RESEARCH PARK DEVELOPMENT
TRAFFIC IMPACT STUDY

ROCHESTER HILLS, MICHIGAN

OCTOBER 15, 2019

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Agency Review	Date	Comments
City of Rochester Hills	8/9/2019	DPS/Engineering Review Letter
RCOC	9/25/2019	Traffic Engineering Review-Email

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1 INTRODUCTION

This report presents the results of the Traffic Impact Study (TIS) for a proposed industrial research park development in the City of Rochester Hills, Michigan. The project site is located adjacent to Livernois Road, between Drexelgate Parkway and Horizon Court; the site location is shown on **Figure 1**. As part of the development, a new loop road is proposed through the research park and will connect Horizon Court and Drexelgate Parkway. Several new offices and warehouses are proposed on the property; in addition to the existing land uses, which are currently occupied and will remain.

The purpose of this study is to identify the traffic related impacts, if any, of the proposed development project on the adjacent road network. Specific tasks undertaken for this study include the following:

1. **Study Area:** Provide a description of the study area including: surrounding land uses, 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**: 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 uses will be accompanied with a complete project site plan (with buildings identified as to proposed use).
3. **Existing Conditions**:
    a. Provide an analysis of the traffic-related impacts of the proposed development at the following study intersections:
        - Livernois Road & Drexelgate Parkway
        - Livernois Road & Horizon Court
    b. Collect AM (7:00 AM to 9:00 AM) and PM (4:00 PM to 6:00 PM) peak period turning movement counts at the study intersections. Traffic counts will be taken when school is in session unless otherwise approved by the City of Rochester Hills Traffic Engineer.
    c. Identify the Existing AM and PM peak hour traffic volumes at the study intersections based on turning movement count data.
    d. Calculate the **Existing** vehicle delays, LOS, and vehicle queues at the study intersections during the AM and PM. The analysis will be performed at each of 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.
    e. Identify improvements (if any) for the study road network that would be required to accommodate the existing traffic volumes.
4. **Future Background Growth**:
    a. If the planned completion date for the project or the last phase of the project is beyond one year of the study, an estimate of background traffic growth for the adjacent street network will be made and included in the analysis.
    b. 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 background developments in the vicinity of this project as identified by the City of Rochester Hills Traffic Engineer.
5. **Background Conditions (No Build)**:
    a. 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.
    b. Any state, local, or private transportation improvement projects in the project study area that will be underway in the build-out year and traffic that is generated by other proposed developments in the study area will be included as background conditions.
    c. Identify improvements (if any) for the study road network that would be required to accommodate the background traffic volumes.

FIGURE 1
SITE LOCATION MAP

ROCHESTER RESEARCH PARK TIS - ROCHESTER HILLS, MI

LEGEND

SITE — SITE LOCATION

NORTH

SCALE: NOT TO SCALE

6. **Trip Generation**:
    a. Forecast the number of AM and PM peak hour trips that would be generated by the proposed development based on data published by the Institute of Transportation Engineers (ITE) in *Trip Generation, 10th Edition* and/or local development data as approved for use in the study by the City of Rochester Hills Traffic Engineer.
    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.
7. **Trip Distribution and Traffic Assignment:**
    a. Assign the trips that would be generated by the proposed development to the adjacent road network based on existing traffic patterns. The distribution of the estimated trip generation to the adjacent street network and nearby intersections shall be included in the report and the basis will be explained.
    b. Combine the site-generated traffic assignments with the background traffic forecasts to establish the Future AM and PM peak hour traffic volumes.
8. **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.
9. Complete a technical report consistent with accepted standards and suitable for submission to City of Rochester Hills, which outlines the methodologies, analyses, results, and recommendations of the traffic study. All work will follow accepted traffic engineering practice and the standards documented by ITE, FHWA, and the City of Rochester Hills.

The scope of the 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 methodologies published by the Institute of Transportation Engineers (ITE). Additionally, F&V solicited input regarding the scope of work from the City of Rochester Hills.

Sources of data for this study include traffic counts conducted by F&V subconsultant Traffic Data Collection, Inc. (TDC), information provided by RCOC, City of Rochester Hills, MDOT 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 by Livernois Road. The lane use 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).

Livernois Road runs in the north and south directions with a posted speed limit of 45 mph. Livernois Road is under the jurisdiction of the Road Commission of Oakland County (RCOC) and is classified a *Minor Arterial.* The study segment of Livernois Road has an AADT of 21,750 vehicles per day (SEMCOG 2018). Livernois Road has a typical 2-lane cross section, with one lane in each direction.

Drexelgate Parkway runs generally in the east and west directions with a posted speed limit of 25 mph. Drexelgate Parkway is under the jurisdiction of the City of Rochester Hills and is classified a *local road.* Drexelgate Parkway has a typical 2-lane cross section, with one lane in each direction.

Horizon Court runs in the east and west directions with a posted speed limit of 25 mph. Horizon Court is under the jurisdiction of the City of Rochester Hills and is classified a *local road.* Horizon Court has a typical 2-lane cross section, with one lane in each direction. At the intersection of Livernois Road and Horizon Court, there is an emergency traffic signal; for use by the Rochester Hills Fire Department, which is located along Horizon Court. When the emergency signal is not activated, it operates in flashing mode; therefore, for the purpose of this analysis, the intersection was treated as minor street (Horizon Ct.) stop-controlled.

2.2 EXISTING TRAFFIC VOLUMES

The existing weekday turning movement traffic volume data were collected by F&V subconsultant Traffic Data Collection, Inc. (TDC) on Wednesday, March 21, 2019. Intersection turning movement counts were collected during the weekday AM (7:00 AM to 9:00 AM) and PM (4:00 PM to 6:00 PM) peak periods at the study intersections. F&V also collected an inventory of existing lane use and traffic controls at the study intersections and obtained existing traffic signal timing information from RCOC. The existing AM and PM peak hour traffic volumes were identified based on the data collection.

This data was used as a baseline to establish the current peak hour traffic volumes for the analysis of existing traffic conditions. During collection of the turning movement counts, pedestrian data and commercial truck percentages were recorded and used in the traffic analysis. Peak Hour Factors (PHFs) were also calculated for each study intersection approach.

The peak hour volumes for each intersection were utilized for this study and the volumes were balanced upward through the study network. The peak hours of existing network traffic were identified to occur between 7:00 AM to 8:00 AM and 4:45 PM to 5:45 PM for the weekday.

The traffic volume data are included in **Appendix A** and the existing peak hour traffic volumes are summarized in **Figure 3**.

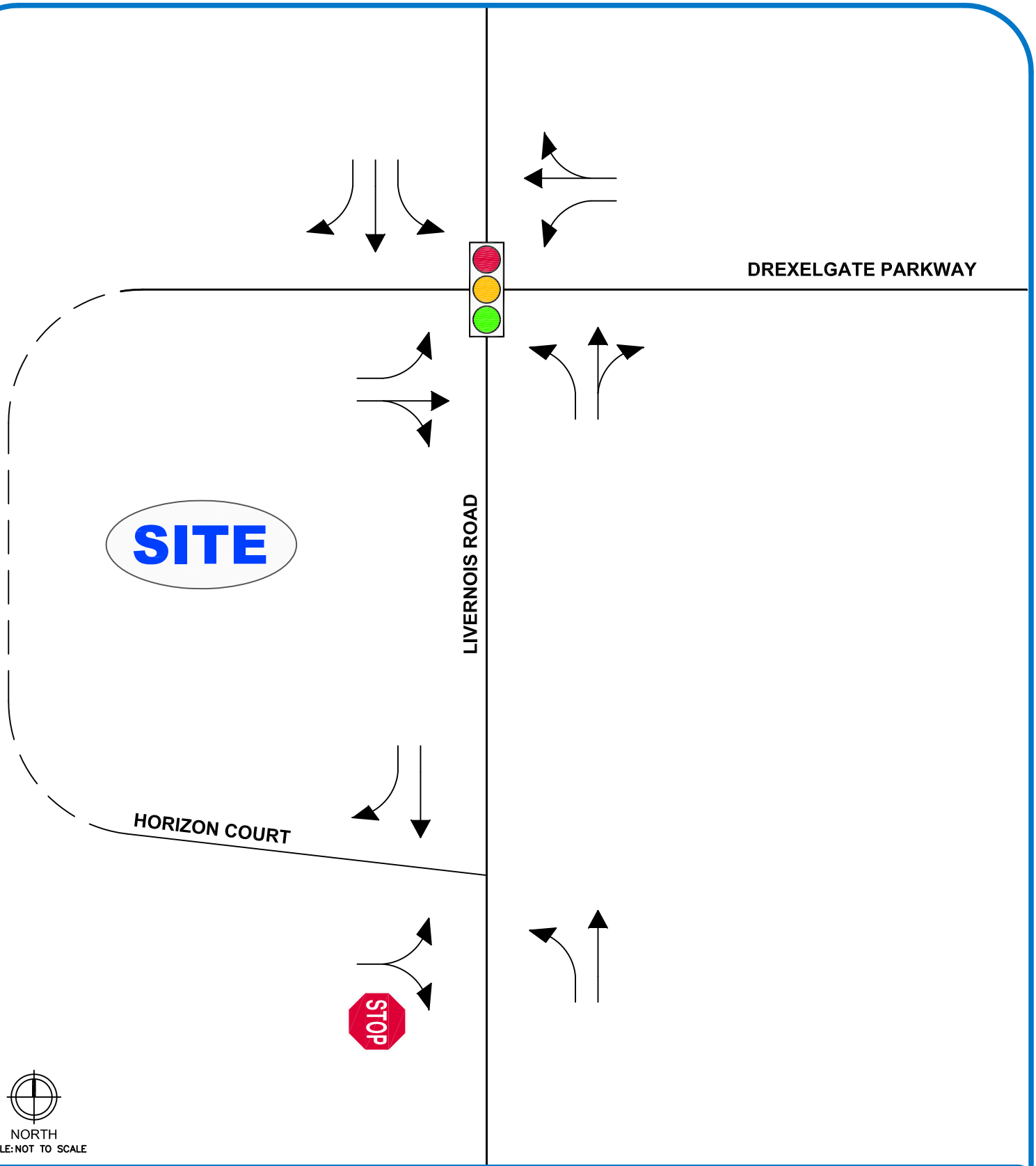


FIGURE 2
LANE USE AND TRAFFIC CONTROL

ROCHESTER RESEARCH PARK TIS - ROCHESTER HILLS, MI

LEGEND

- ROADS
- LANE USE
- SIGNALIZED INTERSECTION
- UNSIGNALIZED INTERSECTION

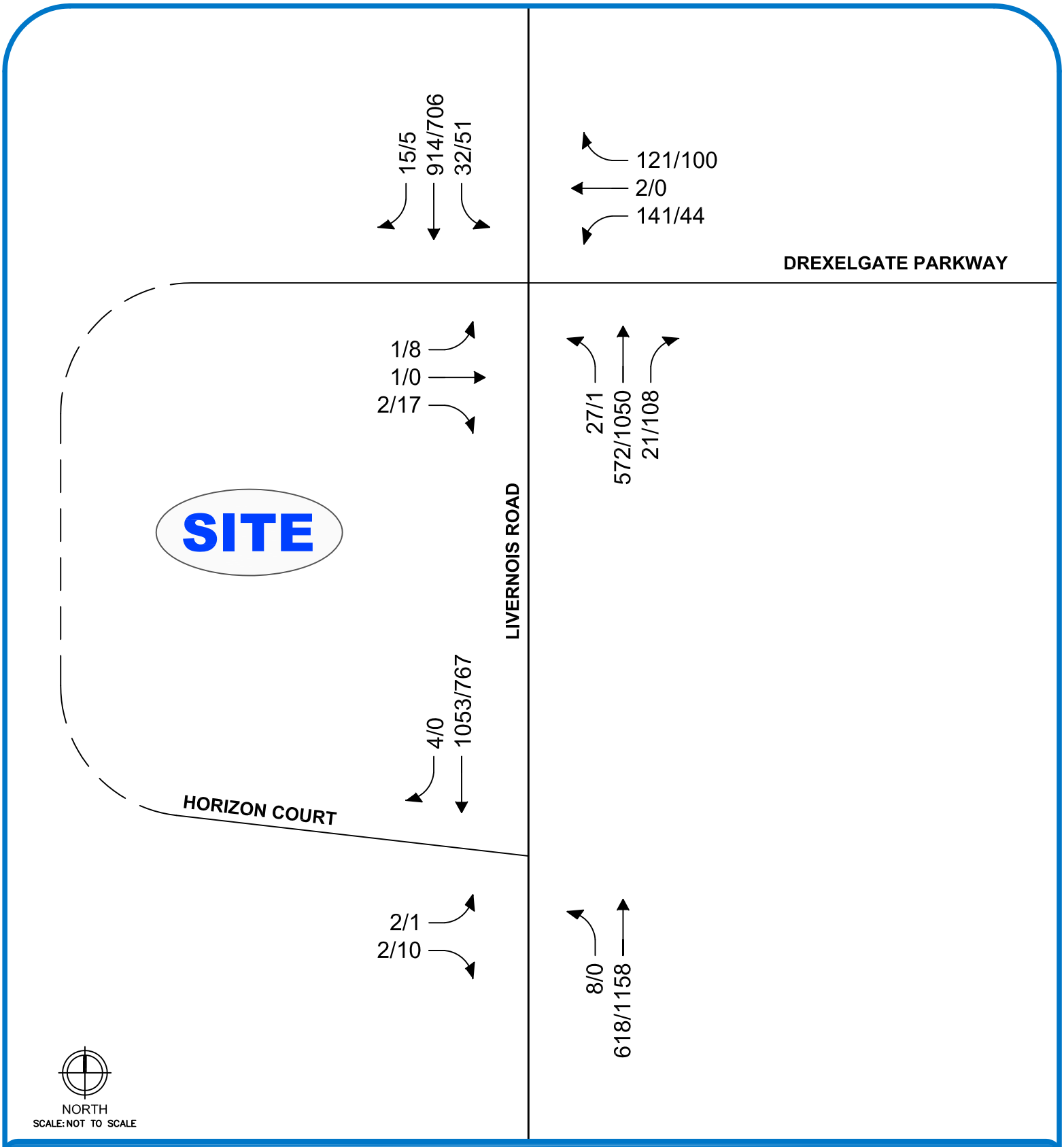


FIGURE 3
EXISTING TRAFFIC VOLUMES

ROCHESTER RESEARCH PARK TIS - ROCHESTER HILLS, MI

LEGEND

- ROADS
- TRAFFIC VOLUMES (AM/PM)
- SIGNALIZED INTERSECTION
- UNSIGNALIZED INTERSECTION

3 ANALYSIS

3.1 EXISTING CONDITIONS

The existing AM and PM peak hour vehicle delays and Levels of Service (LOS) were calculated at the study intersections using Synchro (Version 10) traffic analysis software. The results of the existing conditions analysis were based on the existing lane use and traffic control shown on **Figure 2**, the existing traffic volumes provided in **Figure 3**, and the methodologies presented in the HCM (6th Edition).

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 1**. Microsimulation was also conducted at the study intersections using SimTraffic to further evaluate the network performance; the average and 95th percentile queues are summarized in **Table 2**.

The results of the existing conditions analysis indicate that all approaches and movements at the study intersections currently operate at LOS D or better during both peak hours, with exception to the following:

Livernois Road & Drexelgate Parkway:

- The eastbound left-turn and westbound through/right movements currently operate at LOS E during the PM peak hour.
- Review of SimTraffic network simulations indicates acceptable traffic operations during both peak periods. Minor vehicle queues (1-6 vehicles) were observed at the eastbound and westbound approaches; however, these vehicle queues were serviced within each cycle length.

Livernois Road & Horizon Court:

- The eastbound approach currently operates at LOS E during the AM peak hour.
- Review of network simulations indicates acceptable traffic operations during the AM and PM peak periods. Eastbound egress vehicles were observed to find adequate gaps in traffic along Livernois Road and experienced minimal delays

Table 1: Existing Intersection Operations

Intersection		Control	Approach	Existing Conditions			
				AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	Livernois Road & Drexelgate Parkway	Signalized	EBL	53.1	D	58.2	E
			EBTR	45.2	D	51.6	D
			WBL	54.2	D	54.6	D
			WBTR	52.1	D	62.1	E
			NBL	13.4	B	6.0	A
			NBTR	6.2	A	8.9	A
			SBL	8.8	A	17.8	B
			SBT	8.3	A	4.6	A
			SBR	3.3	A	2.1	A
			Overall	**13.9**	**B**	**11.6**	**B**
2	Livernois Road & Horizon Court	Stop (Minor)	EB	36.5	E	24.2	C
			NB LT	10.8	B	0.0*	A
			SB	Free		Free	

* Indicates no vehicle volume present

Table 2: Existing Vehicle Queues (feet)

Intersection		Control	Approach	Existing Conditions			
				AM Peak		PM Peak	
				Avg.	95th %	Avg.	95th %
1	Livernois Road & Drexelgate Parkway	Signalized	EBL	1	11	5	22
			EBTR	3	19	9	28
			WBL	97	167	44	92
			WBTR	48	89	68	121
			NBL	21	60	0	6
			NBTR	104	204	202	391
			SBL	24	81	53	123
			SBT	150	277	84	181
			SBR	5	51	1	9
2	Livernois Road & Horizon Court	Stop (Minor)	EB	3	17	12	42
			NB LT	4	21	0*	0*
			SB	Free		Free	

* Indicates no vehicle volume present

3.2 Background Conditions

In order to determine the applicable traffic growth rate for the existing traffic volumes to the project buildout year of 2024, historical traffic data and community profiles in Rochester Hills were obtained. Historical traffic volume data indicates that traffic volumes have a stagnant or negative growth trend in recent years. Therefore, population and employment projections from 2015 to 2045 were obtained from the Southeast Michigan Council of Governments (SEMCOG) and show an average annual growth of 0.26% and 0.30%, respectively. Therefore, a conservative background growth rate of **0.5%** per year was assumed for this study in the analysis of background conditions ***without the proposed development.***

In addition to background growth, it is important to account for traffic that will be generated by approved developments within the vicinity of the study area that have yet to be constructed or are currently under construction. No background developments were identified near the study area that are expected to be completed prior to the site buildout of the proposed development. Background peak hour traffic volumes are shown in **Figure 4.**

3.3 Background Operations

Background peak hour vehicle delays and LOS 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 HCM (6th Edition). The results of the analysis of background conditions and vehicle queues are presented in **Appendix C** and are summarized in **Table 3** and **Table 4**, respectively.

