

NORTHVILLE DOWNS TRAFFIC IMPACT STUDY

CITY OF NORTHVILLE, MICHIGAN

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PREPARED FOR:



Hunter Pasteur

HOMES

**2300 NORTHWESTERN HWY #125,
FARMINGTON HILLS, MI 4833**

PREPARED BY:



**27725 STANSBURY BLVD., SUITE 150
FARMINGTON HILLS, MI 48834**

#835540

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Agency Review	Date	Comments

TABLE OF CONTENTS

1	INTRODUCTION.....	1
2	BACKGROUND DATA.....	4
2.1	EXISTING ROAD NETWORK.....	4
2.2	EXISTING TRAFFIC VOLUMES.....	5
3	ANALYSIS.....	8
3.1	EXISTING CONDITIONS.....	8
3.1.1	Main Street and Hutton Street.....	9
3.1.2	Main Street and Griswold Street.....	9
3.1.3	Cady Street and Center Street.....	10
3.1.4	Sheldon Avenue/Center Street and 7 Mile Road/Hines Drive.....	10
3.1.5	7 Mile Road and Hines Drive.....	10
3.2	EXISTING IMPROVEMENTS.....	10
3.2.1	Main Street and Hutton Street.....	10
3.2.2	Main Street and Griswold Street.....	10
3.2.3	Sheldon Avenue/Center Street and 7 Mile Road/Hines Drive.....	10
3.2.4	7 Mile Road and Hines Drive.....	11
3.2.5	Existing Conditions with Improvements.....	11
3.3	BACKGROUND CONDITIONS.....	13
3.4	BACKGROUND OPERATIONS.....	13
3.5	BACKGROUND IMPROVEMENTS.....	16
3.5.1	Main Street and Hutton Street.....	16
3.5.2	Main Street and Griswold Street.....	16
3.5.3	Sheldon Avenue/Center Street and 7 Mile Road/Hines Drive.....	16
3.5.4	7 Mile Road and Hines Drive.....	17
3.5.5	Background Conditions with Improvements.....	17
3.6	SITE TRIP GENERATION.....	19
3.6.1	Vehicular Trip Generation Analysis.....	19
3.6.2	ITE Residential Modal Split.....	20
3.7	CITY OF NORTHVILLE MODAL SPLIT.....	20
3.8	SITE TRIP DISTRIBUTION.....	21
3.9	FUTURE CONDITIONS.....	24
3.9.1	Main Street and Hutton Street.....	25
3.9.2	Main Street and Griswold Street.....	25
3.9.3	Cady Street and Center Street.....	26
3.9.4	Center Street and Fairbrook Street.....	26
3.9.5	Sheldon Avenue/Center Street and 7 Mile Road/Hines Drive.....	26
3.9.6	7 Mile Road and Hines Drive.....	26
3.9.7	Center Street and NW. Site Drive.....	26
3.10	FUTURE IMPROVEMENTS.....	26
3.10.1	Main Street and Hutton Street.....	27
3.10.2	Main Street and Griswold Street.....	27
3.10.3	Sheldon Avenue/Center Street and 7 Mile Road/Hines Drive.....	27
3.10.4	7 Mile Road and Hines Drive.....	27
3.10.5	Future Conditions with Improvements.....	27
4	CONCLUSIONS AND RECOMMENDATIONS.....	29

4.1	EXISTING CONDITIONS	29
4.1.1	Main Street and Griswold Street	29
4.1.2	Cady Street and Center Street.....	29
4.1.3	Sheldon Avenue/Center Street and 7 Mile Road/Hines Drive	29
4.1.4	7 Mile Road and Hines Drive	29
4.1.5	Main Street and Hutton Street.....	29
4.2	BACKGROUND CONDITIONS.....	29
4.3	FUTURE CONDITIONS.....	30

LIST OF TABLES

TABLE 1: EXISTING INTERSECTION OPERATIONS	8
TABLE 2: EXISTING INTERSECTION OPERATIONS WITH IMPROVEMENTS	11
TABLE 3: EXISTING VEHICLE QUEUES (FEET) WITH IMPROVEMENTS.....	12
TABLE 4: BACKGROUND INTERSECTION OPERATIONS	13
TABLE 5: BACKGROUND INTERSECTION OPERATIONS WITH IMPROVEMENTS	17
TABLE 6: BACKGROUND VEHICLE QUEUES (FEET) WITH IMPROVEMENTS	18
TABLE 7: COMMERCIAL DEVELOPMENT TRIP GENERATION	19
TABLE 8: RESIDENTIAL DEVELOPMENT TRIP GENERATION	19
TABLE 9: PERSON-TRIP GENERATION PER <i>ITE TRIP GENERATION HANDBOOK, 3RD EDITION</i>	20
TABLE 10: RESIDENTIAL MODAL SPLIT TRIP GENERATION	21
TABLE 11: NEW SITE TRIP DISTRIBUTION.....	21
TABLE 12: FUTURE INTERSECTION OPERATIONS	24
TABLE 13: FUTURE INTERSECTION OPERATIONS WITH IMPROVEMENTS	27
TABLE 14: FUTURE VEHICLE QUEUES WITH IMPROVEMENTS	28

LIST OF FIGURES

FIGURE 1: SITE LOCATION	3
FIGURE 2: LANE USE AND TRAFFIC CONTROL	6
FIGURE 3: EXISTING TRAFFIC VOLUMES	7
FIGURE 4: BACKGROUND TRAFFIC VOLUMES	14
FIGURE 5: SITE-GENERATED TRAFFIC VOLUMES.....	22
FIGURE 6: FUTURE TRAFFIC VOLUMES	23

LIST OF APPENDICES

- A. BACKGROUND INFORMATION
- B. EXISTING TRAFFIC CONDITIONS
- C. BACKGROUND TRAFFIC CONDITIONS
- D. FUTURE TRAFFIC CONDITIONS

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1 INTRODUCTION

This report presents the results of a Traffic Impact Study (TIS) for the proposed development in the City of Northville, Michigan. The project site is located generally in the northeast quadrant of the Center Road and 7 Mile Road intersection on the property that was previously occupied by Northville Downs, as shown on **Figure 1**. The proposed development includes the construction of mixed-use office/commercial and residential units. The development includes site access to Cady Street, Griswold Street, Beal Street, Fairbrook Street, and Center Street.

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). In addition, the City of Northville and the Wayne County Department of Public Service (WCDPS) were contacted regarding the scope of work for this study. The study analyses were completed using Synchro and SimTraffic (Version 10) traffic analysis software. The study intersections analyzed for this TIS include:

- Main Street & Center Street,
- Main Street & Hutton Street,
- Main Street & Griswold Street,
- Cady Street & Center Street,
- Cady Street & Hutton Street,
- Cady Street & Griswold Street,
- Beal Street & Griswold Street,
- Beal Street & River Street,
- Center Street & Fairbrook Street,
- 7 Mile Road/Hines Drive & Center Street/Sheldon Avenue,
- 7 Mile Road & Hines Drive,
- 7 Mile Road & River Street, and
- The proposed site driveway intersections.

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. Obtain and review the proposed site plan which includes the proposed land use, density, and desired site access locations.
2. Provide an analysis of the traffic-related impacts of the proposed development at the study intersections.
3. Conduct a site visit and collect a field inventory for the site locations. The inventory will include: the existing geometries, lane use, and traffic control at the study intersections.
4. Collect weekday 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. Weekday counts will be collected on a day in which events are not being held at Northville Downs.
5. Identify the existing AM and PM peak hour traffic volumes at the study intersections based on the traffic count data collected.
6. Calculate the **Existing** vehicle delays, Levels of Service (LOS), and vehicle queues at the study intersections based on the methodologies of the *Highway Capacity Manual, 6th Edition* using Synchro (Version 10) traffic analysis software.
7. Calculate the future background traffic volumes based on an appropriate traffic growth rate to the project build-out year and the applicable background developments (outside of the study area) in the immediate vicinity of the project area as provided by City of Northville Planning Department for use in this study.
8. Calculate the **Background (without the proposed development)** vehicle delays, LOS, and vehicle queues at the study intersections and identify improvements (if any) that would be required to mitigate any unacceptable background traffic conditions.

9. 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 the *ITE Trip Generation Handbook, 3rd Edition*.
10. Assign the trips that would be generated by the proposed development to the adjacent road network based on existing traffic patterns and methodologies outlined in the *ITE Transportation and Land Development, 2nd Edition*.
11. Combine the site-generated traffic assignments with the background traffic forecasts to establish the Future AM and PM peak hour traffic volumes for each alternative.
12. Calculate the **Future (with the proposed development)** vehicle delays, LOS, and vehicle queues at the study intersections.
13. Evaluate the applicable traffic signal warrants using the projected traffic volumes, the traffic volume data collected, and the standards published in the current *Michigan Manual on Uniform Traffic Control Devices (MMUTCD)*.
14. Identification of improvements (if any) for the study road network that would be required to accommodate the site-generated traffic volumes, including the potential need for auxiliary taper/lanes according to City of Northville standards for all scenarios.

Sources of data for this study include traffic counts conducted by F&V subconsultant Traffic Data Collection, Inc. (TDC), information provided by the developer, City of Northville, Wayne County Department of Public Services (WCDPS), and ITE. All background information is provided in **Appendix A**.



FIGURE 1
SITE LOCATION MAP
NORTHVILLE DOWNS TIS - NORTHVILLE, MI

LEGEND
 SITE LOCATION


NORTH
SCALE: NOT TO SCALE



2 BACKGROUND DATA

2.1 EXISTING ROAD NETWORK

Vehicle transportation for the proposed development is provided via Center Street, Cady Street, and Beal Street. Regional transportation is provided via I-96, I-275, and M-14; with access to these routes within 5 miles of the project site location. 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).

