8	19.7	0.0	38.9	34.8
Incr Delay (d2), s/veh	0.0	6.2	0.3	0.0	0.9	0.2	2.4	0.7	1.5	0.0	2.9	1.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	20.9	15.0	0.0	11.5	3.6	5.7	6.8	6.2	0.0	8.2	2.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	0.0	47.2	19.4	0.0	29.7	24.1	48.7	20.5	21.2	0.0	41.8	36.0
LnGrp LOS	A	D	B	A	C	C	D	C	C	A	D	D
Approach Vol, veh/h		1778			1185			1507			721	
Approach Delay, s/veh		40.5			28.8			28.2			41.0	
Approach LOS		D			C			C			D	
Timer - Assigned Phs		2		4	5	6		8				
Phs Duration (G+Y+Rc), s		64.9		55.1	26.9	38.0		55.1				
Change Period (Y+Rc), s		6.4		6.4	6.4	6.4		6.4				
Max Green Setting (Gmax), s		56.6		50.6	18.6	31.6		50.6				
Max Q Clear Time (g_c+I1), s		17.7		43.3	14.2	19.2		27.5				
Green Ext Time (p_c), s		9.2		5.4	0.7	3.4		8.1				
Intersection Summary												
HCM 6th Ctrl Delay			34.3									
HCM 6th LOS			C									

Intersection: 1: Rochdale Drive & Walton Boulevard

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	TR	L	TR
Maximum Queue (ft)	46	117	139	27	60	80	47	58	130	78
Average Queue (ft)	12	31	50	4	15	20	8	17	50	27
95th Queue (ft)	38	83	114	20	45	57	32	45	103	62
Link Distance (ft)		2092	2092		680	680		893		621
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (ft)	500			500			125		500	
Storage Blk Time (%)										
Queuing Penalty (veh)										

Intersection: 2: Livernois Road & Walton Boulevard

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	NB	NB	SB
Directions Served	T	T	R	T	T	R	L	L	T	T	R	T
Maximum Queue (ft)	255	290	199	450	461	225	180	195	145	120	113	367
Average Queue (ft)	130	139	126	259	278	139	88	107	50	38	32	226
95th Queue (ft)	210	237	214	391	416	273	163	177	108	89	82	332
Link Distance (ft)	657	657		2662	2662				1979	1979		1651
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)			150			100	225	225				500
Storage Blk Time (%)		7	5		41	6		0	0			
Queuing Penalty (veh)		24	13		68	32		0	1			

Intersection: 2: Livernois Road & Walton Boulevard

Movement	SB	SB
Directions Served	T	R
Maximum Queue (ft)	352	148
Average Queue (ft)	212	68
95th Queue (ft)	317	127
Link Distance (ft)	1651	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		400
Storage Blk Time (%)	0	
Queuing Penalty (veh)	0	

Intersection: 91: HS Drive & Walton Boulevard

Movement	EB	EB	EB	WB	NB	NB
Directions Served	T	T	R	L	L	R
Maximum Queue (ft)	4	14	8	91	100	117
Average Queue (ft)	0	0	0	41	31	39
95th Queue (ft)	3	8	6	75	72	82
Link Distance (ft)	680	680			431	
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)			300	500		75
Storage Blk Time (%)					1	2
Queuing Penalty (veh)					2	1

Zone Summary

Zone wide Queuing Penalty: 142

HCM 6th TWSC
2: HS Drive & Walton Boulevard

Background Conditions
AM Peak Hour

Intersection						
Int Delay, s/veh	2.7					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↑	↑	↑↑	↑	↑
Traffic Vol, veh/h	735	177	113	1277	53	166
Future Vol, veh/h	735	177	113	1277	53	166
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	300	500	-	0	75
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	82	47	57	90	52	52
Heavy Vehicles, %	3	0	0	2	1	1
Mvmt Flow	896	377	198	1419	102	319

Major/Minor	Major1	Major2	Minor1	Minor2	Minor3
Conflicting Flow All	0	0	1273	0	2002
Stage 1	-	-	-	-	896
Stage 2	-	-	-	-	1106
Critical Hdwy	-	-	4.1	-	6.82
Critical Hdwy Stg 1	-	-	-	-	5.82
Critical Hdwy Stg 2	-	-	-	-	5.82
Follow-up Hdwy	-	-	2.2	-	3.51
Pot Cap-1 Maneuver	-	-	694	-	*266
Stage 1	-	-	-	-	*643
Stage 2	-	-	-	-	*537
Platoon blocked, %	-	-	1	-	1
Mov Cap-1 Maneuver	-	-	694	-	*190
Mov Cap-2 Maneuver	-	-	-	-	*297
Stage 1	-	-	-	-	*643
Stage 2	-	-	-	-	*384

Approach	EB	WB	NB
HCM Control Delay, s	0	1.5	15.1
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	297	799	-	-	694	-
HCM Lane V/C Ratio	0.343	0.4	-	-	0.286	-
HCM Control Delay (s)	23.3	12.5	-	-	12.2	-
HCM Lane LOS	C	B	-	-	B	-
HCM 95th %tile Q(veh)	1.5	1.9	-	-	1.2	-

