

TRAFFIC IMPACT STUDY UPDATE
FOR THE PROPOSED
SHERWOOD RESIDENTIAL DEVELOPMENT
HEATHERWOOD DRIVE
TOWN OF HAMBURG
ERIE COUNTY, NEW YORK

Prepared for:

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Locally-owned and Operated since 1933



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1.0 INTRODUCTION AND SUMMARY

This Traffic Impact Study (TIS) is an update to the previously prepared Traffic Impact Study Update (December 2013), the Supplemental Traffic Impact Study (October 2013) which addressed additional local intersections within the study area at the request of the Town of Hamburg Planning Board and the original Traffic Impact Study (May 2013) prepared to analyze the intersections of Camp and Howard Roads, Southwestern Boulevard and Howard Road, and Howard and Roundtree Roads. The December 2013 study addressed 224 apartments and 3 single family homes with access to Howard Road while the other previous studies addressed the development of 128 apartments in multiple buildings off of Heatherwood Drive.

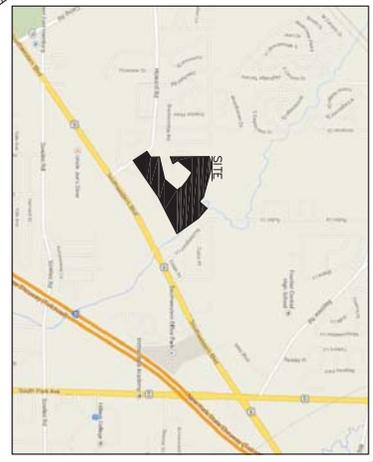
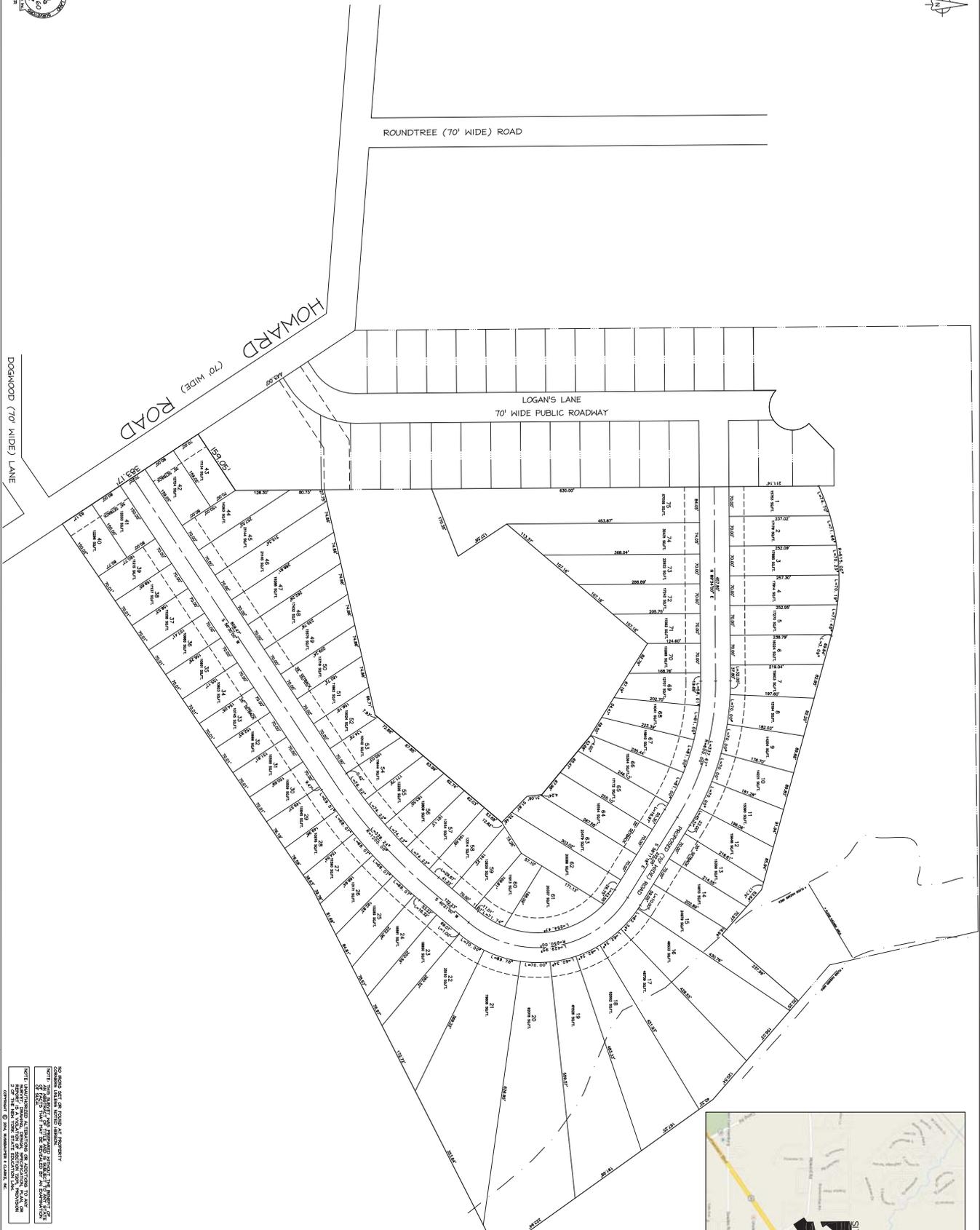
As originally proposed, DATO Development, LLC planned to redevelop a vacant parcel of land at the end of Heatherwood Drive (3,750) for the construction of multiple apartment buildings (that would have a total of 128 units). The project site is located at the eastern end of Heatherwood Drive in the Town of Hamburg.

DATO Development purchased additional land from the former Hopevale School adjacent to the south of the existing property for the development of a new access road to Howard Road and additional apartments in which an updated TIS (December 2013) was prepared. The proposed new access road would connect to the southern portion of the property where a cul-de-sac is currently located and connects to Howard Road where an existing driveway for the former Hopevale School is located. A total of 96 apartments would be located off of this access road bringing the total development to 224 apartments. In addition to these apartments, a total of 3 single family lots would be located on Howard Road from the additional land purchased.

The December 2013 study had the overall project with access to both Heatherwood Drive and Howard Road, with all vehicles utilizing Howard Road to access either Camp Road or Southwestern Boulevard. Since that report the site plan has been revised to include 110 apartments and 106 single family homes with access only off of Howard Road via two new roads. **Figure 1** shows the location of the proposed new access roads. This supplemental study will review the existing and future traffic patterns and levels of services associated with the intersections identified by the Planning Board for analysis in connection with the ongoing coordinated environmental review of the project pursuant to SEQRA.

1.1 Purpose and Objectives

The purpose of this TIS is to evaluate the potential impacts that traffic generated by the proposed project (at full occupancy) may have on the adjacent local roadway network, summarize our firm's analysis, evaluate various entrance and exit alternatives, and to provide our firm's professional opinion and recommendations for the Planning Board's consideration in connection with environmental review of the project pursuant to SEQRA.



LOCATION MAP

TOTAL AREA: 3.02 AC

SKETCH PLAN
BURKE HOMES, LLC

PART OF LOT(S) 6 & 14
 TOWNSHIP 9 RANGE 8
 COUNTY OF ERIE STATE OF NEW YORK

Wassenaar & DeGisi Inc.
 Buffalo, New York 14207-1494
 www.wassenaar.com

DATE: 12-01-14	REV. 01-25-15	SHEET NO.
SCALE: 1"=100'	JOB NO. 06.12-0716	OF 1
	DRAWN BY: K.S.A.	

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According to the records of Genesee County, New York, the land shown on this plan is owned by Burke Homes, LLC.

2.0 PROJECT DESCRIPTION

The Sherwood Residential Development project consists of the construction of 110 apartments consisting exclusively of two story structures and 106 single family homes. For purposes of our firm's analysis, it was anticipated that construction of the proposed Sherwood Residential Development project would start in the Spring of 2015, with completion of the project expected by the end of 2018. Therefore, the full build-out is assumed by Year 2018. The project would utilize the new access roads to Howard Road to gain access to either Southwestern Boulevard or Camp Road.

3.0 EXISTING AREA CONDITIONS

The transportation network serving vehicular and pedestrian traffic generated by the Sherwood Residential Development project consists of roads and intersections immediately adjacent to the project site such as Heatherwood Drive, Roundtree Road, Howard Road and other residential streets, as well as major roads such as Southwestern Boulevard and Camp Road. Sidewalks are located on the roads and limited NFTA bus service is available on Camp Road at Howard Road.

A brief description of each roadway and intersection follows under Section 3.1 Transportation Systems. The existing conditions of the roadways within the study area are summarized in Table 1.

Roadway	Class ¹	Route ²	Number Lanes ³	Feature ⁴	Width ⁵		Speed ⁶		Profile ⁷	Drainage ⁸
					Lane	Shoulder	Limit	Operating		
Southwestern Boulevard	Principal Arterial	US 20	4	Undivided	12	Paved (5)	45	45-50	Flat	Closed
Camp Road	Principal Arterial	SR 75	4	Undivided	12	Paved (5)	45	45-50	Flat	Closed
Howard Road	Local		2	Undivided	12	Varies	30	30-35	Flat	Closed
Roundtree Road	Local		2	Undivided	12	Varies	30	30-35	Flat	Closed
Heatherwood Drive	Local		2	Undivided	12	Varies	30	30-35	Flat	Closed
Deerfield Road	Local		2	Undivided	12	Varies	30	30-35	Flat	Closed

1. Federal Aid Functional Class of the Roadway.
2. US – Federal Route Number; NY – State Route Number; CR – County Route Number; None – No Route Number.
3. Number of travel lanes in the "highway proper", i.e., the highway segment between intersections and/or interchanges, excluding turning lanes developed at the intersections and/or interchanges.
4. Divided – opposing travel lanes separated by either a curbed (raised), grass or yellow striped median; Undivided – opposing travel lanes separated by either a yellow full barrier, yellow partial barrier, yellow broken line or a two-way, left-turn lane.
5. Lane and paved shoulder widths are in feet; R – Right; L – Left; Curb – no paved shoulders, offset in feet in parenthesis; gutter – no paved shoulders, offset in feet in parenthesis.
6. Miles per hour (MPH); Limit – posted or statewide speed limit; Operating – average operating speeds in the "highway proper."
7. Flat – 0 to 3 percent grades; Rolling – 3 to 10 percent grades; Mountainous – 10 plus percent grades.
8. Open – ditches convey surface water away from the roadway; Closed – catch basins and underground pipes collect and convey surface water away from the roadway.