Center Street / Sheldon Avenue runs in the north and south directions. The study section of roadway north of 7 Mile Road is known as Center Street, has an Average Annual Daily Traffic (AADT) volume of 13,166 vehicles per day (MDOT 2010), and is under the jurisdiction of the City of Northville. The section of roadway south of 7 Mile Road is known as Sheldon Avenue, has an Average Annual Daily Traffic (AADT) volume of 20,555 vehicles per day (MDOT 2014), and is under the jurisdiction of Wayne County. The study section of roadway has a posted speed limit of 35 mph south of Cady Street and a posted speed limit of 25 mph north of Cady Street. The roadway is a typical two-lane cross-section, with one lane in each direction. At its intersection with 7 Mile Road, the roadway is striped as a single shared lane for northbound and southbound traffic. However, vehicles on the northbound and southbound approaches utilize the available pavement width as a short (50-ft) left-turn lane and a shared through/right-turn lane. The functional classification of Center Street / Sheldon Avenue through the study area is *Principal Arterial*.

Main Street runs in the east and west directions and has an AADT volume of 7,337 vehicles per day (MDOT 2006). The study section of Main Street is under the jurisdiction of the City of Northville and has a posted speed limit of 25 mph. The roadway is a typical two-lane cross-section with one lane in each direction and on-street parking in both sides of the road. On-street parking typically ends prior to an intersection, in order to provide a short (25-50ft typical) right-turn lanes at the intersections. The functional classification of Main Street through the study area is *Minor Arterial*.

7 Mile Road runs in the east and west directions and has an AADT volume of 7,035 vehicles per day (SEMCOG 2009). The study section of 7 Mile Road is under the jurisdiction of WCDPS and has a posted speed limit of 35 mph. The roadway is a typical two-lane cross-section with one lane in each direction. The functional classification of 7 Mile Road through the study area is *Minor Arterial*.

Edward N. Hines Drive generally runs in the north and south directions; however, the study section of Edward N. Hines Drive runs in the east/southeast and west/northwest directions. The study section of Hines Drive is under the jurisdiction of WCDPS, has a posted speed limit of 40 mph south of 7 Mile Road, and has a posted speed limit of 35 mph north of 7 Mile Road. The section of Hines Drive between Center Street and 7 Mile Road has an AADT volume of 10,200 vehicles per day (SEMCOG 2009); the section south of 7 Mile Road has an AADT volume of 2,933 vehicles per day (MDOT 2012). The roadway is a typical two-lane cross-section with one lane in each direction. The functional classification of Edward N. Hines Drive through the study area is *Principal Arterial*.

Cady Street runs in the east and west directions. The study section of Cady Street is under the jurisdiction of the City of Northville and has a posted speed limit of 25 mph. The roadway has a typical two-lane cross-section with one lane in each direction and has on-street parking on both sides of the road between Hutton Street and Griswold Street. The functional classification of Cady Street through the study area is *Local Road*.

Griswold Street generally runs in the north and south directions and has an AADT volume of 7,018 vehicles per day (MDOT 2012). The study section of Griswold Street is under the jurisdiction of the WCDPS and has a posted speed limit of 35 mph. The roadway is a typical two-lane cross-section with one lane in each direction and has on-street parking, on the west side of the road, south of Main Street. The functional classification of Griswold Street through the study area is *Local Road*.

Hutton Street runs in the north and south directions and is under the jurisdiction of the City of Northville with a posted speed limit of 25 mph. The roadway has a typical two-lane cross-section with one lane in each direction and has on-street parking north of Main Street, on both sides of the roadway. The functional classification of Hutton Street through the study area is *Local Road*.

River Street runs in the north and south directions. The study section of River Street is under the jurisdiction of the City of Northville and has a posted speed limit of 25 mph. The roadway has a typical two-lane cross-

section with one lane in each direction. The functional classification of River Street through the study area is *Local Road*.

Beal Street runs in the east and west directions and is under the jurisdiction of the City of Northville with a posted speed limit of 25 mph. The roadway has a typical two-lane cross-section with one lane in each direction. The functional classification of Beal Street through the study area is *Local Road*.

Fairbrook Street runs in the east and west directions and is under the jurisdiction of the City of Northville with a posted speed limit of 25 mph. The roadway has a typical two-lane cross-section with one lane in each direction and has on-street parking on both sides of the roadway. The functional classification of Fairbrook Street through the study area is *Local Road*.

2.2 EXISTING TRAFFIC VOLUMES

Existing traffic volume data at the study intersections were collected by F&V subconsultant TDC on May 15, 2018 for the Weekday AM (7:00 AM to 9:00 AM) and PM (4:00 PM to 6:00 PM). The data collection for this site was intentionally taken on a day in which events were not being held at the current Northville Downs racetrack to avoid any additional traffic generated by the current facility. These data were used as a baseline to establish the current peak hour traffic volumes for the analysis of existing traffic conditions. During collection of the manual intersection 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. At locations where access is provided between study intersections, “dummy” intersections were used to account for sink and source volumes, and through volumes were carried along the main study roadways. The AM and PM peak hours of existing network traffic were identified to generally occur between 8:00 AM to 9:00 AM and 5:00 PM to 6:00 PM, respectively, for a typical weekday. The traffic volume data are included in **Appendix A** and the existing peak hour traffic volumes are summarized on **Figure 3**.

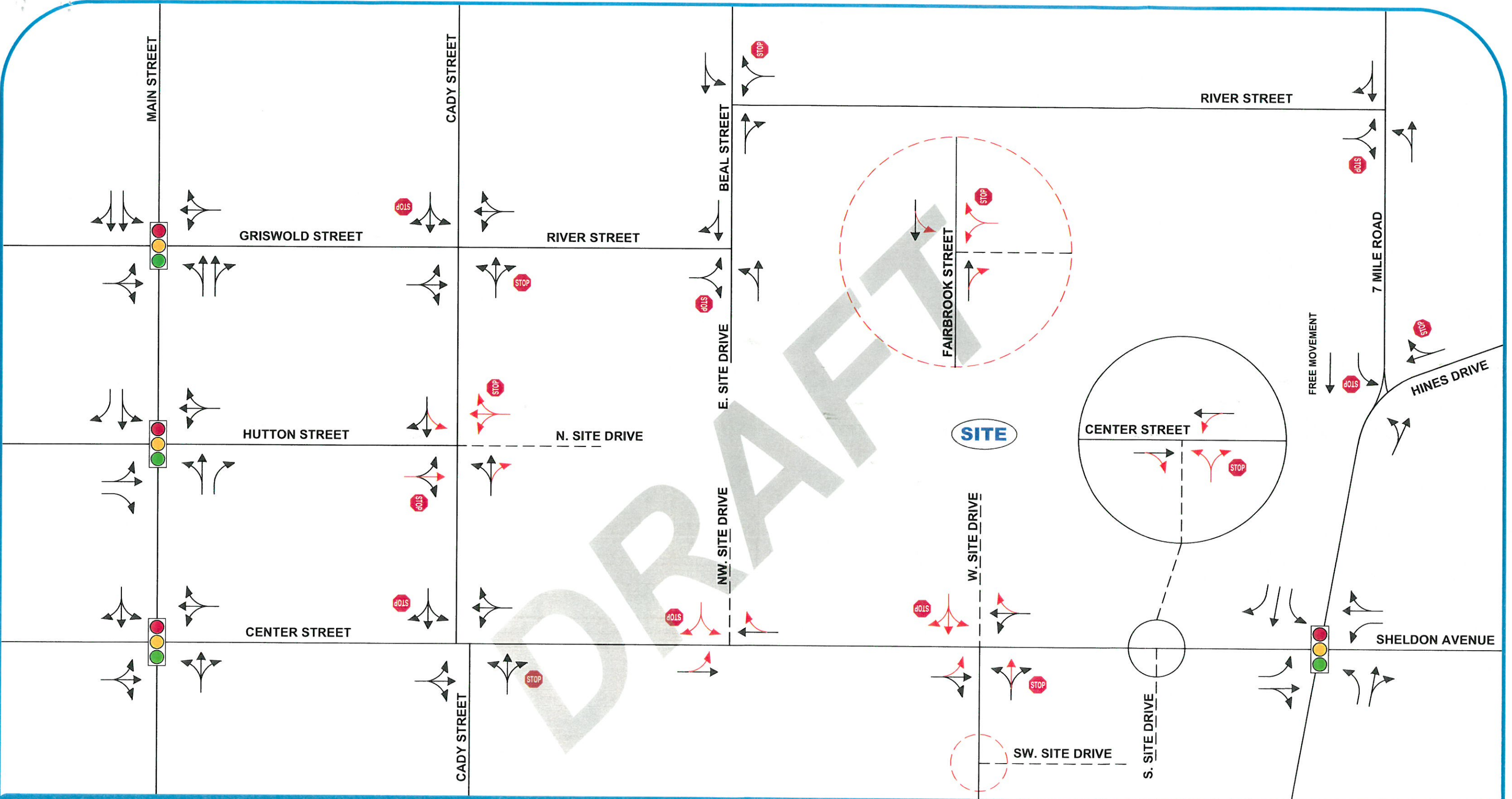


FIGURE 2
LANE USE AND TRAFFIC CONTROL
 NORTHVILLE DOWNS TIS - NORTHVILLE, MI

- LEGEND**
- ROADS
 - PROPOSED ROADS
 - SIGNALIZED INTERSECTION
 - UNSIGNALIZED INTERSECTION
 - EXISTING LANE USE
 - PROPOSED LANE USE