Notes
 ~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection: 1: Rochdale Drive & Walton Boulevard

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	TR	L	TR
Maximum Queue (ft)	74	202	211	41	82	90	51	44	146	107
Average Queue (ft)	33	89	104	12	28	26	16	17	65	42
95th Queue (ft)	67	171	189	34	71	68	45	44	120	82
Link Distance (ft)		2092	2092		680	680		893		621
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (ft)	500			500			125		500	
Storage Blk Time (%)										
Queuing Penalty (veh)										

Intersection: 2: Livernois Road & Walton Boulevard

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	NB	NB	SB
Directions Served	T	T	R	T	T	R	L	L	T	T	R	T
Maximum Queue (ft)	645	661	200	318	361	225	212	234	223	217	270	264
Average Queue (ft)	389	424	187	192	204	114	123	141	132	133	123	177
95th Queue (ft)	592	630	244	279	311	242	200	214	202	205	216	239
Link Distance (ft)	657	657		2662	2662				1979	1979		1651
Upstream Blk Time (%)	1	2										
Queuing Penalty (veh)	7	12										
Storage Bay Dist (ft)			150			100	225	225			500	
Storage Blk Time (%)		39	8		32	5	0	0	0			
Queuing Penalty (veh)		155	52		55	23	0	2	1			

Intersection: 2: Livernois Road & Walton Boulevard

Movement	SB	SB
Directions Served	T	R
Maximum Queue (ft)	251	144
Average Queue (ft)	156	53
95th Queue (ft)	231	110
Link Distance (ft)	1651	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)	400	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 91: HS Drive & Walton Boulevard

Movement	EB	EB	EB	WB	NB	NB
Directions Served	T	T	R	L	L	R
Maximum Queue (ft)	230	252	74	56	79	42
Average Queue (ft)	16	18	3	17	13	7
95th Queue (ft)	142	149	53	48	51	26
Link Distance (ft)	680	680			431	
Upstream Blk Time (%)	0	0				
Queuing Penalty (veh)	0	1				
Storage Bay Dist (ft)			300	500		75
Storage Blk Time (%)		1			2	0
Queuing Penalty (veh)		0			0	0

Zone Summary

Zone wide Queuing Penalty: 308

HCM 6th TWSC
2: HS Drive & Walton Boulevard

Background Conditions
PM Peak Hour

Intersection						
Int Delay, s/veh	0.5					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↑	↑	↑↑	↑	↑
Traffic Vol, veh/h	1659	46	18	1356	13	12
Future Vol, veh/h	1659	46	18	1356	13	12
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	300	500	-	0	75
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	73	61	64	72	69	69
Heavy Vehicles, %	2	0	0	2	0	0
Mvmt Flow	2273	75	28	1883	19	17

Major/Minor	Major1	Major2	Minor1	Minor2	Minor3
Conflicting Flow All	0	0	2348	0	3271
Stage 1	-	-	-	-	2273
Stage 2	-	-	-	-	998
Critical Hdwy	-	-	4.1	-	6.8
Critical Hdwy Stg 1	-	-	-	-	5.8
Critical Hdwy Stg 2	-	-	-	-	5.8
Follow-up Hdwy	-	-	2.2	-	3.5
Pot Cap-1 Maneuver	-	-	214	-	*0
Stage 1	-	-	-	-	*119
Stage 2	-	-	-	-	*490
Platoon blocked, %	-	-	1	-	1
Mov Cap-1 Maneuver	-	-	214	-	*0
Mov Cap-2 Maneuver	-	-	-	-	*85
Stage 1	-	-	-	-	*119
Stage 2	-	-	-	-	*426

Approach	EB	WB	NB
HCM Control Delay, s	0	0.4	37.7
HCM LOS			E

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	85	391	-	-	214	-
HCM Lane V/C Ratio	0.222	0.044	-	-	0.131	-
HCM Control Delay (s)	59	14.6	-	-	24.4	-
HCM Lane LOS	F	B	-	-	C	-
HCM 95th %tile Q(veh)	0.8	0.1	-	-	0.4	-

