

# LIBERTY TREE ACADEMY TRAFFIC IMPACT STUDY

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*Prepared for:*

**Liberty Tree Academy Building Corporation**

*Prepared by:*



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Denver, Colorado 80202

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*On Behalf of:*

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**Project Number: PPR-18-023**

**Final  
August 9, 2018**

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**Traffic Engineer's Statement**

The attached traffic report and supporting information were prepared under my responsible charge and they comport with the standard of care. So far as is consistent with the standard of care, said report was prepared in general conformance with the criteria established by the County for traffic reports.



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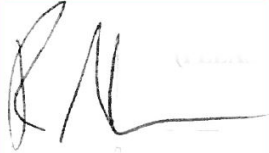
*David Robert Kline, P.E. #24520*

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Date

**Developer's Statement**

I, the Developer, have read and will comply with all commitments made on my behalf within this report.



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*Ronnie Wilson, Vice-President  
Liberty Tree Academy Building Corporation  
PO Box 64614  
Colorado Springs, CO 80962*

8/9/2018

Date

## Introduction

The Liberty Tree Academy is a proposed private school with an initial kindergarten through 8<sup>th</sup> grade enrollment of 540 student in one building on approximately 4 acres of undeveloped land. For the purposes of this Traffic Impact Study (TIS) the project is assumed to be fully built-out in 2019. In the long-range condition, the school may be expanded to include high school enrollment, but this condition is uncertain and is not included in this TIS. The purpose of this TIS is to assess the effects the site traffic has on the intersection serving the site in 1) the short range condition with 540 students, and 2) the long-range condition, 2040, with the same student enrollment. The remaining site, north of the school, may be developed to include an alternate use, but due to development uncertainty is not included in this TIS.

The proposed site is bounded on the north by Eastonville Road and the eastern property line, on the east by undeveloped property, on the south by a residential property, and on the west by Eastonville Road. Figure 1 depicts the location of the site.

## Project Description

Liberty Tree Academy is proposed as a single two-story building and includes administrative offices, class rooms, gymnasium, warming kitchen, and ancillary rooms. The building area is 39,676 square feet. Adjacent to and south of the building is a fenced play area for younger aged children. Exterior to the building the facility includes a circular one-way drive aisle, with a near side drop off lane. Parking is located along the west and north portion of the site. Pedestrians are accommodated with sidewalks and curb ramps. Bicyclists share the drive aisle. (In the future, an attached building with an additional 11, 640 square feet of class rooms is proposed. With this addition the total building area would be 51,316 square feet. This total building area is not included in this TIS).

Access to the Site is proposed through one primary location at the existing Eastonville Road/Motley Road intersection. Eastonville Road is planned as an urban minor arterial roadway. Motley Road is a local street. The existing intersection is configured as a “T” which will be modified to a four-leg intersection, with stop control on the side street. Figure 2 shows the proposed access locations and internal drive aisle and circulation.

Figure 1 – Vicinity Map

Figure 2 – Site Plan

## Existing Traffic Conditions

### Roadway Network

The existing Eastonville Road is classified as an urban minor arterial roadway with an existing right of way (ROW) width of 80 feet with and an ultimate ROW of 100 feet. Motley Road is a local street with a ROW of 60 feet. The existing intersection configuration is described below:

#### Eastonville Road/Motley Road

Eastonville Road and Motley Road are paved roadways with curb and gutter. Motley Road is stop controlled. The existing intersection geometry at the Eastonville Road and Motley Road intersection includes:

- Northbound, striped center two way turn lane, and one through lane, and no right turn lane.
- Southbound, striped center two way turn lane, and one through lane, and one right turn lane.
- Eastbound, shared right/left turn lane.

#### Eastonville Road/Judd Orr Road

Eastonville Road and Meridan/Judd Orr Road are paved roadways with curb and gutter. East of the intersection Judd Orr Road the south curb and gutter discontinues. The intersection is all-way stop controlled. The existing intersection geometry at the Eastonville Road and Meridan/Judd Orr Road intersection includes:

- Northbound, one striped left turn lane, one shared through/right turn lane, and no right turn lane.
- Southbound, one striped left turn lane, one shared through/right turn lane, and no right turn lane.
- Westbound, one striped left turn lane, one through lane, and an exclusive right turn lane.
- Eastbound, one striped left turn lane, one shared through/right turn lane, and no right turn lane.



***Eastonville Road/Stapleton Drive***

Eastonville Road and Stapleton Drive are paved roadway without curb and gutter, however the existing eastbound approach has curb and gutter. The intersection is stop controlled on the eastbound and westbound approaches. The existing intersection geometry at the Eastonville Road and Stapleton Drive intersection includes.

- Northbound, shared left/through/right turn lane.
- Southbound, shared left/through/right turn lane.
- Westbound, one striped left turn lane, one shared through/right turn lane, and one right turn lane.
- Eastbound, one striped left turn lane, one shared through/right turn lane, and one right turn lane.

**Traffic Volumes**

Traffic counts were conducted for the intersection of Eastonville Road/Motley Road on Wednesday, April 11, 2018 which reflects traffic pattern associated with school being in session. Per County request subsequent traffic count were conducted at the Eastonville Road/Judd Orr Road, and Eastonville Road/Stapleton Drive intersections. Figure 3 shows both AM and PM peak hour intersection turning movement counts. Appendix A contains the raw traffic count data. The AM peak hour generally occurs between 7:00 and 8:00 AM. The PM peak hour generally occurs between 4:45 and 5:45 PM.

**Intersection and Roadway Capacity Analysis**

For unsignalized (side-street stop controlled) intersections, Synchro 9 software was used. The software applies the Transportation Research Board’s 2010 *Highway Capacity Manual* (HCM) methodology for unsignalized intersections to determine average control delay per vehicle (measured in seconds) for each stop-controlled movement. The method incorporates delay associated with deceleration, acceleration, stopping, and moving up in the queue. For side street stop-controlled intersections, delay is represented as the average delay per vehicle for the worst approach, not the overall intersection. Table 1 summarizes the relationship between delay and level of service.

**Table 1 – Unsignalized Intersection Level of Service Criteria**

Level of Service	Average Total Delay (seconds per vehicle)	Description
A	< 10	Little or no conflicting traffic for minor street approach.
B	>10 to 15	Minor street begins to notice absence of available gaps.
C	>15 to 25	Minor street begins experiencing delay for available gaps.
D	>25 to 35	Minor street starts to experience queuing.
E	>35 to 50	Extensive minor street queuing due to insufficient gaps.
F	> 50	Insufficient gaps to allow minor street traffic to cross safely through the major street traffic stream.

Source: HCM2010 *Highway Capacity Manual* (Transportation Research Board, 2010)

Table 2 presents the existing 2018 intersection levels of service (LOS). As presented, the Eastonville Road/Motley Road, Eastonville Road/Judd Orr Road, and Eastonville Road/Stapleton Drive intersections currently operates well with an overall LOS of B or better in both the AM and PM peak hour.

**Table 2 – 2018 Existing Traffic Level of Service**

<b>Intersection</b>	<b>Control</b>	<b>AM LOS</b>	<b>PM LOS</b>
<b>Eastonville Rd/Motley Rd</b>	Un-signalized		
-Eastbound Left/Right	Stop	A	A
-Northbound Left	Free	A	A
-Northbound Thru	Free	A	A
-Southbound Thru/Right	Free	A	A
<b>Eastonville Rd/Judge Orr Rd</b>	Un-signalized	<b>A</b>	<b>A</b>
-Eastbound Left	Stop	A	A
-Eastbound Thru/Right	Stop	A	A
-Westbound Left	Stop	A	A
-Westbound Thru	Stop	A	A
-Westbound Right	Stop	A	A
-Northbound Left	Stop	A	B
-Northbound Thru/Right	Stop	A	A
-Southbound Left	Stop	A	A
-Southbound Thru/Right	Stop	A	A
<b>Eastonville Rd/Stapleton Dr</b>	Un-signalized		
-Eastbound Left/Thru/Right	Stop	B	B
-Westbound Left	Stop	B	B
-Westbound Thru/Right	Stop	B	B
-Northbound Left/Thru/Right	Free	A	A
-Southbound Left/Thru/Right	Free	A	A

Figure 3 – Existing AM and PM Traffic Volumes

## Future Traffic

### Future Background Traffic

Future background traffic is intended to show how existing volumes are expected to grow over time without the proposed development. The background traffic is established based on the adjacent US 24 highway growth rate since the two facilities are in the vicinity to each other and parallel. Colorado Department of Transportation performs regional forecast modeling and publishes them on their website. In the case of US24 the annual growth rate of 1.5% per year is anticipated and is therefore assumed as the traffic background rate for Eastonville Road, Judge Orr Road and Stapleton Drive.

### Trip Generation

The vehicle trips associated with a private school are calculated using the *ITE Trip Generation Manual, Tenth Edition*. This methodology consists of choosing an independent variable for the land use for a particular time of day. The independent variable correlates to the variation in trip ends and is related to the land use. The value of the independent variable is either multiplied by a weighted average or used in a regression equation to calculate the trips generated by the land use. The *ITE Trip Generation Manual* provides guidance on when to use the weighted average versus the regression equation. In most cases, the regression equations are recommended when there are adequate study data points.