3.1 Transportation Systems

3.1.1 Highway Proper

Southwestern Boulevard (US 20). Southwestern Boulevard accommodates four-lane, two-way traffic within the project area in a northeast-southwestern direction. It is classified on the federal-aid highway system as a Principal Arterial. It has a posted speed limit of 45 MPH. The pavement condition is good. Parking at any time is prohibited in both travel directions.

Camp Road (SR 75). Camp Road accommodates four-lane, two-way traffic in a north-south direction. The facility is classified on the federal-aid highway system as a principal arterial. The posted speed limit is 45 MPH. The pavement condition is good. Parking at any time is prohibited in both travel directions.

Howard Road. Howard Road accommodates two-lane, two-way traffic in an east-west direction. The facility is classified as a local road. The posted speed limit is 30 MPH. The pavement condition is good. No parking restrictions are designated on the road, although observations showed a majority of cars parked on the street were on the north side. This road connects to Southwestern Boulevard and Camp Road.

Roundtree Road. Roundtree Road accommodates two-lane, two-way traffic in a north-south direction. The facility is classified as a local road. The posted speed limit is 30 MPH. The pavement condition is good. No parking restrictions are designated on the road.

Heatherwood Drive. Heatherwood Drive accommodates two-lane, two-way traffic in an east-west direction from the project site to just past the west of Ironwood Drive where it becomes north to south. The facility is classified as a local road. The posted speed limit is 30 MPH. The pavement condition is good to fair in some locations. No parking restrictions are designated on the road.

Deerfield Road. Deerfield Road accommodates two-lane, two-way traffic in a north-south direction. The facility is classified as a local road. The posted speed limit is 30 MPH. The pavement condition is good. No parking restrictions are designated on the road.

3.1.2 Intersections

The following existing intersections were analyzed within the study area.

Southwestern Boulevard at Howard Road. This four-way intersection uses an actuated-coordinated 3 phase quad left signal control for traffic assignments. Southwestern Boulevard consists of two lanes in each direction (northeast and southwest), with a dedicated left turn in each direction and combined through/right lanes. Howard Road (southbound) and a business driveway (northbound) consist of combined left/through/right lanes.

Camp Road at Howard Road. This four-way intersection is un-signalized. Camp Road consists of two lanes in each direction (north and south), with dedicated left turn lanes and through/right lanes, while Howard Road and Queens Lane consists of a lane in each direction with a dedicated left turn lane and through/right turn lane. Howard Road and Queen's Lane are controlled by stop signs.

Howard Road at Roundtree Road. This three-way intersection is un-signalized. Howard Road consists of one lane in each direction (east and west), with combined left/through/right lanes, and Roundtree Road consists of one southbound approach that is a combined left/through/right lane. Roundtree Road is controlled by a stop sign.

Howard Road at Heatherwood Drive. This four-way intersection is un-signalized. Heatherwood Drive consists of one lane in each direction (north and south), with combined left/through/right lanes, while Howard Road consists of a lane in each direction (east and west) with a combined left/through/right turn lane. Heatherwood Drive is controlled by stop signs.

Howard Road at Deerfield Road/Cumberland Lane. This four-way intersection is un-signalized. Deerfield Road and Cumberland Lane consist of one lane in each direction (north and south), with combined left/through/right lanes, while Howard Road consists of a lane in each direction (east and west) with a combined left/through/right turn lane. This intersection is an all way stop.

The aforementioned intersections require a detailed capacity and level of service analysis for the existing and future traffic generated by the Sherwood Residential Development project once assigned and distributed over the existing transportation system. Refer to the Appendices for details relative to geometric layout and lane configurations.

3.2 Study Area Land Use

The lands immediately surrounding the proposed site consist of uses that are commercial, institutional and residential.

3.3 Site Accessibility

Previously the site for the apartment portion of the project had existing access to Heatherwood Drive. With the recent purchase of the land for the access road and single family homes, the overall project would consolidate vehicular access to Howard Road.

4.0 PROJECTED TRAFFIC

4.1 Existing Traffic Volumes and Transportation Network

Traffic counts were performed by Nussbaumer (“NCI”) staff on February 5, 2013 (original TIS) and September 12-19th, 2013 (supplemental TIS). These counts were used for development of existing and future year background traffic needed for this traffic impact study analysis. The manual turning counts provide data on individual approach turning volumes and turning patterns.

The listing in **Table 2** is a summary of the traffic count data collected in the vicinity of the project site. Appendix A from the previous studies includes the summary and details of all the individual intersection manual turning counts gathered for the traffic study.

Location	Year Count Taken	By Whom
<u>Intersection Manual Turning Movement Counts</u>		
Southwestern Boulevard at Howard Road (Weekday)	2013	NCI
Camp Road at Howard Road (Weekday)	2013	NCI
Howard Road at Roundtree Road (Weekday)	2013	NCI
Howard Road & Heatherwood (Weekday)	2013	NCI
Howard Road & Deerfield Road (Weekday)	2013	NCI

4.1.1 Growth and Seasonal Adjustment Factor

Traffic is typically affected by the seasons of the year with it being low during the winter months and high during the summer months. Seasonal Adjustment Factors are used to remove this seasonal bias in order to reflect typical traffic volume conditions on roads and at intersections. The seasonal adjustment factor of 0.838 was added to the traffic counts conducted in February 2013 and the seasonal adjustment factor of 1.066 was added to the traffic counts conducted in September 2013 in order to accurately reflect normal conditions at these intersections. These factors were obtained from the New York State Department of Transportation (NYSDOT) and are included in Appendix A of the previous studies.

The growth rate developed to project the future build-out year of 2018 was based on data obtained from the NYSDOT. A growth rate of 0.5% was used to project future volumes. **Tables 3 A-E** shows the calculated growth rates for each approach.

4.1.2 Existing Peak Period Traffic Volumes

As noted earlier, and in **Table 2** for this traffic study, manual intersection turning movement counts were performed for the intersections in the study area. **Tables 3A-3E** shows the 2013 existing traffic and the projected 2018 future traffic volumes for the intersection in the study area.

Existing Bus Service

The Niagara Frontier Transportation Authority (NFTA) Metro Bus provides limited bus service within the project area at the intersection of Camp Road and Howard Road (NFTA Route 74 Hamburg).

TABLE 3A PROJECTED GROWTH			
Sherwood Apartments Heatherwood Drive Hamburg, New York Intersection: Camp Road and Howard Road			
Movement	AM PEAK EXISTING 2013	Annual Growth Rate	AM PEAK BACKGROUND 2018
Camp Road Northbound			
Left Turn Movement	2	0.005	2
Through Movement	1048	0.005	1074
Right Turn Movement	15	0.005	15
Camp Road Southbound			
Left Turn Movement	38	0.005	39
Through Movement	353	0.005	362
Right Turn Movement	7	0.005	7
Queens Lane Eastbound			
Left Turn Movement	16	0.005	16
Through Movement	0	0.005	0
Right Turn Movement	17	0.005	17
Howard Road Westbound			
Left Turn Movement	31	0.005	32
Through Movement	0	0.005	0
Right Turn Movement	120	0.005	123
Movement	PM PEAK EXISTING 2013	Annual Growth Rate	PM PEAK EXISTING 2018
Camp Road Northbound			
Left Turn Movement	14	0.005	14
Through Movement	531	0.005	544
Right Turn Movement	73	0.005	75
Camp Road Southbound			
Left Turn Movement	74	0.005	76
Through Movement	1057	0.005	1083
Right Turn Movement	13	0.005	13
Queens Lane Eastbound			
Left Turn Movement	6	0.005	6
Through Movement	0	0.005	0
Right Turn Movement	7	0.005	7
Howard Road Westbound			
Left Turn Movement	33	0.005	34
Through Movement	1	0.005	1
Right Turn Movement	51	0.005	52

TABLE 3B PROJECTED GROWTH			
Sherwood Apartments Heatherwood Drive Hamburg, New York Intersection: Southwestern Boulevard (RT 20) and Howard Road			
Movement	AM PEAK EXISTING 2013	Annual Growth Rate	AM PEAK BACKGROUND 2018
RT 20 Northeastbound			
Left Turn Movement	30	0.005	31
Through Movement	602	0.005	617
RT 20 Southwestbound			
Through Movement	378	0.005	387
Right Turn Movement	49	0.005	50
Howard Road Southbound			
Left Turn Movement	99	0.005	101
Right Turn Movement	46	0.005	47
Movement	PM PEAK EXISTING 2013	Annual Growth Rate	PM PEAK BACKGROUND 2018
RT 20 Northeastbound			
Left Turn Movement	43	0.005	44
Through Movement	693	0.005	710
RT 20 Southwestbound			
Through Movement	832	0.005	853
Right Turn Movement	99	0.005	101
Howard Road Southbound			
Left Turn Movement	64	0.005	66
Right Turn Movement	31	0.005	32

TABLE 3C PROJECTED GROWTH			
Sherwood Apartments Heatherwood Drive Hamburg, New York Intersection: Howard Road & Roundtree Road			
Movement	AM PEAK EXISTING 2013	Annual Growth Rate	AM PEAK BACKGROUND 2018
Howard Road Eastbound			
Left Turn Movement	4	0.005	4
Through Movement	76	0.005	78
Howard Road Westbound			
Through Movement	37	0.005	38
Right Turn Movement	17	0.005	17
Roundtree Road Southbound			
Left Turn Movement	63	0.005	65
Right Movement	16	0.005	16
Movement	PM PEAK EXISTING 2013	Annual Growth Rate	PM PEAK BACKGROUND 2018
Howard Road Eastbound			
Left Turn Movement	16	0.005	16
Through Movement	57	0.005	58
Howard Road Westbound			
Through Movement	69	0.005	71
Right Turn Movement	54	0.005	55
Roundtree Road Southbound			
Left Turn Movement	42	0.005	43
Right Movement	7	0.005	7