Notes
 ~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Appendix D

FUTURE TRAFFIC CONDITIONS

HCM 6th Signalized Intersection Summary
1: Rochdale Drive & Walton Boulevard

Future Conditions
AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	23	847	12	12	1301	28	7	2	22	54	3	36
Future Volume (veh/h)	23	847	12	12	1301	28	7	2	22	54	3	36
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.99	0.99		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1969	1969	1969	1969	1969	1969	2000	2000	2000	1938	1938	1938
Adj Flow Rate, veh/h	28	1033	15	13	1446	31	10	3	32	82	5	55
Peak Hour Factor	0.82	0.82	0.82	0.90	0.90	0.90	0.68	0.68	0.68	0.66	0.66	0.66
Percent Heavy Veh, %	2	2	2	2	2	2	0	0	0	4	4	4
Cap, veh/h	360	2801	41	429	2747	59	147	14	153	166	13	148
Arrive On Green	0.02	0.74	0.74	0.02	1.00	1.00	0.10	0.10	0.10	0.10	0.10	0.10
Sat Flow, veh/h	1875	3774	55	1875	3744	80	1358	146	1561	1345	138	1516
Grp Volume(v), veh/h	28	512	536	13	722	755	10	0	35	82	0	60
Grp Sat Flow(s),veh/h/ln	1875	1870	1959	1875	1870	1954	1358	0	1708	1345	0	1654
Q Serve(g_s), s	0.4	11.7	11.7	0.2	0.0	0.0	0.8	0.0	2.3	7.2	0.0	4.1
Cycle Q Clear(g_c), s	0.4	11.7	11.7	0.2	0.0	0.0	4.9	0.0	2.3	9.4	0.0	4.1
Prop In Lane	1.00		0.03	1.00		0.04	1.00		0.91	1.00		0.92
Lane Grp Cap(c), veh/h	360	1388	1454	429	1372	1434	147	0	167	166	0	162
V/C Ratio(X)	0.08	0.37	0.37	0.03	0.53	0.53	0.07	0.00	0.21	0.49	0.00	0.37
Avail Cap(c_a), veh/h	418	1388	1454	503	1372	1434	240	0	285	259	0	276
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	3.7	5.5	5.5	4.3	0.0	0.0	53.0	0.0	49.9	54.2	0.0	50.7
Incr Delay (d2), s/veh	0.1	0.8	0.7	0.0	1.4	1.4	0.2	0.0	0.6	2.3	0.0	1.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	4.0	4.2	0.1	0.6	0.6	0.3	0.0	1.0	2.6	0.0	1.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	3.8	6.2	6.2	4.4	1.4	1.4	53.2	0.0	50.5	56.5	0.0	52.1
LnGrp LOS	A	A	A	A	A	A	D	A	D	E	A	D
Approach Vol, veh/h		1076			1490			45				142
Approach Delay, s/veh		6.2			1.4			51.1				54.6
Approach LOS		A			A			D				D
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	7.3	95.0		17.7	8.3	93.9		17.7				
Change Period (Y+Rc), s	5.9	5.9		6.0	5.9	5.9		6.0				
Max Green Setting (Gmax), s	6.1	76.1		20.0	6.1	76.1		20.0				
Max Q Clear Time (g_c+I1), s	2.2	13.7		11.4	2.4	2.0		6.9				
Green Ext Time (p_c), s	0.0	8.0		0.3	0.0	15.0		0.1				
Intersection Summary												
HCM 6th Ctrl Delay				6.8								
HCM 6th LOS				A								

HCM 6th TWSC
2: HS Drive & Walton Boulevard

Future Conditions
AM Peak Hour

Intersection						
Int Delay, s/veh	2.7					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↑	↑	↑↑	↑	↑
Traffic Vol, veh/h	746	177	113	1288	53	166
Future Vol, veh/h	746	177	113	1288	53	166
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	300	150	-	0	75
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	82	47	57	90	52	52
Heavy Vehicles, %	3	0	0	2	1	1
Mvmt Flow	910	377	198	1431	102	319

Major/Minor	Major1	Major2	Minor1	Minor2	Minor3
Conflicting Flow All	0	0	1287	0	2022
Stage 1	-	-	-	-	910
Stage 2	-	-	-	-	1112
Critical Hdwy	-	-	4.1	-	6.82
Critical Hdwy Stg 1	-	-	-	-	5.82
Critical Hdwy Stg 2	-	-	-	-	5.82
Follow-up Hdwy	-	-	2.2	-	3.51
Pot Cap-1 Maneuver	-	-	683	-	*266
Stage 1	-	-	-	-	*630
Stage 2	-	-	-	-	*537
Platoon blocked, %	-	-	1	-	1
Mov Cap-1 Maneuver	-	-	683	-	*189
Mov Cap-2 Maneuver	-	-	-	-	*295
Stage 1	-	-	-	-	*630
Stage 2	-	-	-	-	*381

Approach	EB	WB	NB
HCM Control Delay, s	0	1.5	15.2
HCM LOS			C













Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	295	799	-	-	683	-
HCM Lane V/C Ratio	0.346	0.4	-	-	0.29	-
HCM Control Delay (s)	23.5	12.5	-	-	12.4	-
HCM Lane LOS	C	B	-	-	B	-
HCM 95th %tile Q(veh)	1.5	1.9	-	-	1.2	-