ITE Trip Generation Code 534, Private School (K-8) is used since it most closely represents the Liberty Tree Academy. As a K-8 school sagged start times are proposed. Current enrollment indicates that 67 percentage of students have siblings therefore participating in carpooling, so the trip generation established through ITE may be conservative. An affordable school bus program is available through the School District. For the purpose of this study trip reduction is not considered for student walking, carpooling or bus service.

**Table 3 – Trip Generation**

Land Use – ITE Code 534	Variable Student	AM Peak			PM Peak*			Daily		
		Total	In	Out	Total	In	Out	Total	In	Out
<b>Private School (K-8)</b>	540	491	270	221	140	64	76	2,219	1,110	1,109

\*PM peak hour of adjacent street traffic.

### Trip Distribution

The site generated trips are assigned to the roadway network based on existing counts and the external trip distribution assumptions. Since the site access is through the Eastonville Rd/Motley Rd intersection site trips are distributed predominately to/from Eastonville Road with a smaller percentage to/from the west, which serves the adjacent residential area. As a north/south minor arterial roadway Eastonville Road is anticipated to accommodate 95% of the total site trips, with 50% to/from the south, and 45% to/from the north. Motley Road is anticipated to accommodate 5% of the site generated trips. Figure 3 and Figure 5 shows the percentage of trips that will be traveling along the roadway network.

## 2019 Short Range Traffic Analysis

Synchro 9 software is a traffic modeling software that analyzes intersections based on a variety of variable. The variables are used to calibrate/customize the model to better reflect site specific conditions. One variable “Peak Hour Factor (PHF)” assigns traffic to the intersection based on traffic intensity. Since schools typically have a very intense traffic pattern the PHF was modified to reflect arrival and departure time. (PHF was changed from the standard 0.92 to 0.5 which better reflects the school traffic pattern).

In addition to considering the school traffic intensity in the Synchro analysis, information presented in the Municipal School Transportation Assistance (MSTA) was considered. The state of North Carolina prepared this research study and found that the school traffic vehicular queue lengths should be considered since insufficient internal circulation pattern, loading area, and parking can create traffic flow problems. Traffic queue analysis is presented in the following sections.

### Transportation Improvements

The proposed roadway improvements at the Eastonville Road/Motley Road intersection include the addition of a westbound approach with one entering lane and two exiting lanes (one shared left/thru lane and one right turn lane). The intersection lane configuration is presented below:

- Northbound – Left Turn Lane, Shared Thru/Right Turn Lane
- Southbound – Left Turn Lane, Shared Thru/Right Turn Lane
- Eastbound – Shared Right/Thu/Left Turn Lane
- Westbound – Shared Thu/Left Turn Lane, Right Turn Lane

No existing sidewalks along Easton Road and vicinity intersecting roadways exists. To serve pedestrian Eastonville Road is proposed to include detached sidewalks and intersection cross walks in its ultimate configuration. Right-Of-Way is being dedicated to accommodate the ultimate typical section, and sidewalk adjacent to the proposed constructed portion of the site will be installed for pedestrian use. Extension to the north will occur with the high school expansion and or the north property development. Liberty Tree Academy will supply crossing guards at the Eastonville Rd/Motley Road to help students cross Eastonville Rd. In addition, the site includes accommodation for pedestrians.

### Total Traffic

The existing traffic plus the background growth is added to the proposed 2019 developed traffic volumes to establish 2019 total traffic. Figure 4 shows the 2019 total volumes for both the AM and PM peak periods.

### Level of Service Analysis

To determine how efficiently and effectively the roadway system and intersection accommodates the short-range future traffic volumes, the intersection serving the

development was analyzed using Synchro 9 software. Table 4 presents the results by time period. Appendix C contains the 2019 total traffic analysis output for the appropriate intersection control condition.

**Table 4 – 2019 Total Traffic Level of Service**

Intersection	Control	AM LOS	AM Queue	PM LOS	PM Queue
<b>Eastonville Rd/Motley Rd</b>	Un-signalized				
-Eastbound Left/Thru/Right	Stop	C	8	B	0
-Westbound Left/Thru	Stop	F	298	B	12
-Westbound Right	Stop	B	22	A	6
-Northbound Left	Free	A	0	A	0
-Northbound Thru/Right	Free	A	0	A	0
-Southbound Left	Free	A	16	A	2
-Southbound Thru/Right	Free	A	0	A	0
<b>Eastonville Rd/Judge Orr Rd</b>	Un-signalized	<b>B</b>		<b>A</b>	
-Eastbound Left	Stop	A	0	A	0
-Eastbound Thru/Right	Stop	B	36	A	14
-Westbound Left	Stop	A	2	A	6
-Westbound Thru	Stop	A	2	B	14
-Westbound Right	Stop	A	12	A	4
-Northbound Left	Stop	A	2	B	12
-Northbound Thru/Right	Stop	B	14	B	18
-Southbound Left	Stop	B	8	A	2
-Southbound Thru/Right	Stop	B	20	A	10
<b>Eastonville Rd/Stapleton Dr</b>	Un-signalized				
-Eastbound Left/Thru/Right	Stop	C	20	B	10
-Westbound Left	Stop	C	8	B	2
-Westbound Thru/Right	Stop	B	8	B	30
-Northbound Left/Thru/Right	Free	A	0	A	0
-Southbound Left/Thru/Right	Free	A	4	A	2

As presented in Table 4, with short range improvements, the overall intersections are expected to perform well and meet established performance standards at 2019 short range condition, except for the westbound left/through lane, which operates at LOS F. When turning movements are anticipated to operate at LOS F, queue length, and delay are also studied. The 2010 *Highway Capacity Manual* (HCM) analysis results show a 95% queue length of 298 feet and a delay of 262 seconds. This internal delay and queue length is typical of school traffic and vehicles either divert or experience the delay.

The MSTA offers guidance on internal queue and the Average Queue Length of 1,322 feet is recommended. The Liberty Tree Academy internal 20 feet wide circulatory roadway has an available queue length of 1,380 feet, in addition to 750 feet of loading parking. There are a total of 50 parking stalls, 40 restricted parking stalls that serve administrative/teacher parking, and 10 short term parking stalls that serve parents needing class room or office visits. As recommended in MSTA the visitor parking is located at the end of the circulatory roadway to minimize congestion. Based on these results the proposed site is in general conformance with the guidelines presented in the MSTA.

Figure 4 – 2019 AM and PM Total Traffic Volumes

## 2040 Long Range Traffic Analysis

Similar to the 2019 Short Range Traffic Analysis, since schools typically have a very intense traffic pattern the PHF was modified to reflect arrival and departure time. (PHF was changed from the standard 0.92 to 0.50 which better reflect the school traffic pattern).

In addition, the Municipal School Transportation Assistance (MSTA) was considered regarding traffic vehicular queue lengths, internal circulation pattern, loading area, and parking. Traffic queue analysis is presented in the following sections.

### Transportation Improvements

The proposed roadway improvements include the addition of a westbound approach with one entering lane and two exiting lanes (one shared left/thru lane, and one right turn lane). The intersection lane configuration is presented below:

- Northbound – Left Turn Lane, Shared Thru/Right Turn Lane
- Southbound – Left Turn Lane, Shared Thru/Right Turn Lane
- Eastbound – Shared Right/Thu/Left Turn Lane.
- Westbound – Shared Thu/Left Turn Lane, Right Turn Lane

### Total Traffic

The background traffic is established based on the adjacent US 24 highway growth rate since the two facilities are in the vicinity to each other and parallel. The US 24 annual growth rate of 1.5% per year is anticipated and is therefore assumed as background for Eastonville Road, Meridian/Judge Orr Road and Stapleton Drive. The site traffic is added on top of the background volumes to get 2040 total traffic. Figure 5 show the 2040 total traffic volumes for both the AM and PM peak hours.

### Level of Service Analysis

To determine how efficiently and effectively the roadway system and intersection accommodates the future traffic volumes, the intersection serving the development is analyzed using Synchro 9 software. The results are presented as Levels of Service. Table 5 present the results by time period. Appendix D contains the 2040 total traffic analysis output for the appropriate intersection traffic control.



**Table 5 – 2040 Total Traffic TWSC Level of Service**

Intersection	Control	AM LOS	AM Queue	PM LOS	PM Queue
<b>Eastonville Rd/Motley Rd</b>	Un-signalized				
-Eastbound Left/Thru/Right	Stop	C	8	B	2
-Westbound Left/Thru	Stop	<b>F</b>	334	C	14
-Westbound Right	Stop	B	26	B	6
-Northbound Left	Free	A	0	A	0
-Northbound Thru/Right	Free	A	0	A	0
-Southbound Left	Free	A	16	A	2
-Southbound Thru/Right	Free	A	0	0	0
<b>Eastonville Rd/Judge Orr Rd</b>	Un-signalized	<b>B</b>		<b>B</b>	
-Eastbound Left	Stop	A	0	B	0
-Eastbound Thru/Right	Stop	C	68	B	26
-Westbound Left	Stop	B	10	B	8
-Westbound Thru	Stop	B	4	B	24
-Westbound Right	Stop	B	16	A	6
-Northbound Left	Stop	B	4	B	20
-Northbound Thru/Right	Stop	B	20	B	30
-Southbound Left	Stop	B	12	B	2
-Southbound Thru/Right	Stop	B	22	B	16
<b>Eastonville Rd/Stapleton Dr</b>	Un-signalized				
-Eastbound Left/Thru/Right	Stop	C	38	C	20
-Westbound Left	Stop	C	10	B	4
-Westbound Thru/Right	Stop	B	14	C	58
-Northbound Left/Thru/Right	Free	A	0	A	0
-Southbound Left/Thru/Right	Free	A	6	A	2

As presented in Table 5, the overall intersections are expected to perform well and meet established performance standards at 2040 long range condition, except for the westbound left/through lane, which operates at LOS F. The 2010 *Highway Capacity Manual* (HCM) analysis results show a 95% queue length of 334 feet and a delay of 344.1 seconds. This internal delay and queue length is typical of school traffic and vehicles either divert or experience the delay.