TABLE 3D PROJECTED GROWTH			
Sherwood Apartments Heatherwood Drive Hamburg, New York Intersection: Howard Road & Heatherwood Drive			
Movement	AM PEAK EXISTING 2013	Annual Growth Rate	AM PEAK BACKGROUND 2018
Heatherwood Drive Northbound			
Left Turn Movement	24	0.005	25
Through Movement	2	0.005	2
Right Turn Movement	7	0.005	7
Heatherwood Drive Southbound			
Left Turn Movement	6	0.005	6
Through Movement	1	0.005	1
Right Turn Movement	32	0.005	33
Howard Road Eastbound			
Left Turn Movement	7	0.005	7
Through Movement	64	0.005	66
Right Turn Movement	6	0.005	6
Howard Road Westbound			
Left Turn Movement	5	0.005	5
Through Movement	112	0.005	115
Right Turn Movement	1	0.005	1
Movement	PM PEAK EXISTING 2013	Annual Growth Rate	PM PEAK EXISTING 2018
Heatherwood Drive Northbound			
Left Turn Movement	9	0.005	9
Through Movement	1	0.005	1
Right Turn Movement	7	0.005	7
Heatherwood Drive Southbound			
Left Turn Movement	9	0.005	9
Through Movement	0	0.005	0
Right Turn Movement	9	0.005	9
Howard Road Eastbound			
Left Turn Movement	22	0.005	23
Through Movement	123	0.005	126
Right Turn Movement	12	0.005	12
Howard Road Westbound			
Left Turn Movement	2	0.005	2
Through Movement	74	0.005	76
Right Turn Movement	9	0.005	9

TABLE 3E PROJECTED GROWTH			
Sherwood Apartments Heatherwood Drive Hamburg, New York Intersection: Howard Road & Deerfield Road			
Movement	AM PEAK EXISTING 2013	Annual Growth Rate	AM PEAK BACKGROUND 2018
Cumberland Lane Northbound			
Left Turn Movement	4	0.005	4
Through Movement	1	0.005	1
Right Turn Movement	2	0.005	2
Deerfield Road Southbound			
Left Turn Movement	11	0.005	11
Through Movement	0	0.005	0
Right Turn Movement	25	0.005	26
Howard Road Eastbound			
Left Turn Movement	3	0.005	3
Through Movement	87	0.005	89
Right Turn Movement	3	0.005	3
Howard Road Westbound			
Left Turn Movement	0	0.005	0
Through Movement	65	0.005	67
Right Turn Movement	5	0.005	5
Movement	PM PEAK EXISTING 2013	Annual Growth Rate	PM PEAK EXISTING 2018
Cumberland Lane Northbound			
Left Turn Movement	2	0.005	2
Through Movement	0	0.005	0
Right Turn Movement	4	0.005	4
Deerfield Road Southbound			
Left Turn Movement	8	0.005	8
Through Movement	2	0.005	2
Right Turn Movement	8	0.005	8
Howard Road Eastbound			
Left Turn Movement	27	0.005	28
Through Movement	90	0.005	92
Right Turn Movement	4	0.005	4
Howard Road Westbound			
Left Turn Movement	5	0.005	5
Through Movement	71	0.005	73
Right Turn Movement	13	0.005	13

4.2 2013 Existing Traffic Volumes

Traffic impact studies (TIS) are required to be prepared in accordance with policies and procedures of the traffic engineering profession (i.e., the Institute of Transportation Engineers ("ITE")). The analysis of these intersections will focus on the future impacts the proposed development will have on the intersections' level of service within the study area.

For level of service and site traffic impact analysis, the background and year of completion/occupancy of the Sherwood Residential Development project is 2018. The TIS utilized traffic counts (manual intersection turning counts) gathered in 2013 under existing operating conditions.

4.3 2018 Background and 2018 with Development Traffic Volumes

Level of service was evaluated for 2013 existing background and 2018 background traffic volume conditions for the intersections within the study area. These traffic-operating conditions can be expected to be realized without the Sherwood Residential Development project. Signalized and un-signalized level of service analyses were also conducted for the peak hours of the 2018 background traffic volumes with the proposed apartments.

Figures 2A-B summarizes the 2018 Background with Development Traffic Volumes at the intersections within the study area. The methodology used to estimate project generated trips are further explained in **Section 4.4** of this report. The level of service analyses for all studied years and conditions are summarized in **Tables 5A-5F** of **Section 5.1** of this report. Copies of the Synchro reports for the intersection analyses are included in Appendix B.

4.4 Trip Generation – Site – Generated Traffic

Trip Generation

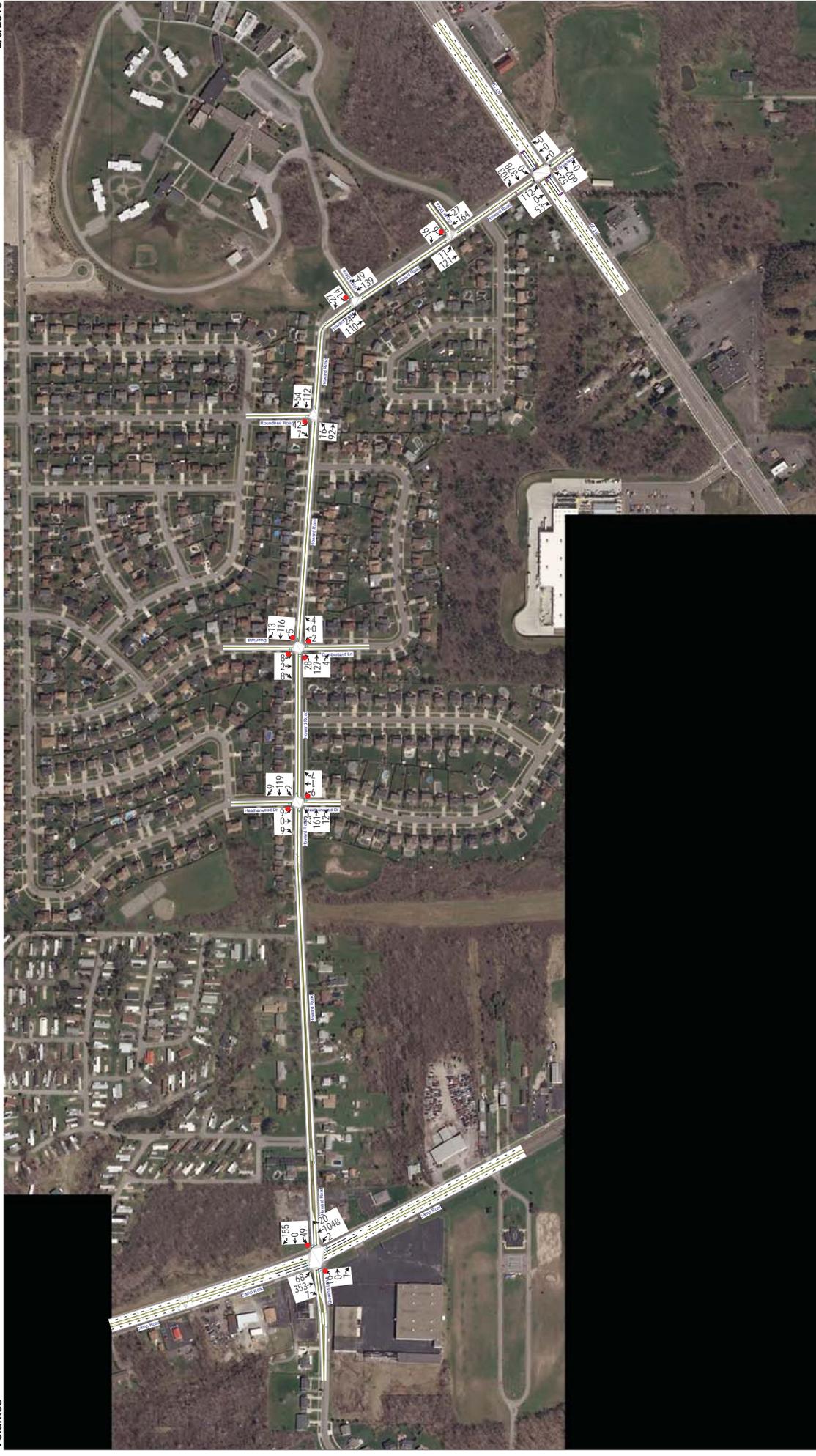
Traffic impact studies generally apply the Institute of Transportation Engineers (ITE) Trip Generation Manual procedures in the calculation of trips generated for a development proposal. The ITE guidelines for estimating trip generation have been followed in determining traffic generated for the proposed land use through application of the procedures of the 9th Edition of the ITE Trip Generation Manual.

For purposes of estimating trip generation for this project site, ITE Code 220 – Apartments, with the independent variable dwelling units was used to estimate project generated trips for the apartments. ITE Code 210 – Single Family Homes, with the independent variable dwelling units was used to estimate project generated trips for the single family houses.

For reference purposes, **Table 4** shows the trips generated by the proposed Sherwood Residential Development apartments and single family houses for the AM and PM Peaks using the ITE Code.

Figure 2B - PM 2018 With Project Volumes

2/6/2015



H:\Land Development\0505PF5-0076C Sherwood Apts TISISynchro\Sherwood PM February 2018 with project.syn

Sherwood Residential Development Baseline

Table 4 - Project Trip Generation-ITE 8th Edition											
Site Information						Adjacent Highway PassBy Information					
Name of Development	Sherwood Residential Development					North/ South Roadway					
Name of Applicant	David Burke					Howard Road					
Date	2/2/2015					East/ West Roadway					
Development Phase	N/A										
Analysis Year	2018										
AM Peak Trips											
ITE Code	Land Type	# Units/Sq. Ft	Independent Variable	Unit Conversion	Trip Rate Per Unit	Total Single Use Trips	Directional Distribution		Trip Generation		Method
							In	Out	In	Out	
220	Apartments	110	dwelling unit	1	0.51	56	0.2	0.8	11	45	Rt
210	S.F. Houses	106	dwelling unit	1	0.75	80	0.25	0.75	20	60	Rt
PM Peak Trips											
ITE Code	Land Type	# Units	Independent Variable	Unit Conversion	Trip Rate Per Unit	Total Single Use Trips	Directional Distribution		Trip Generation		Method
							In	Out	In	Out	
220	Apartments	110	dwelling unit	1	0.62	68	0.65	0.35	44	24	Rt
210	S.F. Houses	106	dwelling unit	1	1	106	0.63	0.37	67	39	Rt

4.5 Trip Distribution

The directional distribution of trips to and from the Sherwood Residential Development site was determined through existing traffic counts performed at the intersections counted in the study area. For the purposes of this traffic analysis, traffic distribution patterns identified through the traffic counts and observations available for this study period were reviewed and applied to derive trip distribution patterns specifically for 2018 when it is anticipated that the full build-out and occupancy would occur.