Notes
 ~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

HCM 6th Signalized Intersection Summary

3: Livernois Road & Walton Boulevard

Future Conditions
AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↗		↑↑	↗	↗↗	↑↑	↗		↑↑	↗
Traffic Volume (veh/h)	0	603	333	0	976	163	279	317	124	0	941	173
Future Volume (veh/h)	0	603	333	0	976	163	279	317	124	0	941	173
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	0	1953	1953	0	1969	1969	1938	1938	1938	0	1984	1984
Adj Flow Rate, veh/h	0	735	406	0	1162	194	332	377	148	0	1107	204
Peak Hour Factor	0.82	0.82	0.82	0.84	0.84	0.84	0.84	0.84	0.84	0.85	0.85	0.85
Percent Heavy Veh, %	0	3	3	0	2	2	4	4	4	0	1	1
Cap, veh/h	0	1268	788	0	1278	570	484	2031	905	0	1370	611
Arrive On Green	0.00	0.45	0.45	0.00	0.34	0.34	0.14	0.55	0.55	0.00	0.36	0.36
Sat Flow, veh/h	0	3809	1651	0	3839	1668	3580	3681	1639	0	3870	1682
Grp Volume(v), veh/h	0	735	406	0	1162	194	332	377	148	0	1107	204
Grp Sat Flow(s),veh/h/ln	0	1856	1651	0	1870	1668	1790	1841	1639	0	1885	1682
Q Serve(g_s), s	0.0	17.6	0.0	0.0	35.6	10.4	10.6	6.1	5.3	0.0	31.8	10.5
Cycle Q Clear(g_c), s	0.0	17.6	0.0	0.0	35.6	10.4	10.6	6.1	5.3	0.0	31.8	10.5
Prop In Lane	0.00		1.00	0.00		1.00	1.00		1.00	0.00		1.00
Lane Grp Cap(c), veh/h	0	1268	788	0	1278	570	484	2031	905	0	1370	611
V/C Ratio(X)	0.00	0.58	0.52	0.00	0.91	0.34	0.69	0.19	0.16	0.00	0.81	0.33
Avail Cap(c_a), veh/h	0	1317	810	0	1328	592	484	2031	905	0	1370	611
HCM Platoon Ratio	1.00	1.33	1.33	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	0.0	26.4	17.1	0.0	37.7	29.4	49.5	13.4	13.3	0.0	34.4	27.7
Incr Delay (d2), s/veh	0.0	0.6	0.5	0.0	9.3	0.4	4.2	0.2	0.4	0.0	5.2	1.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	7.0	13.6	0.0	17.5	4.2	4.9	2.5	2.0	0.0	15.0	4.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	0.0	27.0	17.6	0.0	47.0	29.8	53.7	13.6	13.6	0.0	39.6	29.1
LnGrp LOS	A	C	B	A	D	C	D	B	B	A	D	C
Approach Vol, veh/h		1141			1356			857			1311	
Approach Delay, s/veh		23.6			44.5			29.2			38.0	
Approach LOS		C			D			C			D	
Timer - Assigned Phs		2		4	5	6		8				
Phs Duration (G+Y+Rc), s		72.6		47.4	22.6	50.0		47.4				
Change Period (Y+Rc), s		6.4		6.4	6.4	6.4		6.4				
Max Green Setting (Gmax), s		64.6		42.6	14.6	43.6		42.6				
Max Q Clear Time (g_c+I1), s		8.1		19.6	12.6	33.8		37.6				
Green Ext Time (p_c), s		3.8		6.6	0.3	5.5		3.4				
Intersection Summary												
HCM 6th Ctrl Delay			34.8									
HCM 6th LOS			C									

Intersection						
Int Delay, s/veh	0.7					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↘	↑↑	↑↑		↘	↘
Traffic Vol, veh/h	30	882	1361	67	54	40
Future Vol, veh/h	30	882	1361	67	54	40
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	150	-	-	-	0	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	82	82	90	90	90	90
Heavy Vehicles, %	3	3	2	2	2	2
Mvmt Flow	37	1076	1512	74	60	44

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	1586	0	-	0	2161 793
Stage 1	-	-	-	-	1549 -
Stage 2	-	-	-	-	612 -
Critical Hdwy	4.16	-	-	-	6.84 6.94
Critical Hdwy Stg 1	-	-	-	-	5.84 -
Critical Hdwy Stg 2	-	-	-	-	5.84 -
Follow-up Hdwy	2.23	-	-	-	3.52 3.32
Pot Cap-1 Maneuver	747	-	-	-	*228 *516
Stage 1	-	-	-	-	*487 -
Stage 2	-	-	-	-	*680 -
Platoon blocked, %	1	-	-	-	1 1
Mov Cap-1 Maneuver	747	-	-	-	*217 *516
Mov Cap-2 Maneuver	-	-	-	-	*345 -
Stage 1	-	-	-	-	*463 -
Stage 2	-	-	-	-	*680 -

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	15.5
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	747	-	-	-	345	516
HCM Lane V/C Ratio	0.049	-	-	-	0.174	0.086
HCM Control Delay (s)	10.1	-	-	-	17.6	12.6
HCM Lane LOS	B	-	-	-	C	B
HCM 95th %tile Q(veh)	0.2	-	-	-	0.6	0.3