The results of the background conditions analysis indicate that all study intersection approaches and movements will continue to operate in a manner similar to existing conditions. Review of the network simulations indicates that background traffic conditions will operate acceptably during both peak periods, similar to the existing conditions observations.

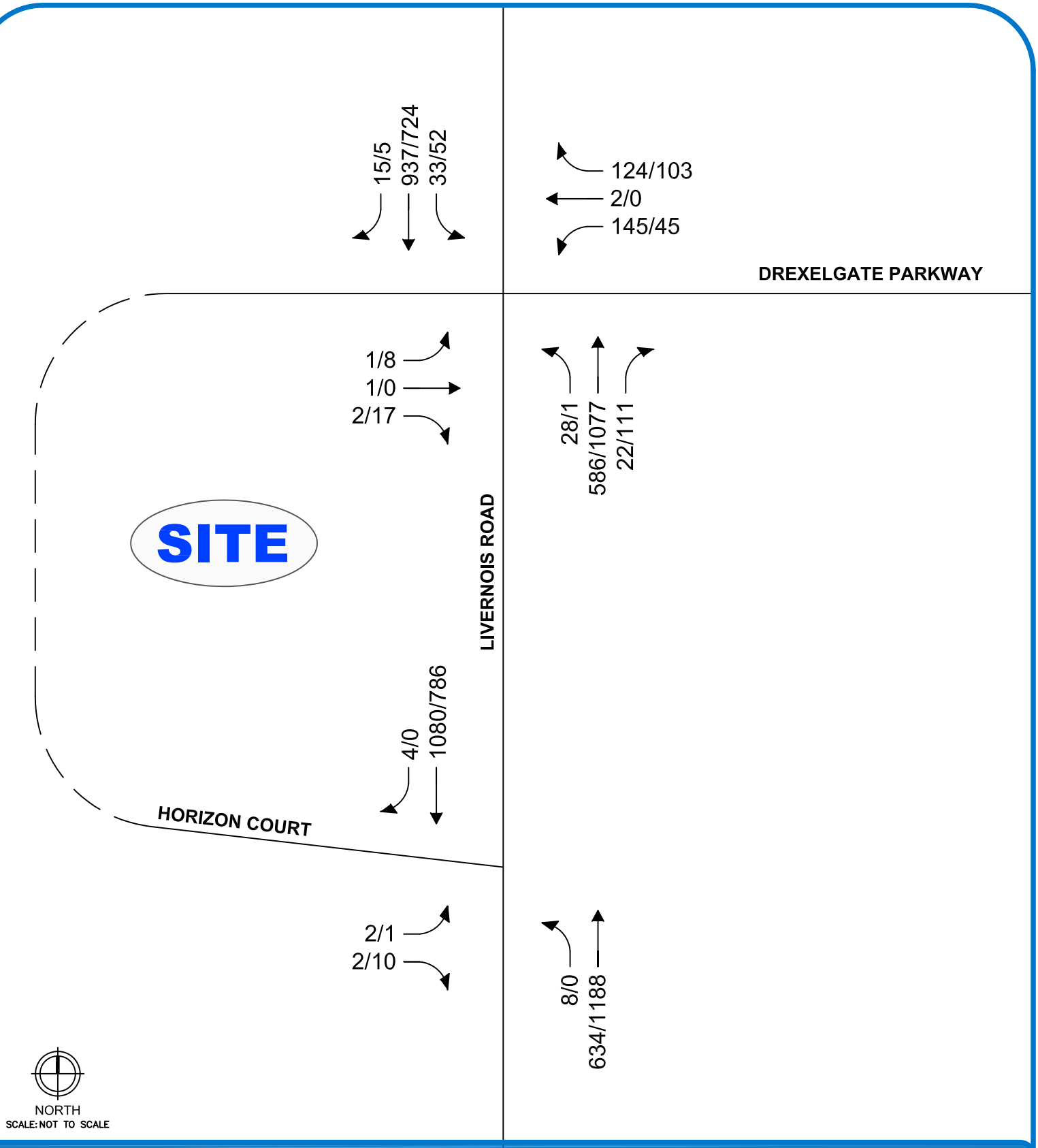


FIGURE 4
BACKGROUND TRAFFIC VOLUMES

ROCHESTER RESEARCH PARK TIS - ROCHESTER HILLS, MI

LEGEND

- ROADS
- TRAFFIC VOLUMES (AM/PM)
- SIGNALIZED INTERSECTION
- UNSIGNALIZED INTERSECTION

Table 3: Background Intersection Operations

Intersection		Control	Approach	Existing Conditions				Background Conditions			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	Livernois Road & Drexelgate Parkway	Signalized	EBL	53.1	D	58.2	E	53.0	D	58.2	E
			EBTR	45.2	D	51.6	D	45.0	D	51.3	D
			WBL	54.2	D	54.6	D	54.1	D	54.4	D
			WBTR	52.1	D	62.1	E	51.8	D	62.1	E
			NBL	13.4	B	6.0	A	14.4	B	6.3	A
			NBTR	6.2	A	8.9	A	6.5	A	9.6	A
			SBL	8.8	A	17.8	B	9.3	A	20.0	C
			SBT	8.3	A	4.6	A	8.8	A	4.9	A
			SBR	3.3	A	2.1	A	3.4	A	2.1	A
			Overall	**13.9**	**B**	**11.6**	**B**	**14.3**	**B**	**12.2**	**B**
2	Livernois Road & Horizon Court	Stop (Minor)	EB	36.5	E	24.2	C	38.5	E	25.4	D
			NB LT	10.8	B	0.0*	A	11.0	B	0.0*	A
			SB	Free		Free		Free		Free	

* Indicates no vehicle volume present

Table 4: Background Vehicle Queues (feet)

Intersection		Control	Approach	Existing Conditions				Background Conditions			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Avg.	95th %	Avg.	95th %	Avg.	95th %	Avg.	95th %
1	Livernois Road & Drexelgate Parkway	Signalized	EBL	1	11	5	22	1	9	5	23
			EBTR	3	19	9	28	4	22	10	30
			WBL	97	167	44	92	97	175	39	80
			WBTR	48	89	68	121	45	80	65	121
			NBL	21	60	0	6	21	67	0	0
			NBTR	104	204	202	391	100	200	229	448
			SBL	24	81	53	123	21	50	58	126
			SBT	150	277	84	181	153	289	80	187
			SBR	5	51	1	9	2	14	1	6
2	Livernois Road & Horizon Court	Stop (Minor)	EB	3	17	12	42	4	21	12	43
			NB LT	4	21	0*	0*	5	23	0*	0*
			SB	Free		Free		Free		Free	

* Indicates no vehicle volume present

3.4 SITE TRIP GENERATION

The number of AM and PM peak hour vehicle trips that would be generated by the proposed development was forecast based on data published by ITE in the *Trip Generation Manual, 10th Edition* and the ITE *Trip Generation Handbook, 3rd Edition*. The proposed development includes the addition of 99,630 SF of additional office space and 51,580 SF of additional warehouse space. The site trip generation forecast was reviewed by the City for use in this analysis and is summarized in **Table 5**.

Table 5: Site 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
General Office Building	710	99,630	SF	1,057	103	17	120	18	95	113
Warehousing	150	51,580	SF	127	25	7	32	9	25	34
Total Trips				**1,184**	**128**	**24**	**152**	**27**	**120**	**147**

3.5 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. To determine trips distribution for office developments using the adjacent street traffic it is assumed that the trips in the AM are home-to-work based trips, and in the PM are work-to-home based trips. Therefore, the global trip generation is based on trips in the AM entering the study network and traveling to the development and exiting the study network in the PM. The ITE trip distribution methodology assumes that new trips will return to their direction of origin. The site trip distributions used in the analysis are summarized in **Table 6**.

Table 6: Site Trip Distribution Summary

To/From	Via	AM	PM
North	Livernois Road	52%	55%
South	Livernois Road	34%	37%
East	Drexelgate Parkway	14%	8%
Total		**100%**	**100%**

The site-generated traffic volumes in **Table 5** were distributed to the adjacent roadway network based on the distribution shown in **Table 6.** The site generated traffic volumes, as shown on **Figure 5**, were added to the background traffic volumes to calculate the future traffic volumes with the proposed development. Future traffic volumes are provided in **Figure 6.**

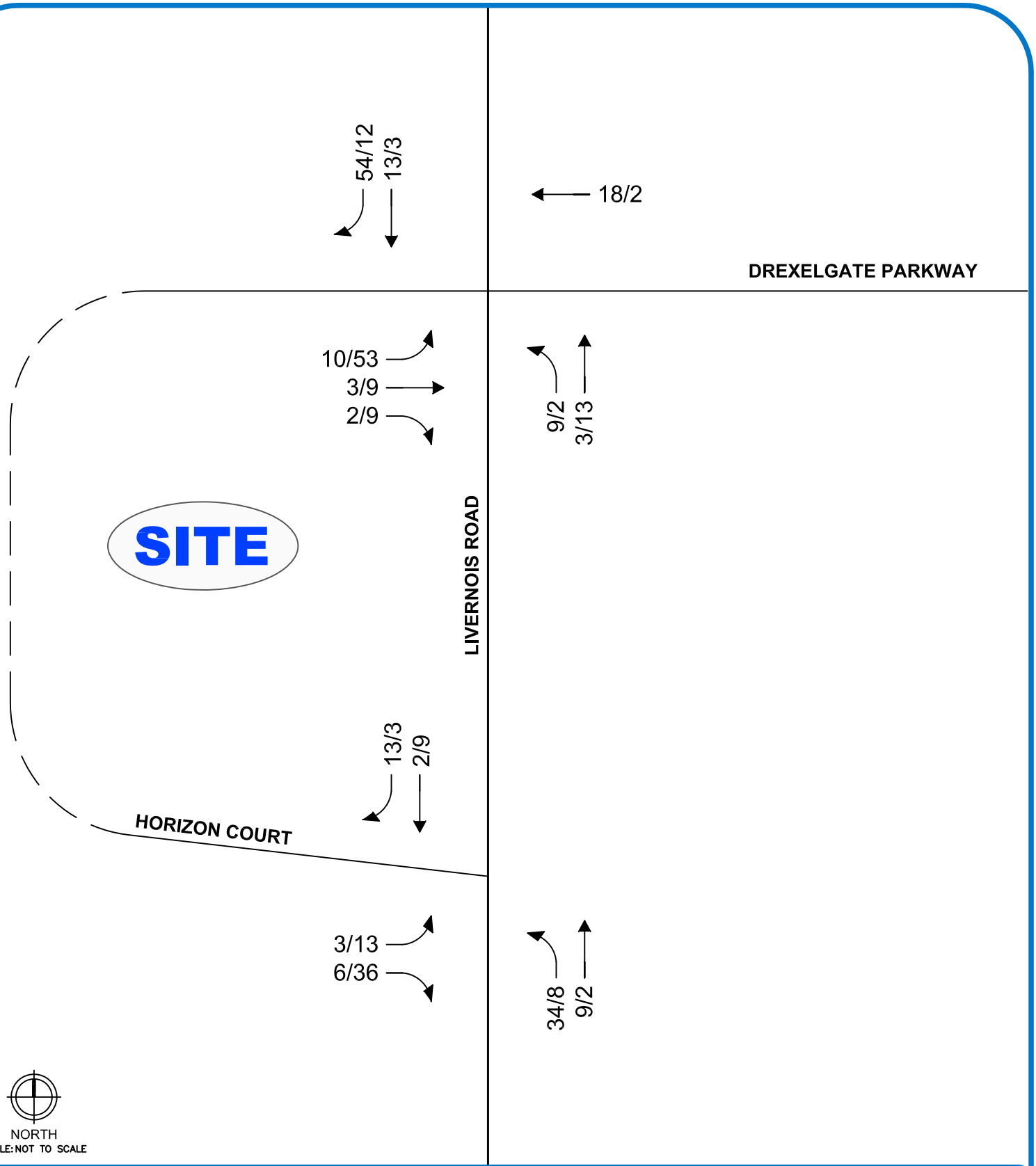


FIGURE 5
SITE-GENERATED TRAFFIC VOLUMES

ROCHESTER RESEARCH PARK TIS - ROCHESTER HILLS, MI

LEGEND

- ROADS
- TRAFFIC VOLUMES (AM/PM)
- SIGNALIZED INTERSECTION
- UNSIGNALIZED INTERSECTION

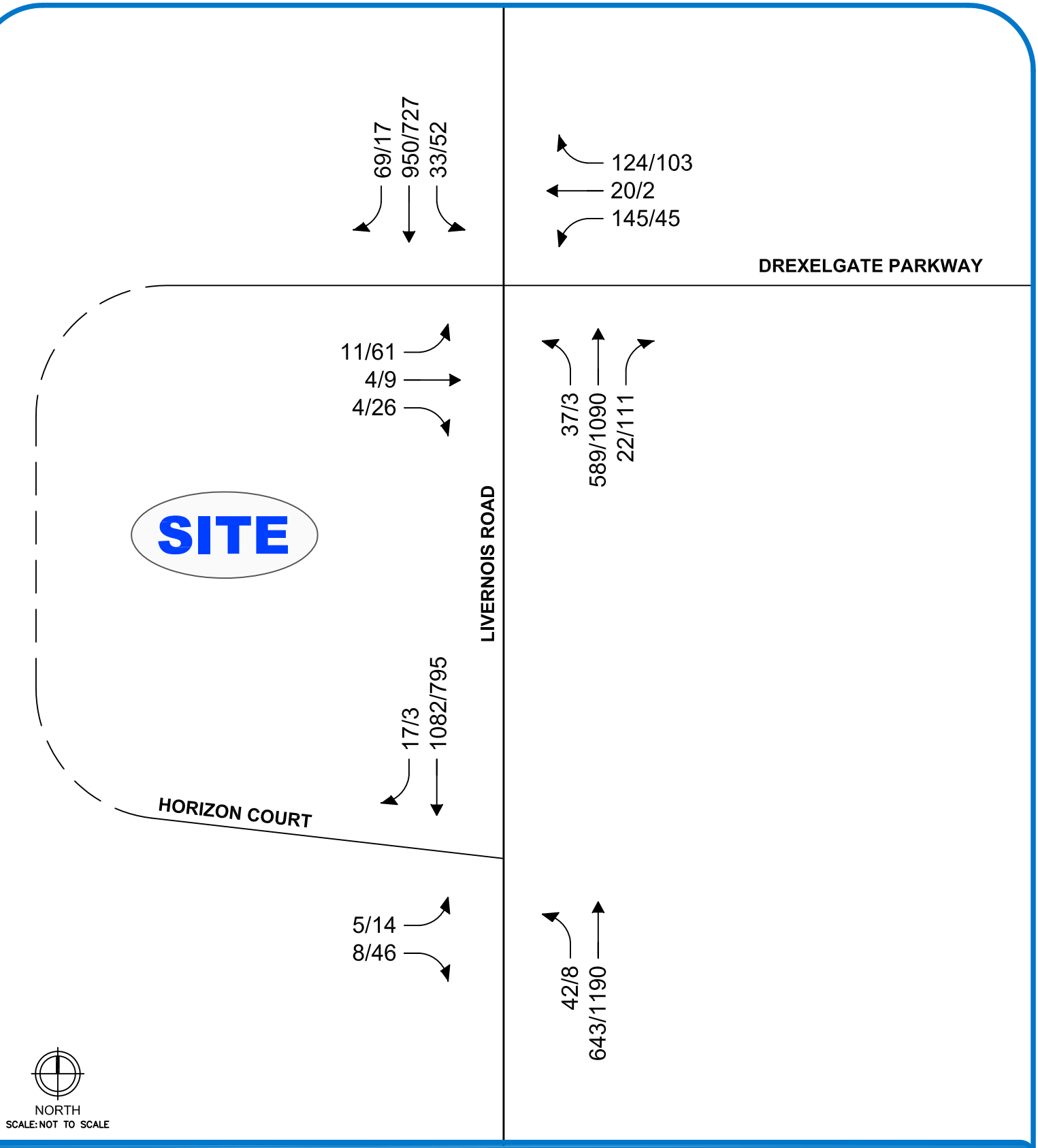


FIGURE 6
FUTURE TRAFFIC VOLUMES

ROCHESTER RESEARCH PARK TIS - ROCHESTER HILLS, MI

LEGEND

- ROADS
- TRAFFIC VOLUMES (AM/PM)
- SIGNALIZED INTERSECTION
- UNSIGNALIZED INTERSECTION

3.6 FUTURE CONDITIONS

Future peak hour vehicle delays and LOS ***with the proposed development*** were calculated based on the existing lane use and traffic control shown on **Figure 2**, the proposed site access plan, the future traffic volumes shown on **Figure 6**, and the methodologies presented in the HCM 6th. The results of the future conditions analysis and vehicle queues are presented in **Appendix D** and are summarized in **Table 7** and **Table 8**, respectively.