Liberty Tree Academy internal circulatory roadway has an available internal queue length of 1,380 feet, in addition to 750 feet of loading parking and parking. As recommended in MSTA the visitor parking is located at the end of the circulatory roadway to minimize congestion. Based on these results the proposed site is in general conformance with the guidelines presented in the MSTA.

Figure 5 – 2040 AM and PM Total Traffic Volumes

## Mitigation Improvements

A couple improvements that can be considered to mitigate the delay include, 1) changing the intersection control from two-way stop to all-way stop or 2) changing the intersection to roundabout control, and 3) additional access north of the school access.

### All Way Stop Control

One way to improve operation at the of Eastonville Rd/Motely Rd intersection is to change of traffic control from a two way stop control (TWSC) to an all way stop control (AWSC). This can be accomplished without further ROW or major improvements to the roadway. A disadvantage to this option is the increase in delay to Eastonville Road corridor. Since future school expansion and north lot development is uncertain this mitigation is not recommended.

### Roundabout

Another mitigation option is changing the intersection to a roundabout. This alternative improves overall intersection delay, however has some challenges in implementation. These challenges include 1) less pedestrian friendly due to the free flow traffic condition, 2) Increase ROW need, and 3) increase construction costs associated with removal and replacement of a portion of the existing intersection.

### Alternative Access

An alternative access north of the school access is a consideration as a defined development plan is prepared for the school addition and remain parcel. It is uncertain whether the school will be expanded to include K-8 or high school. The development plan on the north property is also uncertain. Once the development plans are prepared another access may be beneficial.

## Safety Consideration

Many jurisdictions find it beneficial to advise road users that they are approaching a school and designate school zones that have a legal standing that fines for speeding and other traffic violations are increased. This safety enhancement is currently in place as a school located approximately 1 mile south on Eastonville Road. To reinforce safe travel speed and to increase safety a similar utilization is proposed at the Liberty Tree access.

## Findings and Recommendations

Based on the traffic operational analysis, the following finding and recommendations are presented.

- For the purpose of this TIS the Liberty Tree Academy development is will accommodate 540 K-8 students with build-out in 2019. A future development north of the school site is proposed, but specific use is uncertain at this time, so analysis is not included in this TIS.

- At 2019 build-out, the project is expected to generate 491 trips in the AM peak hour, 140 trips in the PM peak hour, and 2,219 trips ADT.
- It is anticipated that the proposed development will make the following improvements to the Eastonville Rd/Motley Rd intersection at 2019 build-out:
  - Northbound – Left Turn Lane, Shared Thru/Right Turn Lane
  - Southbound – Left Turn Lane, Shared Thru/Right Turn Lane
  - Eastbound – Shared Right/Thru/Left Turn Lane, stop controlled
  - Westbound – Shared Thru/Left Turn Lane, Right Turn Lane, stop controlled
  - School Zone Striping & school zone speed control.
- With the Eastonville Rd/Motley Rd intersection improvements in the 2019 Short Range total traffic condition and the 2040 Long Range total traffic condition, the intersection impeding movements are expected to operate at LOS C or better with one exception. The westbound shared left/through lane experiences internal traffic queue and delay typical of school traffic patterns. In accordance with MSTA the site traffic queue can be accommodated internal to the site drive aisle.
- In the long term 2040 queue and delay experienced by the site exiting traffic can be mitigated, by implementing an all-way stop intersection control improved operation, but overall corridor delay is increased. Roundabout mitigation also improves overall intersection operation but introduces pedestrian safety concerns, ROW acquisition, and additional cost. Due to the school expansion and north property uncertainty, improvements without these details may not address the comprehensive traffic condition.
- Analysis indicates that the Eastonville Rd/Judge Orr Rd and the Eastonville Rd/Stapleton Dr intersections are expected to operate at LOS C or better in the near range and long-range total traffic conditions without intersection improvements.

## Conclusion

The Traffic Impact Study results indicate in the 2019 Short Range condition and the 2040 Long Range condition with the Liberty Tree Academy, K-8, traffic and the Eastonville Rd/Motley Rd intersection improvements operates well with one except. The westbound shared left/through lane experiences internal queue and delay typical of school traffic patterns. The site queue can be accommodated internal within the site drive aisles. Due to introducing delay to the Eastonville Rd corridor associated with all-way stop control and the impacts of a roundabout these mitigation options should be studied in greater detail. In the near term the project, as proposed, does not adversely impact the existing and proposed intersection operation or roadway corridor.

## **Appendix A: Existing Traffic Counts**

**Appendix B:  
2018 Level of Service Output  
Existing Traffic**

**Appendix C:  
2019 Level of Service Output  
Total Traffic**

**Appendix D:**  
**2040 Level of Service Output**  
**Total Traffic TWSC**



**Appendix E:  
Municipal School Transportation Assistance  
(MSTA) Worksheet**

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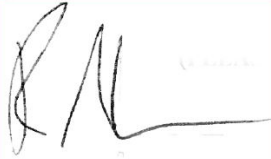
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*Ronnie Wilson, Vice-President  
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## Project Description

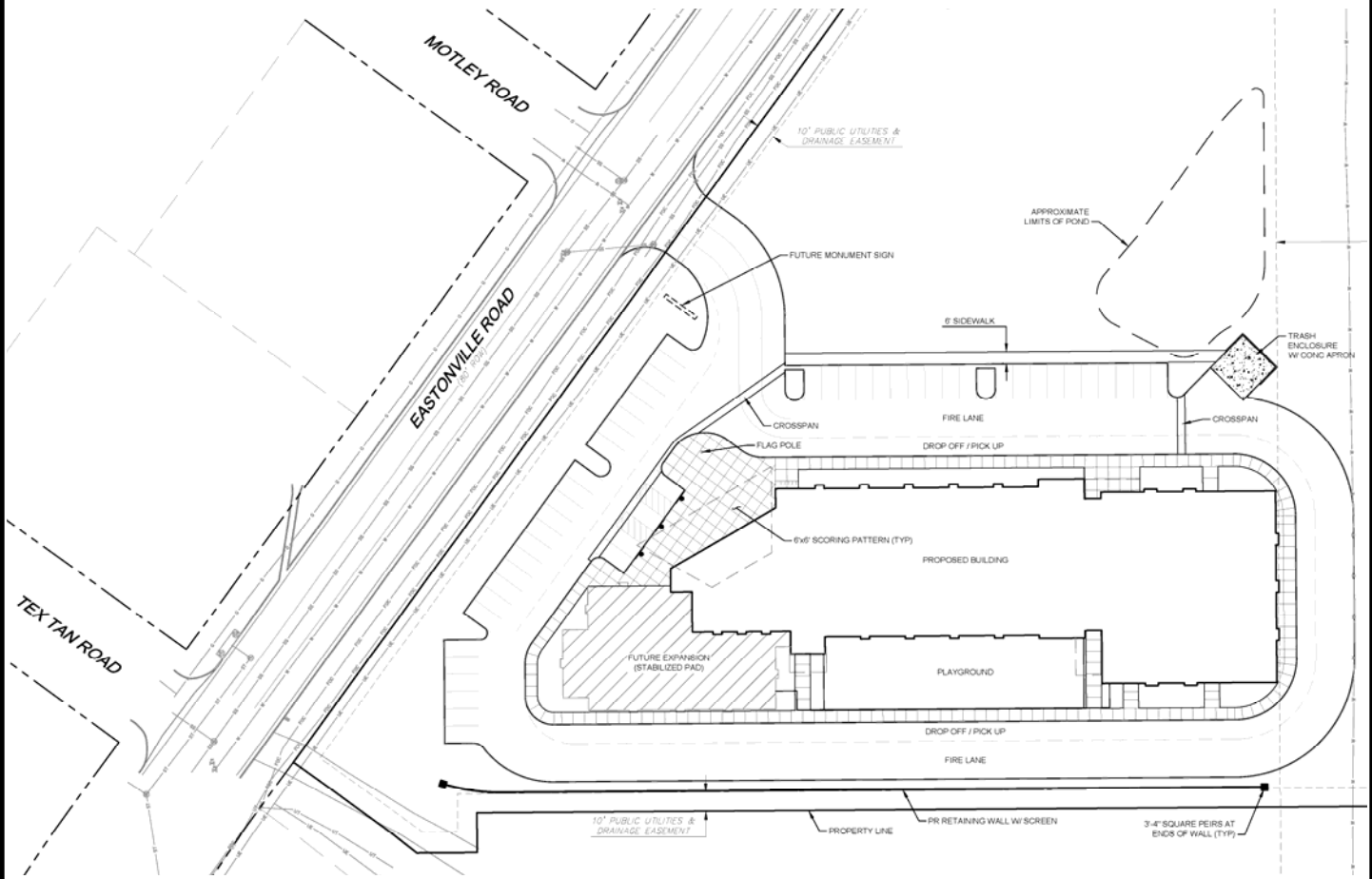
Liberty Tree Academy is proposed as a single two-story building and includes administrative offices, class rooms, gymnasium, warming kitchen, and ancillary rooms. The building area is 39,676 square feet. Adjacent to and south of the building is a fenced play area for younger aged children. Exterior to the building the facility includes a circular one-way drive aisle, with a near side drop off lane. Parking is located along the west and north portion of the site. Pedestrians are accommodated with sidewalks and curb ramps. Bicyclists share the drive aisle. (In the future, an attached building with an additional 11, 640 square feet of class rooms is proposed. With this addition the total building area would be 51,316 square feet. This total building area is not included in this TIS).