Notes
 ~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

HCM 6th Signalized Intersection Summary

1: Rochdale Drive & Walton Boulevard

Future Conditions
PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	60	1610	16	26	1283	65	17	2	24	77	5	53
Future Volume (veh/h)	60	1610	16	26	1283	65	17	2	24	77	5	53
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1984	1984	1984	1984	1984	1984	2000	2000	2000	1938	1938	1938
Adj Flow Rate, veh/h	63	1695	17	28	1395	71	25	3	35	90	6	62
Peak Hour Factor	0.95	0.95	0.95	0.92	0.92	0.92	0.68	0.68	0.68	0.86	0.86	0.86
Percent Heavy Veh, %	1	1	1	1	1	1	0	0	0	4	4	4
Cap, veh/h	377	2778	28	244	2619	133	150	14	166	174	15	159
Arrive On Green	0.03	0.73	0.73	0.04	1.00	1.00	0.10	0.10	0.10	0.10	0.10	0.10
Sat Flow, veh/h	1890	3824	38	1890	3650	185	1354	135	1580	1348	147	1518
Grp Volume(v), veh/h	63	835	877	28	719	747	25	0	38	90	0	68
Grp Sat Flow(s),veh/h/ln	1890	1885	1977	1890	1885	1951	1354	0	1716	1348	0	1664
Q Serve(g_s), s	1.0	26.1	26.2	0.5	0.0	0.0	2.1	0.0	2.4	7.9	0.0	4.6
Cycle Q Clear(g_c), s	1.0	26.1	26.2	0.5	0.0	0.0	6.7	0.0	2.4	10.3	0.0	4.6
Prop In Lane	1.00		0.02	1.00		0.10	1.00		0.92	1.00		0.91
Lane Grp Cap(c), veh/h	377	1370	1437	244	1353	1400	150	0	180	174	0	175
V/C Ratio(X)	0.17	0.61	0.61	0.11	0.53	0.53	0.17	0.00	0.21	0.52	0.00	0.39
Avail Cap(c_a), veh/h	433	1370	1437	318	1353	1400	223	0	272	246	0	264
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	4.0	8.1	8.1	6.9	0.0	0.0	53.2	0.0	49.2	53.9	0.0	50.1
Incr Delay (d2), s/veh	0.2	2.0	1.9	0.2	1.5	1.5	0.5	0.0	0.6	2.4	0.0	1.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	9.4	9.9	0.2	0.6	0.6	0.7	0.0	1.1	2.8	0.0	2.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	4.2	10.1	10.0	7.1	1.5	1.5	53.7	0.0	49.7	56.2	0.0	51.5
LnGrp LOS	A	B	B	A	A	A	D	A	D	E	A	D
Approach Vol, veh/h		1775			1494			63			158	
Approach Delay, s/veh		9.8			1.6			51.3			54.2	
Approach LOS		A			A			D			D	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.3	93.1		18.6	9.4	92.0		18.6				
Change Period (Y+Rc), s	5.9	5.9		6.0	5.9	5.9		6.0				
Max Green Setting (Gmax), s	7.1	76.1		19.0	7.1	76.1		19.0				
Max Q Clear Time (g_c+I1), s	2.5	28.2		12.3	3.0	2.0		8.7				
Green Ext Time (p_c), s	0.0	18.8		0.3	0.0	14.8		0.1				
Intersection Summary												
HCM 6th Ctrl Delay				9.1								
HCM 6th LOS				A								

HCM 6th TWSC
2: HS Drive & Walton Boulevard

Future Conditions
PM Peak Hour

Intersection						
Int Delay, s/veh	0.3					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↑	↑	↑↑	↑	↑
Traffic Vol, veh/h	1665	46	18	1361	13	12
Future Vol, veh/h	1665	46	18	1361	13	12
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	300	150	-	0	75
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	61	64	92	69	69
Heavy Vehicles, %	2	0	0	2	0	0
Mvmt Flow	1771	75	28	1479	19	17

Major/Minor	Major1	Major2	Minor1	Minor2	Minor3
Conflicting Flow All	0	0	1846	0	2567
Stage 1	-	-	-	-	1771
Stage 2	-	-	-	-	796
Critical Hdwy	-	-	4.1	-	6.8
Critical Hdwy Stg 1	-	-	-	-	5.8
Critical Hdwy Stg 2	-	-	-	-	5.8
Follow-up Hdwy	-	-	2.2	-	3.5
Pot Cap-1 Maneuver	-	-	*587	-	*122
Stage 1	-	-	-	-	*369
Stage 2	-	-	-	-	*490
Platoon blocked, %	-	-	1	-	1
Mov Cap-1 Maneuver	-	-	*587	-	*117
Mov Cap-2 Maneuver	-	-	-	-	*240
Stage 1	-	-	-	-	*369
Stage 2	-	-	-	-	*466

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	18.1
HCM LOS			C













Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	240	391	-	-	* 587	-
HCM Lane V/C Ratio	0.079	0.044	-	-	0.048	-
HCM Control Delay (s)	21.3	14.6	-	-	11.4	-
HCM Lane LOS	C	B	-	-	B	-
HCM 95th %tile Q(veh)	0.3	0.1	-	-	0.2	-