Based on the 2013 existing background traffic volumes at the analyzed intersections, traffic trip distribution patterns were identified that would be assumed to represent trip distribution to and from the proposed Sherwood Residential Development project. From the observations and counts taken at these intersections, trip distribution patterns were developed to determine where the project generated trips would be assigned at the 2018 build-out year. **Figure 3** shows the project generated distribution estimated trips.

5.0 TRAFFIC ANALYSIS

The capacity analyses and levels of service center on the analyses of the intersections as opposed to the arterial or highway proper. Capacity and levels of service analyses were undertaken for all identified intersections in the study during the morning and afternoon weekday peak periods.

The intersections identified under **Section 3.1.2** of this report were previously analyzed during the weekday morning and afternoon peak periods for the 2013 existing traffic.

The results of the 2013 existing traffic analyses concluded that both peak periods had varying worst conditions, i.e., the worst case scenario. All intersections were analyzed for the 2018 background plus project generated traffic during the weekday AM and PM peak periods

For signalized intersections, the level of service is evaluated on the basis of “control delay per vehicle” where control delay is the portion of the total delay attributed to traffic signal operations at the intersection. Mitigation is considered at the intersection when the level of service is lower than the minimal acceptable “Level of Service D”, i.e., when the control delay per vehicle is greater than fifty-five (55) seconds per vehicle.

These analyses utilized the existing 2013 lane configurations, pavement markings and signal operations, e.g., phasing, sequencing, timing, and head locations, when projecting 2018 traffic conditions.

For un-signalized intersections, the level of service is evaluated on the basis of “control delay per vehicle” where control delay is the portion of the delay attributed to vehicles on the stop sign approach and/or turn lane approaches. Mitigation is considered at the intersection when the level of service is lower than the minimal acceptable “Level of Service D”, i.e., when the control delay per vehicle is greater than fifty-five (55) seconds per vehicle and observations show this to be true.

Level of Service Criteria for Unsignalized Intersections

LOS	Average Delay per Vehicle
A	Very low control delay 10 or less seconds per vehicle. All drivers find freedom of operation. Very rarely more than one vehicle in queue.
B	Control delay greater than 10 and up to 15 seconds per vehicle. Some drivers begin to consider the delay troublesome. Seldom there is more than one vehicle in queue.
C	Control delay greater than 15 and up to 25 seconds per vehicle. Most drivers feel restricted, but tolerably so. Often there is more than one vehicle in queue.
D	Control delay greater than 25 and up to 35 seconds per vehicle. Drivers feel restricted. Most often, there is more than one vehicle in queue.
E	Control delay greater than 35 and up to 50 seconds per vehicle. Drivers find delays approaching intolerable levels. There is frequently more than one vehicle in queue. This level denotes a state in which the demand is close or equal to the probable maximum number of vehicles that can be accommodated by the movement.
F	Control delay in excess of 50 seconds per vehicle. Very constrained flow. Represents an intersection failure situation that is caused by geometric and/or operational constraints external to the intersection.

Unsignalized Intersections

LOS	Unsignalized Intersections	Signalized Intersections
A	≤ 10	≤ 10
B	> 10 and ≤ 15	> 10 and ≤ 20
C	> 15 and ≤ 25	> 20 and ≤ 35
D	> 25 and ≤ 35	> 35 and ≤ 55
E	> 35 and ≤ 50	> 55 and ≤ 80
F	> 50	> 80

Certain approaches at un-signalized intersections when analyzed may indicate poor levels of service; however, this condition may not require mitigation due to a proposed project. A poor level of service is an indicator that visual on-site observations are necessary to determine if a problem is really occurring. Field conditions such as gaps from nearby signalized intersections may indicate that no mitigation is needed. Many un-signalized intersections have at least one approach that operates at a poor level of service; however, on-site observations may show that no major problems exist.

5.1 Intersection Capacity Analysis

- Camp Road at Howard Road/Queens Lane -

Existing 2013: The intersection operates at a LOS A during the morning peak period. The eastbound left turn approach experiences the highest delay of all movements with 26.2 seconds per vehicle (LOS D). The intersection operates at a LOS A during the afternoon peak period, while the eastbound left turn approach experiences the highest delay of all movements with 37.4 seconds per vehicle (LOS E). The afternoon peak period is the worst-case scenario.

Projected 2018 Background: The intersection operates at a LOS A during the morning peak period. The eastbound left turn approach experiences the highest delay of all movements with 27.7 seconds per vehicle (LOS D). The intersection operates at a LOS A during the afternoon peak period, while the eastbound left turn approach experiences the highest delay of all movements with 42.8 seconds per vehicle (LOS E). The afternoon peak period is the worst-case scenario.

Projected 2018 Background plus Development: The intersection operates at a LOS A during the morning peak period. The eastbound left turn approach experiences the highest delay of all movements with 35.4 seconds per vehicle (LOS E). The intersection operates at a LOS A during the afternoon peak period, while the eastbound left turn approach experiences the highest delay of all movements with 45.8 seconds per vehicle (LOS E). The afternoon peak period is the worst-case scenario.

Conclusion: There is little to no impact at this intersection as a result of the overall project. The intersection operates at an acceptable level of service.

- Southwestern Boulevard at Howard Road -

Existing 2013: The intersection operates at a LOS B during the morning peak period. The southbound approach experiences the highest delay of all movements with 47.4 seconds per

vehicle (LOS D). The intersection operates at a LOS A during the afternoon peak period, while the southbound approach experiences the highest delay of all movements with 43.6 seconds per vehicle (LOS D). The morning peak period is the worst-case scenario.

Projected 2018 Background: The intersection operates at a LOS B during the morning peak period. The eastbound left turn approach experiences the highest delay of all movements with 47.5 seconds per vehicle (LOS D). The intersection operates at a LOS A during the afternoon peak period, while the eastbound left turn approach experiences the highest delay of all movements with 43.9 seconds per vehicle (LOS D). The morning peak period is the worst-case scenario.

Projected 2018 Background plus Development: The intersection operates at a LOS B during the morning peak period. The southbound approach experiences the highest delay of all movements with 42.9 seconds per vehicle (LOS D). The intersection operates at a LOS B during the afternoon peak period, while the southbound approach experiences the highest delay of all movements with 39.5 seconds per vehicle (LOS D). The morning peak period is the worst-case scenario.

Conclusion: There is little to no impact at this intersection as a result of the overall project. The intersection operates at an acceptable level of service.

- Howard Road at Roundtree Road -

Existing 2013: The intersection operates at a LOS A during the morning peak period. The southbound approach experiences the highest delay of all movements with 9.8 seconds per vehicle (LOS A). The intersection operates at a LOS A during the afternoon peak period, while the southbound approach experiences the highest delay of all movements with 10.3 seconds per vehicle (LOS B). The morning peak period is the worst-case scenario.

Projected 2018 Background: The intersection operates at a LOS A during the morning peak period. The southbound approach experiences the highest delay of all movements with 9.9 seconds per vehicle (LOS A). The intersection operates at a LOS A during the afternoon peak period, while the southbound approach experiences the highest delay of all movements with 10.3 seconds per vehicle (LOS B). The morning peak period is the worst-case scenario.

Projected 2018 Background plus Development: The intersection operates at a LOS A during the morning peak period. The southbound approach experiences the highest delay of all movements with 10.2 seconds per vehicle (LOS B). The intersection operates at a LOS A during the afternoon peak period, while the southbound approach experiences the highest delay of all movements with 11.2 seconds per vehicle (LOS B). The morning peak period is the worst-case scenario.

Conclusion: There is little to no impact at this intersection as a result of the overall project. The intersection operates at an acceptable level of service.

- Howard Road at Heatherwood Drive -

Existing 2013: The intersection operates at a LOS A during the morning peak period. The northbound approach experiences the highest delay of all movements with 11.5 seconds per vehicle (LOS B). The intersection operates at a LOS A during the afternoon peak period, while

the northbound approach experiences the highest delay of all movements with 10.9 seconds per vehicle (LOS B). The morning peak period is the worst-case scenario.

Projected 2018 Background plus Development: The intersection operates at a LOS A during the morning peak period. The northbound approach experiences the highest delay of all movements with 12.3 seconds per vehicle (LOS B). The intersection operates at a LOS A during the afternoon peak period, while the northbound approach experiences the highest delay of all movements with 11.9 seconds per vehicle (LOS B). The morning peak period is the worst-case scenario.

Conclusion: There is little to no impact at this intersection as a result of the overall project. The intersection operates at an acceptable level of service.

- Howard Road at Deerfield Road/Cumberland Lane -

Existing 2013: The intersection operates at a LOS A during the morning peak period. The westbound approach experiences the highest delay of all movements with 8 seconds per vehicle (LOS A). The intersection operates at a LOS A during the afternoon peak period, while the eastbound approach experiences the highest delay of all movements with 8.1 seconds per vehicle (LOS A). The afternoon peak period is the worst-case scenario.

Projected 2018 Background plus Development: The intersection operates at a LOS A during the morning peak period. The westbound approach experiences the highest delay of all movements with 8.3 seconds per vehicle (LOS A). The intersection operates at a LOS A during the afternoon peak period, while the eastbound approach experiences the highest delay of all movements with 8.7 seconds per vehicle (LOS A). The afternoon peak period is the worst-case scenario.

Conclusion: There is little to no impact at this intersection as a result of the overall project. The intersection operates at an acceptable level of service.

- Howard Road at North Access Drive -

Projected 2018 Background plus Development: The intersection operates at a LOS A during the morning peak period. The westbound approach experiences the highest delay of all movements with 10.2 seconds per vehicle (LOS B). The intersection operates at a LOS A during the afternoon peak period, while the eastbound approach experiences the highest delay of all movements with 10.3 seconds per vehicle (LOS B). The afternoon peak period is the worst-case scenario.

Conclusion: There is little to no impact at this intersection as a result of the overall project. The intersection operates at an acceptable level of service.

- Howard Road at North Access Drive -

Projected 2018 Background plus Development: The intersection operates at a LOS A during the morning peak period. The westbound approach experiences the highest delay of all movements with 10.1 seconds per vehicle (LOS B). The intersection operates at a LOS A during the afternoon peak period, while the eastbound approach experiences the highest delay of all movements with 10 seconds per vehicle (LOS B). The morning peak period is the worst-case scenario.

Conclusion: There is little to no impact at this intersection as a result of the overall project. The intersection operates at an acceptable level of service.