Access to the Site is proposed through one primary location at the existing Eastonville Road/Motley Road intersection. Eastonville Road is planned as an urban minor arterial roadway. Motley Road is a local street. The existing intersection is configured as a “T” which will be modified to a four-leg intersection, with stop control on the side street. Figure 2 shows the proposed access locations and internal drive aisle and circulation.



**LIBERTY TREE ACADEMY  
TRAFFIC IMPACT STUDY**

**Figure 1  
VICINITY MAP**



## Existing Traffic Conditions

### Roadway Network

The existing Eastonville Road is classified as an urban minor arterial roadway with an existing right of way (ROW) width of 80 feet with and an ultimate ROW of 100 feet. Motley Road is a local street with a ROW of 60 feet. The existing intersection configuration is described below:

#### Eastonville Road/Motley Road

Eastonville Road and Motley Road are paved roadways with curb and gutter. Motley Road is stop controlled. The existing intersection geometry at the Eastonville Road and Motley Road intersection includes:

- Northbound, striped center two way turn lane, and one through lane, and no right turn lane.
- Southbound, striped center two way turn lane, and one through lane, and one right turn lane.
- Eastbound, shared right/left turn lane.

#### Eastonville Road/Judd Orr Road

Eastonville Road and Meridan/Judd Orr Road are paved roadways with curb and gutter. East of the intersection Judd Orr Road the south curb and gutter discontinues. The intersection is all-way stop controlled. The existing intersection geometry at the Eastonville Road and Meridan/Judd Orr Road intersection includes:

- Northbound, one striped left turn lane, one shared through/right turn lane, and no right turn lane.
- Southbound, one striped left turn lane, one shared through/right turn lane, and no right turn lane.
- Westbound, one striped left turn lane, one through lane, and an exclusive right turn lane.
- Eastbound, one striped left turn lane, one shared through/right turn lane, and no right turn lane.



***Eastonville Road/Stapleton Drive***

Eastonville Road and Stapleton Drive are paved roadway without curb and gutter, however the existing eastbound approach has curb and gutter. The intersection is stop controlled on the eastbound and westbound approaches. The existing intersection geometry at the Eastonville Road and Stapleton Drive intersection includes.

- Northbound, shared left/through/right turn lane.
- Southbound, shared left/through/right turn lane.
- Westbound, one striped left turn lane, one shared through/right turn lane, and one right turn lane.
- Eastbound, one striped left turn lane, one shared through/right turn lane, and one right turn lane.

**Traffic Volumes**

Traffic counts were conducted for the intersection of Eastonville Road/Motley Road on Wednesday, April 11, 2018 which reflects traffic pattern associated with school being in session. Per County request subsequent traffic count were conducted at the Eastonville Road/Judd Orr Road, and Eastonville Road/Stapleton Drive intersections. Figure 3 shows both AM and PM peak hour intersection turning movement counts. Appendix A contains the raw traffic count data. The AM peak hour generally occurs between 7:00 and 8:00 AM. The PM peak hour generally occurs between 4:45 and 5:45 PM.

**Intersection and Roadway Capacity Analysis**

For unsignalized (side-street stop controlled) intersections, Synchro 9 software was used. The software applies the Transportation Research Board’s 2010 *Highway Capacity Manual* (HCM) methodology for unsignalized intersections to determine average control delay per vehicle (measured in seconds) for each stop-controlled movement. The method incorporates delay associated with deceleration, acceleration, stopping, and moving up in the queue. For side street stop-controlled intersections, delay is represented as the average delay per vehicle for the worst approach, not the overall intersection. Table 1 summarizes the relationship between delay and level of service.

**Table 1 – Unsignalized Intersection Level of Service Criteria**

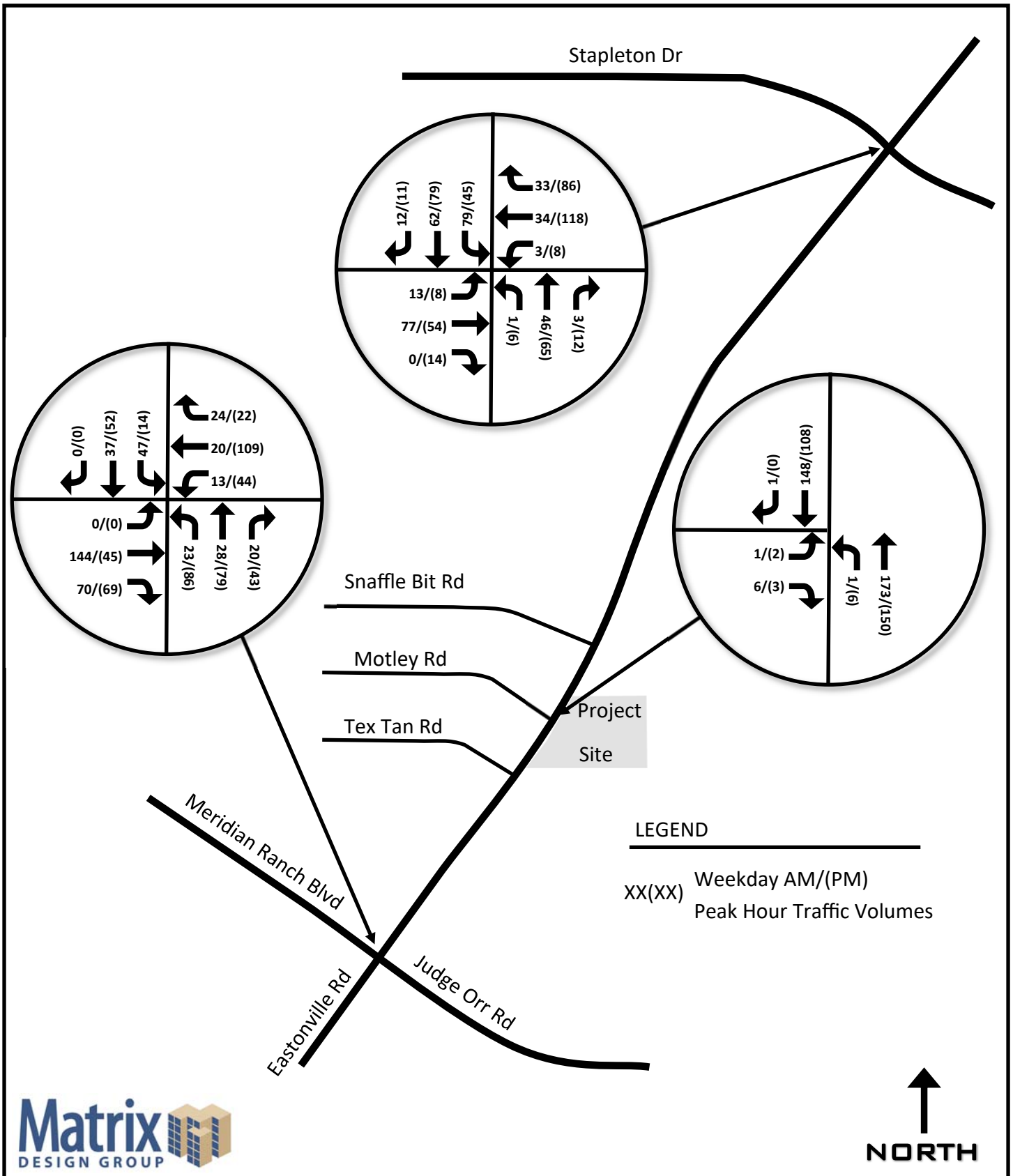
Level of Service	Average Total Delay (seconds per vehicle)	Description
A	< 10	Little or no conflicting traffic for minor street approach.
B	>10 to 15	Minor street begins to notice absence of available gaps.
C	>15 to 25	Minor street begins experiencing delay for available gaps.
D	>25 to 35	Minor street starts to experience queuing.
E	>35 to 50	Extensive minor street queuing due to insufficient gaps.
F	> 50	Insufficient gaps to allow minor street traffic to cross safely through the major street traffic stream.

Source: HCM2010 *Highway Capacity Manual* (Transportation Research Board, 2010)

Table 2 presents the existing 2018 intersection levels of service (LOS). As presented, the Eastonville Road/Motley Road, Eastonville Road/Judd Orr Road, and Eastonville Road/Stapleton Drive intersections currently operates well with an overall LOS of B or better in both the AM and PM peak hour.