The results of the future conditions analysis indicate that all study intersection approaches and movements are expected to operate acceptably, at a LOS D or better, with exception of the following:

Livernois Road & Drexelgate Parkway:

- The eastbound left-turn movement is expected to operate at LOS E during the PM peak hour.
- Review of SimTraffic network simulations indicates acceptable traffic operations during both peak periods. Minor vehicle queues (4-5 vehicles) were present at the eastbound approach; however, these vehicle queues were observed to be serviced within each cycle length.

Livernois Road & Horizon Court:

- The eastbound approach is expected to operate at LOS F during the PM peak hour. Additionally, the eastbound approach will continue to operate at LOS E during the AM peak hour.
- Review of network simulations indicates acceptable traffic operations during the AM and PM peak periods. Eastbound egress vehicles were observed to find adequate gaps in traffic along Livernois Road and experienced minimal delays.
    - Although a failing LOS is reported for the eastbound approach during the PM peak period, microsimulations indicate acceptable operations. Therefore, it is recommended to monitor this intersection after the development is completed and occupied; in order to determine if mitigation measures are necessary.

Table 7: Future Intersection Operations

Intersection		Control	Approach	Background Conditions				Future Conditions			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	Livernois Road & Drexelgate Parkway	Signalized	EBL	53.0	D	58.2	E	54.9	D	57.5	E
			EBTR	45.0	D	51.3	D	44.6	D	46.6	D
			WBL	54.1	D	54.4	D	53.9	D	49.6	D
			WBTR	51.8	D	62.1	E	52.0	D	50.5	D
			NBL	14.4	B	6.3	A	16.4	B	9.8	A
			NBTR	6.5	A	9.6	A	6.9	A	14.6	B
			SBL	9.3	A	20.0	C	9.9	A	32.3	C
			SBT	8.8	A	4.9	A	9.4	A	7.1	A
			SBR	3.4	A	2.1	A	3.7	A	3.3	A
			Overall	**14.3**	**B**	**12.2**	**B**	**15.2**	**B**	**16.4**	**B**
2	Livernois Road & Horizon Court	Stop (Minor)	EB	38.5	E	25.4	D	44.7	E	57.6	F
			NB LT	11.0	B	0.0*	A	11.5	B	9.9	A
			SB	Free		Free		Free		Free	

* Indicates no vehicle volume present
** Improved LOS on minor approaches is the result of higher ratio of vehicles arriving on a green light

Table 8: Future Vehicle Queues (feet)

Intersection		Control	Approach	Background Conditions				Future Conditions			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Avg.	95th %	Avg.	95th %	Avg.	95th %	Avg.	95th %
1	Livernois Road & Drexelgate Parkway	Signalized	EBL	1	9	5	23	11	40	54	113
			EBTR	4	22	10	30	8	31	21	51
			WBL	97	175	39	80	100	176	34	73
			WBTR	45	80	65	121	66	128	72	128
			NBL	21	67	0	0	35	98	3	30
			NBTR	100	200	229	448	120	230	305	590
			SBL	21	50	58	126	18	44	56	119
			SBT	153	289	80	187	173	326	104	206
			SBR	2	14	1	6	20	96	3	18
2	Livernois Road & Horizon Court	Stop (Minor)	EB	4	21	12	43	11	38	46	108
			NB LT	5	23	0*	0*	23	54	4	20
			SB	Free		Free		Free		Free	

* Indicates no vehicle volume present

3.7 SIGNAL WARRANT ANALYSIS

A signal warrant analysis was performed at the study intersection of Livernois Road & Horizon Court, with the addition of the site generated traffic. The *Michigan Manual on Uniform Traffic Control Devices (MMUTCD)* documents eight warrants by which traffic signal control may or should be considered. Warrant 1 (8-Hour Vehicular Volume), Warrant 2 (4-Hour Vehicular Volume) and Warrant 3 (Peak-Hour) were evaluated for this study using the four hours of traffic volume data collected.

The site-generated hourly traffic volumes used in this signal warrant analysis were determined based on hourly variations in daily traffic data published by ITE in *Trip Generation, 10th Edition*. The corresponding hourly volumes for the Warehouse (LUC #150) and the General Office Building (LUC #710) land uses were projected and combined with the background traffic volumes to provide 4-hours of traffic volume data with the proposed development. The global distribution for the site-generated traffic was determined based on the adjacent street traffic volumes. The ingress/egress percentages provided in the ITE *Trip Generation Manual* for the AM and PM peak hour of the adjacent street were also utilized.

Table 9: Future Signal Warrant Analysis Summary

Livernois Road and Horizon Court		
Warrant 1: Eight-Hour	*Hours Met*	**0**
	Warrant Met	**NO**
Warrant 2: Four-Hour	*Hours Met*	**0**
	Warrant Met	**NO**
Warrant 3: Peak-Hour	*Hours Met*	**0**
	Warrant Met	**NO**

The results of the signal warrant evaluation indicate that, with the addition of the site generated traffic, the future traffic volumes **do not meet** the thresholds to satisfy Warrant 2 or Warrant 3. Furthermore, a preliminary evaluation of Warrant 1: 8-Hour Volumes shows that 0 hours are met. If Warrant 1 was close to meeting the thresholds, it would be expected to see the four highest hours evaluated met. However, since 0 hours were met, it is not expected that four additional hours of off-peak traffic volumes will exceed the thresholds.

4 CONCLUSIONS

The conclusions of this TIS are as follows:

1. The results of the existing conditions analysis show that all study intersection approaches and movements currently operate acceptably at a LOS D or better during the AM and PM peak periods, with exception of the following:
   - The eastbound left-turn and westbound through/right movements, at the signalized intersection of Livernois Road and Drexelgate Parkway, currently operate at LOS E during the PM peak hour.
   - The eastbound approach at the intersection of Livernois Road and Horizon Court currently operates at LOS E during the AM peak hour.
2. The background traffic operations ***without the proposed development*** will continue to operate acceptably, in a manner similar to existing conditions.
3. In future conditions ***with the proposed development***, the study intersections are expected to operate acceptably, in a manner similar to background conditions.
   - The eastbound approach at the intersection of Livernois Road and Horizon Court is expected to operate at LOS F during the PM peak period.
   - Network simulations indicate acceptable operations, with egress vehicles able to find adequate gaps in traffic along Livernois Road. Egress vehicle queues of approximately 4-5 vehicles are expected at this intersection during the PM peak hour, which is not significant.
4. A traffic signal warrant analysis was performed for the intersection of Livernois Road & Horizon Court, with the addition of the site-generated traffic. The results of the analysis indicate that a signal **is not warranted**.

5 RECOMMENDATIONS

The recommendations of this TIS are as follows:

1. The results of the analysis show that the existing intersection geometry and operations can adequately accommodate the projected site generated traffic volume. No off-site improvements are recommended.

Appendix A

BACKGROUND INFORMATION

Traffic Data Collection, LLC

www:tdccounts.com

Phone: 586.786-5407

Traffic Study Performed For:

Fleis & Vandenbrink

Project: Rochester Hills Design Haus TIS
Study:4 Hr. Video Turning Movement Count
Weather:Sunny/Cldy. Deg's 30s
Count By Miovision Video VCU 4BT NE

File Name : TMC_1 Livernois & Drexelgate_3-21-19
Site Code : TMC_1
Start Date : 3/21/2019
Page No : 1

4 Hour 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.

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

	Livernois Road Southbound					Drexelgate Pkwy. Westbound					Livernois Road Northbound					Business 1400 Livernois Eastbound					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	4	201	10	0	215	39	0	31	0	70	9	177	3	0	189	0	0	0	0	0	474
07:15 AM	4	236	9	0	249	35	1	35	0	71	2	129	1	0	132	2	0	0	0	2	454
07:30 AM	3	244	6	0	253	20	0	35	2	57	4	115	7	0	126	0	1	1	0	2	438
07:45 AM	4	231	7	0	242	27	1	40	0	68	6	147	16	0	169	0	0	0	0	0	479
Total	15	912	32	0	959	121	2	141	2	266	21	568	27	0	616	2	1	1	0	4	1845
08:00 AM	1	220	8	0	229	16	0	45	0	61	13	106	11	0	130	0	0	0	0	0	420
08:15 AM	0	209	9	0	218	17	0	39	0	56	11	135	2	0	148	0	0	0	0	0	422
08:30 AM	0	198	5	0	203	24	0	47	0	71	4	155	0	0	159	1	0	0	0	1	434
08:45 AM	1	166	6	0	173	21	0	24	0	45	5	145	1	0	151	0	0	0	0	0	369
Total	2	793	28	0	823	78	0	155	0	233	33	541	14	0	588	1	0	0	0	1	1645
*** BREAK ***																					
04:00 PM	2	145	14	0	161	29	0	7	0	36	12	235	0	0	247	2	0	3	0	5	449
04:15 PM	2	162	4	0	168	18	0	16	0	34	25	238	0	0	263	9	1	1	0	11	476
04:30 PM	0	143	17	0	160	25	0	11	0	36	17	272	0	0	289	8	2	5	0	15	500
04:45 PM	0	172	12	0	184	27	0	11	0	38	19	271	1	0	291	5	0	2	0	7	520
Total	4	622	47	0	673	99	0	45	0	144	73	1016	1	0	1090	24	3	11	0	38	1945
05:00 PM	2	209	10	0	221	24	0	10	0	34	26	251	0	0	277	4	0	2	1	7	539
05:15 PM	0	151	18	0	169	23	0	12	0	35	30	266	0	0	296	2	0	1	0	3	503
05:30 PM	3	168	11	0	182	26	0	11	3	40	33	262	0	0	295	6	0	3	0	9	526
05:45 PM	0	159	13	0	172	32	0	13	0	45	27	249	0	0	276	2	0	2	0	4	497
Total	5	687	52	0	744	105	0	46	3	154	116	1028	0	0	1144	14	0	8	1	23	2065
Grand Total	26	3014	159	0	3199	403	2	387	5	797	243	3153	42	0	3438	41	4	20	1	66	7500
Apprch %	0.8	94.2	5	0		50.6	0.3	48.6	0.6		7.1	91.7	1.2	0		62.1	6.1	30.3	1.5		
Total %	0.3	40.2	2.1	0	42.7	5.4	0	5.2	0.1	10.6	3.2	42	0.6	0	45.8	0.5	0.1	0.3	0	0.9	
Pass Cars	24	2968	156	0	3148	397	2	382	0	781	240	3092	42	0	3374	40	3	20	0	63	7366
% Pass Cars	92.3	98.5	98.1	0	98.4	98.5	100	98.7	0	98	98.8	98.1	100	0	98.1	97.6	75	100	0	95.5	98.2
Single Units	1	39	3	0	43	6	0	4	0	10	3	53	0	0	56	1	1	0	0	2	111
% Single Units	3.8	1.3	1.9	0	1.3	1.5	0	1	0	1.3	1.2	1.7	0	0	1.6	2.4	25	0	0	3	1.5
Heavy Trucks	1	7	0	0	8	0	0	1	0	1	0	8	0	0	8	0	0	0	0	0	17
% Heavy Trucks	3.8	0.2	0	0	0.3	0	0	0.3	0	0.1	0	0.3	0	0	0.2	0	0	0	0	0	0.2
Peds	0	0	0	0	0	0	0	0	5	5	0	0	0	0	0	0	0	0	1	1	6
% Peds	0	0	0	0	0	0	0	0	100	0.6	0	0	0	0	0	0	0	0	100	1.5	0.1

TDC Traffic Comments: SCATS signalized intersection, with ped. signals for north & east legs. Push buttons for north leg. Video VCU camera was located within NE intersection quadrant. Note: Peds. are excluded from peak hour reports. Traffic study was performed for City of Rochester Hills Design Haus / Rochester Hills Research Park Traffic Impact Study for Fleis & Vandenbrink.

Traffic Data Collection, LLC

www:tdccounts.com

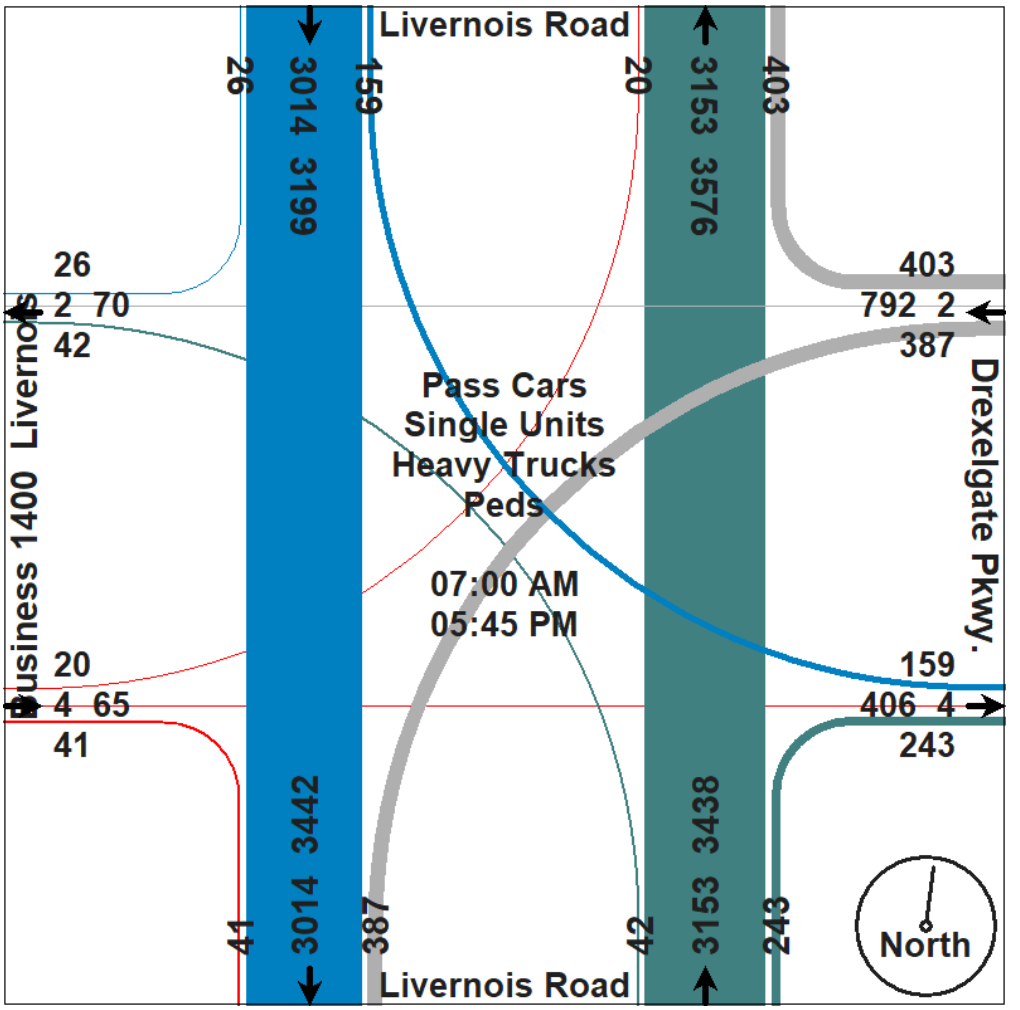
Phone: 586.786-5407

Traffic Study Performed For:

Fleis & Vandenbrink

Project: Rochester Hills Design Haus TIS
Study:4 Hr. Video Turning Movement Count
Weather:Sunny/Cldy. Deg's 30s
Count By Miovision Video VCU 4BT NE

File Name : TMC_1 Livernois & Drexelgate_3-21-19
Site Code : TMC_1
Start Date : 3/21/2019
Page No : 2