NORTH
 SCALE: NOT TO SCALE



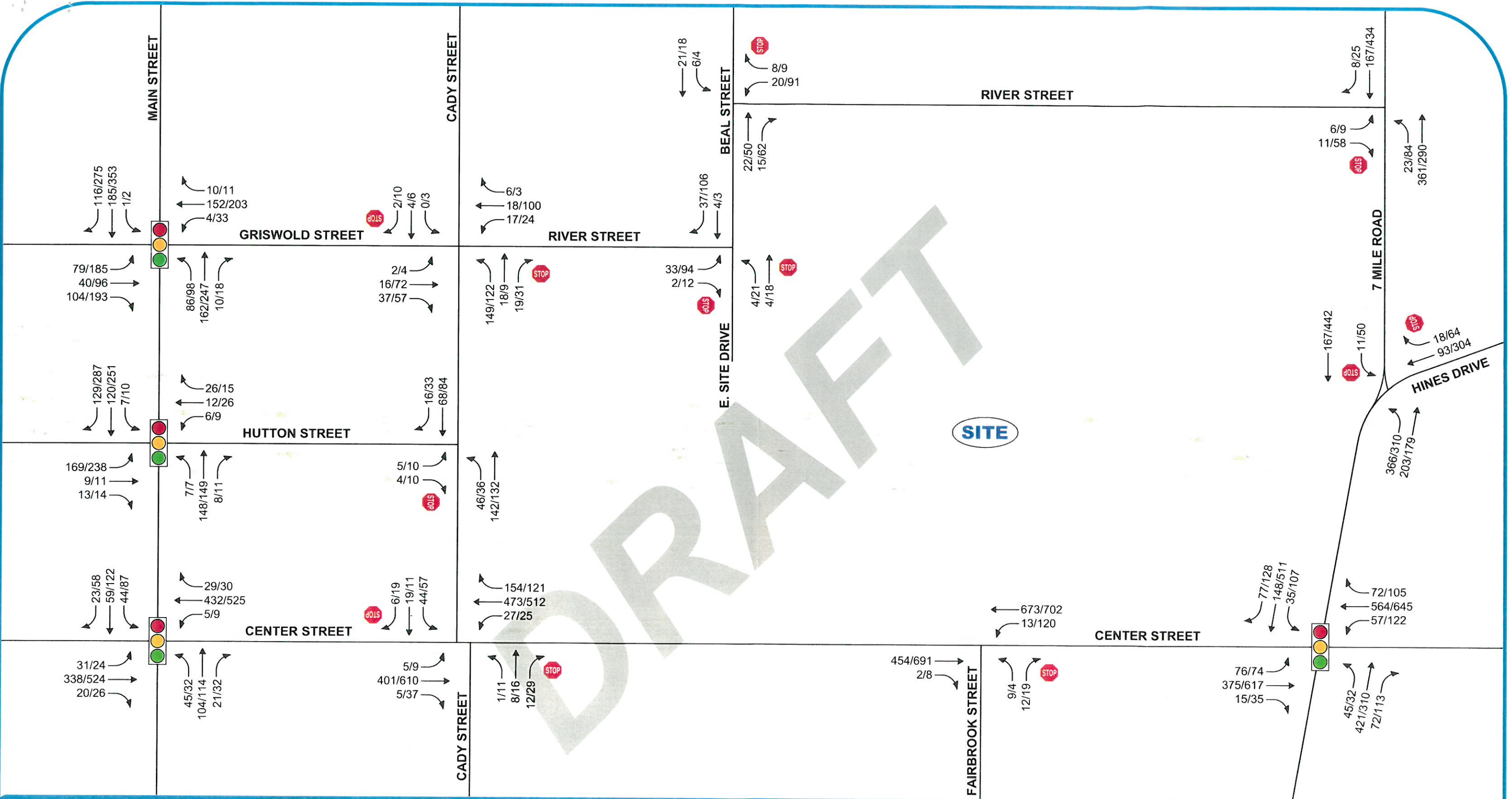
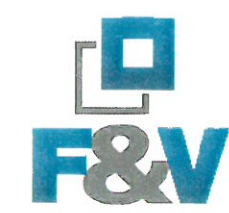


FIGURE 3
EXISTING TRAFFIC
VOLUMES
 NORTHVILLE DOWNS TIS - NORTHVILLE, MI

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

NORTH
 SCALE: NOT TO SCALE



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 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 (HCM) 6th Edition.

There are several study intersections where the traffic control used are not supported by the HCM 6th Edition analysis methodology; therefore, SimTraffic simulation delays was determined to be more appropriate for use at these intersections. All remaining study intersections and driveways were analyzed using the HCM 6th Edition methodology. These intersections are summarized below:

- Griswold Street & Beal Street: The two-way stop control (along the eastbound and southbound approaches) for the T-intersection is not supported by the HCM.
- 7 Mile Road & Hines Drive: The stop control for northbound Hines Drive and the westbound left-turn for 7 Mile Road is not supported by the HCM.

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**.

Table 1: Existing Intersection Operations

Intersection	Control	Approach	Existing Conditions 2018			
			AM Peak		PM Peak	
			Delay (s/veh)	LOS	Delay (s/veh)	LOS
1 Main Street & Center Street	Signalized	EB	19.9	B	20.1	C
		WB	18.9	B	19.2	B
		NB	9.8	A	10.0	A
		SB	8.6	A	10.2	B
		Overall	11.9	B	12.9	B
2 Main Street & Hutton Street	Signalized	EBTL	0.3	A	0.3	A
		EBR	0.0	A	0.0	A
		WBTL	6.7	A	7.6	A
		WBR	7.1	A	9.1	A
		NB	17.2	B	19.1	B
		SBTL	21.4	C	69.3	E
		SBR	16.5	B	16.5	B
		Overall	10.3	B	21.9	C
3 Main Street & Griswold Street	Signalized	EBTL	12.0	B	15.5	B
		EBTR	10.1	B	11.0	B
		WBTL	10.1	B	11.8	B
		WBTR	10.5	B	12.5	B
		NB	15.0	B	16.4	B
		SB	16.8	B	29.3	C
		Overall	12.7	B	17.5	B
4 Cady Street & Center Street	Stop (Minor)	EB	19.3	C	37.7	E
		WB	44.5	E	137.8	F
		NBL	8.4	A	9.2	A
		SBL	9.0	A	8.9	A

Intersection		Control	Approach	Existing Conditions 2018			
				AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS
5	Cady Street & Hutton Street	Stop (Minor)	EBL	7.6	A	7.6	A
			WB	Free		Free	
			SB	10.7	B	10.2	B
6	Cady Street & Griswold Street	Stop (Minor)	EB	10.7	B	12.8	B
			WB	9.5	A	10.2	B
			NBL	7.4	A	7.6	A
			SBL	7.3	A	7.4	A
7*	Beal Street & Griswold Street	Stop (Minor)	EB	4.7	A	5.3	A
			WB	Free		Free	
			SB	4.2	A	4.8	A
8	Beal Street & River Street	Stop (Minor)	EB	Free		Free	
			WBL	7.3	A	7.4	A
			NB	9.1	A	9.7	A
9	Center Street & Fairbrook Street	Stop (Minor)	EB	22.4	C	27.6	D
			NBL	8.5	A	10.0	A
			SB	Free		Free	
10	Sheldon Avenue / Center Street & 7 Mile Road / Hines Drive	Signalized	EBL	20.5	C	33.5	C
			EBTR	32.9	C	26.5	C
			WBL	37.3	D	38.9	D
			WBT	18.2	B	28.2	C
			WBR	17.3	B	18.2	B
			NBL	20.4	C	40.5	D
			NBTR	21.5	C	26.5	C
			SBL	33.5	C	41.8	D
			SBTR	15.8	B	22.3	C
			Overall	23.6	C	27.0	C
11*	7 Mile Road & Hines Drive	Stop (NB Hines & WBL 7 Mile)	EB	Free		Free	
			WBL	10.5	B	18.6	C
			WBT	Free		Free	
			NB	17.2	C	131.5	F
12	7 Mile Road & River Street	Stop (Minor)	EBL	7.7	A	8.7	A
			WB	Free		Free	
			SB	11.2	B	13.5	B

* Indicates SimTraffic delay used

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

3.1.1 Main Street and Hutton Street

- The southbound left/through movement currently operates at a LOS E during the PM peak hour.

A review of network simulations indicates acceptable operations and all queues were observed to be serviced within the cycle length.

3.1.2 Main Street and Griswold Street

The intersection LOS on all approaches were seen to operate acceptably; however occasional periods of long vehicle queues were observed on the southbound approach during the PM peak hour. These queues were observed to dissipate and are not present throughout the duration of the peak hour.

3.1.3 Cady Street and Center Street

- The westbound approach currently operates at a LOS E and LOS F during the AM and PM peak hours, respectively. Additionally, the eastbound approach operates at a LOS E during the PM peak hour.

Although intersection LOS analysis indicate poor operations, a review of SimTraffic the simulations indicates that the signalized intersections allow for gaps in traffic, therefore, vehicles on Cady Street are serviced without significant vehicle queues.

3.1.4 Sheldon Avenue/Center Street and 7 Mile Road/Hines Drive

Review of the network simulations indicates acceptable traffic operations during the AM peak hours. During the PM peak hour, long vehicle queues were observed for the northbound approach. These queues exist throughout the entire peak hour and are a result of the approach being near capacity and northbound left-turning vehicles blocking the northbound through traffic while waiting for gaps in the southbound through traffic. Periods of long vehicle queues were also observed on the westbound movements; however, they were not present throughout the entire peak hour. These queues are the result of left-turning vehicle queues exceeding the turn lane storage length and causing backup in the through lane and the right-turn lane. Additionally, occasional periods of long vehicle queues were observed on the southbound approach and were created by southbound left-turning vehicles waiting for gaps in northbound traffic. These queues were observed to dissipate quickly as a result of the northbound left-turning vehicles blocking the northbound through vehicles and therefore creating gaps in traffic southbound left-turning vehicles.

3.1.5 7 Mile Road and Hines Drive

- The northbound approach currently operates at a LOS F during the PM peak hour.

Brief periods of long vehicle queues are observed at the northbound approach during the PM peak hour; however, these vehicle queues are a result of the westbound vehicle queues at the intersection of 7 Mile Road and Center Street. Simulations indicate that the queuing created at the intersection of 7 Mile Road and Center Street causes upstream blocking at Hines Drive for 13% of the PM peak hour. During the remaining portion of the peak hour, the signalized intersection of 7 Mile Road and Center Street allows for gaps in traffic, allowing northbound vehicles to progress through the intersection.

3.2 EXISTING IMPROVEMENTS

In order to improve traffic operations to a LOS D or better for all intersection approaches and movements in the existing condition, mitigation measures were investigated. Signal cycle length and timing changes were analyzed.

3.2.1 Main Street and Hutton Street

The results of this analysis indicate that signal timing optimization is enough to improve all approaches to operating at a LOS D or better during PM peak period. A review of network simulations confirms acceptable operations.

3.2.2 Main Street and Griswold Street

A review of network simulations indicates that signal timing optimization was observed to reduce vehicle queues on the southbound approach.

3.2.3 Sheldon Avenue/Center Street and 7 Mile Road/Hines Drive

Signal timing adjustments were investigated; however, it was determined that signal timing adjustments alone would not address the operational deficiencies previously identified. In order to address the operational deficiencies at this intersection, geometric improvements were investigated.