**Table 2 – 2018 Existing Traffic Level of Service**

Intersection	Control	AM LOS	PM LOS
<b>Eastonville Rd/Motley Rd</b>	Un-signalized		
-Eastbound Left/Right	Stop	A	A
-Northbound Left	Free	A	A
-Northbound Thru	Free	A	A
-Southbound Thru/Right	Free	A	A
<b>Eastonville Rd/Judge Orr Rd</b>	Un-signalized	<b>A</b>	<b>A</b>
-Eastbound Left	Stop	A	A
-Eastbound Thru/Right	Stop	A	A
-Westbound Left	Stop	A	A
-Westbound Thru	Stop	A	A
-Westbound Right	Stop	A	A
-Northbound Left	Stop	A	B
-Northbound Thru/Right	Stop	A	A
-Southbound Left	Stop	A	A
-Southbound Thru/Right	Stop	A	A
<b>Eastonville Rd/Stapleton Dr</b>	Un-signalized		
-Eastbound Left/Thru/Right	Stop	B	B
-Westbound Left	Stop	B	B
-Westbound Thru/Right	Stop	B	B
-Northbound Left/Thru/Right	Free	A	A
-Southbound Left/Thru/Right	Free	A	A



## Future Traffic

### Future Background Traffic

Future background traffic is intended to show how existing volumes are expected to grow over time without the proposed development. The background traffic is established based on the adjacent US 24 highway growth rate since the two facilities are in the vicinity to each other and parallel. Colorado Department of Transportation performs regional forecast modeling and publishes them on their website. In the case of US24 the annual growth rate of 1.5% per year is anticipated and is therefore assumed as the traffic background rate for Eastonville Road, Judge Orr Road and Stapleton Drive.

### Trip Generation

The vehicle trips associated with a private school are calculated using the *ITE Trip Generation Manual, Tenth Edition*. This methodology consists of choosing an independent variable for the land use for a particular time of day. The independent variable correlates to the variation in trip ends and is related to the land use. The value of the independent variable is either multiplied by a weighted average or used in a regression equation to calculate the trips generated by the land use. The *ITE Trip Generation Manual* provides guidance on when to use the weighted average versus the regression equation. In most cases, the regression equations are recommended when there are adequate study data points.

ITE Trip Generation Code 534, Private School (K-8) is used since it most closely represents the Liberty Tree Academy. As a K-8 school sagged start times are proposed. Current enrollment indicates that 67 percentage of students have siblings therefore participating in carpooling, so the trip generation established through ITE may be conservative. An affordable school bus program is available through the School District. For the purpose of this study trip reduction is not considered for student walking, carpooling or bus service.

**Table 3 – Trip Generation**

Land Use – ITE Code 534	Variable Student	AM Peak			PM Peak*			Daily		
		Total	In	Out	Total	In	Out	Total	In	Out
<b>Private School (K-8)</b>	540	491	270	221	140	64	76	2,219	1,110	1,109

\*PM peak hour of adjacent street traffic.

### Trip Distribution

The site generated trips are assigned to the roadway network based on existing counts and the external trip distribution assumptions. Since the site access is through the Eastonville Rd/Motley Rd intersection site trips are distributed predominately to/from Eastonville Road with a smaller percentage to/from the west, which serves the adjacent residential area. As a north/south minor arterial roadway Eastonville Road is anticipated to accommodate 95% of the total site trips, with 50% to/from the south, and 45% to/from the north. Motley Road is anticipated to accommodate 5% of the site generated trips. Figure 3 and Figure 5 shows the percentage of trips that will be traveling along the roadway network.

## 2019 Short Range Traffic Analysis

Synchro 9 software is a traffic modeling software that analyzes intersections based on a variety of variable. The variables are used to calibrate/customize the model to better reflect site specific conditions. One variable “Peak Hour Factor (PHF)” assigns traffic to the intersection based on traffic intensity. Since schools typically have a very intense traffic pattern the PHF was modified to reflect arrival and departure time. (PHF was changed from the standard 0.92 to 0.5 which better reflects the school traffic pattern).

In addition to considering the school traffic intensity in the Synchro analysis, information presented in the Municipal School Transportation Assistance (MSTA) was considered. The state of North Carolina prepared this research study and found that the school traffic vehicular queue lengths should be considered since insufficient internal circulation pattern, loading area, and parking can create traffic flow problems. Traffic queue analysis is presented in the following sections.

### Transportation Improvements

The proposed roadway improvements at the Eastonville Road/Motley Road intersection include the addition of a westbound approach with one entering lane and two exiting lanes (one shared left/thru lane and one right turn lane). The intersection lane configuration is presented below:

- Northbound – Left Turn Lane, Shared Thru/Right Turn Lane
- Southbound – Left Turn Lane, Shared Thru/Right Turn Lane
- Eastbound – Shared Right/Thu/Left Turn Lane
- Westbound – Shared Thu/Left Turn Lane, Right Turn Lane

No existing sidewalks along Easton Road and vicinity intersecting roadways exists. To serve pedestrian Eastonville Road is proposed to include detached sidewalks and intersection cross walks in its ultimate configuration. Right-Of-Way is being dedicated to accommodate the ultimate typical section, and sidewalk adjacent to the proposed constructed portion of the site will be installed for pedestrian use. Extension to the north will occur with the high school expansion and or the north property development. Liberty Tree Academy will supply crossing guards at the Eastonville Rd/Motley Road to help students cross Eastonville Rd. In addition, the site includes accommodation for pedestrians.

### Total Traffic

The existing traffic plus the background growth is added to the proposed 2019 developed traffic volumes to establish 2019 total traffic. Figure 4 shows the 2019 total volumes for both the AM and PM peak periods.

### Level of Service Analysis

To determine how efficiently and effectively the roadway system and intersection accommodates the short-range future traffic volumes, the intersection serving the

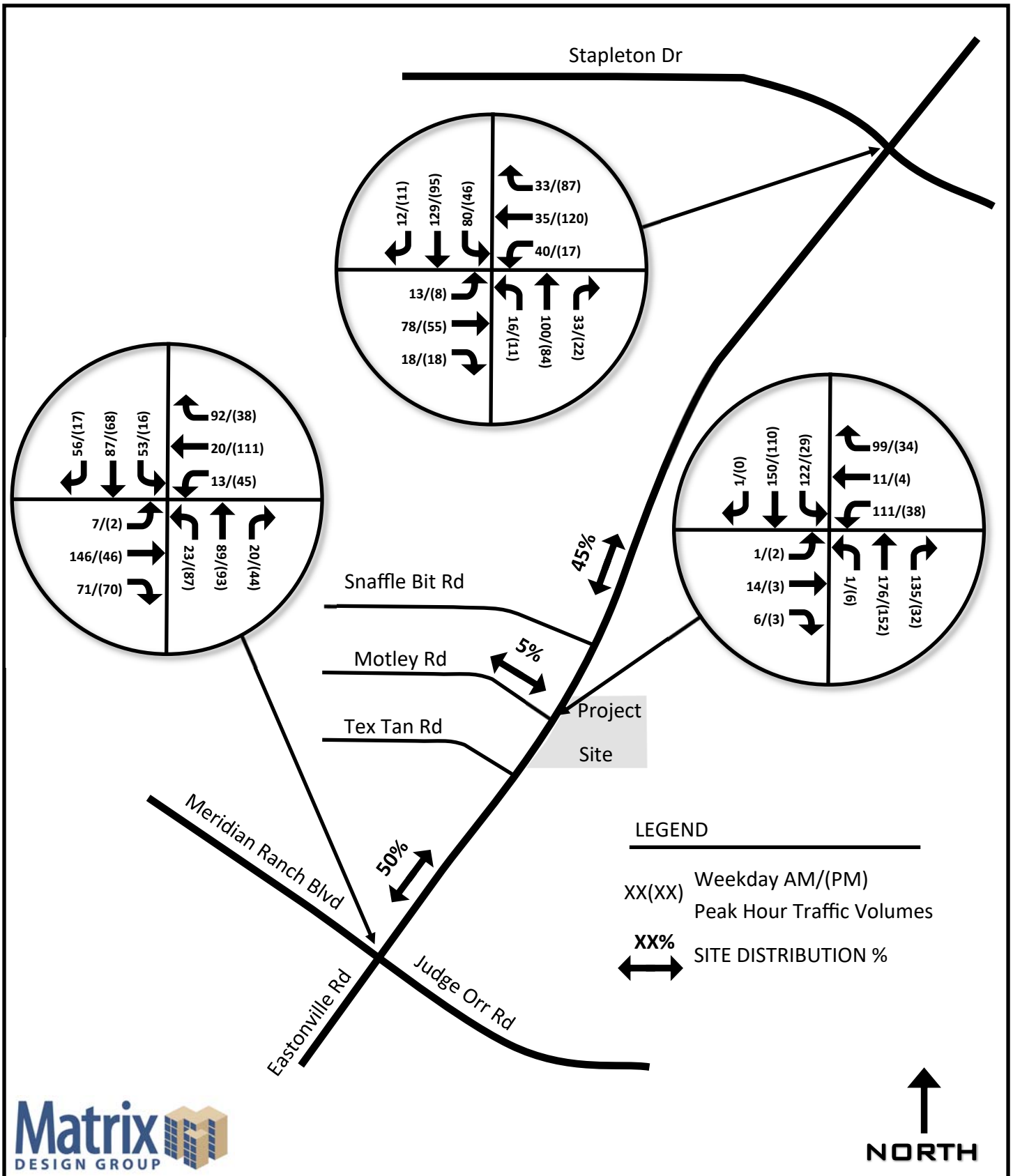
development was analyzed using Synchro 9 software. Table 4 presents the results by time period. Appendix C contains the 2019 total traffic analysis output for the appropriate intersection control condition.