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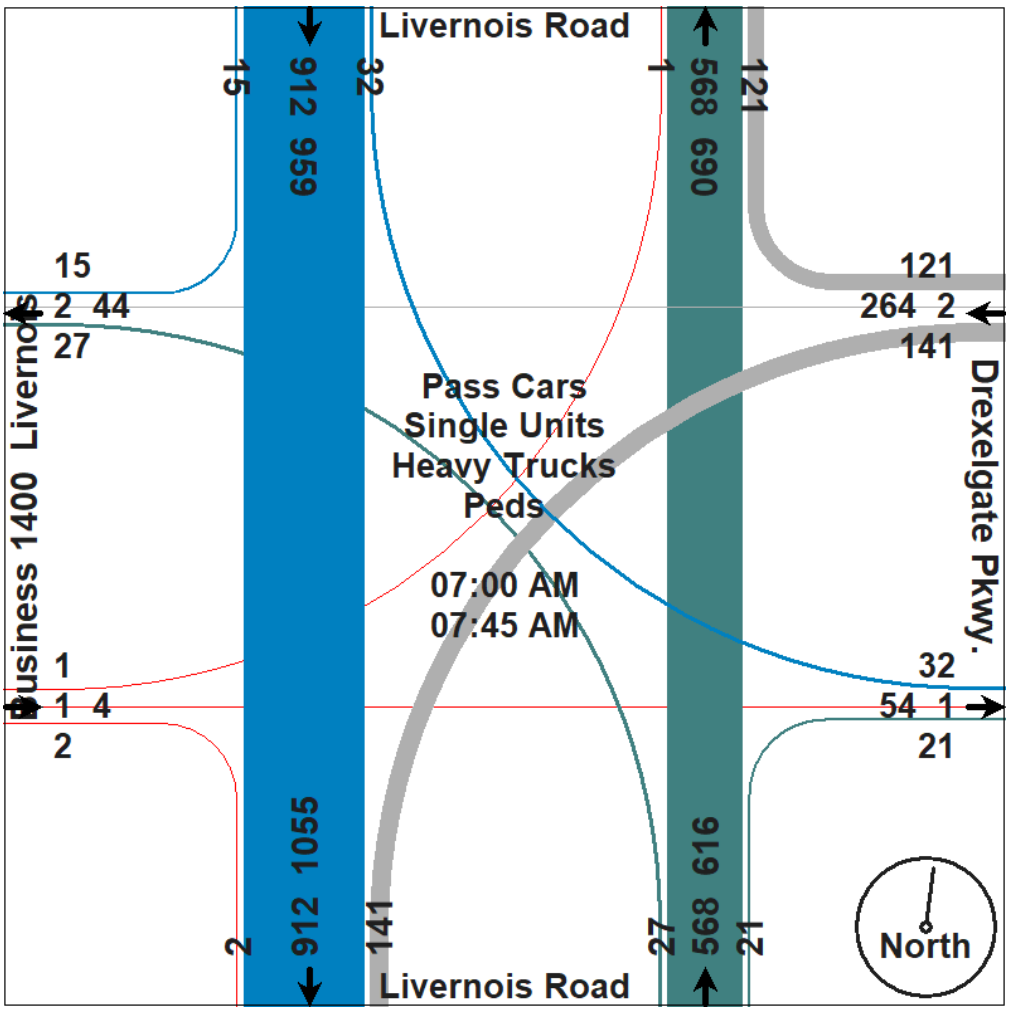
Project: Rochester Hills Design Haus TIS
Study:4 Hr. Video Turning Movement Count
Weather:Sunny/Cldy. Deg's 30s
Count By Miovision Video VCU 4BT NE

File Name : TMC_1 Livernois & Drexelgate_3-21-19
Site Code : TMC_1
Start Date : 3/21/2019
Page No : 3

	Livernois Road Southbound				Drexelgate Pkwy. Westbound				Livernois Road Northbound				Business 1400 Livernois Eastbound				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 12:30 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:00 AM																	
07:00 AM	**4**	201	**10**	215	**39**	0	31	70	**9**	**177**	3	**189**	0	0	0	0	474
07:15 AM	4	236	9	249	35	**1**	35	**71**	2	129	1	132	**2**	0	0	**2**	454
07:30 AM	3	**244**	6	**253**	20	0	35	55	4	115	7	126	0	**1**	**1**	2	436
07:45 AM	4	231	7	242	27	1	**40**	68	6	147	**16**	169	0	0	0	0	**479**
Total Volume	15	912	32	959	121	2	141	264	21	568	27	616	2	1	1	4	1843
% App. Total	1.6	95.1	3.3		45.8	0.8	53.4		3.4	92.2	4.4		50	25	25		
PHF	.938	.934	.800	.948	.776	.500	.881	.930	.583	.802	.422	.815	.250	.250	.250	.500	.962
Pass Cars	13	905	31	949	120	2	141	263	21	555	27	603	2	0	1	3	1818
% Pass Cars	86.7	99.2	96.9	99.0	99.2	100	100	99.6	100	97.7	100	97.9	100	0	100	75.0	98.6
Single Units	1	6	1	8	1	0	0	1	0	11	0	11	0	1	0	1	21
% Single Units	6.7	0.7	3.1	0.8	0.8	0	0	0.4	0	1.9	0	1.8	0	100	0	25.0	1.1
Heavy Trucks	1	1	0	2	0	0	0	0	0	2	0	2	0	0	0	0	4
% Heavy Trucks	6.7	0.1	0	0.2	0	0	0	0	0	0.4	0	0.3	0	0	0	0	0.2
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



Traffic Data Collection, LLC

www:tdccounts.com

Phone: 586.786-5407

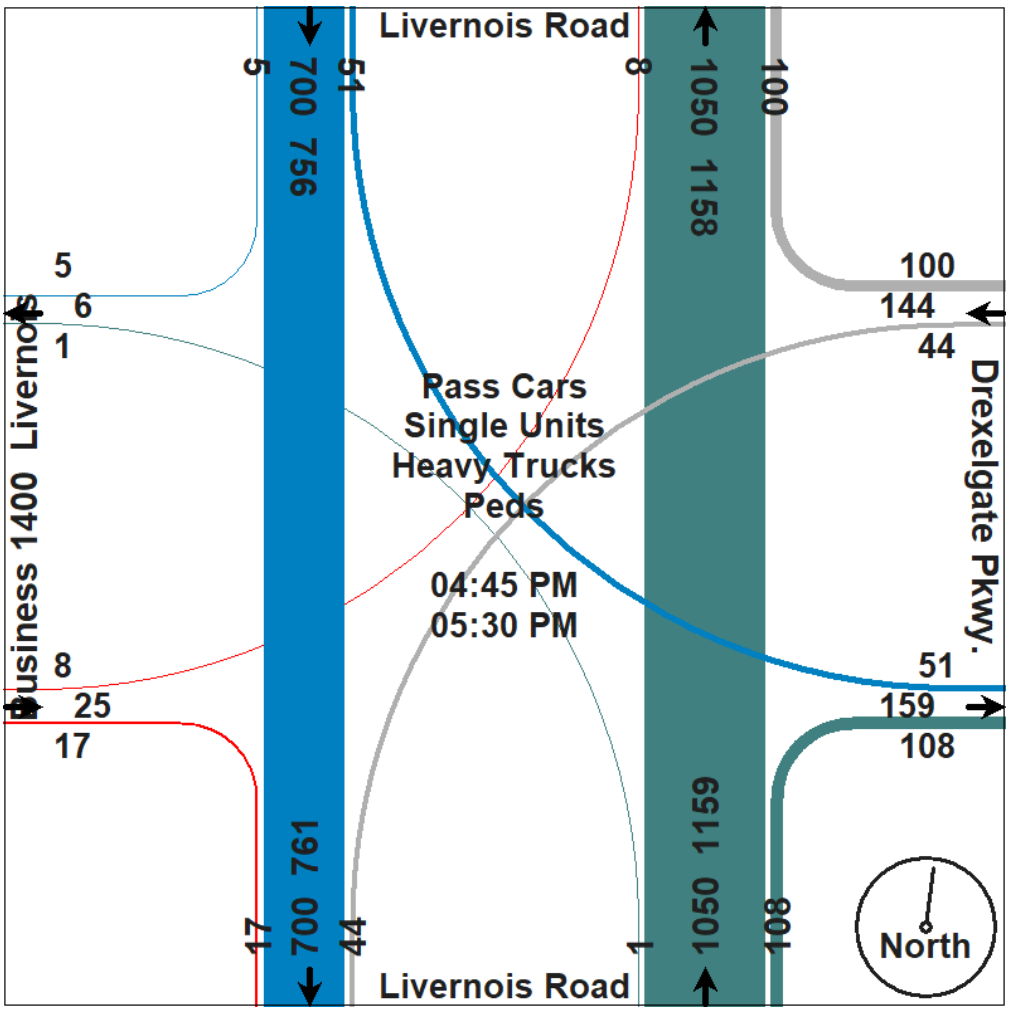
Traffic Study Performed For:

Fleis & Vandenbrink

Project: Rochester Hills Design Haus TIS
Study:4 Hr. Video Turning Movement Count
Weather:Sunny/Cldy. Deg's 30s
Count By Miovision Video VCU 4BT NE

File Name : TMC_1 Livernois & Drexelgate_3-21-19
Site Code : TMC_1
Start Date : 3/21/2019
Page No : 4

	Livernois Road Southbound				Drexelgate Pkwy. Westbound				Livernois Road Northbound				Business 1400 Livernois Eastbound				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Peak Hour Analysis From 12:45 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:45 PM																	
04:45 PM	0	172	12	184	**27**	0	11	**38**	19	**271**	**1**	291	5	0	2	7	520
05:00 PM	2	**209**	10	**221**	24	0	10	34	26	251	0	277	4	0	2	6	**538**
05:15 PM	0	151	**18**	169	23	0	**12**	35	30	266	0	**296**	2	0	1	3	503
05:30 PM	**3**	168	11	182	26	0	11	37	**33**	262	0	295	**6**	0	**3**	**9**	523
Total Volume	5	700	51	756	100	0	44	144	108	1050	1	1159	17	0	8	25	2084
% App. Total	0.7	92.6	6.7		69.4	0	30.6		9.3	90.6	0.1		68	0	32		
PHF	.417	.837	.708	.855	.926	.000	.917	.947	.818	.969	.250	.979	.708	.000	.667	.694	.968
Pass Cars	5	691	51	747	100	0	44	144	107	1046	1	1154	17	0	8	25	2070
% Pass Cars	100	98.7	100	98.8	100	0	100	100	99.1	99.6	100	99.6	100	0	100	100	99.3
Single Units	0	7	0	7	0	0	0	0	1	3	0	4	0	0	0	0	11
% Single Units	0	1.0	0	0.9	0	0	0	0	0.9	0.3	0	0.3	0	0	0	0	0.5
Heavy Trucks	0	2	0	2	0	0	0	0	0	1	0	1	0	0	0	0	3
% Heavy Trucks	0	0.3	0	0.3	0	0	0	0	0	0.1	0	0.1	0	0	0	0	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



Traffic Data Collection, LLC

www:tdccounts.com

Phone: 586.786-5407

Traffic Study Performed For:

Fleis & Vandenbrink

Project: Rochester Hills Design Haus TIS
Study:4 Hr. Video Turning Movement Count
Weather:Sunny/Cldy. Deg's 30s
Count By Miovision Video VCU 2Z4 SE

File Name : TMC_2 Livernois & HorizonCt_3-21-19
Site Code : TMC_2
Start Date : 3/21/2019
Page No : 1

4 Hour 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.

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

	Livernois Road Southbound				Livernois Road Northbound				Horizon Court / Fire Station Eastbound				
Start Time	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Int. Total
07:00 AM	1	224	0	225	188	1	0	189	0	1	0	1	415
07:15 AM	1	277	0	278	133	0	0	133	2	0	0	2	413
07:30 AM	1	275	0	276	130	2	0	132	0	1	0	1	409
07:45 AM	1	277	0	278	167	5	0	172	0	0	0	0	450
Total	4	1053	0	1057	618	8	0	626	2	2	0	4	1687
08:00 AM	0	256	0	256	126	5	0	131	1	0	0	1	388
08:15 AM	0	253	0	253	146	1	0	147	1	0	0	1	401
08:30 AM	0	243	0	243	161	1	0	162	0	0	0	0	405
08:45 AM	3	188	0	191	150	2	0	152	1	0	0	1	344
Total	3	940	0	943	583	9	0	592	3	0	0	3	1538
*** BREAK ***													
04:00 PM	0	155	0	155	251	1	0	252	2	2	0	4	411
04:15 PM	1	184	0	185	274	0	0	274	5	1	0	6	465
04:30 PM	0	161	0	161	282	2	0	284	0	0	0	0	445
04:45 PM	0	192	0	192	283	0	0	283	3	1	0	4	479
Total	1	692	0	693	1090	3	0	1093	10	4	0	14	1800
05:00 PM	0	225	0	225	270	0	0	270	1	0	1	2	497
05:15 PM	0	166	0	166	301	0	0	301	4	0	0	4	471
05:30 PM	0	184	0	184	285	0	0	285	2	0	0	2	471
05:45 PM	0	174	0	174	298	2	0	300	2	0	0	2	476
Total	0	749	0	749	1154	2	0	1156	9	0	1	10	1915
Grand Total	8	3434	0	3442	3445	22	0	3467	24	6	1	31	6940
Apprch %	0.2	99.8	0		99.4	0.6	0		77.4	19.4	3.2		
Total %	0.1	49.5	0	49.6	49.6	0.3	0	50	0.3	0.1	0	0.4	
Pass Cars	7	3385	0	3392	3383	16	0	3399	15	5	0	20	6811
% Pass Cars	87.5	98.6	0	98.5	98.2	72.7	0	98	62.5	83.3	0	64.5	98.1
Single Units	1	41	0	42	54	6	0	60	9	1	0	10	112
% Single Units	12.5	1.2	0	1.2	1.6	27.3	0	1.7	37.5	16.7	0	32.3	1.6
Heavy Trucks	0	8	0	8	8	0	0	8	0	0	0	0	16
% Heavy Trucks	0	0.2	0	0.2	0.2	0	0	0.2	0	0	0	0	0.2
Peds	0	0	0	0	0	0	0	0	0	0	1	1	1
% Peds	0	0	0	0	0	0	0	0	0	0	100	3.2	0

TDC Traffic Comments: Emergency signalized intersection in flashing mode. Video VCU camera was located within SE intersection quadrant. Note: Peds. are excluded from peak hour reports. Traffic study was performed for City of Rochester Hills Design Haus / Rochester Hills Research Park Traffic Impact Study for Fleis & Vandenbrink.

Traffic Data Collection, LLC

www:tdccounts.com

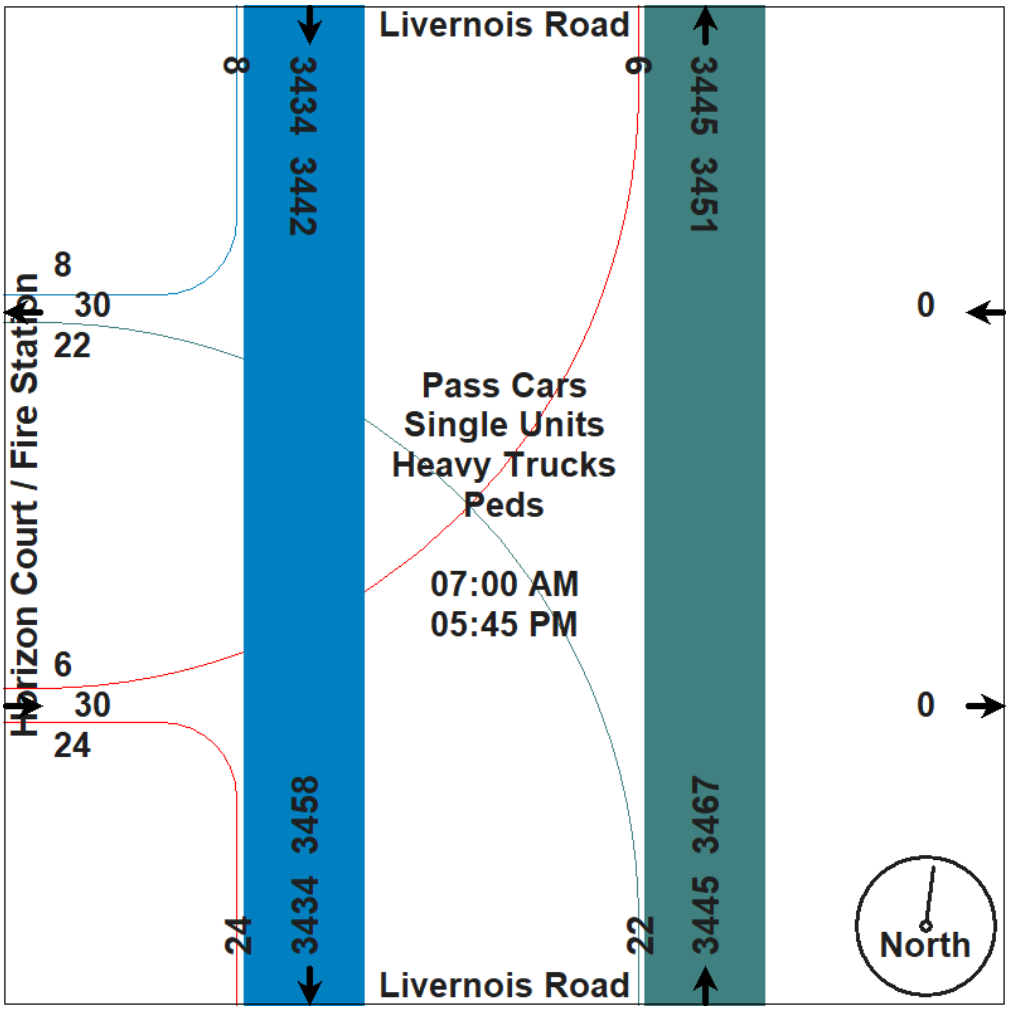
Phone: 586.786-5407

Traffic Study Performed For:

Fleis & Vandenbrink

Project: Rochester Hills Design Haus TIS
Study:4 Hr. Video Turning Movement Count
Weather:Sunny/Cldy. Deg's 30s
Count By Miovision Video VCU 2Z4 SE

File Name : TMC_2 Livernois & HorizonCt_3-21-19
Site Code : TMC_2
Start Date : 3/21/2019
Page No : 2



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Traffic Study Performed For:

Fleis & Vandenbrink

Project: Rochester Hills Design Haus TIS
Study:4 Hr. Video Turning Movement Count
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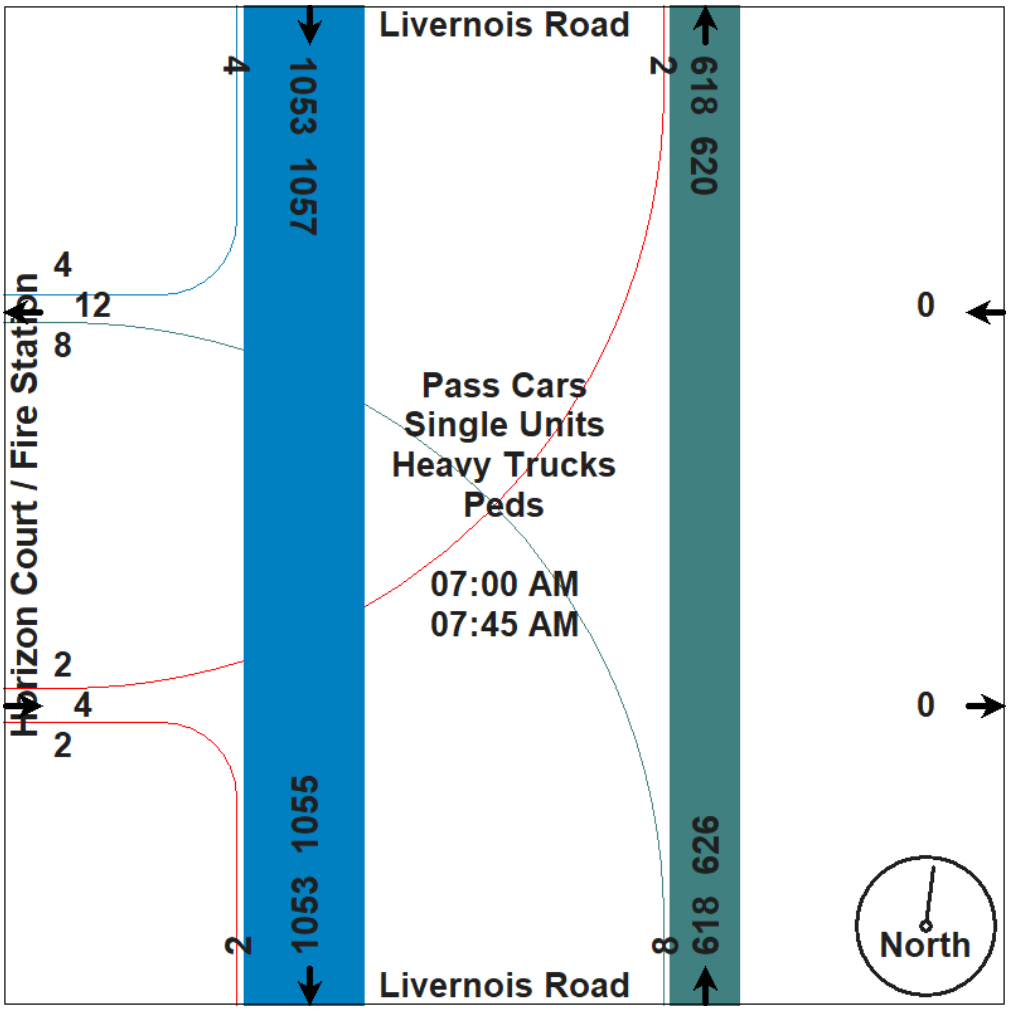
Count By Miovision Video VCU 2Z4 SE

File Name : TMC_2 Livernois & HorizonCt_3-21-19
Site Code : TMC_2
Start Date : 3/21/2019
Page No : 3

	Livernois Road Southbound			Livernois Road Northbound			Horizon Court / Fire Station Eastbound			
Start Time	Right	Thru	App. Total	Thru	Left	App. Total	Right	Left	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 12:30 PM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 07:00 AM										
07:00 AM	**1**	224	225	**188**	1	**189**	0	**1**	1	415
07:15 AM	1	**277**	**278**	133	0	133	**2**	0	**2**	413
07:30 AM	1	275	276	130	2	132	0	1	1	409
07:45 AM	1	277	278	167	**5**	172	0	0	0	**450**
Total Volume	4	1053	1057	618	8	626	2	2	4	1687
% App. Total	0.4	99.6		98.7	1.3		50	50		
PHF	1.00	.950	.951	.822	.400	.828	.250	.500	.500	.937
Pass Cars	4	1046	1050	606	7	613	2	2	4	1667
% Pass Cars	100	99.3	99.3	98.1	87.5	97.9	100	100	100	98.8
Single Units	0	6	6	10	1	11	0	0	0	17
% Single Units	0	0.6	0.6	1.6	12.5	1.8	0	0	0	1.0
Heavy Trucks	0	1	1	2	0	2	0	0	0	3
% Heavy Trucks	0	0.1	0.1	0.3	0	0.3	0	0	0	0.2
Peds	0	0	0	0	0	0	0	0	0	0
% Peds	0	0	0	0	0	0	0	0	0	0



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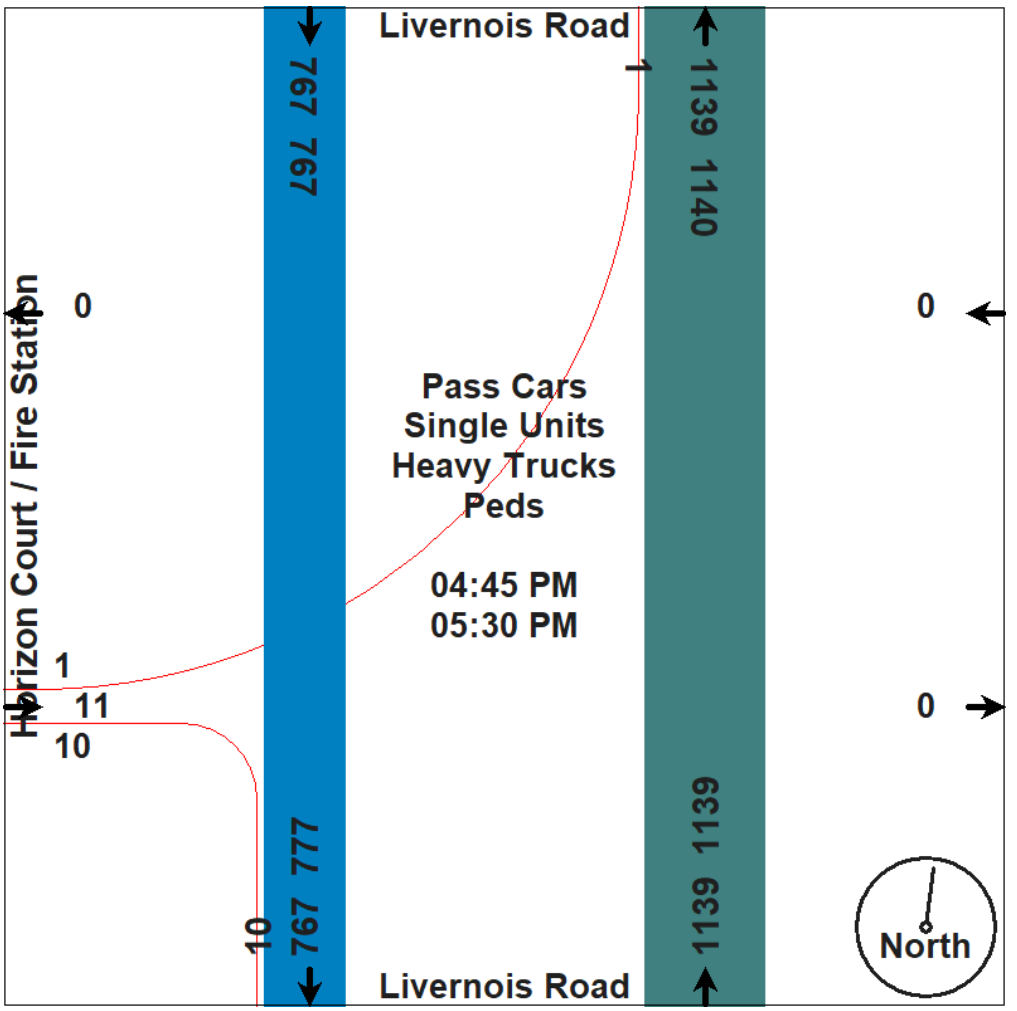
Project: Rochester Hills Design Haus TIS
Study:4 Hr. Video Turning Movement Count
Weather:Sunny/Cldy. Deg's 30s
Count By Miovision Video VCU 2Z4 SE

File Name : TMC_2 Livernois & HorizonCt_3-21-19
Site Code : TMC_2
Start Date : 3/21/2019
Page No : 4

	Livernois Road Southbound			Livernois Road Northbound			Horizon Court / Fire Station Eastbound			
Start Time	Right	Thru	App. Total	Thru	Left	App. Total	Right	Left	App. Total	Int. Total
Peak Hour Analysis From 12:45 PM to 05:45 PM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 04:45 PM										
04:45 PM	0	192	192	283	0	283	3	**1**	**4**	479
05:00 PM	0	**225**	**225**	270	0	270	1	0	1	**496**
05:15 PM	0	166	166	**301**	0	**301**	**4**	0	4	471
05:30 PM	0	184	184	285	0	285	2	0	2	471
Total Volume	0	767	767	1139	0	1139	10	1	11	1917
% App. Total	0	100		100	0		90.9	9.1		
PHF	.000	.852	.852	.946	.000	.946	.625	.250	.688	.966
Pass Cars	0	759	759	1134	0	1134	7	1	8	1901
% Pass Cars	0	99.0	99.0	99.6	0	99.6	70.0	100	72.7	99.2
Single Units	0	7	7	4	0	4	3	0	3	14
% Single Units	0	0.9	0.9	0.4	0	0.4	30.0	0	27.3	0.7
Heavy Trucks	0	1	1	1	0	1	0	0	0	2
% Heavy Trucks	0	0.1	0.1	0.1	0	0.1	0	0	0	0.1
Peds	0	0	0	0	0	0	0	0	0	0
% Peds	0	0	0	0	0	0	0	0	0	0



SEMCOG | Southeast Michigan Council of Governments

Community Profiles

YOU ARE VIEWING DATA FOR:

City of Rochester Hills

1000 Rochester Hills Dr
Rochester Hills, MI 48309-3033
http://www.rochesterhills.org

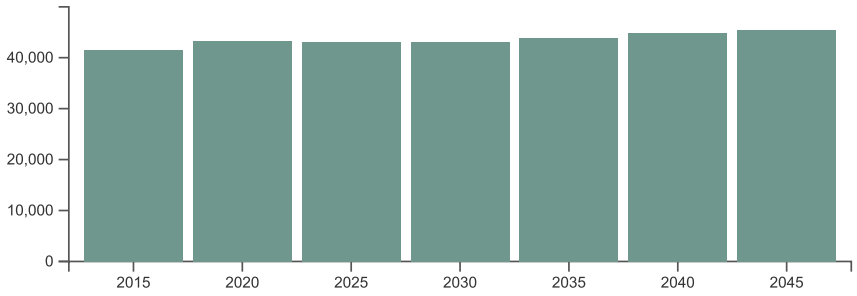
SEMCOG MEMBER

Census 2010 Population: 70,995
Area: 32.9 square miles

Economy & Jobs

Link to American Community Survey (ACS) Profiles: **Select a Year** 2017 ▼ **Economic**

Forecasted Jobs



Source: **SEMCOG 2045 Regional Development Forecast**

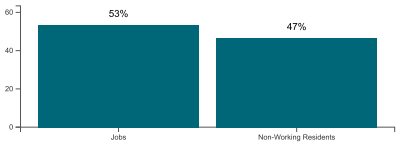
Forecasted Jobs by Industry Sector

Forecasted Jobs By Industry Sector	2015	2020	2025	2030	2035	2040	2045	Change 2015-2045	Pct Change 2015-2045
Natural Resources, Mining, & Construction	1,755	2,005	1,907	1,886	1,911	1,938	1,967	212	12.1%
Manufacturing	5,018	4,705	4,429	4,098	3,886	3,704	3,505	-1,513	-30.2%
Wholesale Trade	1,437	1,484	1,482	1,465	1,465	1,464	1,454	17	1.2%
Retail Trade	6,186	6,284	5,952	5,927	5,740	5,662	5,599	-587	-9.5%
Transportation, Warehousing, & Utilities	699	723	721	719	730	743	756	57	8.2%
Information & Financial Activities	3,877	4,008	3,960	3,911	3,955	3,973	3,952	75	1.9%
Professional and Technical Services & Corporate HQ	3,552	3,647	3,850	4,080	4,551	5,061	5,412	1,860	52.4%
Administrative, Support, & Waste Services	3,708	3,835	3,885	3,906	3,992	4,080	4,134	426	11.5%
Education Services	2,261	2,377	2,375	2,363	2,389	2,419	2,449	188	8.3%
Healthcare Services	6,774	7,303	7,578	7,758	8,230	8,705	9,124	2,350	34.7%
Leisure & Hospitality	3,951	4,433	4,527	4,572	4,660	4,776	4,818	867	21.9%
Other Services	1,982	2,041	1,993	1,956	1,950	1,937	1,910	-72	-3.6%
Public Administration	359	361	359	354	354	351	351	-8	-2.2%
Total Employment Numbers	41,559	43,206	43,018	42,995	43,813	44,813	45,431	3,872	9.3%

Source: **SEMCOG 2045 Regional Development Forecast**

Daytime Population

Daytime Population	SEMCOG and ACS 2015
Jobs	41,559
Non-Working Residents	36,257
Age 15 and under	14,348
Not in labor force	19,738
Unemployed	2,171
Daytime Population	77,816



Source: **SEMCOG 2045 Regional Development Forecast** and **2015 American Community Survey 5-Year Estimates**

Note: The number of residents attending school outside Southeast Michigan is not available. Likewise, the number of students commuting into Southeast Michigan to attend school is also not known.

SEMCOG | Southeast Michigan Council of Governments

Community Profiles

YOU ARE VIEWING DATA FOR:

City of Rochester Hills

1000 Rochester Hills Dr
Rochester Hills, MI 48309-3033
http://www.rochesterhills.org

SEMCOG MEMBER

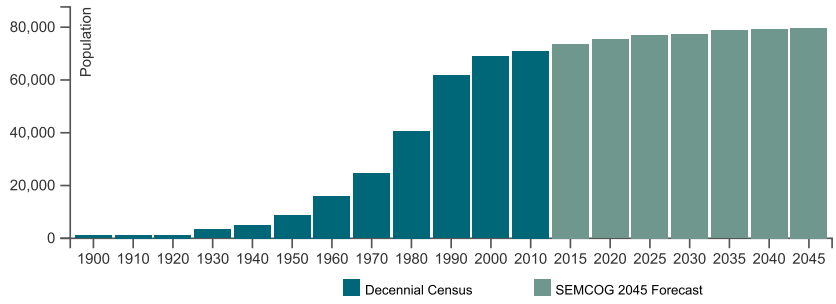
Census 2010 Population: 70,995
Area: 32.9 square miles

Population and Households

Link to American Community Survey (ACS) Profiles: **Select a Year** 2017 ▼ **Social** | **Demographic**

Population and Household Estimates for Southeast Michigan, 2018

Population Forecast



Note for City of Rochester Hills : Incorporated in 1984 from Avon Charter Township. Population numbers prior to 1984 are of the township.

Population and Households

Population and Households	Census 2010	Change 2000-2010	Pct Change 2000-2010	SEMCOG Jul 2018	SEMCOG 2045
Total Population	70,995	2,170	3.2%	74,556	79,709
Group Quarters Population	1,181	398	50.8%	1,112	1,494
Household Population	69,814	1,772	2.6%	73,444	78,215
Housing Units	29,494	2,231	8.2%	30,595	-
Households (Occupied Units)	27,578	1,263	4.8%	29,155	32,471
Residential Vacancy Rate	6.5%	3.0%	-	4.7%	-
Average Household Size	2.53	-0.05	-	2.52	2.41

Source: **U.S. Census Bureau**, **SEMCOG Population and Household Estimates**, and **SEMCOG 2045 Regional Development Forecast**

Components of Population Change

Components of Population Change	2000-2005 Avg.	2006-2010 Avg.	2011-2015 Avg.
Natural Increase (Births - Deaths)	384	233	194
Births	950	755	750
Deaths	566	522	556
Net Migration (Movement In - Movement Out)	-368	185	351
Population Change (Natural Increase + Net Migration)	16	418	545

Source: **Michigan Department of Community Health Vital Statistics**, **U.S. Census Bureau**, and SEMCOG

SEMCOG

MS2

Transportation Data Management System

List View | All DIRs

Record 1 of 1 Goto Record go

Location ID	2256	**MPO ID**	12815
Type	LINK	**HPMS ID**	
On NHS		**On HPMS**	
LRS ID		**LRS Loc Pt.**	
SF Group		**Route Type**	
AF Group		**Route**	
GF Group		**Active**	Yes
Class Dist Grp		**Category**	HPMS
Seas Clss Grp			
WIM Group			
Fnct'l Class	-	**Milepost**	
Located On	LIVERNOIS		
Loc On Alias			
From Road	HAMLIN		
To Road	AVON		

More Detail

STATION DATA

Directions: 2-WAY

AADT

Year	AADT	DHV-30	K %	D %	PA	BC	Src
2018	21,750						
2012	14,910						
2009	17,190						
2006	18,730						
2003	16,330						

|<< < > >>| 1-5 of 7

Travel Demand Model

	Model Year	Model AADT	AM PHV	AM PPV	MD PHV	MD PPV	PM PHV	PM PPV	NT PHV	NT PPV

VOLUME COUNT

	Date	Int	Total
	Mon 4/30/2018	60	22,739
	Thu 11/29/2012	60	15,682
	Wed 7/15/2009	60	19,008

VOLUME TREND

Year	Annual Growth
2018	6%
2012	-5%

Appendix B

EXISTING TRAFFIC CONDITIONS

Level of Service Criteria for Stop Sign Controlled Intersections

The level of service criteria are given in Table 17-2. As used here, control delay is defined as the total elapsed time from the time a vehicle stops at the end of the queue until the vehicle departs from the stop line; this time includes the time required for the vehicle to travel from the last-in-queue position to the first-in-queue position, including deceleration of vehicles from free-flow speed to the speed of vehicles in queue.