- Howard Road at South Access Drive -

Projected 2018 Background plus Development: The intersection operates at a LOS A during the morning peak period. The westbound approach experiences the highest delay of all movements with 10.1 seconds per vehicle (LOS B). The intersection operates at a LOS A during the afternoon peak period, while the eastbound approach experiences the highest delay of all movements with 9.8 seconds per vehicle (LOS A). The morning peak period is the worst-case scenario.

Conclusion: There is little to no impact at this intersection as a result of the overall project. The intersection operates at an acceptable level of service.

Appendix A provides full reports of the Synchro 9 capacity/level of service analyses of the various intersection locations analyzed for the study.

6.0 FINDINGS, RECOMMENDATIONS & CONCLUSION

For the un-signalized intersections analyzed in this study, there are minimal or virtually no change in levels of service as a result of the proposed Sherwood Residential Development project. All intersections analyzed operate at a LOS A with the exception of Southwestern Boulevard and Howard Road which operates at a LOS B with or without the proposed project.

Certain approaches at un-signalized intersections when analyzed may indicate poor levels of service; however, this condition may not require mitigation due to a proposed project. A poor level of service is an indicator that visual on-site observations are necessary to determine if a problem is really occurring. Field conditions such as gaps from nearby signalized intersections may indicate that no mitigation is needed. Many un-signalized intersections have at least one approach that operates at a poor level of service; however, on-site observations may show that no major problems exist.

While the eastbound left turn approach of Queens Lane at the intersection with Camp Road has a LOS E during the afternoon peak, the proposed project does not contribute to increased traffic at this approach and does not increase the overall delay. Field observations observed during traffic counts at this location also indicated appropriate gaps in traffic volumes on Camp Road for vehicles to exit Queens Lane.

Based on the results of our firm's comprehensive analysis of potential traffic impacts within the original TIS, the Supplemental TIS and this updated TIS it is our firm's professional opinion that the project will not have any potentially significant traffic impacts on the existing transportation network including the local roadways in the study area. In fact, the project will only result in minimal traffic impacts on the local roadway network.

This TIS Update, Supplemental TIS and the original TIS demonstrate that given the lack of potentially significant traffic impacts resulting from the project that potential traffic impacts on the local roadway system do not warrant the issuance of a positive declaration and preparation of an Environmental Impact Statement in connection with the environmental review of the project pursuant to SEQRA.

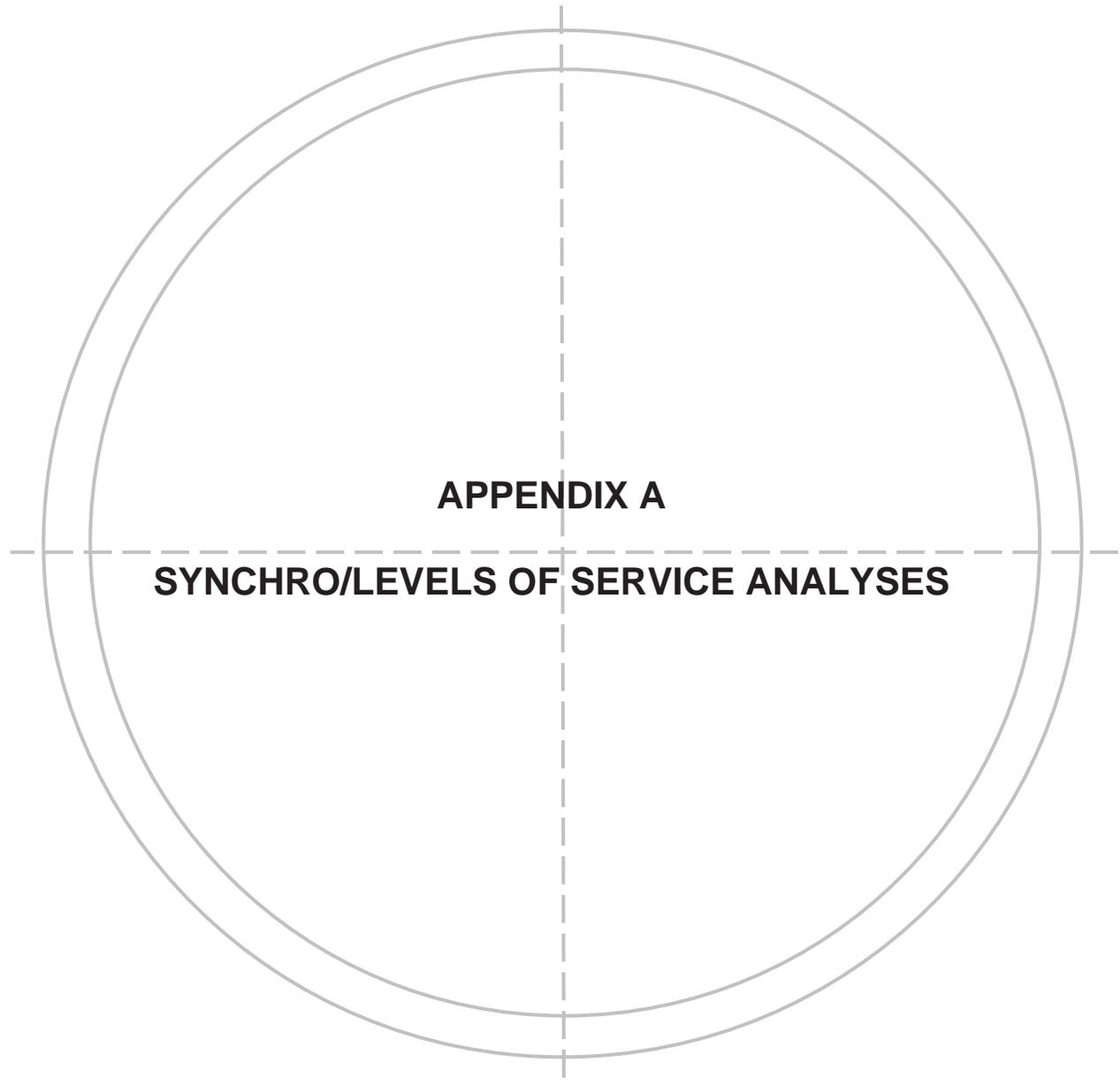
7.0 STUDY CONTACT

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Lanes, Volumes, Timings
3: Camp Road & Queens Lane/Howard Road

2018 AM with project
2/6/2015



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	16	0	7	36	0	144	2	1048	20	55	353	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	100		0	100		0	150		0	150		0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (ft)	50			50			50			50		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.850			0.850			0.997				0.992
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1703	1369	0	1805	1538	0	1805	3521	0	1556	3316	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1703	1369	0	1805	1538	0	1805	3521	0	1556	3316	0
Link Speed (mph)		30			30			45			45	
Link Distance (ft)		267			461			1034			607	
Travel Time (s)		6.1			10.5			15.7			9.2	
Peak Hour Factor	0.80	0.92	0.53	0.86	0.92	0.77	0.50	0.97	0.94	0.73	0.84	0.29
Heavy Vehicles (%)	6%	0%	18%	0%	0%	5%	0%	2%	13%	16%	6%	43%
Adj. Flow (vph)	20	0	13	42	0	187	4	1080	21	75	420	24
Shared Lane Traffic (%)												
Lane Group Flow (vph)	20	13	0	42	187	0	4	1101	0	75	444	0
Enter Blocked Intersection	No	No	No									
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane								Yes			Yes	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	56.2%
ICU Level of Service	B
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis

3: Camp Road & Queens Lane/Howard Road

2018 AM with project
2/6/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	16	0	7	36	0	144	2	1048	20	55	353	7
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.80	0.92	0.53	0.86	0.92	0.77	0.50	0.97	0.94	0.73	0.84	0.29
Hourly flow rate (vph)	20	0	13	42	0	187	4	1080	21	75	420	24
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								TWLTL			TWLTL	
Median storage (veh)								2			2	
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1318	1693	222	1473	1694	551	444			1102		
vC1, stage 1 conf vol	583	583		1099	1099							
vC2, stage 2 conf vol	735	1110		374	595							
vCu, unblocked vol	1318	1693	222	1473	1694	551	444			1102		
tC, single (s)	7.6	6.5	7.3	7.5	6.5	7.0	4.1			4.4		
tC, 2 stage (s)	6.6	5.5		6.5	5.5							
tF (s)	3.6	4.0	3.5	3.5	4.0	3.3	2.2			2.4		
p0 queue free %	86	100	98	80	100	60	100			86		
cM capacity (veh/h)	138	195	734	212	245	471	1126			554		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3		
Volume Total	20	13	42	187	4	720	381	75	280	164		
Volume Left	20	0	42	0	4	0	0	75	0	0		
Volume Right	0	13	0	187	0	0	21	0	0	24		
cSH	138	734	212	471	1126	1700	1700	554	1700	1700		
Volume to Capacity	0.14	0.02	0.20	0.40	0.00	0.42	0.22	0.14	0.16	0.10		
Queue Length 95th (ft)	12	1	18	47	0	0	0	12	0	0		
Control Delay (s)	35.4	10.0	26.1	17.6	8.2	0.0	0.0	12.5	0.0	0.0		
Lane LOS	E	A	D	C	A			B				
Approach Delay (s)	25.3		19.2		0.0			1.8				
Approach LOS	D		C									
Intersection Summary												
Average Delay			3.3									
Intersection Capacity Utilization			56.2%		ICU Level of Service				B			
Analysis Period (min)			15									

Lanes, Volumes, Timings
9: Cumberland Ln/Deerfield & Howard Road

2018 AM with project
2/6/2015



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Volume (vph)	3	111	3	0	96	5	4	1	2	11	0	26
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.996			0.988			0.966			0.905	
Flt Protected		0.997						0.976			0.985	
Satd. Flow (prot)	0	1728	0	0	1588	0	0	1433	0	0	1524	0
Flt Permitted		0.997						0.976			0.985	
Satd. Flow (perm)	0	1728	0	0	1588	0	0	1433	0	0	1524	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		683			1025			314			309	
Travel Time (s)		15.5			23.3			7.1			7.0	
Confl. Peds. (#/hr)			3						1			
Peak Hour Factor	0.38	0.91	0.75	0.92	0.81	0.42	0.50	0.25	0.50	0.69	0.92	0.69
Heavy Vehicles (%)	0%	9%	33%	0%	14%	60%	0%	100%	0%	9%	0%	12%
Adj. Flow (vph)	8	122	4	0	119	12	8	4	4	16	0	38
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	134	0	0	131	0	0	16	0	0	54	0
Enter Blocked Intersection	No	No	No									
Lane Alignment	Left	Left	Right									
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	19.2%
Analysis Period (min)	15
	ICU Level of Service A