**Table 4 – 2019 Total Traffic Level of Service**

Intersection	Control	AM LOS	AM Queue	PM LOS	PM Queue
<b>Eastonville Rd/Motley Rd</b>	Un-signalized				
-Eastbound Left/Thru/Right	Stop	C	8	B	0
-Westbound Left/Thru	Stop	F	298	B	12
-Westbound Right	Stop	B	22	A	6
-Northbound Left	Free	A	0	A	0
-Northbound Thru/Right	Free	A	0	A	0
-Southbound Left	Free	A	16	A	2
-Southbound Thru/Right	Free	A	0	A	0
<b>Eastonville Rd/Judge Orr Rd</b>	Un-signalized	<b>B</b>		<b>A</b>	
-Eastbound Left	Stop	A	0	A	0
-Eastbound Thru/Right	Stop	B	36	A	14
-Westbound Left	Stop	A	2	A	6
-Westbound Thru	Stop	A	2	B	14
-Westbound Right	Stop	A	12	A	4
-Northbound Left	Stop	A	2	B	12
-Northbound Thru/Right	Stop	B	14	B	18
-Southbound Left	Stop	B	8	A	2
-Southbound Thru/Right	Stop	B	20	A	10
<b>Eastonville Rd/Stapleton Dr</b>	Un-signalized				
-Eastbound Left/Thru/Right	Stop	C	20	B	10
-Westbound Left	Stop	C	8	B	2
-Westbound Thru/Right	Stop	B	8	B	30
-Northbound Left/Thru/Right	Free	A	0	A	0
-Southbound Left/Thru/Right	Free	A	4	A	2

As presented in Table 4, with short range improvements, the overall intersections are expected to perform well and meet established performance standards at 2019 short range condition, except for the westbound left/through lane, which operates at LOS F. When turning movements are anticipated to operate at LOS F, queue length, and delay are also studied. The 2010 *Highway Capacity Manual* (HCM) analysis results show a 95% queue length of 298 feet and a delay of 262 seconds. This internal delay and queue length is typical of school traffic and vehicles either divert or experience the delay.

The MSTA offers guidance on internal queue and the Average Queue Length of 1,322 feet is recommended. The Liberty Tree Academy internal 20 feet wide circulatory roadway has an available queue length of 1,380 feet, in addition to 750 feet of loading parking. There are a total of 50 parking stalls, 40 restricted parking stalls that serve administrative/teacher parking, and 10 short term parking stalls that serve parents needing class room or office visits. As recommended in MSTA the visitor parking is located at the end of the circulatory roadway to minimize congestion. Based on these results the proposed site is in general conformance with the guidelines presented in the MSTA.



## 2040 Long Range Traffic Analysis

Similar to the 2019 Short Range Traffic Analysis, since schools typically have a very intense traffic pattern the PHF was modified to reflect arrival and departure time. (PHF was changed from the standard 0.92 to 0.50 which better reflect the school traffic pattern).

In addition, the Municipal School Transportation Assistance (MSTA) was considered regarding traffic vehicular queue lengths, internal circulation pattern, loading area, and parking. Traffic queue analysis is presented in the following sections.

### Transportation Improvements

The proposed roadway improvements include the addition of a westbound approach with one entering lane and two exiting lanes (one shared left/thru lane, and one right turn lane). The intersection lane configuration is presented below:

- Northbound – Left Turn Lane, Shared Thru/Right Turn Lane
- Southbound – Left Turn Lane, Shared Thru/Right Turn Lane
- Eastbound – Shared Right/Thu/Left Turn Lane.
- Westbound – Shared Thu/Left Turn Lane, Right Turn Lane

### Total Traffic

The background traffic is established based on the adjacent US 24 highway growth rate since the two facilities are in the vicinity to each other and parallel. The US 24 annual growth rate of 1.5% per year is anticipated and is therefore assumed as background for Eastonville Road, Meridian/Judge Orr Road and Stapleton Drive. The site traffic is added on top of the background volumes to get 2040 total traffic. Figure 5 show the 2040 total traffic volumes for both the AM and PM peak hours.

### Level of Service Analysis

To determine how efficiently and effectively the roadway system and intersection accommodates the future traffic volumes, the intersection serving the development is analyzed using Synchro 9 software. The results are presented as Levels of Service. Table 5 present the results by time period. Appendix D contains the 2040 total traffic analysis output for the appropriate intersection traffic control.

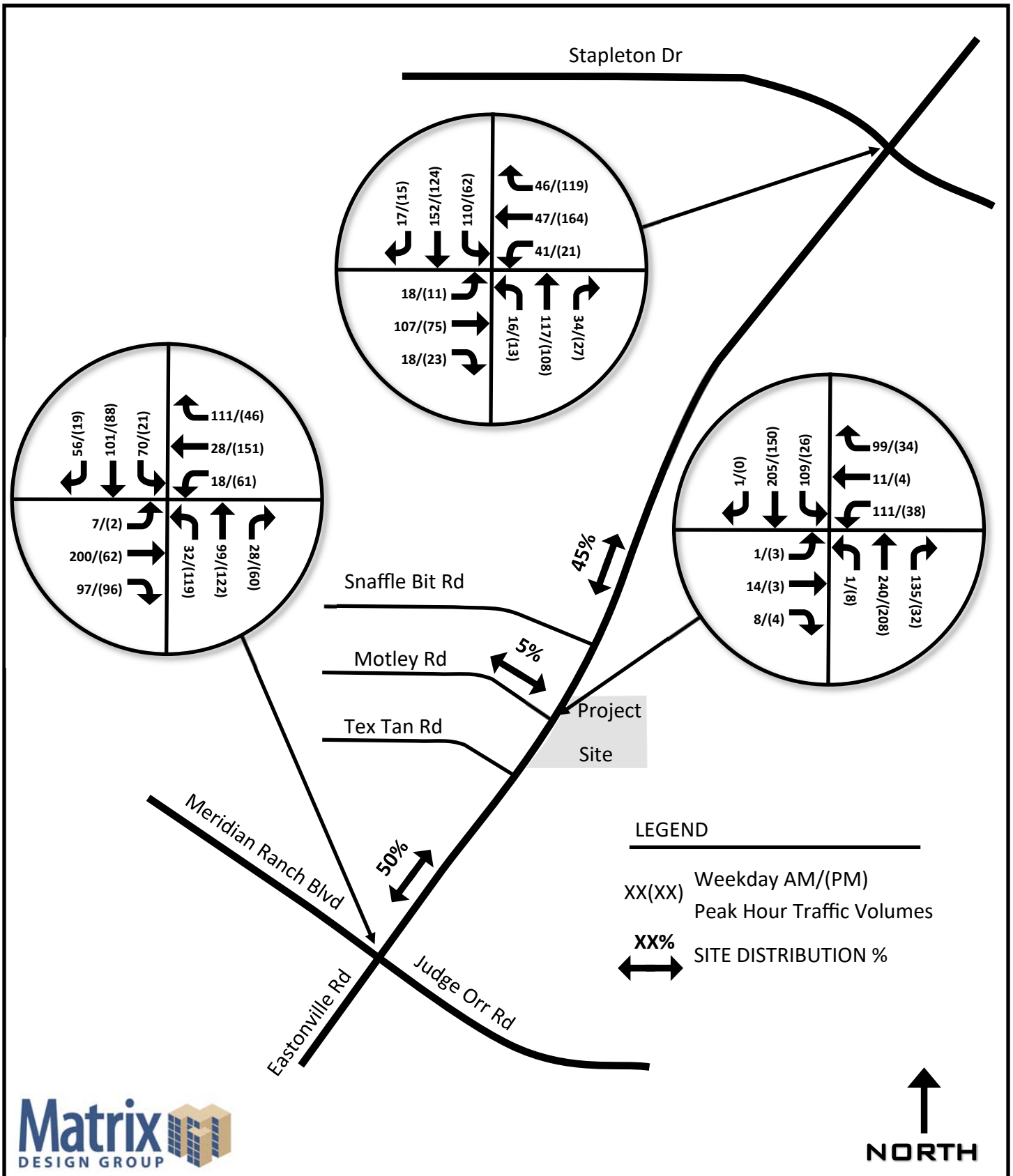


**Table 5 – 2040 Total Traffic TWSC Level of Service**

Intersection	Control	AM LOS	AM Queue	PM LOS	PM Queue
<b>Eastonville Rd/Motley Rd</b>	Un-signalized				
-Eastbound Left/Thru/Right	Stop	C	8	B	2
-Westbound Left/Thru	Stop	<b>F</b>	334	C	14
-Westbound Right	Stop	B	26	B	6
-Northbound Left	Free	A	0	A	0
-Northbound Thru/Right	Free	A	0	A	0
-Southbound Left	Free	A	16	A	2
-Southbound Thru/Right	Free	A	0	0	0
<b>Eastonville Rd/Judge Orr Rd</b>	Un-signalized	<b>B</b>		<b>B</b>	
-Eastbound Left	Stop	A	0	B	0
-Eastbound Thru/Right	Stop	C	68	B	26
-Westbound Left	Stop	B	10	B	8
-Westbound Thru	Stop	B	4	B	24
-Westbound Right	Stop	B	16	A	6
-Northbound Left	Stop	B	4	B	20
-Northbound Thru/Right	Stop	B	20	B	30
-Southbound Left	Stop	B	12	B	2
-Southbound Thru/Right	Stop	B	22	B	16
<b>Eastonville Rd/Stapleton Dr</b>	Un-signalized				
-Eastbound Left/Thru/Right	Stop	C	38	C	20
-Westbound Left	Stop	C	10	B	4
-Westbound Thru/Right	Stop	B	14	C	58
-Northbound Left/Thru/Right	Free	A	0	A	0
-Southbound Left/Thru/Right	Free	A	6	A	2

As presented in Table 5, the overall intersections are expected to perform well and meet established performance standards at 2040 long range condition, except for the westbound left/through lane, which operates at LOS F. The 2010 *Highway Capacity Manual (HCM)* analysis results show a 95% queue length of 334 feet and a delay of 344.1 seconds. This internal delay and queue length is typical of school traffic and vehicles either divert or experience the delay.