The results of this analysis indicate widening Center Street/Sheldon Avenue to provide an additional through lane in the northbound direction would improve existing operations; however, this improvement is a regional improvement that is outside of the scope of this study. WCDPS should consider improvements on Center Street and 7 Mile Road to increase the capacity of this regional route. Therefore, the recommended improvements at this intersection are limited to adding turn lane capacity.

- Re-stripe the NB and SB approaches to provide a through/right lane and an exclusive left-turn lane.

- Upgrade to a fully actuated signal and provide protected/permissive left-turn phasing for all approaches.
- Optimize traffic signal timings and cycle lengths during peak periods

After analyzing the intersection with the recommended improvements implemented, the through movements and overall intersection showed a degradation in delay and LOS; however, the delay and LOS were improved for the left-turning movements on all approaches. A review of network simulations indicated significantly reduced vehicle queues on the northbound approach. Additionally, reduced vehicle queues were observed for the westbound movements.

3.2.4 7 Mile Road and Hines Drive

The recommended signal improvements at the intersection of 7 Mile Road and Center Street significantly decreased the delay on the northbound approach; however, the westbound queues at 7 Mile Road and Center Street were still observed to cause upstream blocking for 6% of the PM peak hour. Therefore, further mitigation is recommended through geometric improvements.

- Construct a northbound right turn lane.

3.2.5 Existing Conditions with Improvements

Intersection operations and vehicle queues with the recommended improvements are summarized in **Table 2** and **Table 3**, respectively.

Table 2: Existing Intersection Operations with Improvements

Intersection		Control	Approach	Existing Conditions 2018				Existing Conditions 2018 (With Improvements)			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
2	Main Street & Hutton Street	Signalized	EBTL	0.3	A	0.3	A	No Change		18.0	B
			EBR	0.0	A	0.0	A			15.6	B
			WBTL	6.7	A	7.6	A			13.4	B
			WBR	7.1	A	9.1	A			17.0	B
			NB	17.2	B	19.1	B			14.5	B
			SBTL	21.4	C	69.3	E			42.2	D
			SBR	16.5	B	16.5	B			10.6	B
			Overall	10.3	B	21.9	C			21.9	C
3	Main Street & Griswold Street	Signalized	EBTL	12.0	B	15.5	B	No Change		23.3	C
			EBTR	10.1	B	11.0	B			15.4	B
			WBTL	10.1	B	11.8	B			16.5	B
			WBTR	10.5	B	12.5	B			17.8	B
			NB	15.0	B	16.4	B			11.9	B
			SB	16.8	B	29.3	C			18.0	B
			Overall	12.7	B	17.5	B			16.9	B
10	Sheldon Avenue / Center Street & Seven Mile Road / Hines Drive	Signalized	EBL	20.5	C	33.5	C	24.6	C	31.8	C
			EBTR	32.9	C	26.5	C	53.6	D	52.5	D
			WBL	37.3	D	38.9	D	30.1	C	35.8	D
			WBT	18.2	B	28.2	C	28.8	C	53.1	D
			WBR	17.3	B	18.2	B	24.4	C	27.2	C
			NBL	20.4	C	40.5	D	20.8	C	26.5	C
			NBTR	21.5	C	26.5	C	48.0	D	52.8	D
			SBL	33.5	C	41.8	D	27.7	C	28.6	C
			SBTR	15.8	B	22.3	C	29.5	C	38.2	D
			Overall	23.6	C	27.0	C	40.9	D	45.6	D

Intersection		Control	Approach	Existing Conditions 2018				Existing Conditions 2018 (With Improvements)			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
11*	Seven Mile Road & Hines Drive	Stop (NB Hines & WBL Seven Mile)	EB	Free		Free		Free		Free	
			WBL	10.5	B	18.6	C	20.3	C	26.7	D
			WBT	Free		Free		Free		Free	
			NB	17.2	C	131.5	F	19.0	C	73.2	F

* Indicates SimTraffic delay used

Table 3: Existing Vehicle Queues (feet) with Improvements

Intersection		Control	Approach	Existing Conditions 2018				Existing Conditions 2018 (With Improvements)			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Avg	95th %	Avg	95th %	Avg	95th %	Avg	95th %
2	Main Street & Hutton Street	Signalized	EBTL	No Changes		45	91	No Changes		68	122
			EBR			6	27			8	31
			WBTL			78	158			93	179
			WBR			70	113			72	117
			NB			19	44			16	42
			SBTL			104	173			82	138
			SBR			6	22			4	18
3	Main Street & Griswold Street	Signalized	EBTL	No Changes		85	145	No Changes		104	182
			EBTR			65	114			78	133
			WBTL			86	130			93	138
			WBTR			89	149			96	153
			NB			76	122			68	116
			SB			341	565			189	352
			10			Sheldon Avenue / Center Street & Seven Mile Road / Hines Drive	Signalized			EBL	40
EBTR	186	313		158	261			236	394	239	407
WBL	26	64		99	161			19	58	91	165
WBT	47	99		367	703			62	124	374	652
WBR	14	43		253	675			19	60	237	596
NBL	21	52		44	61			49	158	133	247
NBTR	259	440		3814	7104			327	537	1937	3593
SBL	60	121		57	113			45	85	62	117
11	Seven Mile Road & Hines Drive	Stop (NW Hines & WBL Seven Mile)	EB	Free		Free		Free		Free	
			WBL	0	0	1	10	0	0	1	8
			WBT	Free		Free		Free		Free	
			NB	45	83	390	1086	44	78	221	518

3.3 BACKGROUND CONDITIONS

Historical traffic volume data was not available in the area; therefore, population and employment data was used in order to determine the applicable growth rate for the existing traffic volumes to the project build-out year of 2023. The SEMCOG community profile for the City of Northville was reviewed and showed a 0.10% population growth and a 0.07% employment growth from 2015 to 2045. Therefore, a conservative growth rate of 0.5% per year along all roadways was utilized in this study for 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 and/or proposed developments within the vicinity of the study area that have yet to be constructed or are currently under construction. The following developments were identified:

- Cady Project – 6 unit condominium (South side of Cady Street, east of Center Street)
- Corner House – 11 unit condominium (NW corner of Griswold Street and Cady Street)
- McDonald Ford Site – 60 unit townhouses (South side of 7 Mile Road, near S. Main Street)
- Foundry Flask – 140 unit apartments (SE corner of Griswold Street and Cady Street)

The number of AM and PM peak hour vehicle trips that would be generated by the proposed developments were forecast based on data published by ITE in the *Trip Generation Manual, 10th Edition* and the *ITE Trip Generation Handbook, 3rd Edition*. The trip distribution that was determined for the proposed Northville Downs development was used to distribute the trip projections for these developments. The background 2023 traffic volumes are shown on **Figure 4**.

3.4 BACKGROUND OPERATIONS

The background traffic growth was applied to the existing traffic volumes shown on **Figure 3** to determine the background traffic volumes shown on **Figure 4**. 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. The results of the analysis of background conditions are presented in **Appendix C** and are summarized in **Table 4**.

Table 4: Background Intersection Operations

Intersection		Control	Approach	Existing Conditions 2018				Background Conditions 2023			
				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	Main Street & Center Street	Signalized	EB	19.9	B	20.1	C	20.1	C	20.3	C
			WB	18.9	B	19.2	B	18.9	B	19.5	B
			NB	9.8	A	10.0	A	10.2	B	10.3	B
			SB	8.6	A	10.2	B	8.8	A	10.6	B
			Overall	11.9	B	12.9	B	12.1	B	13.2	B
2	Main Street & Hutton Street	Signalized	EBTL	0.3	A	0.3	A	0.3	A	0.3	A
			EBR	0.0	A	0.0	A	0.0	A	0.0	A
			WBTL	6.7	A	7.6	A	6.7	A	7.6	A
			WBR	7.1	A	9.1	A	7.1	A	9.2	A
			NB	17.2	B	19.1	B	17.3	B	19.1	B
			SBTL	21.4	C	69.3	E	21.6	C	80.0	F
			SBR	16.5	B	16.5	B	16.5	B	16.5	B
			Overall	10.3	B	21.9	C	10.4	B	24.6	C