HCM Unsignalized Intersection Capacity Analysis
 9: Cumberland Ln/Deerfield & Howard Road

2018 AM with project
 2/6/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	3	111	3	0	96	5	4	1	2	11	0	26
Peak Hour Factor	0.38	0.91	0.75	0.92	0.81	0.42	0.50	0.25	0.50	0.69	0.92	0.69
Hourly flow rate (vph)	8	122	4	0	119	12	8	4	4	16	0	38
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	134	130	16	54								
Volume Left (vph)	8	0	8	16								
Volume Right (vph)	4	12	4	38								
Hadj (s)	0.15	0.25	0.38	-0.17								
Departure Headway (s)	4.4	4.5	4.9	4.4								
Degree Utilization, x	0.16	0.16	0.02	0.06								
Capacity (veh/h)	807	789	681	768								
Control Delay (s)	8.2	8.3	8.1	7.7								
Approach Delay (s)	8.2	8.3	8.1	7.7								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.2									
Level of Service			A									
Intersection Capacity Utilization			19.2%	ICU Level of Service	A							
Analysis Period (min)			15									

Lanes, Volumes, Timings
 10: Howard Road & Roundtree Road

2018 AM with project
 2/6/2015



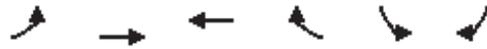
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	4	92	66	17	63	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.958		0.971	
Flt Protected		0.997			0.962	
Satd. Flow (prot)	0	1857	1579	0	1643	0
Flt Permitted		0.997			0.962	
Satd. Flow (perm)	0	1857	1579	0	1643	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		1025	389		305	
Travel Time (s)		23.3	8.8		6.9	
Peak Hour Factor	0.50	0.83	0.84	0.47	0.88	0.80
Heavy Vehicles (%)	2%	2%	14%	18%	5%	19%
Adj. Flow (vph)	8	111	79	36	72	20
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	119	115	0	92	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		0	0		12	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15			9	15	9
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	19.2%
Analysis Period (min)	15
	ICU Level of Service A

HCM Unsignalized Intersection Capacity Analysis
 10: Howard Road & Roundtree Road

2018 AM with project
 2/6/2015



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	4	92	66	17	63	16
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.50	0.83	0.84	0.47	0.88	0.80
Hourly flow rate (vph)	8	111	79	36	72	20
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	115				223	97
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	115				223	97
tC, single (s)	4.1				6.4	6.4
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.5
p0 queue free %	99				91	98
cM capacity (veh/h)	1474				754	915

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	119	115	92
Volume Left	8	0	72
Volume Right	0	36	20
cSH	1474	1700	784
Volume to Capacity	0.01	0.07	0.12
Queue Length 95th (ft)	0	0	10
Control Delay (s)	0.5	0.0	10.2
Lane LOS	A		B
Approach Delay (s)	0.5	0.0	10.2
Approach LOS			B

Intersection Summary			
Average Delay		3.1	
Intersection Capacity Utilization		19.2%	ICU Level of Service
Analysis Period (min)		15	A

Lanes, Volumes, Timings
15: RT 20 & Driveway/Howard Road

2018 AM with project
2/6/2015



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations		↕			↕		↕	↕↔		↕	↕↔	
Volume (vph)	151	0	70	0	0	0	33	602	0	0	378	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	100		0	100		0
Storage Lanes	0		0	0		0	1		0	1		0
Taper Length (ft)	25			25			50			50		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.957									0.978	
Flt Protected		0.967					0.950					
Satd. Flow (prot)	0	1675	0	0	1863	0	1641	3505	0	1863	3349	0
Flt Permitted		0.796					0.427					
Satd. Flow (perm)	0	1379	0	0	1863	0	738	3505	0	1863	3349	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		76										25
Link Speed (mph)		30			30			45				45
Link Distance (ft)		505			175			642				812
Travel Time (s)		11.5			4.0			9.7				12.3
Peak Hour Factor	0.83	0.92	0.82	0.92	0.92	0.92	0.63	0.85	0.92	0.92	0.97	0.82
Heavy Vehicles (%)	4%	2%	7%	2%	2%	2%	10%	3%	2%	2%	6%	2%
Adj. Flow (vph)	182	0	85	0	0	0	52	708	0	0	390	67
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	267	0	0	0	0	52	708	0	0	457	0
Enter Blocked Intersection	No											
Lane Alignment	Left	Left	Right									
Median Width(ft)		0			0			12				12
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane								Yes				Yes
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru										
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex										
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA					pm+pt	NA		pm+pt	NA	
Protected Phases		3			3		1	6		5	2	
Permitted Phases	3			3			6			2		

Lanes, Volumes, Timings
15: RT 20 & Driveway/Howard Road

2018 AM with project
2/6/2015

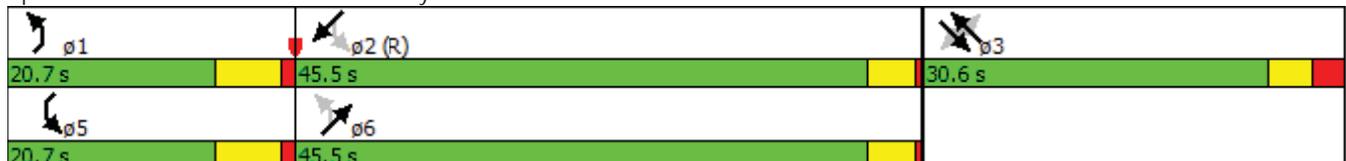


Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Detector Phase	3	3		3	3		1	6		5	2	
Switch Phase												
Minimum Initial (s)	6.0	6.0		6.0	6.0		6.0	20.0		6.0	20.0	
Minimum Split (s)	11.6	11.6		11.6	11.6		11.7	25.5		11.7	25.5	
Total Split (s)	30.6	30.6		30.6	30.6		20.7	45.5		20.7	45.5	
Total Split (%)	31.6%	31.6%		31.6%	31.6%		21.4%	47.0%		21.4%	47.0%	
Maximum Green (s)	25.0	25.0		25.0	25.0		15.0	41.5		15.0	41.5	
Yellow Time (s)	3.2	3.2		3.2	3.2		4.7	3.5		4.7	3.5	
All-Red Time (s)	2.4	2.4		2.4	2.4		1.0	0.5		1.0	0.5	
Lost Time Adjust (s)		0.0			0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		5.6			5.6		5.7	4.0		5.7	4.0	
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	Min		None	C-Min	
Walk Time (s)								5.0			5.0	
Flash Dont Walk (s)								11.0			11.0	
Pedestrian Calls (#/hr)								0			0	
Act Effct Green (s)		19.2					66.3	68.0			57.8	
Actuated g/C Ratio		0.20					0.68	0.70			0.60	
v/c Ratio		0.80					0.09	0.29			0.23	
Control Delay		42.9					7.1	6.6			10.8	
Queue Delay		0.0					0.0	0.0			0.0	
Total Delay		42.9					7.1	6.6			10.8	
LOS		D					A	A			B	
Approach Delay		42.9						6.6			10.8	
Approach LOS		D						A			B	

Intersection Summary

Area Type: Other
 Cycle Length: 96.8
 Actuated Cycle Length: 96.8
 Offset: 8 (8%), Referenced to phase 2:SWTL, Start of Green
 Natural Cycle: 55
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.80
 Intersection Signal Delay: 14.4
 Intersection Capacity Utilization 47.1%
 Analysis Period (min) 15
 Intersection LOS: B
 ICU Level of Service A

Splits and Phases: 15: RT 20 & Driveway/Howard Road



Lanes, Volumes, Timings
17: Howard Road & South Drive

2018 AM with project
2/6/2015



Lane Group	WBL	WBR	SEL	SET	NWT	NWR
Lane Configurations						
Volume (vph)	25	9	10	192	63	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.964				0.994	
Flt Protected	0.965			0.998		
Satd. Flow (prot)	1733	0	0	1859	1852	0
Flt Permitted	0.965			0.998		
Satd. Flow (perm)	1733	0	0	1859	1852	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	230			484	505	
Travel Time (s)	5.2			11.0	11.5	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	27	10	11	209	68	3
Shared Lane Traffic (%)						
Lane Group Flow (vph)	37	0	0	220	71	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	12			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9	15			9
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	27.3%
ICU Level of Service	A
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis
 17: Howard Road & South Drive

2018 AM with project
 2/6/2015



Movement	WBL	WBR	SEL	SET	NWT	NWR
Lane Configurations						
Volume (veh/h)	25	9	10	192	63	3
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	27	10	11	209	68	3
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)					505	
pX, platoon unblocked						
vC, conflicting volume	301	70	72			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	301	70	72			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	96	99	99			
cM capacity (veh/h)	686	993	1528			
Direction, Lane #	WB 1	SE 1	NW 1			
Volume Total	37	220	72			
Volume Left	27	11	0			
Volume Right	10	0	3			
cSH	747	1528	1700			
Volume to Capacity	0.05	0.01	0.04			
Queue Length 95th (ft)	4	1	0			
Control Delay (s)	10.1	0.4	0.0			
Lane LOS	B	A				
Approach Delay (s)	10.1	0.4	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			1.4			
Intersection Capacity Utilization		27.3%		ICU Level of Service		A
Analysis Period (min)			15			

Lanes, Volumes, Timings
 19: Howard Road & North Drive

2018 AM with project
 2/6/2015



Lane Group	WBL	WBR	SEL	SET	NWT	NWR
Lane Configurations						
Volume (vph)	51	20	12	149	63	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.961				0.987	
Flt Protected	0.966			0.996		
Satd. Flow (prot)	1729	0	0	1855	1839	0
Flt Permitted	0.966			0.996		
Satd. Flow (perm)	1729	0	0	1855	1839	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	149			204	484	
Travel Time (s)	3.4			4.6	11.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	55	22	13	162	68	7
Shared Lane Traffic (%)						
Lane Group Flow (vph)	77	0	0	175	75	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	12			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9	15			9
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	25.9%
Analysis Period (min)	15
	ICU Level of Service A