Liberty Tree Academy internal circulatory roadway has an available internal queue length of 1,380 feet, in addition to 750 feet of loading parking and parking. As recommended in MSTA the visitor parking is located at the end of the circulatory roadway to minimize congestion. Based on these results the proposed site is in general conformance with the guidelines presented in the MSTA.



## Mitigation Improvements

A couple improvements that can be considered to mitigate the delay include, 1) changing the intersection control from two-way stop to all-way stop or 2) changing the intersection to roundabout control, and 3) additional access north of the school access.

### All Way Stop Control

One way to improve operation at the of Eastonville Rd/Motely Rd intersection is to change of traffic control from a two way stop control (TWSC) to an all way stop control (AWSC). This can be accomplished without further ROW or major improvements to the roadway. A disadvantage to this option is the increase in delay to Eastonville Road corridor. Since future school expansion and north lot development is uncertain this mitigation is not recommended.

### Roundabout

Another mitigation option is changing the intersection to a roundabout. This alternative improves overall intersection delay, however has some challenges in implementation. These challenges include 1) less pedestrian friendly due to the free flow traffic condition, 2) Increase ROW need, and 3) increase construction costs associated with removal and replacement of a portion of the existing intersection.

### Alternative Access

An alternative access north of the school access is a consideration as a defined development plan is prepared for the school addition and remain parcel. It is uncertain whether the school will be expanded to include K-8 or high school. The development plan on the north property is also uncertain. Once the development plans are prepared another access may be beneficial.

## Safety Consideration

Many jurisdictions find it beneficial to advise road users that they are approaching a school and designate school zones that have a legal standing that fines for speeding and other traffic violations are increased. This safety enhancement is currently in place as a school located approximately 1 mile south on Eastonville Road. To reinforce safe travel speed and to increase safety a similar utilization is proposed at the Liberty Tree access.

## Findings and Recommendations

Based on the traffic operational analysis, the following finding and recommendations are presented.

- For the purpose of this TIS the Liberty Tree Academy development is will accommodate 540 K-8 students with build-out in 2019. A future development north of the school site is proposed, but specific use is uncertain at this time, so analysis is not included in this TIS.

- At 2019 build-out, the project is expected to generate 491 trips in the AM peak hour, 140 trips in the PM peak hour, and 2,219 trips ADT.
- It is anticipated that the proposed development will make the following improvements to the Eastonville Rd/Motley Rd intersection at 2019 build-out:
  - Northbound – Left Turn Lane, Shared Thru/Right Turn Lane
  - Southbound – Left Turn Lane, Shared Thru/Right Turn Lane
  - Eastbound – Shared Right/Thru/Left Turn Lane, stop controlled
  - Westbound – Shared Thru/Left Turn Lane, Right Turn Lane, stop controlled
  - School Zone Striping
- With the Eastonville Rd/Motley Rd intersection improvements in the 2019 Short Range total traffic condition and the 2040 Long Range total traffic condition, the intersection impeding movements are expected to operate at LOS C or better with one exception. The westbound shared left/through lane experiences internal traffic queue and delay typical of school traffic patterns. In accordance with MSTA the site traffic queue can be accommodated internal to the site drive aisle.
- In the long term 2040 queue and delay experienced by the site exiting traffic can be mitigated, by implementing an all-way stop intersection control improved operation, but overall corridor delay is increased. Roundabout mitigation also improves overall intersection operation but introduces pedestrian safety concerns, ROW acquisition, and additional cost. Due to the school expansion and north property uncertainty, improvements without these details may not address the comprehensive traffic condition.
- Analysis indicates that the Eastonville Rd/Judge Orr Rd and the Eastonville Rd/Stapleton Dr intersections are expected to operate at LOS C or better in the near range and long-range total traffic conditions without intersection improvements.

## Conclusion

The Traffic Impact Study results indicate in the 2019 Short Range condition and the 2040 Long Range condition with the Liberty Tree Academy, K-8, traffic and the Eastonville Rd/Motley Rd intersection improvements operates well with one except. The westbound shared left/through lane experiences internal queue and delay typical of school traffic patterns. The site queue can be accommodated internal within the site drive aisles. Due to introducing delay to the Eastonville Rd corridor associated with all-way stop control and the impacts of a roundabout these mitigation options should be studied in greater detail. In the near term the project, as proposed, does not adversely impact the existing and proposed intersection operation or roadway corridor.

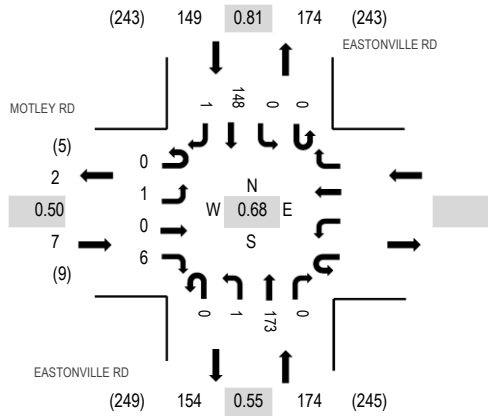
## **Appendix A: Existing Traffic Counts**



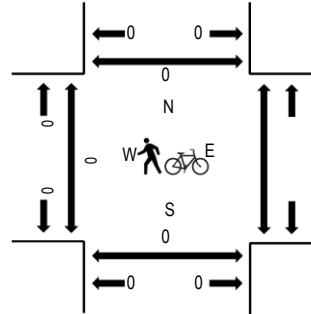
(303) 216-2439  
www.alltrafficdata.net

Location: 1 EASTONVILLE RD & MOTLEY RD AM  
Date and Start Time: Wednesday, April 11, 2018  
Peak Hour: 07:00 AM - 08:00 AM  
Peak 15-Minutes: 07:00 AM - 07:15 AM

**Peak Hour - All Vehicles**



**Peak Hour - Pedestrians/Bicycles on Crosswalk**



Note: Total study counts contained in parentheses.

**Traffic Counts**

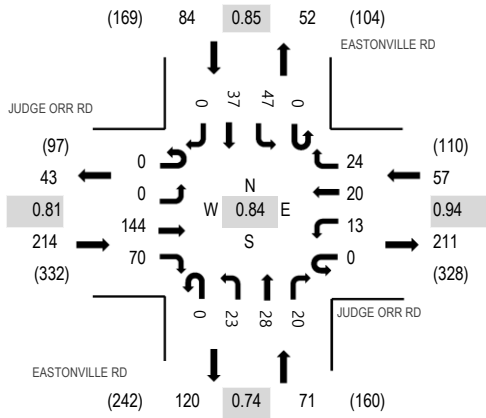
Interval Start Time	MOTLEY RD Eastbound				Westbound			EASTONVILLE RD Northbound				EASTONVILLE RD Southbound				Total	Rolling Hour	Pedestrian Crossings				
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru			Right	West	East	South	North
7:00 AM	0	0	0	0				0	0	79	0	0	0	0	42	0	121	330	0	0	0	0
7:15 AM	0	0	0	2				0	0	68	0	0	0	45	1	116	249	0	0	0	0	
7:30 AM	0	0	0	4				0	1	13	0	0	0	38	0	56	205	0	0	0	0	
7:45 AM	0	1	0	0				0	0	13	0	0	0	23	0	37	177	0	0	0	0	
8:00 AM	0	0	0	1				0	1	10	0	0	0	27	1	40	167	0	0	0	0	
8:15 AM	0	0	0	0				0	1	33	0	0	0	38	0	72		0	0	0	0	
8:30 AM	0	0	0	1				0	0	13	0	0	0	14	0	28		0	0	0	0	
8:45 AM	0	0	0	0				0	0	13	0	0	0	14	0	27		0	0	0	0	
Count Total	0	1	0	8				0	3	242	0	0	0	241	2	497		0	0	0	0	
Peak Hour	0	1	0	6				0	1	173	0	0	0	148	1	330		0	0	0	0	



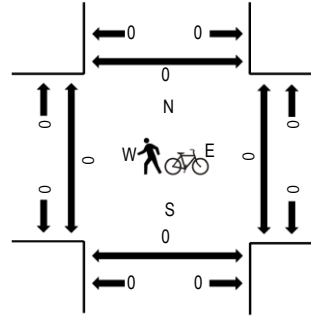
(303) 216-2439  
www.alltrafficdata.net

Location: 1 EASTONVILLE RD & JUDGE ORR RD AM  
Date and Start Time: Tuesday, June 19, 2018  
Peak Hour: 07:00 AM - 08:00 AM  
Peak 15-Minutes: 07:15 AM - 07:30 AM

**Peak Hour - All Vehicles**



**Peak Hour - Pedestrians/Bicycles on Crosswalk**



Note: Total study counts contained in parentheses.