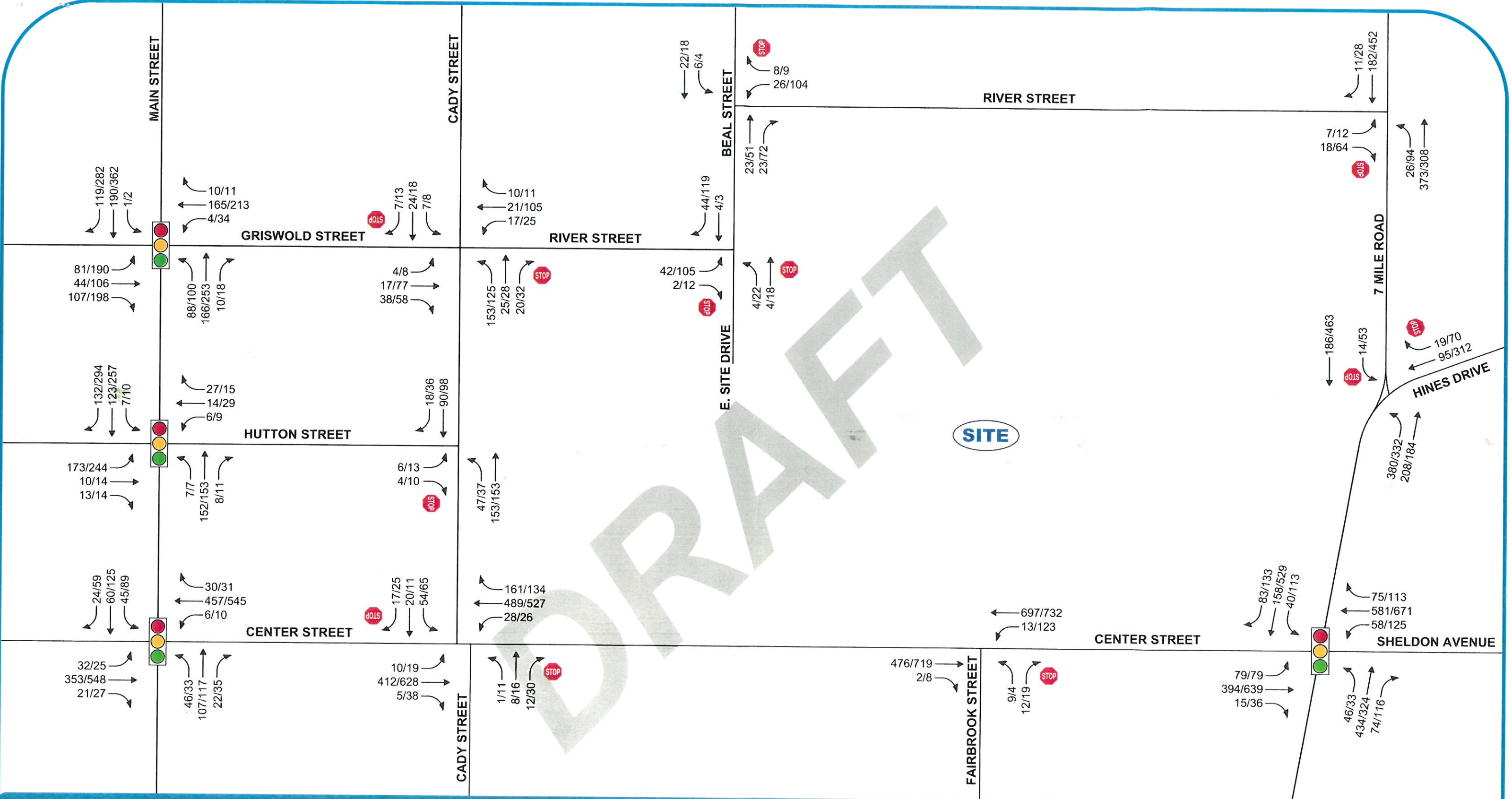


FIGURE 4
BACKGROUND TRAFFIC
VOLUMES
NORTHVILLE DOWNS TIS - NORTHVILLE, MI

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

NORTH
SCALE: NOT TO SCALE



Intersection		Control	Approach	Existing Conditions 2018				Background Conditions 2023			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
3	Main Street & Griswold Street	Signalized	EBTL	12.0	B	15.5	B	12.1	B	16.0	B
			EBTR	10.1	B	11.0	B	10.1	B	11.1	B
			WBTL	10.1	B	11.8	B	10.2	B	11.9	B
			WBTR	10.5	B	12.5	B	10.5	B	12.6	B
			NB	15.0	B	16.4	B	15.2	B	16.6	B
			SB	16.8	B	29.3	C	17.0	B	32.6	C
			Overall	12.7	B	17.5	B	12.9	B	18.6	B
4	Cady Street & Center Street	Stop (Minor)	EB	19.3	C	37.7	E	20.5	C	44.3	E
			WB	44.5	E	137.8	F	59.1	F	244.5	F
			NBL	8.4	A	9.2	A	8.4	A	9.3	A
			SBL	9.0	A	8.9	A	9.2	A	9.1	A
5	Cady Street & Hutton Street	Stop (Minor)	EBL	7.6	A	7.6	A	7.7	A	7.6	A
			WB	Free		Free		Free		Free	
			SB	10.7	B	10.2	B	11.2	B	10.7	B
6	Cady Street & Griswold Street	Stop (Minor)	EB	10.7	B	12.8	B	11.5	B	14.5	B
			WB	9.5	A	10.2	B	10.1	B	11.3	B
			NBL	7.4	A	7.6	A	7.4	A	7.6	A
			SBL	7.3	A	7.4	A	7.3	A	7.5	A
7*	Beal Street & Griswold Street	Stop (Minor)	EB	4.7	A	5.3	A	4.7	A	5.5	A
			WB	Free		Free		Free		Free	
			SB	4.2	A	4.8	A	4.3	A	4.7	A
8	Beal Street & River Street	Stop (Minor)	EB	Free		Free		Free		Free	
			WBL	7.3	A	7.4	A	7.4	A	7.5	A
			NB	9.1	A	9.7	A	9.2	A	9.8	A
9	Center Street & Fairbrook Street	Stop (Minor)	EB	22.4	C	27.6	D	23.9	C	30.5	D
			NBL	8.5	A	10.0	A	8.6	A	10.2	B
			SB	Free		Free		Free		Free	
10	Sheldon Avenue / Center Street & 7 Mile Road / Hines Drive	Signalized	EBL	20.5	C	33.5	C	20.8	C	34.8	C
			EBTR	32.9	C	26.5	C	34.8	C	27.5	C
			WBL	37.3	D	38.9	D	39.6	D	42.0	D
			WBT	18.2	B	28.2	C	18.4	B	29.4	C
			WBR	17.3	B	18.2	B	17.5	B	18.3	B
			NBTL	20.4	C	40.5	D	21.2	C	45.2	D
			NBR	21.5	C	26.5	C	22.4	C	29.5	C
			SBL	33.5	C	41.8	D	36.1	D	48.7	D
			SBTR	15.8	B	22.3	C	16.2	B	23.5	C
Overall	23.6	C	27.0	C	24.6	C	29.0	C			
11*	7 Mile Road & Hines Drive	Stop (NW Hines & WBL 7 Mile)	EB	Free		Free		Free		Free	
			WBL	10.5	B	18.6	C	16.2	C	30.8	D
			WBT	Free		Free		Free		Free	
			NB	17.2	C	131.5	F	18.5	C	263.6	F
12	7 Mile Road & River Street	Stop (Minor)	EBL	7.7	A	8.7	A	7.8	A	8.8	A
			WB	Free		Free		Free		Free	
			SB	11.2	B	13.5	B	11.2	B	14.6	B

* Indicates SimTraffic delay used

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, with the exception of the following:

- The southbound left/through movement at the signalized intersection of **Main Street and Hutton Street**, will degrade to a LOS F during the PM peak hour.
 - A review of network simulations indicates acceptable operations and queues were generally observed to be serviced within the cycle length.
- The westbound approach at the unsignalized intersection of **Cady Street & Center Street** will degrade to a LOS F during the AM peak hour.
 - Although increased delay during the AM and PM peak was observed, network simulations indicate that the gaps provided by the signalized intersections provide acceptable operations for Cady Street, with minor vehicle queues being observed.
- The northbound approach at the unsignalized intersection of **7 Mile Road and Hines Drive** showed a large increase in delay during the PM peak hour.
 - Brief periods of long vehicle queues continue to occur at the northbound approach of 7 Mile Road and Hines Drive during the PM peak hour; however, these vehicle queues continue to be present as a result of the westbound vehicle queues at the intersection of 7 Mile Road and Center Street. Simulations indicate that the queuing created at the intersection of 7 Mile Road and Center Street causes upstream blocking at Hines Drive for 15% of the PM peak hour.
- A review of the network simulations at **7 Mile Road and Center Street** also indicates background traffic operations will be similar to existing conditions. During the PM peak hour, excessively long vehicle queues continue to occur for the northbound approach. Additionally, occasional periods of long vehicle queues continue to occur at the westbound and southbound approaches of 7 Mile Road and Center Street.

3.5 BACKGROUND IMPROVEMENTS

In order to improve traffic operations to a LOS D or better for all intersection approaches and movements under background conditions, mitigation measures that were identified under existing conditions were applied. The results of this analysis are summarized in **Table 5** and indicate that all study intersection approaches and movements would operate acceptably at a LOS D or better during both peak periods, with the exception of following:

3.5.1 Main Street and Hutton Street

The results of this analysis indicate that signal timing optimization is enough to improve all approaches to operating at a LOS D or better during PM peak period. A review of network simulations confirms acceptable operations.

3.5.2 Main Street and Griswold Street

A review of network simulations indicates that signal timing optimization was observed to reduce vehicle queues on the southbound approach.

3.5.3 Sheldon Avenue/Center Street and 7 Mile Road/Hines Drive

- With mitigation measures applied, the eastbound and northbound through movements will operate at a LOS E during the AM peak period. Additionally, the northbound through movement will exceed capacity and therefore will operate with a LOS F during the PM peak period.

Although the intersection LOS analysis indicates poor operation of the eastbound and northbound through movements during the AM peak hour, network simulations show acceptable operations with only minor increases in vehicle queues. Additionally, the analysis indicates failing operation for the northbound through movement during the PM peak period; however, network simulations indicate the vehicle queues show a significant reduction. An increased delay and reduced LOS were also observed for the westbound through movement and right-turn movement; however, the vehicle queues observed in network simulations were noticeably reduced.

3.5.4 7 Mile Road and Hines Drive

The recommended signal improvements at the intersection of 7 Mile Road and Center Street significantly decreased the delay on the northbound approach; however, the westbound queues at 7 Mile Road and Center Street were observed to not cause upstream blocking during the PM peak hour.

3.5.5 Background Conditions with Improvements

Intersection operations and vehicle queues with the recommended improvements are summarized in **Table 5** and **Table 6**, respectively.