HCM Unsignalized Intersection Capacity Analysis
 19: Howard Road & North Drive

2018 AM with project
 2/6/2015



Movement	WBL	WBR	SEL	SET	NWT	NWR
Lane Configurations						
Volume (veh/h)	51	20	12	149	63	6
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	55	22	13	162	68	7
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)						989
pX, platoon unblocked						
vC, conflicting volume	260	72	75			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	260	72	75			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	92	98	99			
cM capacity (veh/h)	723	991	1524			
Direction, Lane #	WB 1	SE 1	NW 1			
Volume Total	77	175	75			
Volume Left	55	13	0			
Volume Right	22	0	7			
cSH	782	1524	1700			
Volume to Capacity	0.10	0.01	0.04			
Queue Length 95th (ft)	8	1	0			
Control Delay (s)	10.1	0.6	0.0			
Lane LOS	B	A				
Approach Delay (s)	10.1	0.6	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			2.7			
Intersection Capacity Utilization			25.9%	ICU Level of Service	A	
Analysis Period (min)			15			

Lanes, Volumes, Timings
26: Heatherwood Dr & Howard Road

2018 AM with project
2/6/2015



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (vph)	7	88	6	5	144	1	25	2	7	6	1	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.983			0.997			0.972			0.889	
Flt Protected		0.995			0.998			0.969			0.993	
Satd. Flow (prot)	0	1737	0	0	1822	0	0	1672	0	0	1607	0
Flt Permitted		0.995			0.998			0.969			0.993	
Satd. Flow (perm)	0	1737	0	0	1822	0	0	1672	0	0	1607	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		267			683			189			295	
Travel Time (s)		6.1			15.5			4.3			6.7	
Confl. Peds. (#/hr)												1
Peak Hour Factor	0.58	0.89	0.38	0.63	0.76	0.25	0.67	0.25	0.58	0.50	0.25	0.44
Heavy Vehicles (%)	0%	9%	0%	0%	4%	0%	0%	50%	0%	0%	100%	0%
Adj. Flow (vph)	12	99	16	8	189	4	37	8	12	12	4	75
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	127	0	0	201	0	0	57	0	0	91	0
Enter Blocked Intersection	No	No	No									
Lane Alignment	Left	Left	Right									
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	22.4%
Analysis Period (min)	15
	ICU Level of Service A

HCM Unsignalized Intersection Capacity Analysis
26: Heatherwood Dr & Howard Road

2018 AM with project
2/6/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	7	88	6	5	144	1	25	2	7	6	1	33
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.58	0.89	0.38	0.63	0.76	0.25	0.67	0.25	0.58	0.50	0.25	0.44
Hourly flow rate (vph)	12	99	16	8	189	4	37	8	12	12	4	75
Pedestrians		1										
Lane Width (ft)		12.0										
Walking Speed (ft/s)		4.0										
Percent Blockage		0										
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	193			115			416	340	107	354	346	192
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	193			115			416	340	107	354	346	192
tC, single (s)	4.1			4.1			7.1	7.0	6.2	7.1	7.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.5	3.3	3.5	4.9	3.3
p0 queue free %	99			99			92	98	99	98	99	91
cM capacity (veh/h)	1392			1487			493	504	953	583	442	854

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	127	201	57	91
Volume Left	12	8	37	12
Volume Right	16	4	12	75
cSH	1392	1487	550	774
Volume to Capacity	0.01	0.01	0.10	0.12
Queue Length 95th (ft)	1	0	9	10
Control Delay (s)	0.8	0.3	12.3	10.3
Lane LOS	A	A	B	B
Approach Delay (s)	0.8	0.3	12.3	10.3
Approach LOS			B	B

Intersection Summary			
Average Delay		3.8	
Intersection Capacity Utilization	22.4%		ICU Level of Service
Analysis Period (min)		15	A

Lanes, Volumes, Timings
3: Camp Road & Queens Lane/Howard Road

2018 PM with project
2/6/2015



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	16	0	7	49	0	155	2	1048	20	68	353	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	100		0	100		0	150		0	150		0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (ft)	50			50			50			50		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.850			0.850			0.997				0.992
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1703	1369	0	1805	1538	0	1805	3521	0	1556	3316	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1703	1369	0	1805	1538	0	1805	3521	0	1556	3316	0
Link Speed (mph)		30			30			45			45	
Link Distance (ft)		267			461			1034			607	
Travel Time (s)		6.1			10.5			15.7			9.2	
Peak Hour Factor	0.80	0.92	0.53	0.86	0.92	0.77	0.50	0.97	0.94	0.73	0.84	0.29
Heavy Vehicles (%)	6%	0%	18%	0%	0%	5%	0%	2%	13%	16%	6%	43%
Adj. Flow (vph)	20	0	13	57	0	201	4	1080	21	93	420	24
Shared Lane Traffic (%)												
Lane Group Flow (vph)	20	13	0	57	201	0	4	1101	0	93	444	0
Enter Blocked Intersection	No	No	No									
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane								Yes			Yes	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	56.7%
ICU Level of Service	B
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis

3: Camp Road & Queens Lane/Howard Road

2018 PM with project
2/6/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	16	0	7	49	0	155	2	1048	20	68	353	7
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.80	0.92	0.53	0.86	0.92	0.77	0.50	0.97	0.94	0.73	0.84	0.29
Hourly flow rate (vph)	20	0	13	57	0	201	4	1080	21	93	420	24
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								TWTL			TWTL	
Median storage (veh)								2			2	
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1368	1728	222	1509	1730	551	444			1102		
vC1, stage 1 conf vol	619	619		1099	1099							
vC2, stage 2 conf vol	750	1110		410	631							
vCu, unblocked vol	1368	1728	222	1509	1730	551	444			1102		
tC, single (s)	7.6	6.5	7.3	7.5	6.5	7.0	4.1			4.4		
tC, 2 stage (s)	6.6	5.5		6.5	5.5							
tF (s)	3.6	4.0	3.5	3.5	4.0	3.3	2.2			2.4		
p0 queue free %	81	100	98	73	100	57	100			83		
cM capacity (veh/h)	108	178	734	209	238	471	1126			554		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3		
Volume Total	20	13	57	201	4	720	381	93	280	164		
Volume Left	20	0	57	0	4	0	0	93	0	0		
Volume Right	0	13	0	201	0	0	21	0	0	24		
cSH	108	734	209	471	1126	1700	1700	554	1700	1700		
Volume to Capacity	0.19	0.02	0.27	0.43	0.00	0.42	0.22	0.17	0.16	0.10		
Queue Length 95th (ft)	16	1	27	53	0	0	0	15	0	0		
Control Delay (s)	45.8	10.0	28.5	18.2	8.2	0.0	0.0	12.8	0.0	0.0		
Lane LOS	E	A	D	C	A			B				
Approach Delay (s)	31.5		20.5		0.0			2.2				
Approach LOS	D		C									
Intersection Summary												
Average Delay			3.9									
Intersection Capacity Utilization			56.7%		ICU Level of Service				B			
Analysis Period (min)			15									

Lanes, Volumes, Timings
9: Cumberland Ln/Deerfield & Howard Road

2018 PM with project
2/6/2015



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (vph)	28	127	4	5	116	13	2	0	4	8	2	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.995			0.972			0.910			0.942	
Flt Protected		0.991			0.997			0.984			0.979	
Satd. Flow (prot)	0	1873	0	0	1841	0	0	1701	0	0	1752	0
Flt Permitted		0.991			0.997			0.984			0.979	
Satd. Flow (perm)	0	1873	0	0	1841	0	0	1701	0	0	1752	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		683			1025			314			333	
Travel Time (s)		15.5			23.3			7.1			7.6	
Confl. Peds. (#/hr)	4											2
Peak Hour Factor	0.68	0.73	0.50	0.42	0.85	0.33	0.50	0.25	0.50	0.67	0.50	0.64
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	41	174	8	12	136	39	4	0	8	12	4	13
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	223	0	0	187	0	0	12	0	0	28	0
Enter Blocked Intersection	No	No	No									
Lane Alignment	Left	Left	Right									
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	29.6%
Analysis Period (min)	15
	ICU Level of Service A

HCM Unsignalized Intersection Capacity Analysis
 9: Cumberland Ln/Deerfield & Howard Road

2018 PM with project
 2/6/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	28	127	4	5	116	13	2	0	4	8	2	8
Peak Hour Factor	0.68	0.73	0.50	0.42	0.85	0.33	0.50	0.25	0.50	0.67	0.50	0.64
Hourly flow rate (vph)	41	174	8	12	136	39	4	0	8	12	4	12
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	223	188	12	28								
Volume Left (vph)	41	12	4	12								
Volume Right (vph)	8	39	8	13								
Hadj (s)	0.02	-0.11	-0.33	-0.18								
Departure Headway (s)	4.2	4.1	4.5	4.6								
Degree Utilization, x	0.26	0.21	0.01	0.04								
Capacity (veh/h)	842	860	728	706								
Control Delay (s)	8.7	8.2	7.6	7.8								
Approach Delay (s)	8.7	8.2	7.6	7.8								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.4									
Level of Service			A									
Intersection Capacity Utilization			29.6%	ICU Level of Service	A							
Analysis Period (min)			15									

Lanes, Volumes, Timings
 10: Howard Road & Roundtree Road

2018 PM with project
 2/6/2015



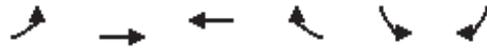
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	16	92	112	54	42	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.937		0.979	
Flt Protected		0.989			0.960	
Satd. Flow (prot)	0	1842	1537	0	1666	0
Flt Permitted		0.989			0.960	
Satd. Flow (perm)	0	1842	1537	0	1666	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		1025	389		305	
Travel Time (s)		23.3	8.8		6.9	
Peak Hour Factor	0.50	0.83	0.84	0.47	0.88	0.80
Heavy Vehicles (%)	2%	2%	14%	18%	5%	19%
Adj. Flow (vph)	32	111	133	115	48	9
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	143	248	0	57	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		0	0		12	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15			9	15	9
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	28.2%
Analysis Period (min)	15
	ICU Level of Service A

HCM Unsignalized Intersection Capacity Analysis
 10: Howard Road & Roundtree Road

2018 PM with project
 2/6/2015



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	16	92	112	54	42	7
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.50	0.83	0.84	0.47	0.88	0.80
Hourly flow rate (vph)	32	111	133	115	48	9
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	248				366	191
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	248				366	191
tC, single (s)	4.1				6.4	6.4
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.5
p0 queue free %	98				92	99
cM capacity (veh/h)	1318				613	809