Notes
 ~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

HCM 6th Signalized Intersection Summary

3: Livernois Road & Walton Boulevard

Future Conditions
PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↗		↑↑	↗	↘↘	↑↑	↗		↑↑	↗
Traffic Volume (veh/h)	0	1277	408	0	902	172	382	725	318	0	584	105
Future Volume (veh/h)	0	1277	408	0	902	172	382	725	318	0	584	105
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	0	1984	1984	0	1984	1984	1984	1984	1984	0	1984	1984
Adj Flow Rate, veh/h	0	1359	434	0	1002	191	406	771	338	0	615	111
Peak Hour Factor	0.94	0.94	0.94	0.90	0.90	0.90	0.94	0.94	0.94	0.95	0.95	0.95
Percent Heavy Veh, %	0	1	1	0	1	1	1	1	1	0	1	1
Cap, veh/h	0	1533	970	0	1533	684	624	1836	817	0	993	443
Arrive On Green	0.00	0.27	0.27	0.00	0.41	0.41	0.17	0.49	0.49	0.00	0.26	0.26
Sat Flow, veh/h	0	3870	1682	0	3870	1682	3666	3770	1679	0	3870	1682
Grp Volume(v), veh/h	0	1359	434	0	1002	191	406	771	338	0	615	111
Grp Sat Flow(s),veh/h/ln	0	1885	1682	0	1885	1682	1833	1885	1679	0	1885	1682
Q Serve(g_s), s	0.0	41.5	2.6	0.0	25.8	9.1	12.4	15.8	15.5	0.0	17.2	6.2
Cycle Q Clear(g_c), s	0.0	41.5	2.6	0.0	25.8	9.1	12.4	15.8	15.5	0.0	17.2	6.2
Prop In Lane	0.00		1.00	0.00		1.00	1.00		1.00	0.00		1.00
Lane Grp Cap(c), veh/h	0	1533	970	0	1533	684	624	1836	817	0	993	443
V/C Ratio(X)	0.00	0.89	0.45	0.00	0.65	0.28	0.65	0.42	0.41	0.00	0.62	0.25
Avail Cap(c_a), veh/h	0	1590	995	0	1590	709	624	1836	817	0	993	443
HCM Platoon Ratio	1.00	0.67	0.67	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(l)	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	0.0	41.0	19.3	0.0	28.8	23.8	46.5	19.9	19.8	0.0	38.9	34.9
Incr Delay (d2), s/veh	0.0	6.3	0.3	0.0	0.9	0.2	2.6	0.7	1.5	0.0	2.9	1.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	21.1	15.5	0.0	11.6	3.6	5.8	6.9	6.2	0.0	8.2	2.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	0.0	47.3	19.6	0.0	29.7	24.1	49.0	20.6	21.3	0.0	41.8	36.2
LnGrp LOS	A	D	B	A	C	C	D	C	C	A	D	D
Approach Vol, veh/h		1793			1193			1515			726	
Approach Delay, s/veh		40.6			28.8			28.4			41.0	
Approach LOS		D			C			C			D	
Timer - Assigned Phs		2		4	5	6		8				
Phs Duration (G+Y+Rc), s		64.8		55.2	26.8	38.0		55.2				
Change Period (Y+Rc), s		6.4		6.4	6.4	6.4		6.4				
Max Green Setting (Gmax), s		56.6		50.6	18.6	31.6		50.6				
Max Q Clear Time (g_c+I1), s		17.8		43.5	14.4	19.2		27.8				
Green Ext Time (p_c), s		9.2		5.3	0.7	3.4		8.2				
Intersection Summary												
HCM 6th Ctrl Delay			34.4									
HCM 6th LOS			C									

HCM 6th TWSC
4: Walton Boulevard & Site Drive

Future Conditions
PM Peak Hour

Intersection						
Int Delay, s/veh	0.4					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↘	↑↑	↑↑		↘	↘
Traffic Vol, veh/h	19	1658	1363	26	27	16
Future Vol, veh/h	19	1658	1363	26	27	16
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	150	-	-	-	0	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	94	94	92	92	72	72
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	20	1764	1482	28	38	22

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	1510	0	-	0	2418 755
Stage 1	-	-	-	-	1496 -
Stage 2	-	-	-	-	922 -
Critical Hdwy	4.14	-	-	-	6.84 6.94
Critical Hdwy Stg 1	-	-	-	-	5.84 -
Critical Hdwy Stg 2	-	-	-	-	5.84 -
Follow-up Hdwy	2.22	-	-	-	3.52 3.32
Pot Cap-1 Maneuver	*773	-	-	-	*130 *516
Stage 1	-	-	-	-	*487 -
Stage 2	-	-	-	-	*367 -
Platoon blocked, %	1	-	-	-	1 1
Mov Cap-1 Maneuver	*773	-	-	-	*127 *516
Mov Cap-2 Maneuver	-	-	-	-	*246 -
Stage 1	-	-	-	-	*475 -
Stage 2	-	-	-	-	*367 -

Approach	EB	WB	SB
HCM Control Delay, s	0.1	0	18.5
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	* 773	-	-	-	246	516
HCM Lane V/C Ratio	0.026	-	-	-	0.152	0.043
HCM Control Delay (s)	9.8	-	-	-	22.2	12.3
HCM Lane LOS	A	-	-	-	C	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.5	0.1

Notes
 ~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection: 1: Rochdale Drive & Walton Boulevard

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	TR	L	TR
Maximum Queue (ft)	56	114	138	23	78	98	35	58	122	95
Average Queue (ft)	15	33	49	5	22	33	5	20	49	31
95th Queue (ft)	43	82	116	19	60	82	25	51	107	75
Link Distance (ft)		2092	2092		677	677		893		621
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (ft)	500			500			125		500	
Storage Blk Time (%)										
Queuing Penalty (veh)										