Table 5: Background Intersection Operations with Improvements

Intersection		Control	Approach	Background Conditions 2023				Background Conditions 2023 (With Improvements)			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
2	Main Street & Hutton Street	Signalized	EBTL	0.3	A	0.3	A	No Change		18.7	B
			EBR	0.0	A	0.0	A		16.2	B	
			WBTL	6.7	A	7.6	A		14.3	B	
			WBR	7.1	A	9.2	A		18.7	B	
			NB	17.3	B	19.1	B		10.4	B	
			SBTL	21.6	C	80.0	F		13.8	B	
			SBR	16.5	B	16.5	B		10.0	A	
			Overall	10.4	B	24.6	C		15.8	B	
3	Main Street & Griswold Street	Signalized	EBTL	12.1	B	16.0	B	No Change		24.3	C
			EBTR	10.1	B	11.1	B		15.5	B	
			WBTL	10.2	B	11.9	B		16.6	B	
			WBTR	10.5	B	12.6	B		18.1	B	
			NB	15.2	B	16.6	B		12.0	B	
			SB	17.0	B	32.6	C		18.8	B	
			Overall	12.9	B	18.6	B		17.3	B	
			10	Sheldon Avenue / Center Street & Seven Mile Road / Hines Drive	Signalized	EBL	20.8		C	34.8	C
EBTR	34.8	C				27.5	C	56.1	E	54.3	D
WBL	39.6	D				42.0	D	30.5	C	38.2	D
WBT	18.4	B				29.4	C	28.7	C	55.0	D
WBR	17.5	B				18.3	B	24.1	C	27.0	C
NBL	21.2	C				45.2	D	21.9	C	31.3	C
NBTR	22.4	C				29.5	C	56.0	E	66.4	F
SBL	36.1	D				48.7	D	31.3	C	33.7	C
SBTR	16.2	B				23.5	C	31.2	C	42.3	D
Overall	24.6	C				29.0	C	44.5	D	51.2	D
11*	Seven Mile Road & Hines Drive	Stop (NW Hines & WBL Seven Mile)	EB	Free		Free		Free		Free	
			WBL	16.2	C	30.8	D	24.0	C	26.2	D
			WBT	Free		Free		Free		Free	
			NB	18.5	C	263.6	F	21.0	C	59.0	F

* Indicates SimTraffic delay used

Table 6: Background Vehicle Queues (feet) with Improvements

Intersection		Control	Approach	Background Conditions 2023				Background Conditions 2023 (With Improvements)			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Avg	95th %	Avg	95th %	Avg	95th %	Avg	95th %
2	Main Street & Hutton Street	Signalized	EBTL	No Changes		46	100	No Changes		72	133
			EBR		6	25	9		32		
			WBTL		82	160	87		175		
			WBR		68	116	71		115		
			NB		20	49	17		45		
			SBTL		111	180	86		154		
			SBR		7	24	6		22		
3	Main Street & Griswold Street	Signalized	EBTL	No Changes		101	172	No Changes		103	178
			EBTR		76	128	82		138		
			WBTL		87	130	95		146		
			WBTR		86	154	96		155		
			NB		79	127	74		118		
			SB		294	533	198		383		
10	Sheldon Avenue / Center Street & Seven Mile Road / Hines Drive	Signalized	EBL	38	122	36	117	49	157	32	119
			EBTR	210	362	171	286	278	453	240	395
			WBL	41	93	110	165	25	65	92	157
			WBT	59	146	432	750	70	143	362	562
			WBR	14	42	351	795	16	52	207	483
			NBL	23	52	45	59	60	185	125	245
			NBTR	309	541	4942	8693	382	631	3203	5105
			SBL	88	171	126	168	54	109	69	142
11	Seven Mile Road & Hines Drive	Stop (NW Hines & WBL Seven Mile)	EB	Free		Free		Free		Free	
			WBL	0	2	30	194	0	4	0	5
			WBT	Free		Free		Free		Free	
			NB	50	87	679	1755	48	93	197	447

3.6 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*. Additional data published by SEMCOG was also used in the analysis in conjunction with the ITE methodology. The trip generation analysis summarized below considers all multi-modal impacts (vehicles, pedestrians, transit and bikes). By using the national database for the proposed development and then adjusting based on local data, we have presented a conservative approach tailored to the specific needs of the City of Northville.

3.6.1 Vehicular Trip Generation Analysis

The first step in evaluating the trip generation for the proposed development is to calculate the trip generation using the *ITE Trip Generation Manual (10th Edition)*. The proposed development includes 52 single-family units, 543 multi-family units, and 10,000 square feet of commercial development. The ITE Trip Generation Manual Land Uses 210, 221, and 820 (Single-Family Detached Housing, Mid-Rise Multifamily Housing, and Shopping Center) were used for this study as they represent the best fit for this development. The land use descriptions are summarized below, and **Table 7** and **Table 8** shows the corresponding trip generation (vehicle trips) for the proposed commercial and residential developments.

Land Use 210-Single-Family Detached Housing: Single-family detached housing includes all single-family detached homes on individual lots. A typical site surveyed is a suburban subdivision.

Land Use 221-Multifamily Housing, Mid-Rise: Mid-rise multifamily housing includes apartments, townhouses, and condominiums located within the same building with at least three other dwelling units and that have between three and 10 levels (floors).

Land Use 820-Shopping Center: shopping center is an integrated group of commercial establishments that is planned, developed, owned, and managed as a unit. A shopping center's composition is related to its market area in terms of size, location, and type of store. A shopping center also provides on-site parking facilities sufficient to serve its own parking demands.

Table 7: Commercial Development Trip Generation

Land Use	ITE Code	Amount	Units	Average Daily Traffic (vpd)	AM Peak Hour (vph)			PM Peak Hour (vph)		
					In	Out	Total	In	Out	Total
Retail	820	10,000	SF	1,256	6	3	9	47	52	99
Total Internal Capture					1	0	1	5	13	18
Pass-By (34%)					2	1	3	14	13	27
Total New Trips					3	2	5	28	26	54

Table 8: Residential Development Trip Generation

Land Use	ITE Code	Amount	Units	Average Daily Traffic (vpd)	AM Peak Hour (vph)			PM Peak Hour (vph)		
					In	Out	Total	In	Out	Total
Single-Family Detached Housing	210	52	D.U.	570	11	31	42	34	20	54
Multifamily Housing (Mid-Rise)	221	543	D.U.	2,958	47	133	180	137	88	225
Total Trips					58	164	222	171	108	279
Total Internal Capture					0	2	2	14	4	18
Total New Trips					58	162	220	157	104	261

Internal trip capture is the portion of trips generated by a mixed-used development that would begin and end within the development; resulting in no additional trips added to the adjacent road network. Additionally, a portion of the site-generated commercial trips are already present on the adjacent road network and are interrupted to visit the site. These trips are known as "pass-by" trips and result in turning movements at the site

driveways, but do not increase traffic volumes on the adjacent road network. The percentage of pass-by trips was determined based on the rates published by ITE in the Trip Generation Handbook, 3rd Edition.

3.6.2 ITE Residential Modal Split

The vehicle trips for the residential development in **Table 8** were then converted to person trips by using the baseline vehicle mode split and baseline vehicle occupancy rates published by ITE in Appendix B of the ITE *Trip Generation Handbook, 3rd Edition*. The vehicle mode splits and vehicle occupancy rates for the studies contained within the *Trip Generation Manual* are provided below.

AM PEAK HOUR					
Inbound			Outbound		
Personal Vehicle	Truck	Vehicle Occupancy	Personal Vehicle	Truck	Vehicle Occupancy
0.892	0.070	1.13	0.968	0.010	1.09
PM PEAK HOUR					
Inbound			Outbound		
Personal Vehicle	Truck	Vehicle Occupancy	Personal Vehicle	Truck	Vehicle Occupancy
0.963	0.010	1.15	0.947	0.015	1.21
WEEKDAY					
Personal Vehicle		Truck	Vehicle Occupancy		
0.943		0.010	1.145		

The above factors were applied to the total new vehicle trips generated by the residential development in **Table 8** to provide the total number of person-trips generated by the proposed residential development. This was accomplished by dividing the number of total site-generated vehicle trips by the personal vehicle mode split (i.e. "personal vehicle" in the tables above) and multiplying by the vehicle occupancy to obtain the total number of site-generated person-trips. The total person trips are summarized in **Table 9**.

Table 9: Person-Trip Generation per ITE Trip Generation Handbook, 3rd Edition

Land Use	Amount	Units	Average Daily Traffic	AM Peak Hour			PM Peak Hour		
				In	Out	Total	In	Out	Total
Single-Family & Multi-Family Housing	595	D.U.	4,287	74	182	256	188	133	321

3.7 CITY OF NORTHVILLE MODAL SPLIT

With the trips converted to Person-Trips using the ITE methodology, a modal split was applied to determine the number of site-generated trips using a variety of mode choices (*Note: Approximately 7% of residents worked from home and therefore did not generate any commuting trips*). This was calculated by applying the modal splits for the City of Northville as published by SEMCOG:

Commuting Modal Splits in Northville	
Vehicle	0.807
Walk	0.120
Bike	0.000
Transit	0.000

These factors were applied to the Person-Trips in **Table 9** to calculate the modal split trip generation for the proposed residential development. For walking, cycling, and transit mode choices, one person-trip corresponds to one pedestrian, bike, or transit trip, and no further adjustment were required. However, site-generated vehicle trips must be adjusted to reflect appropriate vehicle occupancy in accounting for multiple-occupant vehicles. Therefore, the SEMCOG *Transportation Demand Management (TDM) in Southeast Michigan* document was referenced to obtain vehicle occupancy rates relevant to Michigan communities. The document specified an average vehicle occupancy of 1.1 persons/vehicle for work-related trips and 1.4 persons/vehicle for non-work-

related trips. Therefore, it was assumed that residential site-generated vehicle trips would have a vehicle occupancy of 1.1 persons/vehicle for AM and PM peak hour trips and an average of 1.25 persons/vehicle for daily trips. The modal split trip generation for the proposed residential development is summarized in **Table 10**. *Note: The values have been rounded up to the nearest whole number.*

Table 10: Residential Modal Split Trip Generation

Mode of Transportation	Average Daily Traffic	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
Vehicular	2,768	54	134	188	138	97	235
Walk	515	9	22	31	23	16	39

3.8 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 adjacent street traffic volumes were used to develop the trip distribution. To determine trips distribution for residential 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 going from the residential development exiting the study network and returning to the study network in the PM. The ITE trip distribution methodology assumes that new trips will return to their direction of origin, while pass-by trips enter and exit the development in their original direction of travel. The site trip distributions used in the analysis are summarized in **Table 11**.

Table 11: New Site Trip Distribution

New Trips					
Residential				Commercial	
AM	PM	To/From	Via	AM	PM
18%	13%	North	Center Street	14%	14%
5%	6%		Hutton Street	7%	7%
13%	11%		Griswold Street	8%	13%
18%	20%	South	Sheldon Avenue	24%	19%
8%	8%		Hines Drive	4%	5%
9%	15%		Northville Road (Via Beal Street)	10%	10%
14%	11%	East	7-Mile Road (Via River Street)	6%	7%
1%	0%		Cady Street	0%	0%
3%	4%	West	Main Street	6%	4%
2%	1%		Cady Street	1%	2%
1%	1%		Fairbrook Street	1%	3%
8%	10%		7 Mile Road	19%	16%
100%	100%	Total		100%	100%
Commercial Pass-by Trips					
From / To		Via		AM	PM
North to South		Center Street		35%	44%
South to North		Center Street		49%	41%
East to West		Cady Street		5%	6%
West to East		Cady Street		11%	9%
Total				100%	100%

The vehicular traffic volumes shown in **Table 7** and **Table 8** were distributed to the roadway network according to the distribution shown in **Table 11**. As the proposed development has several access points, the internal distribution is fairly evenly distributed, which minimizes the overall impact on the study network. The site generated trips are shown on **Figure 4** and were added to the future background traffic volumes shown on **Figure 3** to calculate the future peak hour traffic volumes shown on **Figure 5**.