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	143	248	56
Volume Left	32	0	48
Volume Right	0	115	9
cSH	1318	1700	637
Volume to Capacity	0.02	0.15	0.09
Queue Length 95th (ft)	2	0	7
Control Delay (s)	1.9	0.0	11.2
Lane LOS	A		B
Approach Delay (s)	1.9	0.0	11.2
Approach LOS			B

Intersection Summary			
Average Delay		2.0	
Intersection Capacity Utilization		28.2%	ICU Level of Service A
Analysis Period (min)		15	

Lanes, Volumes, Timings
 12: Howard Road & South Drive

2018 PM with project
 2/6/2015



Lane Group	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations						
Volume (vph)	11	121	164	27	6	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.981		0.904	
Flt Protected		0.996			0.986	
Satd. Flow (prot)	0	1855	1827	0	1660	0
Flt Permitted		0.996			0.986	
Satd. Flow (perm)	0	1855	1827	0	1660	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		513	489		179	
Travel Time (s)		11.7	11.1		4.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	12	132	178	29	7	17
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	144	207	0	24	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		0	0		12	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15			9	15	9
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	25.5%
Analysis Period (min)	15
	ICU Level of Service A

HCM Unsignalized Intersection Capacity Analysis
 12: Howard Road & South Drive

2018 PM with project
 2/6/2015



Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations						
Volume (veh/h)	11	121	164	27	6	16
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	12	132	178	29	7	17
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)			489			
pX, platoon unblocked						
vC, conflicting volume	208				348	193
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	208				348	193
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				99	98
cM capacity (veh/h)	1363				643	849

Direction, Lane #	SE 1	NW 1	SW 1
Volume Total	143	208	24
Volume Left	12	0	7
Volume Right	0	29	17
cSH	1363	1700	781
Volume to Capacity	0.01	0.12	0.03
Queue Length 95th (ft)	1	0	2
Control Delay (s)	0.7	0.0	9.8
Lane LOS	A		A
Approach Delay (s)	0.7	0.0	9.8
Approach LOS			A

Intersection Summary			
Average Delay		0.9	
Intersection Capacity Utilization		25.5%	ICU Level of Service
Analysis Period (min)		15	A

Lanes, Volumes, Timings
15: RT 20 & Driveway/Howard Road

2018 PM with project
2/6/2015



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations		↕			↕		↕	↕↔		↕	↕↔	
Volume (vph)	112	0	53	0	0	0	52	602	0	0	378	103
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	100		0	100		0
Storage Lanes	0		0	0		0	1		0	1		0
Taper Length (ft)	25			25			50			50		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.956									0.963	
Flt Protected		0.967					0.950					
Satd. Flow (prot)	0	1673	0	0	1863	0	1641	3505	0	1863	3310	0
Flt Permitted		0.797					0.406					
Satd. Flow (perm)	0	1379	0	0	1863	0	701	3505	0	1863	3310	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		76										56
Link Speed (mph)		30			30			45				45
Link Distance (ft)		489			175			642				812
Travel Time (s)		11.1			4.0			9.7				12.3
Peak Hour Factor	0.83	0.92	0.82	0.92	0.92	0.92	0.63	0.85	0.92	0.92	0.97	0.82
Heavy Vehicles (%)	4%	2%	7%	2%	2%	2%	10%	3%	2%	2%	6%	2%
Adj. Flow (vph)	135	0	65	0	0	0	83	708	0	0	390	126
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	200	0	0	0	0	83	708	0	0	516	0
Enter Blocked Intersection	No											
Lane Alignment	Left	Left	Right									
Median Width(ft)		0			0			12				12
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane								Yes				Yes
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru										
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex										
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA					pm+pt	NA		pm+pt	NA	
Protected Phases		3			3		1	6		5	2	
Permitted Phases	3			3			6			2		

Lanes, Volumes, Timings
15: RT 20 & Driveway/Howard Road

2018 PM with project
2/6/2015



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Detector Phase	3	3		3	3		1	6		5	2	
Switch Phase												
Minimum Initial (s)	6.0	6.0		6.0	6.0		6.0	20.0		6.0	20.0	
Minimum Split (s)	11.6	11.6		11.6	11.6		11.7	25.5		11.7	25.5	
Total Split (s)	30.6	30.6		30.6	30.6		20.7	45.5		20.7	45.5	
Total Split (%)	31.6%	31.6%		31.6%	31.6%		21.4%	47.0%		21.4%	47.0%	
Maximum Green (s)	25.0	25.0		25.0	25.0		15.0	41.5		15.0	41.5	
Yellow Time (s)	3.2	3.2		3.2	3.2		4.7	3.5		4.7	3.5	
All-Red Time (s)	2.4	2.4		2.4	2.4		1.0	0.5		1.0	0.5	
Lost Time Adjust (s)		0.0			0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		5.6			5.6		5.7	4.0		5.7	4.0	
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	Min		None	C-Min	
Walk Time (s)								5.0			5.0	
Flash Dont Walk (s)								11.0			11.0	
Pedestrian Calls (#/hr)								0			0	
Act Effct Green (s)		14.5					71.0	72.7			62.2	
Actuated g/C Ratio		0.15					0.73	0.75			0.64	
v/c Ratio		0.74					0.14	0.27			0.24	
Control Delay		39.5					5.3	4.7			8.4	
Queue Delay		0.0					0.0	0.0			0.0	
Total Delay		39.5					5.3	4.7			8.4	
LOS		D					A	A			A	
Approach Delay		39.5						4.7			8.4	
Approach LOS		D						A			A	

Intersection Summary

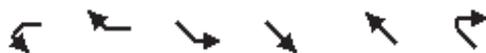
Area Type: Other
 Cycle Length: 96.8
 Actuated Cycle Length: 96.8
 Offset: 8 (8%), Referenced to phase 2:SWTL, Start of Green
 Natural Cycle: 50
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.74
 Intersection Signal Delay: 10.6
 Intersection LOS: B
 Intersection Capacity Utilization 43.9%
 ICU Level of Service A
 Analysis Period (min) 15

Splits and Phases: 15: RT 20 & Driveway/Howard Road



Lanes, Volumes, Timings
18: Howard Road & North Drive

2018 PM with project
2/6/2015



Lane Group	WBL	WBR	SEL	SET	NWT	NWR
Lane Configurations						
Volume (vph)	14	27	24	110	139	49
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.911				0.965	
Flt Protected	0.983			0.991		
Satd. Flow (prot)	1668	0	0	1846	1798	0
Flt Permitted	0.983			0.991		
Satd. Flow (perm)	1668	0	0	1846	1798	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	169			190	513	
Travel Time (s)	3.8			4.3	11.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	15	29	26	120	151	53
Shared Lane Traffic (%)						
Lane Group Flow (vph)	44	0	0	146	204	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	12			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9	15			9
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	30.7%
Analysis Period (min)	15
	ICU Level of Service A

HCM Unsignalized Intersection Capacity Analysis
 18: Howard Road & North Drive

2018 PM with project
 2/6/2015



Movement	WBL	WBR	SEL	SET	NWT	NWR
Lane Configurations						
Volume (veh/h)	14	27	24	110	139	49
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	15	29	26	120	151	53
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)						1002
pX, platoon unblocked						
vC, conflicting volume	349	178	204			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	349	178	204			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	97	98			
cM capacity (veh/h)	635	865	1367			
Direction, Lane #	WB 1	SE 1	NW 1			
Volume Total	45	146	204			
Volume Left	15	26	0			
Volume Right	29	0	53			
cSH	770	1367	1700			
Volume to Capacity	0.06	0.02	0.12			
Queue Length 95th (ft)	5	1	0			
Control Delay (s)	10.0	1.5	0.0			
Lane LOS	A	A				
Approach Delay (s)	10.0	1.5	0.0			
Approach LOS	A					
Intersection Summary						
Average Delay			1.7			
Intersection Capacity Utilization			30.7%	ICU Level of Service	A	
Analysis Period (min)			15			

Lanes, Volumes, Timings
26: Heatherwood Dr & Howard Road

2018 PM with project
2/6/2015



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (vph)	23	161	12	2	119	9	9	1	7	9	0	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.988			0.991			0.955			0.925	
Flt Protected		0.994			0.998			0.973			0.978	
Satd. Flow (prot)	0	1866	0	0	1879	0	0	1766	0	0	1719	0
Flt Permitted		0.994			0.998			0.973			0.978	
Satd. Flow (perm)	0	1866	0	0	1879	0	0	1766	0	0	1719	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		267			683			189			295	
Travel Time (s)		6.1			15.5			4.3			6.7	
Confl. Peds. (#/hr)	1								3			2
Peak Hour Factor	0.79	0.77	0.50	0.25	0.77	0.75	0.45	0.25	0.58	0.56	0.25	0.45
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	29	209	24	8	155	12	20	4	12	16	0	20
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	262	0	0	175	0	0	36	0	0	36	0
Enter Blocked Intersection	No	No	No									
Lane Alignment	Left	Left	Right									
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	31.7%
Analysis Period (min)	15
	ICU Level of Service A

HCM Unsignalized Intersection Capacity Analysis
 26: Heatherwood Dr & Howard Road

2018 PM with project
 2/6/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Volume (veh/h)	23	161	12	2	119	9	9	1	7	9	0	9
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.79	0.77	0.50	0.25	0.77	0.75	0.45	0.25	0.58	0.56	0.25	0.45
Hourly flow rate (vph)	29	209	24	8	155	12	20	4	12	16	0	20
Pedestrians		2			3						1	
Lane Width (ft)		12.0			12.0						12.0	
Walking Speed (ft/s)		4.0			4.0						4.0	
Percent Blockage		0			0						0	
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	168			233			478	463	224	474	469	164
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	168			233			478	463	224	474	469	164
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			99			96	99	99	97	100	98
cM capacity (veh/h)	1421			1346			479	486	818	482	482	884

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	262	175	36	36
Volume Left	29	8	20	16
Volume Right	24	12	12	20
cSH	1421	1346	557	644
Volume to Capacity	0.02	0.01	0.06	0.06
Queue Length 95th (ft)	2	0	5	4
Control Delay (s)	1.0	0.4	11.9	10.9
Lane LOS	A	A	B	B
Approach Delay (s)	1.0	0.4	11.9	10.9
Approach LOS			B	B

Intersection Summary			
Average Delay		2.3	
Intersection Capacity Utilization		31.7%	ICU Level of Service A
Analysis Period (min)		15	