Intersection: 2: HS Drive & Walton Boulevard

Movement	EB	WB	WB	WB	NB	NB
Directions Served	R	L	T	T	L	R
Maximum Queue (ft)	35	100	80	50	390	125
Average Queue (ft)	3	42	4	2	75	48
95th Queue (ft)	19	82	40	26	266	112
Link Distance (ft)			124	124	431	
Upstream Blk Time (%)		0	0	0	3	
Queuing Penalty (veh)		0	2	0	0	
Storage Bay Dist (ft)	300	150				75
Storage Blk Time (%)		0	0		15	5
Queuing Penalty (veh)		0	0		38	4

Intersection: 3: Livernois Road & Walton Boulevard

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	NB	NB	SB
Directions Served	T	T	R	T	T	R	L	L	T	T	R	T
Maximum Queue (ft)	262	331	200	517	536	225	208	229	134	126	143	364
Average Queue (ft)	140	153	119	279	307	140	92	119	50	37	33	229
95th Queue (ft)	220	260	211	440	470	279	174	194	101	89	92	330
Link Distance (ft)	487	487		2662	2662				1979	1979		1657
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)			150			100	225	225				500
Storage Blk Time (%)		8	5		44	6	0	0				
Queuing Penalty (veh)		27	14		73	31	0	1				

Intersection: 3: Livernois Road & Walton Boulevard

Movement	SB	SB
Directions Served	T	R
Maximum Queue (ft)	356	200
Average Queue (ft)	219	85
95th Queue (ft)	322	157
Link Distance (ft)	1657	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		400
Storage Blk Time (%)	0	
Queuing Penalty (veh)	0	

Intersection: 4: Walton Boulevard & Site Drive

Movement	EB	WB	WB	SB	SB
Directions Served	L	T	TR	L	R
Maximum Queue (ft)	52	22	20	104	103
Average Queue (ft)	17	1	1	40	28
95th Queue (ft)	49	12	9	94	68
Link Distance (ft)		487	487	199	199
Upstream Blk Time (%)				0	0
Queuing Penalty (veh)				0	0
Storage Bay Dist (ft)	150				
Storage Blk Time (%)					
Queuing Penalty (veh)					

Zone Summary

Zone wide Queuing Penalty: 191

Intersection: 1: Rochdale Drive & Walton Boulevard

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	TR	L	TR
Maximum Queue (ft)	83	215	231	50	78	88	56	57	152	81
Average Queue (ft)	34	87	108	13	12	24	16	20	63	37
95th Queue (ft)	71	172	201	35	45	65	47	49	119	70
Link Distance (ft)		2092	2092		677	677		893		621
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (ft)	500			500			125		500	
Storage Blk Time (%)										
Queuing Penalty (veh)										

Intersection: 2: HS Drive & Walton Boulevard

Movement	EB	EB	WB	NB	NB
Directions Served	T	T	L	L	R
Maximum Queue (ft)	78	86	51	55	34
Average Queue (ft)	5	7	14	15	9
95th Queue (ft)	49	61	41	44	29
Link Distance (ft)	677	677		431	
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)			150		75
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 3: Livernois Road & Walton Boulevard

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	NB	NB	SB
Directions Served	T	T	R	T	T	R	L	L	T	T	R	T
Maximum Queue (ft)	507	516	200	338	363	225	188	209	236	277	246	261
Average Queue (ft)	370	395	191	200	215	125	116	139	133	134	123	172
95th Queue (ft)	536	549	235	300	321	256	182	201	209	219	216	236
Link Distance (ft)	487	487		2662	2662				1979	1979		1657
Upstream Blk Time (%)	4	5										
Queuing Penalty (veh)	30	46										
Storage Bay Dist (ft)			150			100	225	225				500
Storage Blk Time (%)		38	11		32	5		0	0			
Queuing Penalty (veh)		156	69		56	22		0	1			

Intersection: 3: Livernois Road & Walton Boulevard

Movement	SB	SB
Directions Served	T	R
Maximum Queue (ft)	249	134
Average Queue (ft)	150	61
95th Queue (ft)	222	112
Link Distance (ft)	1657	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		400
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 4: Walton Boulevard & Site Drive

Movement	EB	EB	EB	SB	SB
Directions Served	L	T	T	L	R
Maximum Queue (ft)	62	114	143	108	36
Average Queue (ft)	13	18	30	40	15
95th Queue (ft)	44	85	112	97	40
Link Distance (ft)		124	124	199	199
Upstream Blk Time (%)	0	1	2		
Queuing Penalty (veh)	0	9	16		
Storage Bay Dist (ft)	150				
Storage Blk Time (%)	0	1			
Queuing Penalty (veh)	0	0			