3.9 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. The results of the future conditions analysis are presented in **Appendix D** and are summarized in **Table 12**.

Table 12: Future Intersection Operations

Intersection	Control	Approach	Background Conditions 2023				Future Conditions 2023			
			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 Main Street & Center Street	Signalized	EB	20.1	C	20.3	C	20.1	C	20.5	C
		WB	18.9	B	19.5	B	19.0	B	19.6	B
		NB	10.2	B	10.3	B	10.6	B	10.6	B
		SB	8.8	A	10.6	B	8.9	A	10.9	B
		Overall	12.1	B	13.2	B	12.3	B	13.4	B
2 Main Street & Hutton Street	Signalized	EBTL	0.3	A	0.3	A	0.3	A	0.3	A
		EBR	0.0	A	0.0	A	0.0	A	0.0	A
		WBTL	6.7	A	7.6	A	6.7	A	7.6	A
		WBR	7.1	A	9.2	A	7.1	A	9.2	A
		NB	17.3	B	19.1	B	17.6	B	19.8	B
		SBTL	21.6	C	80.0	F	21.7	C	85.7	F
		SBR	16.5	B	16.5	B	16.5	B	16.5	B
		Overall	10.4	B	24.6	C	10.6	B	26.3	C
3 Main Street & Griswold Street	Signalized	EBTL	12.1	B	16.0	B	12.3	B	16.1	B
		EBTR	10.1	B	11.1	B	10.2	B	11.1	B
		WBTL	10.2	B	11.9	B	10.2	B	11.9	B
		WBTR	10.5	B	12.6	B	10.5	B	12.6	B
		NB	15.2	B	16.6	B	15.5	B	16.9	B
		SB	17.0	B	32.6	C	17.2	B	36.3	D
		Overall	12.9	B	18.6	B	13.0	B	19.8	B
4 Cady Street & Center Street	Stop (Minor)	EB	20.5	C	44.3	E	22.4	C	54.9	F
		WB	59.1	F	244.5	F	71.3	F	337.8	F
		NBL	8.4	A	9.3	A	8.5	A	9.4	A
		SBL	9.2	A	9.1	A	9.3	A	9.2	A
5 Cady Street & Hutton Street	Stop (Minor)	EBL	7.7	A	7.6	A	7.7	A	7.6	A
		WBL	Free		Free		0.0**	A	7.6	A
		NB	N/A		N/A		12.0	B	11.9	B
		SB	11.2	B	10.7	B	12.0	B	11.7	B
6 Cady Street & Griswold Street	Stop (Minor)	EB	11.5	B	14.5	B	11.9	B	15.4	C
		WB	10.1	B	11.3	B	10.2	B	11.6	B
		NBL	7.4	A	7.6	A	7.4	A	7.6	A
		SBL	7.3	A	7.5	A	7.3	A	7.5	A
7* Beal Street & Griswold Street	Stop (Minor)	EB	4.7	A	5.5	A	4.9	A	5.2	A
		WB	Free		Free		Free		Free	
		SB	4.3	A	4.7	A	4.8	A	5.3	A
8 Beal Street & River Street	Stop (Minor)	EB	Free		Free		Free		Free	
		WBL	7.4	A	7.5	A	7.5	A	7.5	A
		NB	9.2	A	9.8	A	9.5	A	10.3	B

Intersection		Control	Approach	Background Conditions 2023				Future Conditions 2023			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
9	Center Street & Fairbrook Street	Stop (Minor)	EB	23.9	C	30.5	D	26.4	C	43.7	E
			WB	N/A		N/A		39.0	E	189.4	F
			NBL	8.6	A	10.2	B	8.6	A	10.3	B
			SBL	Free		Free		9.4	A	9.5	A
10	Sheldon Avenue / Center Street & 7 Mile Road / Hines Drive	Signalized	EBL	20.8	C	34.8	C	21.1	C	37.9	D
			EBTR	34.8	C	27.5	C	34.8	C	27.5	C
			WBL	39.6	D	42.0	D	40.0	D	42.2	D
			WBT	18.4	B	29.4	C	18.4	B	29.4	C
			WBR	17.5	B	18.3	B	17.6	B	18.7	B
			NBTL	21.2	C	45.2	D	22.7	C	53.2	D
			NBR	22.4	C	29.5	C	22.9	C	33.2	C
			SBL	36.1	D	48.7	D	40.0	D	61.7	E
			SBTR	16.2	B	23.5	C	17.0	B	25.8	C
Overall			24.6	C	29.0	C	25.1	C	31.3	C	
11*	7 Mile Road & Hines Drive	Stop (NW Hines & WBL 7 Mile)	EB	Free		Free		Free		Free	
			WBL	16.2	C	30.8	D	16.6	C	64.3	F
			WBT	Free		Free		Free		Free	
			NB	18.5	C	263.6	F	18.5	C	524.3	F
12	7 Mile Road & River Street	Stop (Minor)	EBL	7.8	A	8.8	A	7.8	A	8.9	A
			WB	Free		Free		Free		Free	
			SB	11.2	B	14.6	B	12.9	B	16.8	C
13	Center Street & NW. Site Drive	Stop (Minor)	WB	N/A		N/A		25.3	D	44.3	E
			NB					Free		Free	
			SBL					9.4	A	9.6	A
14	Fairbrook Street & SW. Site Drive	Stop (Minor)	EB	N/A		N/A		Free		Free	
			WBL					0.0**	A	0.0**	A
			NB					0.0**	A	0.0**	A
15	Center Street & S. Site Drive	Stop (Minor)	EB	N/A		N/A		16.7	C	33.6	D
			NBL					8.6	A	9.7	A
			SBL					Free		Free	

* Indicates SimTraffic delay used

** Indicates no traffic volume present (The minimal traffic generated by this portion of the development all use the S. Site Drive)

The results of the future conditions analysis indicate that all study intersection approaches and movements will continue to operate acceptably at a LOS D or better with the exception of the following as shown in **Table 12** and summarized below:

3.9.1 Main Street and Hutton Street

- The southbound left/through movement will operate at a LOS F during the PM peak hour.

A review of network simulations indicates acceptable operations and all queues were observed to be serviced within the cycle length.

3.9.2 Main Street and Griswold Street

The intersection LOS on all approaches were seen to operate acceptably; however occasional periods of long vehicle queues were observed on the southbound approach during the PM peak hour. These queues were observed to be present throughout the duration of the peak hour.

3.9.3 Cady Street and Center Street

- The westbound approach will operate at a LOS F during the AM and PM peak hours. Additionally, the eastbound approach will operate at a LOS F during the PM peak hour.

Although intersection LOS indicate failing operations along Cady Street; a review of the simulations indicates that the signalized intersections allow for gaps in traffic; therefore, vehicles on Cady Street are serviced with only minor vehicle queues.

3.9.4 Center Street and Fairbrook Street

- The westbound approach will operate at a LOS E and LOS F during the AM and PM peak hours, respectively. Additionally, the eastbound approach will operate at a LOS E during the PM peak hour.

A review of network simulations indicates that during the AM peak period, the signalized intersections allow for gaps in traffic; therefore, vehicles on Fairbrook Street are serviced with only minor vehicle queues. During the PM peak hour, brief periods of vehicle queues were observed on the eastbound approach; however, these queues were observed to dissipate quickly and were not present throughout the entire peak hour. Periods of long vehicle queues were also observed for the westbound approach; however, they were not present throughout the entire peak period.

3.9.5 Sheldon Avenue/Center Street and 7 Mile Road/Hines Drive

- The southbound left-turn movement will operate at a LOS E during the PM peak hour.

During the PM peak hour, excessively long vehicle queues were observed for the northbound approach and were present during the entire peak period. A review of network simulations indicates that brief periods of long vehicle queues were also observed on the southbound approach during the PM peak hour. These queues were observed to dissipate quickly, as the northbound through traffic was stopped often by northbound left-turning vehicles, which created many opportunities for southbound left-turning vehicles to progress through the intersection. Periods of long vehicle queues were also observed on the westbound movements and were present for the majority of the peak hour.

3.9.6 7 Mile Road and Hines Drive

- The northbound approach will operate at a LOS F during the PM peak hour. Additionally, the westbound left-turn movement will operate at a LOS F during the PM peak hour.

Brief periods of long vehicle queues are observed at the northbound and westbound approaches during the PM peak hour; however, these vehicle queues are a result of the westbound vehicle queues at the intersection of 7 Mile Road and Center Street. Simulations indicate that the queuing created at the intersection of 7 Mile Road and Center Street causes upstream blocking at Hines Drive for 26% of the PM peak hour. During the remaining portion of the peak hour, the signalized intersection of 7 Mile Road and Center Street allows for gaps in traffic, allowing northbound vehicles to progress through the intersection.

3.9.7 Center Street and NW. Site Drive

- The westbound approach will operate at a LOS E during the PM peak hour.

Although intersection LOS indicate poor operations along the site drive; a review of the simulations indicates that egress vehicles easily find gaps in traffic; therefore, vehicles on NW. Site Drive are serviced with only minimal vehicle queues.

3.10 FUTURE IMPROVEMENTS

In order to improve traffic operations to a LOS D or better for all intersection approaches and movements under future conditions, mitigation measures that were identified under existing and background conditions were applied. The results of this analysis are summarized in **Table 13** and indicate that all study intersection approaches and movements would operate acceptably at a LOS D or better during both peak periods, with the exception of 7 Mile Road & Center Street and 7 Mile Road & Hines Drive.