The average total delay for any particular minor movement is a function of the service rate or capacity of the approach and the degree of saturation. . . .

Exhibit 17-2. Level of Service Criteria for TWSC Intersections

LEVEL OF SERVICE	AVERAGE CONTROL DELAY (sec/veh)
A	$\leq$ 10
B	> 10 and $\leq$ 15
C	> 15 and $\leq$ 25
D	> 25 and $\leq$ 35
E	> 35 and $\leq$ 50
F	> 50

Average total delay less than 10 sec/veh is defined as Level of Service (LOS) A. Follow-up times of less than 5 sec have been measured when there is no conflicting traffic for a minor street movement, so control delays of less than 10 sec/veh are appropriate for low flow conditions. To remain consistent with the AWSC intersection analysis procedure described later in this chapter, a total delay of 50 sec/veh is assumed as the break point between LOS E and F.

The proposed level of service criteria for TWSC intersections are somewhat different from the criteria used in Chapter 16 for signalized intersections. The primary reason for this difference is that drivers expect different levels of performance from different kinds of transportation facilities. The expectation is that a signalized intersection is designed to carry higher traffic volumes than an unsignalized intersection. Additionally, several driver behavior considerations combine to make delays at signalized intersections less onerous than at unsignalized intersections. For example, drivers at signalized intersections are able to relax during the red interval, where drivers on the minor approaches to unsignalized intersections must remain attentive to the task of identifying acceptable gaps and vehicle conflicts. Also, there is often much more variability in the amount of delay experienced by individual drivers at unsignalized than signalized intersections. For these reasons, it is considered that the total delay threshold for any given level of service is less for an unsignalized intersection than for a signalized intersection. . . .

LOS F exists when there are insufficient gaps of suitable size to allow a side street demand to cross safely through a major street traffic stream. This level of service is generally evident from extremely long total delays experienced by side street traffic and by queueing on the minor approaches. The method, however, is based on a constant critical gap size - that is, the critical gap remains constant, no matter how long the side street motorist waits. LOS F may also appear in the form of side street vehicles' selecting smaller-than-usual gaps. In such cases, safety may be a problem and some disruption to the major traffic stream may result. It is important to note that LOS F may not always result in long queues but may result in adjustments to normal gap acceptance behavior. The latter is more difficult to observe on the field than queueing, which is more obvious.

Source: Highway Capacity Manual, 2010. Transportation Research Board, National Research Council

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. Specifically, level-of-service (LOS) criteria are stated in terms of the average stopped delay per vehicle for a 15-min analysis period. The criteria are given in Exhibit 16-2. 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 very low delay, up to 10 sec per vehicle. This level of service occurs when progression is extremely favorable and most vehicles arrive during the green phase. Most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.

LOS B describes operations with delay greater than 10 and up to 20 sec per vehicle. This level generally occurs with good progression, short cycle lengths, or both. More vehicles stop than with LOS A, causing higher levels of average delay.

Exhibit 16-2. Level-of-Service Criteria for Signalized Intersections

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

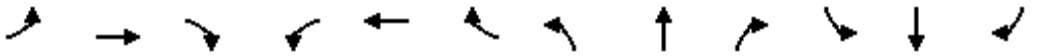
LOS C describes operations with delay greater than 20 and up to 35 sec per vehicle. These higher delays may result from fair progression, longer cycle lengths, or both. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant at this level, though many still pass through the intersection without stopping.

LOS D describes operations with delay greater than 35 and up to 55 sec per vehicle. At level D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or high *v/c* ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.

LOS E describes operations with delay greater than 55 and up to 80 sec per vehicle. This level is considered by many agencies to be the limit of acceptable delay. These high delay values generally indicate poor progression, long cycle lengths, and high *v/c* ratios. Individual cycle failures are frequent occurrences.

LOS F describes operations with delay in excess of 80 sec per vehicle. This level, considered to be unacceptable to most drivers, often occurs with oversaturation, that is, when arrival flow rates exceed the capacity of the intersection. It may also occur at high *v/c* ratios below 1.0 with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

Source: Highway Capacity Manual, 2010. Transportation Research Board, National Research Council



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	1	1	2	141	2	121	27	572	21	32	914	15
Future Volume (veh/h)	1	1	2	141	2	121	27	572	21	32	914	15
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	1610	1610	1610	2000	2000	2000	1969	1969	1969	1984	1984	1984
Adj Flow Rate, veh/h	2	2	3	152	2	130	33	698	26	34	962	16
Peak Hour Factor	0.60	0.60	0.60	0.93	0.93	0.93	0.82	0.82	0.82	0.95	0.95	0.95
Percent Heavy Veh, %	25	25	25	0	0	0	2	2	2	1	1	1
Cap, veh/h	123	78	117	248	3	224	376	1448	54	524	1524	1291
Arrive On Green	0.13	0.13	0.13	0.13	0.13	0.13	0.77	0.77	0.77	0.77	0.77	0.77
Sat Flow, veh/h	1029	581	872	1434	26	1673	575	1886	70	735	1984	1682
Grp Volume(v), veh/h	2	0	5	152	0	132	33	0	724	34	962	16
Grp Sat Flow(s),veh/h/ln	1029	0	1453	1434	0	1699	575	0	1956	735	1984	1682
Q Serve(g_s), s	0.2	0.0	0.4	12.4	0.0	8.8	3.3	0.0	16.4	2.1	26.2	0.3
Cycle Q Clear(g_c), s	9.0	0.0	0.4	12.7	0.0	8.8	29.5	0.0	16.4	18.5	26.2	0.3
Prop In Lane	1.00		0.60	1.00		0.98	1.00		0.04	1.00		1.00
Lane Grp Cap(c), veh/h	123	0	194	248	0	227	376	0	1502	524	1524	1291
V/C Ratio(X)	0.02	0.00	0.03	0.61	0.00	0.58	0.09	0.00	0.48	0.06	0.63	0.01
Avail Cap(c_a), veh/h	208	0	315	366	0	368	376	0	1502	524	1524	1291
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	53.0	0.0	45.2	50.7	0.0	48.8	12.9	0.0	5.1	8.5	6.3	3.3
Incr Delay (d2), s/veh	0.1	0.0	0.1	3.5	0.0	3.3	0.5	0.0	1.1	0.2	2.0	0.0
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	0.0	0.1	4.7	0.0	4.0	0.4	0.0	5.2	0.3	8.6	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	53.1	0.0	45.2	54.2	0.0	52.1	13.4	0.0	6.2	8.8	8.3	3.3
LnGrp LOS	D	A	D	D	A	D	B	A	A	A	A	A
Approach Vol, veh/h		7			284			757			1012	
Approach Delay, s/veh		47.5			53.2			6.6			8.2	
Approach LOS		D			D			A			A	

Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		97.9		22.1		97.9		22.1				
Change Period (Y+Rc), s		5.8		6.0		5.8		6.0				
Max Green Setting (Gmax), s		82.2		26.0		82.2		26.0				
Max Q Clear Time (g_c+I1), s		31.5		11.0		28.2		14.7				
Green Ext Time (p_c), s		5.8		0.0		9.4		1.3				

Intersection Summary												
HCM 6th Ctrl Delay			13.9									
HCM 6th LOS			B									

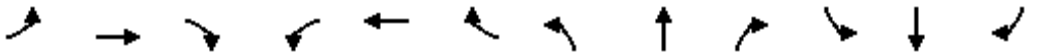
Intersection	
Int Delay, s/veh	0.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	2	2	8	618	1053	4
Future Vol, veh/h	2	2	8	618	1053	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	60	-	-	50
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	60	60	83	83	95	95
Heavy Vehicles, %	0	0	2	2	1	1
Mvmt Flow	3	3	10	745	1108	4

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1873	1108	1112	0	-	0
Stage 1	1108	-	-	-	-	-
Stage 2	765	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.12	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.218	-	-	-
Pot Cap-1 Maneuver	80	258	628	-	-	-
Stage 1	319	-	-	-	-	-
Stage 2	463	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	79	258	628	-	-	-
Mov Cap-2 Maneuver	79	-	-	-	-	-
Stage 1	314	-	-	-	-	-
Stage 2	463	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	36.5	0.1	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	628	-	121	-	-
HCM Lane V/C Ratio	0.015	-	0.055	-	-
HCM Control Delay (s)	10.8	-	36.5	-	-
HCM Lane LOS	B	-	E	-	-
HCM 95th %tile Q(veh)	0	-	0.2	-	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	8	0	17	44	0	100	1	1050	108	51	706	5
Future Volume (veh/h)	8	0	17	44	0	100	1	1050	108	51	706	5
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	2000	2000	2000	2000	2000	2000	2000	2000	2000	1984	1984	1984
Adj Flow Rate, veh/h	12	0	25	46	0	105	1	1105	114	59	821	6
Peak Hour Factor	0.69	0.69	0.69	0.95	0.95	0.95	0.95	0.95	0.95	0.86	0.86	0.86
Percent Heavy Veh, %	0	0	0	0	0	0	0	0	0	1	1	1
Cap, veh/h	95	0	147	163	0	147	521	1453	150	297	1617	1370
Arrive On Green	0.09	0.00	0.09	0.09	0.00	0.09	0.81	0.81	0.81	0.81	0.81	0.81
Sat Flow, veh/h	1309	0	1695	1408	0	1695	673	1783	184	461	1984	1682
Grp Volume(v), veh/h	12	0	25	46	0	105	1	0	1219	59	821	6
Grp Sat Flow(s),veh/h/ln	1309	0	1695	1408	0	1695	673	0	1967	461	1984	1682
Q Serve(g_s), s	1.1	0.0	1.6	3.8	0.0	7.2	0.1	0.0	36.2	8.6	15.7	0.1
Cycle Q Clear(g_c), s	8.3	0.0	1.6	5.4	0.0	7.2	15.7	0.0	36.2	44.8	15.7	0.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.09	1.00		1.00
Lane Grp Cap(c), veh/h	95	0	147	163	0	147	521	0	1603	297	1617	1370
V/C Ratio(X)	0.13	0.00	0.17	0.28	0.00	0.71	0.00	0.00	0.76	0.20	0.51	0.00
Avail Cap(c_a), veh/h	265	0	367	346	0	367	521	0	1603	297	1617	1370
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	57.4	0.0	50.8	53.3	0.0	53.3	6.0	0.0	5.4	16.3	3.5	2.1
Incr Delay (d2), s/veh	0.8	0.0	0.8	1.3	0.0	8.8	0.0	0.0	3.5	1.5	1.1	0.0
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	0.0	0.7	1.4	0.0	3.5	0.0	0.0	9.9	1.0	4.2	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	58.2	0.0	51.6	54.6	0.0	62.1	6.0	0.0	8.9	17.8	4.6	2.1
LnGrp LOS	E	A	D	D	A	E	A	A	A	B	A	A
Approach Vol, veh/h		37			151			1220			886	
Approach Delay, s/veh		53.7			59.8			8.9			5.5	
Approach LOS		D			E			A			A	

Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		103.6		16.4		103.6		16.4				
Change Period (Y+Rc), s		5.8		6.0		5.8		6.0				
Max Green Setting (Gmax), s		82.2		26.0		82.2		26.0				
Max Q Clear Time (g_c+I1), s		38.2		10.3		46.8		9.2				
Green Ext Time (p_c), s		15.1		0.1		7.5		0.9				

Intersection Summary												
HCM 6th Ctrl Delay			11.6									
HCM 6th LOS			B									

Intersection	
Int Delay, s/veh	0.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	1	10	0	1158	767	0
Future Vol, veh/h	1	10	0	1158	767	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	60	-	-	50
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	69	69	95	95	85	85
Heavy Vehicles, %	27	27	0	0	1	1
Mvmt Flow	1	14	0	1219	902	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2121	902	902	0	-	0
Stage 1	902	-	-	-	-	-
Stage 2	1219	-	-	-	-	-
Critical Hdwy	6.67	6.47	4.1	-	-	-
Critical Hdwy Stg 1	5.67	-	-	-	-	-
Critical Hdwy Stg 2	5.67	-	-	-	-	-
Follow-up Hdwy	3.743	3.543	2.2	-	-	-
Pot Cap-1 Maneuver	47	303	762	-	-	-
Stage 1	358	-	-	-	-	-
Stage 2	249	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	47	303	762	-	-	-
Mov Cap-2 Maneuver	47	-	-	-	-	-
Stage 1	358	-	-	-	-	-
Stage 2	249	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	24.2	0	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	762	-	203	-	-
HCM Lane V/C Ratio	-	-	0.079	-	-
HCM Control Delay (s)	0	-	24.2	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0	-	0.3	-	-

Intersection: 1: Livernois Road & Drexelgate Parkway

Movement	EB	EB	WB	WB	NB	NB	SB	SB	SB
Directions Served	L	TR	L	TR	L	TR	L	T	R
Maximum Queue (ft)	25	35	199	120	89	251	125	366	88
Average Queue (ft)	1	3	97	48	21	104	24	150	5
95th Queue (ft)	11	19	167	89	60	204	81	277	51
Link Distance (ft)		808		1074		1346		848	
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)	300		250		125		250		250
Storage Blk Time (%)			0			3		1	
Queuing Penalty (veh)			0			1		0	

Intersection: 2: Livernois Road & Horizon Court

Movement	EB	NB
Directions Served	LR	L
Maximum Queue (ft)	27	32
Average Queue (ft)	3	4
95th Queue (ft)	17	21
Link Distance (ft)	859	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		60
Storage Blk Time (%)		0
Queuing Penalty (veh)		0

Zone Summary

Zone wide Queuing Penalty: 2

Intersection: 1: Livernois Road & Drexelgate Parkway

Movement	EB	EB	WB	WB	NB	NB	SB	SB	SB
Directions Served	L	TR	L	TR	L	TR	L	T	R
Maximum Queue (ft)	39	35	104	145	12	463	142	209	22
Average Queue (ft)	5	9	44	68	0	202	53	84	1
95th Queue (ft)	22	28	92	121	6	391	123	181	9
Link Distance (ft)		808		1074		1346		848	
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)	300		250		125		250		250
Storage Blk Time (%)						11	0	0	
Queuing Penalty (veh)						0	0	0	

Intersection: 2: Livernois Road & Horizon Court

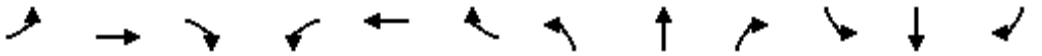
Movement	EB
Directions Served	LR
Maximum Queue (ft)	62
Average Queue (ft)	12
95th Queue (ft)	42
Link Distance (ft)	859
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Zone Summary

Zone wide Queuing Penalty: 0

Appendix C

BACKGROUND TRAFFIC CONDITIONS



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	1	1	2	145	2	124	28	586	22	33	937	15
Future Volume (veh/h)	1	1	2	145	2	124	28	586	22	33	937	15
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	1610	1610	1610	2000	2000	2000	1969	1969	1969	1984	1984	1984
Adj Flow Rate, veh/h	2	2	3	156	2	133	34	715	27	35	986	16
Peak Hour Factor	0.60	0.60	0.60	0.93	0.93	0.93	0.82	0.82	0.82	0.95	0.95	0.95
Percent Heavy Veh, %	25	25	25	0	0	0	2	2	2	1	1	1
Cap, veh/h	124	79	119	252	3	229	360	1442	54	509	1518	1287
Arrive On Green	0.14	0.14	0.14	0.14	0.14	0.14	0.77	0.77	0.77	0.77	0.77	0.77
Sat Flow, veh/h	1026	581	872	1434	25	1674	562	1885	71	723	1984	1682
Grp Volume(v), veh/h	2	0	5	156	0	135	34	0	742	35	986	16
Grp Sat Flow(s),veh/h/ln	1026	0	1453	1434	0	1699	562	0	1956	723	1984	1682
Q Serve(g_s), s	0.2	0.0	0.4	12.7	0.0	8.9	3.6	0.0	17.2	2.3	27.8	0.3
Cycle Q Clear(g_c), s	9.2	0.0	0.4	13.1	0.0	8.9	31.5	0.0	17.2	19.5	27.8	0.3
Prop In Lane	1.00		0.60	1.00		0.99	1.00		0.04	1.00		1.00
Lane Grp Cap(c), veh/h	124	0	199	252	0	232	360	0	1496	509	1518	1287
V/C Ratio(X)	0.02	0.00	0.03	0.62	0.00	0.58	0.09	0.00	0.50	0.07	0.65	0.01
Avail Cap(c_a), veh/h	206	0	315	366	0	368	360	0	1496	509	1518	1287
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	52.9	0.0	44.9	50.5	0.0	48.6	13.9	0.0	5.3	9.0	6.6	3.3
Incr Delay (d2), s/veh	0.1	0.0	0.1	3.5	0.0	3.3	0.5	0.0	1.2	0.3	2.2	0.0
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	0.0	0.1	4.8	0.0	4.0	0.5	0.0	5.6	0.4	9.3	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	53.0	0.0	45.0	54.1	0.0	51.8	14.4	0.0	6.5	9.3	8.8	3.4
LnGrp LOS	D	A	D	D	A	D	B	A	A	A	A	A
Approach Vol, veh/h		7			291			776			1037	
Approach Delay, s/veh		47.2			53.0			6.9			8.7	
Approach LOS		D			D			A			A	

Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		97.6		22.4		97.6		22.4				
Change Period (Y+Rc), s		5.8		6.0		5.8		6.0				
Max Green Setting (Gmax), s		82.2		26.0		82.2		26.0				
Max Q Clear Time (g_c+I1), s		33.5		11.2		29.8		15.1				
Green Ext Time (p_c), s		6.1		0.0		9.9		1.3				

Intersection Summary												
HCM 6th Ctrl Delay			14.3									
HCM 6th LOS			B									

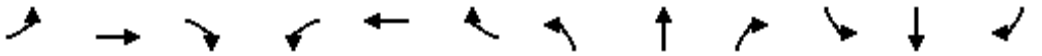
Intersection	
Int Delay, s/veh	0.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	2	2	8	634	1080	4
Future Vol, veh/h	2	2	8	634	1080	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	60	-	-	50
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	60	60	83	83	95	95
Heavy Vehicles, %	0	0	2	2	1	1
Mvmt Flow	3	3	10	764	1137	4

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1921	1137	1141	0	-	0
Stage 1	1137	-	-	-	-	-
Stage 2	784	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.12	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.218	-	-	-
Pot Cap-1 Maneuver	75	248	612	-	-	-
Stage 1	309	-	-	-	-	-
Stage 2	453	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	74	248	612	-	-	-
Mov Cap-2 Maneuver	74	-	-	-	-	-
Stage 1	304	-	-	-	-	-
Stage 2	453	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	38.5	0.1	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	612	-	114	-	-
HCM Lane V/C Ratio	0.016	-	0.058	-	-
HCM Control Delay (s)	11	-	38.5	-	-
HCM Lane LOS	B	-	E	-	-
HCM 95th %tile Q(veh)	0	-	0.2	-	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	8	0	17	45	0	103	1	1077	111	52	724	5
Future Volume (veh/h)	8	0	17	45	0	103	1	1077	111	52	724	5
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	2000	2000	2000	2000	2000	2000	2000	2000	2000	1984	1984	1984
Adj Flow Rate, veh/h	12	0	25	47	0	108	1	1134	117	60	842	6
Peak Hour Factor	0.69	0.69	0.69	0.95	0.95	0.95	0.95	0.95	0.95	0.86	0.86	0.86
Percent Heavy Veh, %	0	0	0	0	0	0	0	0	0	1	1	1
Cap, veh/h	95	0	150	165	0	150	506	1450	150	278	1614	1367
Arrive On Green	0.09	0.00	0.09	0.09	0.00	0.09	0.81	0.81	0.81	0.81	0.81	0.81
Sat Flow, veh/h	1306	0	1695	1408	0	1695	660	1783	184	448	1984	1682
Grp Volume(v), veh/h	12	0	25	47	0	108	1	0	1251	60	842	6
Grp Sat Flow(s),veh/h/ln	1306	0	1695	1408	0	1695	660	0	1967	448	1984	1682
Q Serve(g_s), s	1.1	0.0	1.6	3.8	0.0	7.4	0.1	0.0	39.2	9.5	16.5	0.1
Cycle Q Clear(g_c), s	8.5	0.0	1.6	5.5	0.0	7.4	16.6	0.0	39.2	48.7	16.5	0.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.09	1.00		1.00
Lane Grp Cap(c), veh/h	95	0	150	165	0	150	506	0	1599	278	1614	1367
V/C Ratio(X)	0.13	0.00	0.17	0.28	0.00	0.72	0.00	0.00	0.78	0.22	0.52	0.00
Avail Cap(c_a), veh/h	262	0	367	346	0	367	506	0	1599	278	1614	1367
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	57.4	0.0	50.6	53.1	0.0	53.2	6.3	0.0	5.8	18.3	3.6	2.1
Incr Delay (d2), s/veh	0.8	0.0	0.7	1.3	0.0	8.9	0.0	0.0	3.9	1.8	1.2	0.0
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	0.0	0.7	1.4	0.0	3.6	0.0	0.0	10.9	1.1	4.5	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	58.2	0.0	51.3	54.4	0.0	62.1	6.3	0.0	9.6	20.0	4.9	2.1
LnGrp LOS	E	A	D	D	A	E	A	A	A	C	A	A
Approach Vol, veh/h		37			155			1252			908	
Approach Delay, s/veh		53.6			59.8			9.6			5.8	
Approach LOS		D			E			A			A	

Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		103.4		16.6		103.4		16.6				
Change Period (Y+Rc), s		5.8		6.0		5.8		6.0				
Max Green Setting (Gmax), s		82.2		26.0		82.2		26.0				
Max Q Clear Time (g_c+I1), s		41.2		10.5		50.7		9.4				
Green Ext Time (p_c), s		15.7		0.1		7.6		0.9				

Intersection Summary												
HCM 6th Ctrl Delay			12.2									
HCM 6th LOS			B									

Intersection	
Int Delay, s/veh	0.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	1	10	0	1188	786	0
Future Vol, veh/h	1	10	0	1188	786	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	60	-	-	50
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	69	69	95	95	85	85
Heavy Vehicles, %	27	27	0	0	1	1
Mvmt Flow	1	14	0	1251	925	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2176	925	925	0	-	0
Stage 1	925	-	-	-	-	-
Stage 2	1251	-	-	-	-	-
Critical Hdwy	6.67	6.47	4.1	-	-	-
Critical Hdwy Stg 1	5.67	-	-	-	-	-
Critical Hdwy Stg 2	5.67	-	-	-	-	-
Follow-up Hdwy	3.743	3.543	2.2	-	-	-
Pot Cap-1 Maneuver	43	294	747	-	-	-
Stage 1	349	-	-	-	-	-
Stage 2	240	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	43	294	747	-	-	-
Mov Cap-2 Maneuver	43	-	-	-	-	-
Stage 1	349	-	-	-	-	-
Stage 2	240	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	25.4	0	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	747	-	192	-	-
HCM Lane V/C Ratio	-	-	0.083	-	-
HCM Control Delay (s)	0	-	25.4	-	-
HCM Lane LOS	A	-	D	-	-
HCM 95th %tile Q(veh)	0	-	0.3	-	-

Intersection: 1: Livernois Road & Drexelgate Parkway

Movement	EB	EB	WB	WB	NB	NB	SB	SB	SB
Directions Served	L	TR	L	TR	L	TR	L	T	R
Maximum Queue (ft)	14	36	222	98	118	291	64	357	29
Average Queue (ft)	1	4	97	45	21	100	21	153	2
95th Queue (ft)	9	22	175	80	67	200	50	289	14
Link Distance (ft)		808		1074		1346		848	
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)	300		250		125		250		250
Storage Blk Time (%)			0			3		2	
Queuing Penalty (veh)			0			1		1	

Intersection: 2: Livernois Road & Horizon Court

Movement	EB	NB
Directions Served	LR	L
Maximum Queue (ft)	32	37
Average Queue (ft)	4	5
95th Queue (ft)	21	23
Link Distance (ft)	859	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		60
Storage Blk Time (%)		0
Queuing Penalty (veh)		0

Zone Summary

Zone wide Queuing Penalty: 2

Intersection: 1: Livernois Road & Drexelgate Parkway

Movement	EB	EB	WB	WB	NB	SB	SB	SB
Directions Served	L	TR	L	TR	TR	L	T	R
Maximum Queue (ft)	34	39	87	152	522	156	258	15
Average Queue (ft)	5	10	39	65	229	58	80	1
95th Queue (ft)	23	30	80	121	448	126	187	6
Link Distance (ft)		808		1074	1346		848	
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)	300		250			250		250
Storage Blk Time (%)					11	0	0	
Queuing Penalty (veh)					0	0	0	

Intersection: 2: Livernois Road & Horizon Court

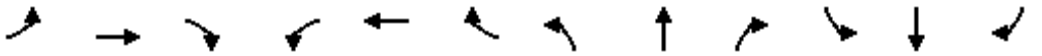
Movement	EB
Directions Served	LR
Maximum Queue (ft)	60
Average Queue (ft)	12
95th Queue (ft)	43
Link Distance (ft)	859
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Zone Summary

Zone wide Queuing Penalty: 0

Appendix D

FUTURE TRAFFIC CONDITIONS



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	11	4	4	145	20	124	37	589	22	33	950	69
Future Volume (veh/h)	11	4	4	145	20	124	37	589	22	33	950	69
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	1610	1610	1610	2000	2000	2000	1969	1969	1969	1984	1984	1984
Adj Flow Rate, veh/h	18	7	7	156	22	133	45	718	27	35	1000	73
Peak Hour Factor	0.60	0.60	0.60	0.93	0.93	0.93	0.82	0.82	0.82	0.95	0.95	0.95
Percent Heavy Veh, %	25	25	25	0	0	0	2	2	2	1	1	1
Cap, veh/h	120	106	106	252	35	213	330	1430	54	500	1505	1275
Arrive On Green	0.14	0.14	0.14	0.14	0.14	0.14	0.76	0.76	0.76	0.76	0.76	0.76
Sat Flow, veh/h	1007	739	739	1422	246	1487	526	1885	71	721	1984	1682
Grp Volume(v), veh/h	18	0	14	156	0	155	45	0	745	35	1000	73
Grp Sat Flow(s),veh/h/ln	1007	0	1477	1422	0	1732	526	0	1956	721	1984	1682
Q Serve(g_s), s	2.1	0.0	1.0	12.8	0.0	10.1	5.5	0.0	17.8	2.4	29.5	1.3
Cycle Q Clear(g_c), s	12.2	0.0	1.0	13.8	0.0	10.1	34.9	0.0	17.8	20.2	29.5	1.3
Prop In Lane	1.00		0.50	1.00		0.86	1.00		0.04	1.00		1.00
Lane Grp Cap(c), veh/h	120	0	212	252	0	248	330	0	1483	500	1505	1275
V/C Ratio(X)	0.15	0.00	0.07	0.62	0.00	0.62	0.14	0.00	0.50	0.07	0.66	0.06
Avail Cap(c_a), veh/h	193	0	320	356	0	375	330	0	1483	500	1505	1275
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	54.1	0.0	44.5	50.4	0.0	48.4	15.6	0.0	5.7	9.6	7.1	3.7
Incr Delay (d2), s/veh	0.8	0.0	0.2	3.5	0.0	3.6	0.9	0.0	1.2	0.3	2.3	0.1
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	0.6	0.0	0.4	4.8	0.0	4.7	0.7	0.0	5.9	0.4	10.0	0.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	54.9	0.0	44.6	53.9	0.0	52.0	16.4	0.0	6.9	9.9	9.4	3.7
LnGrp LOS	D	A	D	D	A	D	B	A	A	A	A	A
Approach Vol, veh/h		32			311			790			1108	
Approach Delay, s/veh		50.4			53.0			7.4			9.0	
Approach LOS		D			D			A			A	

Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		96.8		23.2		96.8		23.2				
Change Period (Y+Rc), s		5.8		6.0		5.8		6.0				
Max Green Setting (Gmax), s		82.2		26.0		82.2		26.0				
Max Q Clear Time (g_c+I1), s		36.9		14.2		31.5		15.8				
Green Ext Time (p_c), s		6.3		0.1		10.4		1.4				

Intersection Summary												
HCM 6th Ctrl Delay			15.2									
HCM 6th LOS			B									

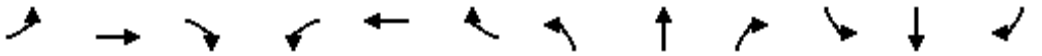
Intersection	
Int Delay, s/veh	0.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	8	42	643	1082	17
Future Vol, veh/h	5	8	42	643	1082	17
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	60	-	-	50
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	60	60	83	83	95	95
Heavy Vehicles, %	0	0	2	2	1	1
Mvmt Flow	8	13	51	775	1139	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2016	1139	1157	0	-	0
Stage 1	1139	-	-	-	-	-
Stage 2	877	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.12	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.218	-	-	-
Pot Cap-1 Maneuver	65	247	604	-	-	-
Stage 1	308	-	-	-	-	-
Stage 2	410	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	60	247	604	-	-	-
Mov Cap-2 Maneuver	60	-	-	-	-	-
Stage 1	282	-	-	-	-	-
Stage 2	410	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	44.7	0.7	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	604	-	112	-	-
HCM Lane V/C Ratio	0.084	-	0.193	-	-
HCM Control Delay (s)	11.5	-	44.7	-	-
HCM Lane LOS	B	-	E	-	-
HCM 95th %tile Q(veh)	0.3	-	0.7	-	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	61	9	26	45	2	103	3	1090	111	52	727	17
Future Volume (veh/h)	61	9	26	45	2	103	3	1090	111	52	727	17
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	2000	2000	2000	2000	2000	2000	2000	2000	2000	1984	1984	1984
Adj Flow Rate, veh/h	71	10	30	47	2	108	3	1147	117	60	845	20
Peak Hour Factor	0.86	0.86	0.86	0.95	0.95	0.95	0.95	0.95	0.95	0.86	0.86	0.86
Percent Heavy Veh, %	0	0	0	0	0	0	0	0	0	1	1	1
Cap, veh/h	155	59	176	217	4	222	448	1372	140	216	1525	1293
Arrive On Green	0.13	0.13	0.13	0.13	0.13	0.13	0.77	0.77	0.77	0.77	0.77	0.77
Sat Flow, veh/h	1304	441	1322	1389	31	1669	650	1785	182	442	1984	1682
Grp Volume(v), veh/h	71	0	40	47	0	110	3	0	1264	60	845	20
Grp Sat Flow(s),veh/h/ln	1304	0	1762	1389	0	1700	650	0	1967	442	1984	1682
Q Serve(g_s), s	6.4	0.0	2.4	3.7	0.0	7.2	0.2	0.0	49.9	12.2	20.6	0.3
Cycle Q Clear(g_c), s	13.6	0.0	2.4	6.1	0.0	7.2	20.8	0.0	49.9	62.1	20.6	0.3
Prop In Lane	1.00		0.75	1.00		0.98	1.00		0.09	1.00		1.00
Lane Grp Cap(c), veh/h	155	0	234	217	0	226	448	0	1512	216	1525	1293
V/C Ratio(X)	0.46	0.00	0.17	0.22	0.00	0.49	0.01	0.00	0.84	0.28	0.55	0.02
Avail Cap(c_a), veh/h	264	0	382	333	0	368	448	0	1512	216	1525	1293
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	54.5	0.0	46.1	48.9	0.0	48.2	9.8	0.0	9.0	29.1	5.6	3.3
Incr Delay (d2), s/veh	3.0	0.0	0.5	0.7	0.0	2.3	0.0	0.0	5.6	3.2	1.5	0.0
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	2.2	0.0	1.1	1.4	0.0	3.2	0.0	0.0	17.0	1.4	6.7	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	57.5	0.0	46.6	49.6	0.0	50.5	9.8	0.0	14.6	32.3	7.1	3.3
LnGrp LOS	E	A	D	D	A	D	A	A	B	C	A	A
Approach Vol, veh/h		111			157			1267			925	
Approach Delay, s/veh		53.6			50.2			14.6			8.6	
Approach LOS		D			D			B			A	

Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		98.0		22.0		98.0		22.0				
Change Period (Y+Rc), s		5.8		6.0		5.8		6.0				
Max Green Setting (Gmax), s		82.2		26.0		82.2		26.0				
Max Q Clear Time (g_c+I1), s		51.9		15.6		64.1		9.2				
Green Ext Time (p_c), s		14.2		0.4		6.4		0.9				

Intersection Summary												
HCM 6th Ctrl Delay			16.4									
HCM 6th LOS			B									

Intersection	
Int Delay, s/veh	1.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	14	46	8	1190	795	3
Future Vol, veh/h	14	46	8	1190	795	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	60	-	-	50
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	95	95	85	85
Heavy Vehicles, %	7	7	0	0	1	1
Mvmt Flow	16	52	8	1253	935	4

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2204	935	939	0	-	0
Stage 1	935	-	-	-	-	-
Stage 2	1269	-	-	-	-	-
Critical Hdwy	6.47	6.27	4.1	-	-	-
Critical Hdwy Stg 1	5.47	-	-	-	-	-
Critical Hdwy Stg 2	5.47	-	-	-	-	-
Follow-up Hdwy	3.563	3.363	2.2	-	-	-
Pot Cap-1 Maneuver	47	315	738	-	-	-
Stage 1	374	-	-	-	-	-
Stage 2	258	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	46	315	738	-	-	-
Mov Cap-2 Maneuver	46	-	-	-	-	-
Stage 1	370	-	-	-	-	-
Stage 2	258	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	57.6	0.1	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	738	-	133	-	-
HCM Lane V/C Ratio	0.011	-	0.513	-	-
HCM Control Delay (s)	9.9	-	57.6	-	-
HCM Lane LOS	A	-	F	-	-
HCM 95th %tile Q(veh)	0	-	2.4	-	-