Zone Summary

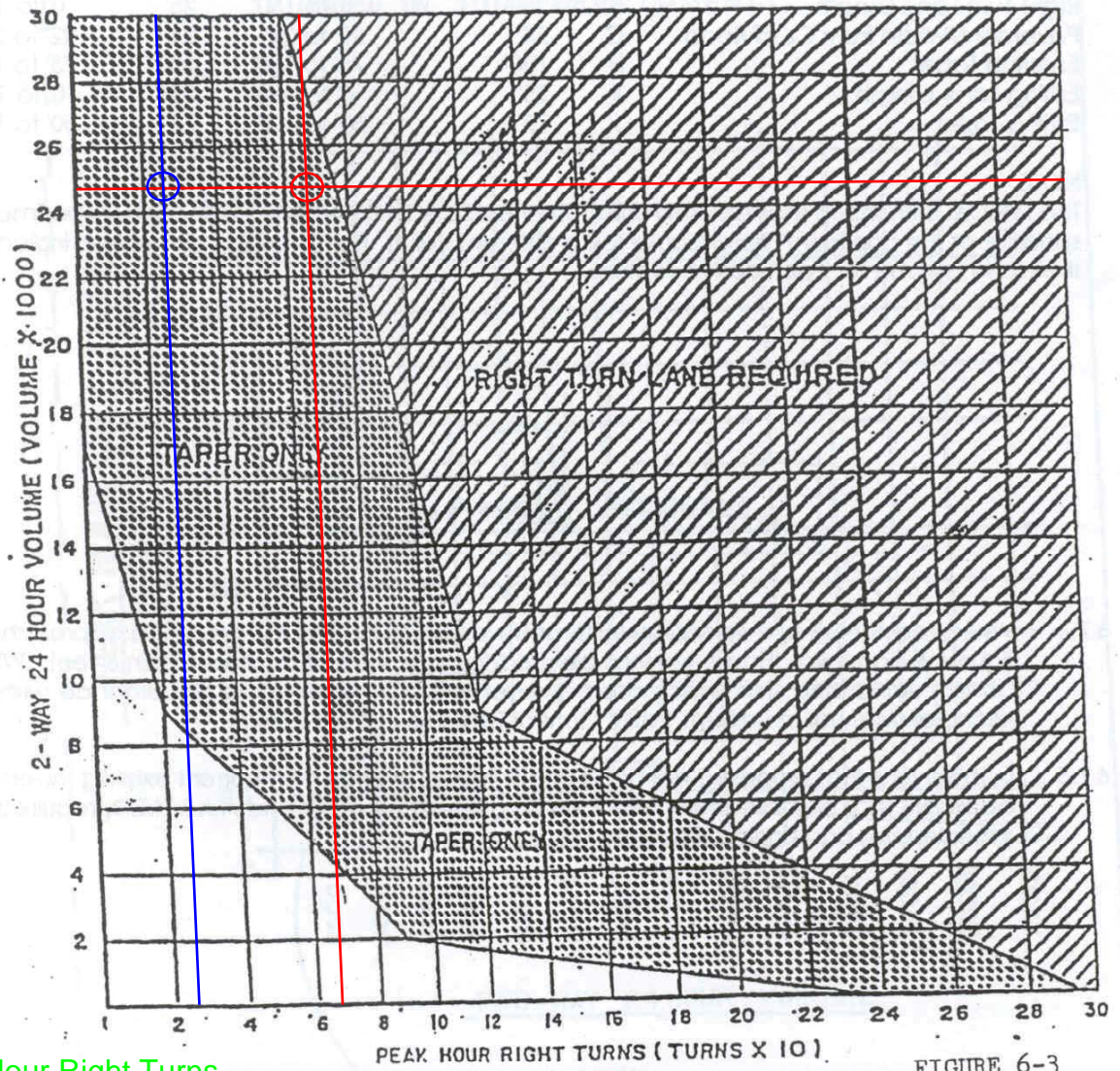
Zone wide Queuing Penalty: 404

Appendix E

WARRANT SUMMARIES

Starbuck's Site Drive at Walton Boulevard
Right-Turn Lane Warrant

WARRANTS FOR RIGHT TURN DECELERATION LANE
OR TAPER



Peak Hour Right Turns
AM: 67 veh
PM: 26 veh

FIGURE 6-3

Right Lane Taper Warranted

2-Way AADT: 24,757 veh per day

Starbuck's Walton Blvd
 95th Percentile Probability - Drive Through Queue Length (# of Vehicles)

Volume = 68 vph
 service rate = 67 veh/hr
 $\lambda = 1.014925$

	1	2	3	4	5	6	7	8	9
λ^x	No Veh in Cycle	X	X!	$P = (e^{(-\lambda)})(\lambda^x)/X!$	ΣP	P* # Cycle containing Volume in 1	Σ Cycles in 6	Volume in Cycle (1*6)	Σ volume
1.0000	0	0	1	36.24%	36.24%	24	24	0	0
1.0149	1	1	1	36.78%	73.03%	25	49	25	25
1.0301	2	2	2	18.67%	91.69%	13	11	25	50
1.0454	3	3	6	6.32%	98.01%	4	15	13	62
1.0611	4	4	24	1.60%	99.61%	1	16	4	67
1.0769	5	5	120	0.33%	99.94%	0	17	1	68
1.0930	6	6	720	0.06%	99.99%	0	17	0	68
1.1093	7	7	5040	0.01%	100.00%	0	17	0	68
1.1258	8	8	40320	0.00%	100.00%	0	17	0	68
1.1426	9	9	362880	0.00%	100.00%	0	17	0	68
1.1597	10	10	3628800	0.00%	100.00%	0	17	0	68
1.1770	11	11	39916800	0.00%	100.00%	0	17	0	68