3.10.1 Main Street and Hutton Street

The results of this analysis indicate that signal timing optimization is enough to improve all approaches to operating at a LOS D or better during PM peak period. A review of network simulations confirms acceptable operations.

3.10.2 Main Street and Griswold Street

A review of network simulations indicates that signal timing optimization was observed to reduce vehicle queues on the southbound approach.

3.10.3 Sheldon Avenue/Center Street and 7 Mile Road/Hines Drive

- With mitigation measures applied, the eastbound and northbound through movements will operate at a LOS E during the AM peak period. Additionally, the northbound through movement will exceed capacity and therefore will operate with a LOS F during the PM peak period.

Although the intersection LOS analysis indicates poor operation of the eastbound and northbound through movements during the AM peak hour, network simulations show acceptable operations with only minor increases in vehicle queues. Additionally, the analysis indicates failing operation for the northbound through movement during the PM peak period; however, network simulations indicate the vehicle queues show a significant reduction. An increased delay and reduced LOS were also observed for the westbound through movement and right-turn movement; however, the vehicle queues observed in network simulations were noticeably reduced.

3.10.4 7 Mile Road and Hines Drive

- With mitigation measures applied, the westbound left-turn movement will operate at a LOS D during the PM peak period.

The recommended signal improvements at the intersection of 7 Mile Road and Center Street significantly decreased the delay on the northbound approach; however, the westbound queues at 7 Mile Road and Center Street were still observed to cause upstream blocking for 3% of the PM peak hour.

3.10.5 Future Conditions with Improvements

Intersection operations and vehicle queues with the recommended improvements are summarized in **Table 13** and **Table 14**, respectively.

Table 13: Future Intersection Operations with Improvements

Intersection	Control	Approach	Future Conditions 2023				Future Conditions 2023			
			AM Peak		PM Peak		AM Peak		PM Peak	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
2	Main Street & Hutton Street	Signalized	EBTL	0.3	A	0.3	A	No Change	19.4	B
			EBR	0.0	A	0.0	A		16.8	B
			WBTL	6.7	A	7.6	A		15.2	B
			WBR	7.1	A	9.2	A		20.2	C
			NB	17.6	B	19.8	B		9.9	A
			SBTL	21.7	C	85.7	F		13.0	B
			SBR	16.5	B	16.5	B		9.4	A
			Overall	10.6	B	26.3	C		16.3	B
3	Main Street & Griswold Street	Signalized	EBTL	12.3	B	16.1	B	No Change	26.6	C
			EBTR	10.2	B	11.1	B		16.5	B
			WBTL	10.2	B	11.9	B		17.7	B
			WBTR	10.5	B	12.6	B		19.4	B
			NB	15.5	B	16.9	B		11.5	B
			SB	17.2	B	36.3	D		18.0	B
			Overall	13.0	B	19.8	B		17.8	B

Intersection		Control	Approach	Future Conditions 2023				Future Conditions 2023			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
10	Sheldon Avenue / Center Street & Seven Mile Road / Hines Drive	Signalized	EBL	21.1	C	37.9	D	24.4	C	31.8	C
			EBTR	34.8	C	27.5	C	56.2	E	49.8	D
			WBL	40.0	D	42.2	D	30.6	C	35.5	D
			WBT	18.4	B	29.4	C	28.8	C	53.6	D
			WBR	17.6	B	18.7	B	24.4	C	27.0	C
			NBL	22.7	C	53.2	D	22.6	C	43.6	D
			NBTR	22.9	C	33.2	C	59.0	E	89.3	F
			SBL	40.0	D	61.7	E	38.4	D	37.0	D
			SBTR	17.0	B	25.8	C	33.0	C	51.8	D
		Overall	25.1	C	31.3	C	45.8	D	58.8	E	
11*	Seven Mile Road & Hines Drive	Stop (NW Hines & WBL Seven Mile)	EB	Free		Free		Free		Free	
			WBL	16.6	C	64.3	F	19.2	C	29.0	D
			WBT	Free		Free		Free		Free	
			NB	18.2	C	524.3	F	20.4	C	85.7	F

* Indicates SimTraffic delay used

Table 14: Future Vehicle Queues with Improvements

Intersection		Control	Approach	Future Conditions 2023				Future Conditions 2023 (With Improvements)			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Average (ft)	95th % (ft)	Average (ft)	95th % (ft)	Average (ft)	95th % (ft)	Average (ft)	95th % (ft)
2	Main Street & Hutton Street	Signalized	EBTL	No Changes		47	97	No Changes		78	145
			EBR			9	32			10	34
			WBTL			81	161			93	178
			WBR			67	110			71	116
			NB			26	56			17	47
			SBTL			113	196			87	148
			SBR			7	44			4	17
3	Main Street & Griswold Street	Signalized	EBTL	No Changes		89	151	No Changes		122	205
			EBTR			71	124			89	147
			WBTL			82	128			95	140
			WBTR			82	131			106	172
			NB			86	146			76	133
			SB			364	605			174	319
10	Sheldon Avenue / Center Street & Seven Mile Road / Hines Drive	Signalized	EBL	36	115	68	168	57	175	55	155
			EBTR	191	328	203	370	286	456	242	417
			WBL	21	74	110	164	27	69	91	159
			WBT	48	94	486	779	68	133	375	616
			WBR	18	51	477	957	23	61	239	547
			NBL	26	58	43	63	73	209	112	235
			NBTR	345	572	5341	9711	443	667	3417	6160
			SBL	130	222	72	154	64	122	72	146
SBTR	136	229	173	209	150	218	181	202			
11	Seven Mile Road & Hines Drive	Stop (NW Hines & WBL & Seven Mile)	EB	Free		Free		Free		Free	
			WBL	0	0	120	406	0	0	1	10
			WBT	Free		Free		Free		Free	
			NB	52	87	1276	3386	43	74	288	696

4 CONCLUSIONS AND RECOMMENDATIONS

The conclusions of this TIS are as follows:

4.1 EXISTING CONDITIONS

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

4.1.1 Main Street and Griswold Street

The SB left/through movement at Main Street and Griswold Street currently operates at a LOS E during the PM peak hour. The SB approach was observed to have occasional periods of long vehicle queues during the PM peak period. These queues were observed to dissipate and not present throughout the peak hour.

- To mitigate the existing intersection delays it is recommended to optimize the existing traffic signal timings during PM peak period.

4.1.2 Cady Street and Center Street

The WB approach at Cady Street and Center Street currently operates at a LOS E and LOS F, during the AM and PM peak periods, respectively. Additionally, the EB approach currently operates at a LOS E during the PM peak hour. Network simulations indicate that the signalized intersections allow for gaps in traffic and therefore Cady Street traffic is serviced with minimal vehicle queues.

4.1.3 Sheldon Avenue/Center Street and 7 Mile Road/Hines Drive

The NB approach was observed to have excessively long vehicle queues during the PM peak period. These queues are the result of insufficient capacity on Sheldon Ave. to accommodate the existing vehicular demand. The existing bridge on Sheldon Ave. on the south leg of this intersection limits the space available for northbound left-turning vehicles to queue, thus blocking through traffic on the northbound approach.

In addition, the WB approach was observed to have periods of long vehicle queues during the PM peak period. These queues are the result of left-turning vehicles exceeding the turn lane storage length and blocking the through and right-turn lanes.

To mitigate the existing intersection delays at this intersection the following improvements are recommended:

- Re-stripe the NB and SB approaches to provide an exclusive left-turn lane (*Note: On the NB approach the left-turn storage length would be limited by existing geometric constraints of the bridge.*)
- Upgrade the existing signalized intersection to provide to a fully actuated signal with permissive/protected left-turn phasing for all approaches.

4.1.4 7 Mile Road and Hines Drive

The NB approach of 7 Mile Road and Hines Drive currently operates at a LOS F during the PM peak period. Network simulations indicate that the delay is caused by the WB queue spillback from the adjacent intersection of Sheldon Avenue/Center Street and 7 Mile Road/Hines Drive.

- To increase capacity at this intersection, a northbound right turn lane on Hines Drive turning onto eastbound 7 Mile Road is recommended.

4.1.5 Main Street and Hutton Street

The SB left/through movement currently operates at a LOS F during the PM peak hour.

- To mitigate the existing intersection delays it is recommended to optimize the existing traffic signal timings during PM peak period.

4.2 BACKGROUND CONDITIONS

- An annual background growth rate of 0.5% was applied to the existing 2018 traffic volumes to calculate the future 2023 background traffic volumes. In addition, several proposed developments planned in the vicinity of the site were identified and included as part of the background traffic volumes.

- The 2023 background traffic operations ***without the proposed development*** will continue to operate in a manner similar to existing conditions. The mitigation measures identified in the existing conditions were applied and found to adequately mitigate the projected delays.

4.3 FUTURE CONDITIONS

With the addition of the development several study intersection approaches and movements will continue to operate at a LOS E or F during the peak periods and with long vehicle queues. The mitigation measures identified in the existing condition analysis were therefore considered for the future conditions and along with additional signal timing optimizations were found to mitigate the delays created by the development.

- No additional improvements are recommended to mitigate future conditions.**

Overall, the operational deficiencies within the study network are due to existing conditions and not the addition of site generated traffic. The impact of this development on the roadway network is lessened by the following factors:

Site Access

The proposed development is located within an existing roadway network. As a result, there are many different roadways in which traffic will enter and exit the study network. Additionally, the proposed development has numerous points of access into the site. Both of these factors create an even distribution throughout the study network and does not overly impact any one site driveway or intersection within the network.

Trip Generation

The proposed development generates a relatively low number of trips for development of this size. This is due to 1) the primary land use is residential, and 2) it is located within a downtown community. In addition, the current land use for site (Horse Race Track) has the potential to generate more traffic during the evening and weekends than the proposed residential development is expected to generate.

Land Use	Average Daily Traffic	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
Residential	2,768	54	134	188	138	97	235
Commercial	1,256	3	2	5	28	26	54
Total New Vehicular Trips	4,024	57	136	193	166	123	289

Appendix A

BACKGROUND INFORMATION

Appendix B

EXISTING TRAFFIC CONDITIONS

Appendix C

BACKGROUND TRAFFIC CONDITIONS

Appendix D

FUTURE TRAFFIC CONDITIONS