Intersection: 1: Livernois Road & Drexelgate Parkway

Movement	EB	EB	WB	WB	NB	NB	SB	SB	SB
Directions Served	L	TR	L	TR	L	TR	L	T	R
Maximum Queue (ft)	58	48	215	175	153	264	51	450	206
Average Queue (ft)	11	8	100	66	35	120	18	173	20
95th Queue (ft)	40	31	176	128	98	230	44	326	96
Link Distance (ft)		808		1074		1346		848	
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)	300		250		125		250		250
Storage Blk Time (%)			0	0		5		2	
Queuing Penalty (veh)			0	0		2		3	

Intersection: 2: Livernois Road & Horizon Court

Movement	EB	NB	NB
Directions Served	LR	L	T
Maximum Queue (ft)	45	64	41
Average Queue (ft)	11	23	1
95th Queue (ft)	38	54	21
Link Distance (ft)	859		1135
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)		60	
Storage Blk Time (%)		1	0
Queuing Penalty (veh)		6	0

Zone Summary

Zone wide Queuing Penalty: 11

Intersection: 1: Livernois Road & Drexelgate Parkway

Movement	EB	EB	WB	WB	NB	NB	SB	SB	SB
Directions Served	L	TR	L	TR	L	TR	L	T	R
Maximum Queue (ft)	140	62	95	145	54	664	133	281	29
Average Queue (ft)	54	21	34	72	3	305	56	104	3
95th Queue (ft)	113	51	73	128	30	590	119	206	18
Link Distance (ft)		808		1074		1346		848	
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)	300		250		125		250		250
Storage Blk Time (%)						17		0	
Queuing Penalty (veh)						0		0	

Intersection: 2: Livernois Road & Horizon Court

Movement	EB	NB
Directions Served	LR	L
Maximum Queue (ft)	156	28
Average Queue (ft)	46	4
95th Queue (ft)	108	20
Link Distance (ft)	859	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		60
Storage Blk Time (%)		
Queuing Penalty (veh)		

Zone Summary

Zone wide Queuing Penalty: 1

Appendix E

SIGNAL WARRANT ANALYSIS

Summary of Warrants

Spot Number:	0		
Major Street:	Livernois Road	Minor Street:	Horizon Court
Intersection:	Livernois Road at Horizon Court		
City/Twp:	Rochester Hills		
Date Performed:	10/14/2019	Performed By:	F&V
Date Volumes Collected:	3/21/2019		

Warrant	Condition	Is Warrant Met
Data Validation Error		**NO**
WARRANT 1: Eight-Hour Vehicular Volume		**NO**
	Condition A	NO
	Condition B	NO
	Condition A&B	N/A
WARRANT 2: Four-Hour Vehicular Volume	(70%)	**NO**
WARRANT 3: Peak-Hour Vehicular Volume	(70%)	**NO**
	Condition A	**NO**
	Condition B	**NO**
WARRANT 4: Pedestrian Volume	(70%)	**NO**
	Four Hour	N/A
	Peak Hour	N/A
(Threshold)	HAWK	NO
(Threshold)	RRFB	NO
WARRANT 5: School Crossing		**NO**
WARRANT 6: Coordinated Signal System		**NO**
WARRANT 7: Crash Experience		**NO**
	Condition A	NO
	Condition B	NO
WARRANT 8: Roadway Network		**NO**
WARRANT 9: Intersection Near a Grade Crossing		**#N/A**

Issue to Be Addressed by Signalization:

0

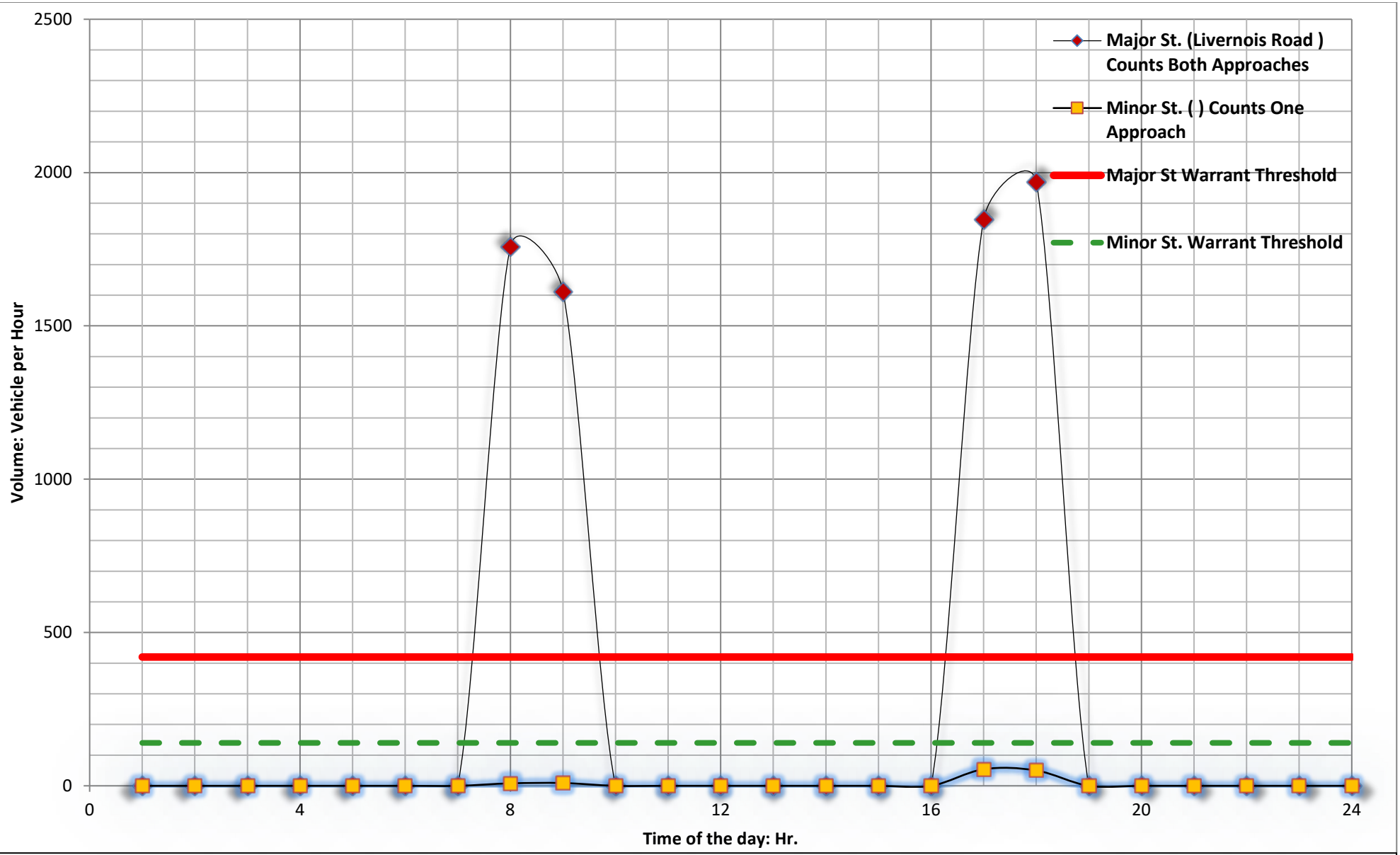


FIGURE 1: WARRANT **1A**

IS THERE A REDUCTION IN THE WARRANT THRESHOLDS TO 70% ...

1- DUE TO SPEED? YES

2- DUE TO ISOLATED COMMUNITY WITH POPULATION LESS THAN 10,000? NO

Spot Number:

Livernois Road @ Horizon Court

NO. OF LANES ON MAJOR ST.? 2

NO. OF LANES ON MINOR ST.? 2

Number of Hours that met the Warrant: 0

Does this intersection meet Warrant 1A for signal installation? NO

Data Collection Date: 3/21/2019

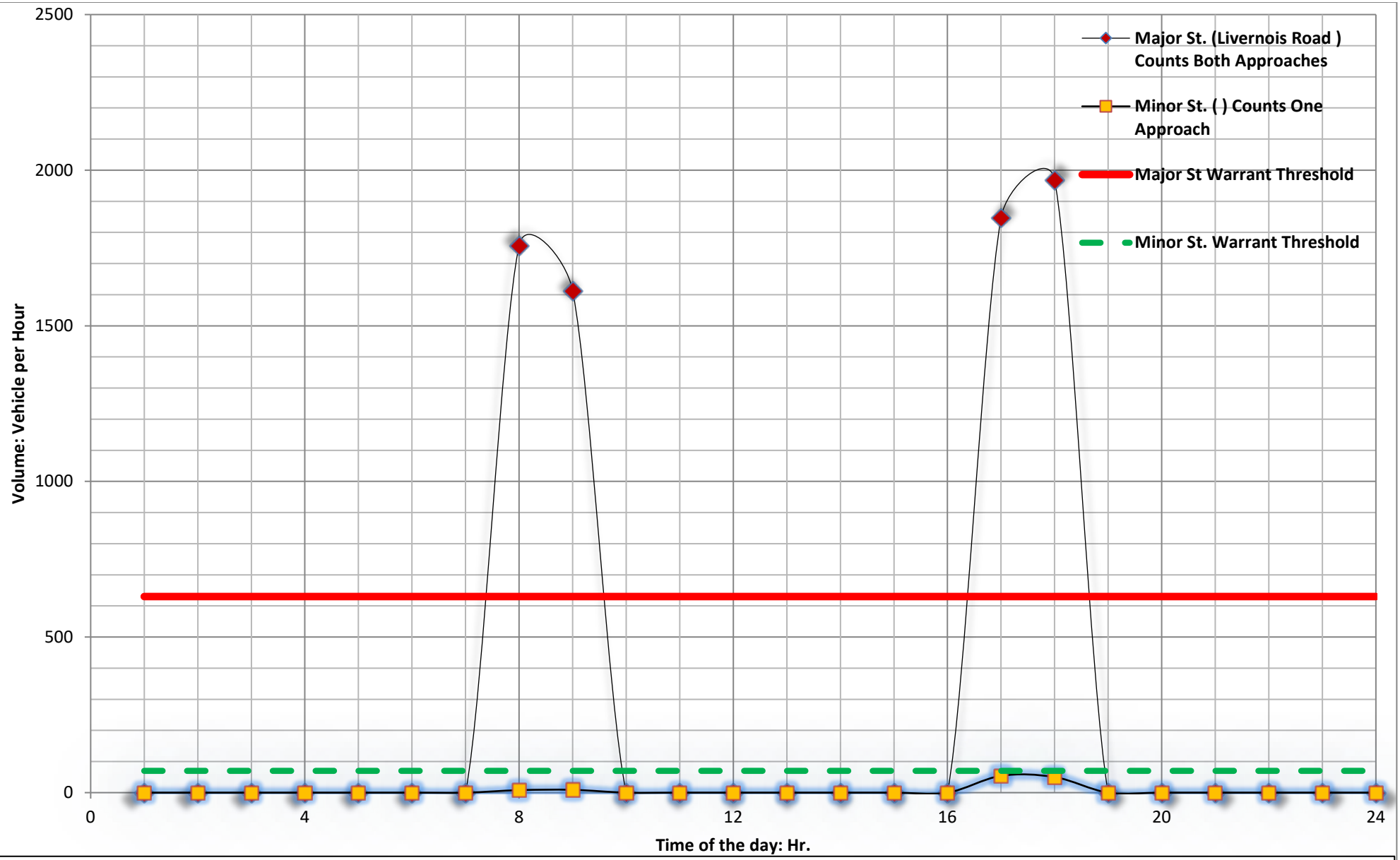


FIGURE 1: WARRANT **1B**

IS THERE A REDUCTION IN THE WARRANT THRESHOLDS TO 70% ...

1- DUE TO SPEED? YES

2- DUE TO ISOLATED COMMUNITY WITH POPULATION LESS THAN 10,000? NO

Spot Number:

Livernois Road @ Horizon Court

NO. OF LANES ON MAJOR ST.? 2

NO. OF LANES ON MINOR ST.? 2

Number of Hours that met the Warrant: 0

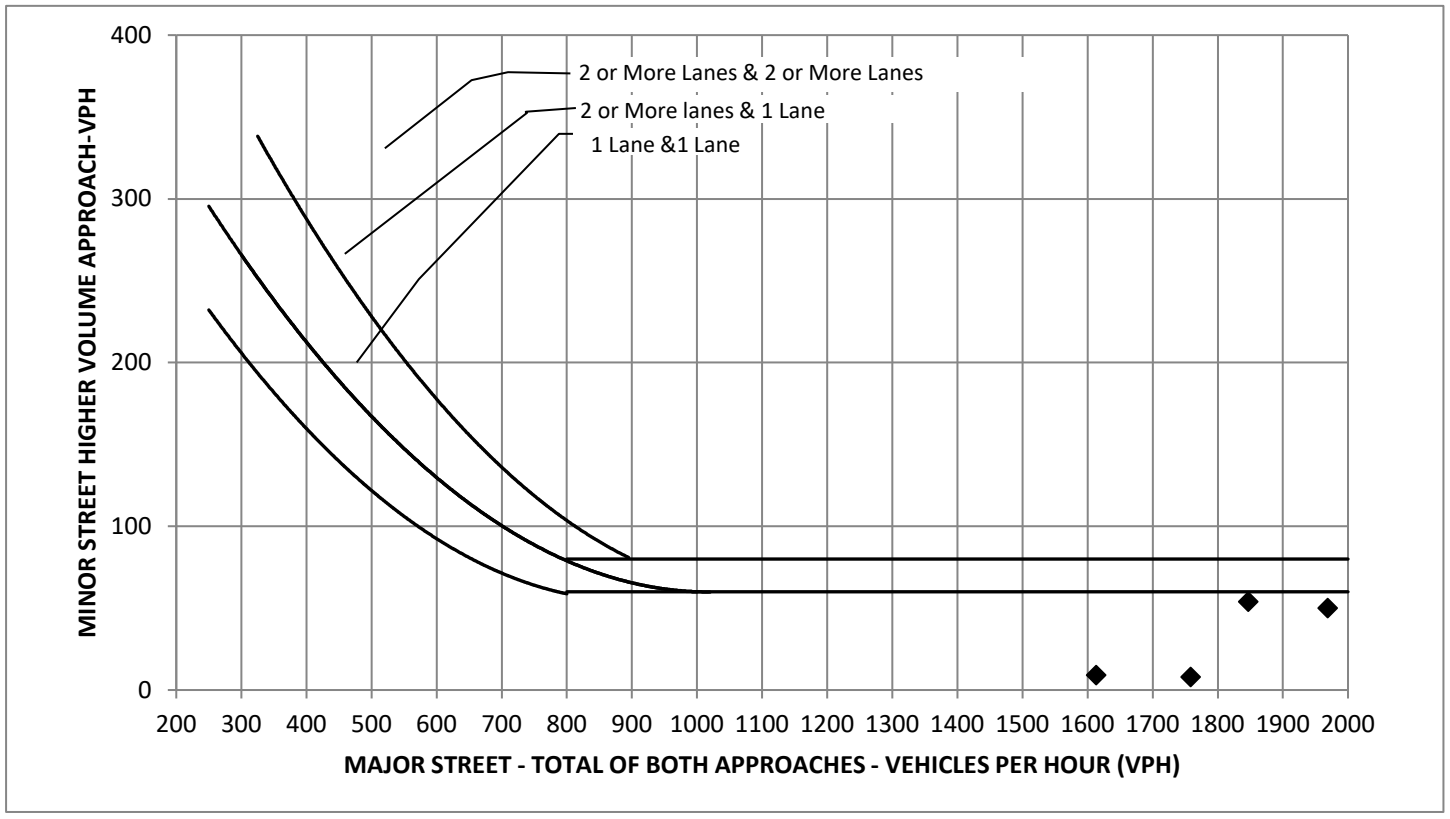
Does this intersection meet Warrant 1B for signal installation? NO

Data Collection Date: 3/21/2019

Michigan Manual of Uniform Traffic Control Devices
Worksheet for Signal Warrants (Section 4C)
WARRANT 2: Four-Hour Vehicular Volume

Spot Number:	0		
Intersection:	Livernois Road @ Horizon Court		
Date	10/14/2019	by	F&V

2	**: No. of Lanes on Major St.**
2	**: No. of Lanes on Minor St.**
45	**: Speed limit or 85th Percentile? (MPH)**
NO	**: Is the intersection within an Isolated community?**
0	**: What is the of the population isolated community?**



How Many Hours Are Met	**0**
Is Warrant (70%) Met?	**NO**

Michigan Manual of Uniform Traffic Control Devices
Worksheet for Signal Warrants (Section 4C)
WARRANT 3 A: Peak-Hour Vehicular Volume

Spot Number:	0		
Intersection:	Livernois Road @ Horizon Court		
Date	10/14/2019	by	F&V

NOT MET	**0.96**	**: Total Stop Time Delay (hrs)**
	2	**: Minor Street Approach Lanes**
	3	**: Total Approaches**
NOT MET	50	**: Minor Approach Volume**
	2019	**: Total Entering Volume**
	17:00 - 18:00	**: Peak Hour**

Is Warrant 3 A Met?	**NO**

Michigan Manual of Uniform Traffic Control Devices

Worksheet for Signal Warrants (Section 4C)

WARRANT 3 B(70%): Peak-Hour Vehicular Volume

Spot Number:	0		
Intersection:	Livernois Road @ Horizon Court		
Date	10/14/2019	by	F&V

2	**: No. of Lanes on Major St.**
2	**: No. of Lanes on Minor St.**
45	**: Speed limit or 85th Percentile? (MPH)**
NO	**: Is the intersection within an Isolated community?**
0	**: What is the of the population isolated community?**

How Many Hours Are Met	**0**
Is Warrant (70%) Met?	**NO**