**Traffic Counts**

Interval Start Time	JUDGE ORR RD Eastbound				JUDGE ORR RD Westbound				EASTONVILLE RD Northbound				EASTONVILLE RD Southbound				Total	Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right			West	East	South	North
7:00 AM	0	0	40	16	0	3	3	6	0	5	1	6	0	18	9	0	107	426	0	0	0	0
7:15 AM	0	0	44	22	0	4	1	11	0	7	5	5	0	17	11	0	127	392	0	0	0	0
7:30 AM	0	0	33	10	0	4	7	2	0	3	5	4	0	9	13	0	90	344	0	0	0	0
7:45 AM	0	0	27	22	0	2	9	5	0	8	17	5	0	3	4	0	102	349	0	0	0	0
8:00 AM	0	1	16	9	0	5	6	4	0	4	5	6	0	9	8	0	73	345	0	0	0	0
8:15 AM	0	1	16	11	0	3	3	2	0	2	12	4	0	9	15	1	79		0	0	0	0
8:30 AM	0	0	17	16	0	5	8	2	0	11	8	7	0	6	14	1	95		0	0	0	1
8:45 AM	0	0	18	13	0	4	8	3	0	10	14	6	0	3	19	0	98		0	0	0	0
Count Total	0	2	211	119	0	30	45	35	0	50	67	43	0	74	93	2	771		0	0	0	1
Peak Hour	0	0	144	70	0	13	20	24	0	23	28	20	0	47	37	0	426		0	0	0	0



(303) 216-2439  
www.alltrafficdata.net

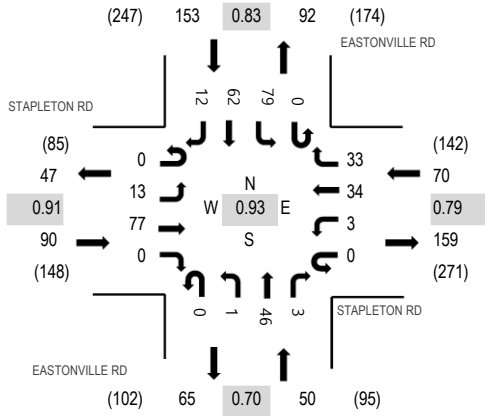
Location: 2 EASTONVILLE RD & STAPLETON RD AM

Date and Start Time: Tuesday, June 19, 2018

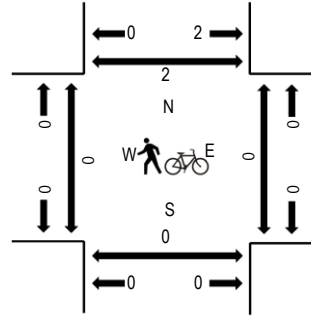
Peak Hour: 07:15 AM - 08:15 AM

Peak 15-Minutes: 08:00 AM - 08:15 AM

**Peak Hour - All Vehicles**



**Peak Hour - Pedestrians/Bicycles on Crosswalk**



Note: Total study counts contained in parentheses.

**Traffic Counts**

Interval Start Time	STAPLETON RD Eastbound				STAPLETON RD Westbound				EASTONVILLE RD Northbound				EASTONVILLE RD Southbound				Total	Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right			West	East	South	North
7:00 AM	0	1	24	0	0	1	5	16	0	3	9	0	0	25	10	1	95	360	0	0	0	0
7:15 AM	0	2	19	0	0	1	8	5	0	0	12	1	0	28	15	1	92	363	0	0	0	0
7:30 AM	0	2	23	0	0	0	9	7	0	0	4	2	0	26	14	6	93	334	0	0	0	0
7:45 AM	0	4	16	0	0	0	9	8	0	0	20	0	0	11	12	0	80	298	0	0	0	0
8:00 AM	0	5	19	0	0	2	8	13	0	1	10	0	0	14	21	5	98	272	0	0	0	2
8:15 AM	0	3	5	0	0	0	7	9	0	2	12	1	0	13	8	3	63		0	0	0	0
8:30 AM	0	0	13	0	0	1	6	10	0	1	8	1	0	9	7	1	57		0	0	0	0
8:45 AM	0	0	12	0	0	2	9	6	0	0	8	0	0	9	8	0	54		0	0	0	0
Count Total	0	17	131	0	0	7	61	74	0	7	83	5	0	135	95	17	632		0	0	0	2
Peak Hour	0	13	77	0	0	3	34	33	0	1	46	3	0	79	62	12	363		0	0	0	2

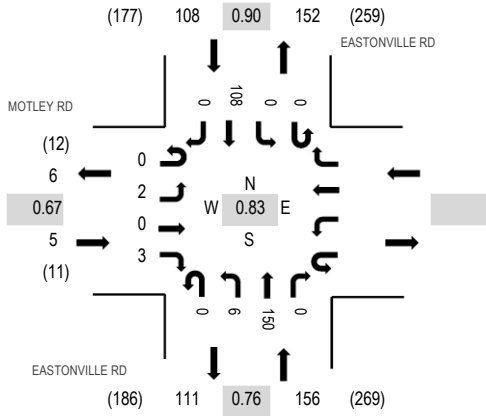




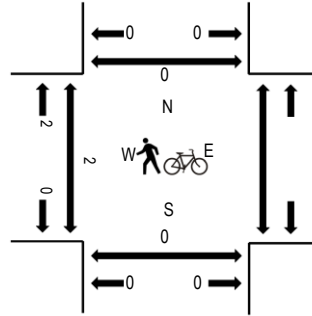
(303) 216-2439  
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Location: 1 EASTONVILLE RD & MOTLEY RD PM  
Date and Start Time: Wednesday, April 11, 2018  
Peak Hour: 04:45 PM - 05:45 PM  
Peak 15-Minutes: 05:30 PM - 05:45 PM

**Peak Hour - All Vehicles**



**Peak Hour - Pedestrians/Bicycles on Crosswalk**



Note: Total study counts contained in parentheses.

**Traffic Counts**

Interval Start Time	MOTLEY RD Eastbound				Westbound			EASTONVILLE RD Northbound				EASTONVILLE RD Southbound				Total	Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru			Right	West	East	South
4:00 PM	0	0	0	1					0	1	18	0	0	0	17	0	37	204	0	0	0
4:15 PM	0	0	0	3					0	0	31	0	0	0	11	0	45	232	0	0	0
4:30 PM	0	0	0	1					0	5	27	0	0	0	21	0	54	242	0	0	0
4:45 PM	0	0	0	2					0	1	37	0	0	0	28	0	68	269	0	0	0
5:00 PM	0	1	0	1					0	2	31	0	0	0	30	0	65	253	2	0	0
5:15 PM	0	1	0	0					0	3	31	0	0	0	20	0	55		0	0	0
5:30 PM	0	0	0	0					0	0	51	0	0	0	30	0	81		0	0	0
5:45 PM	0	0	0	1					0	0	31	0	0	0	20	0	52		0	0	0
Count Total	0	2	0	9					0	12	257	0	0	0	177	0	457		2	0	0
Peak Hour	0	2	0	3					0	6	150	0	0	0	108	0	269		2	0	0



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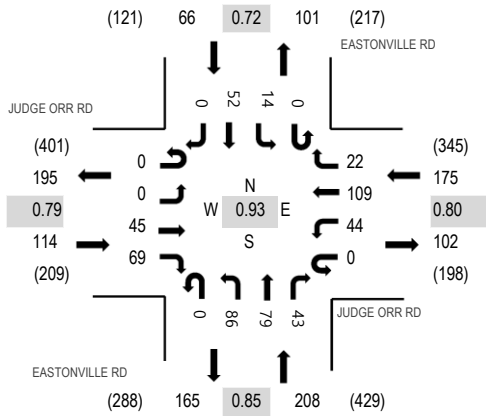
Location: 1 EASTONVILLE RD & JUDGE ORR RD PM

Date and Start Time: Tuesday, June 19, 2018

Peak Hour: 04:00 PM - 05:00 PM

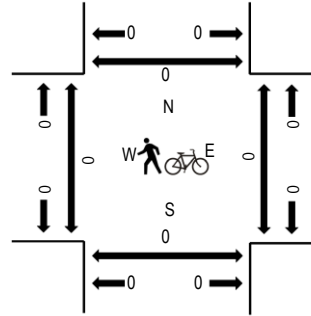
Peak 15-Minutes: 04:00 PM - 04:15 PM

**Peak Hour - All Vehicles**



Note: Total study counts contained in parentheses.

**Peak Hour - Pedestrians/Bicycles on Crosswalk**



**Traffic Counts**

Interval Start Time	JUDGE ORR RD Eastbound				JUDGE ORR RD Westbound				EASTONVILLE RD Northbound			EASTONVILLE RD Southbound				Total	Rolling Hour	Pedestrian Crossings				
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru			Right	West	East	South	North
4:00 PM	0	0	11	25	0	10	25	5	0	18	18	16	0	9	14	0	151	563	0	0	0	0
4:15 PM	0	0	14	12	0	11	26	1	0	18	22	10	0	2	15	0	131	563	0	0	0	0
4:30 PM	0	0	5	17	0	13	33	7	0	24	21	9	0	3	12	0	144	561	0	0	0	0
4:45 PM	0	0	15	15	0	10	25	9	0	26	18	8	0	0	11	0	137	544	0	0	0	0
5:00 PM	0	1	7	15	0	8	39	14	0	18	22	17	0	4	6	0	151	541	0	0	0	0
5:15 PM	0	0	6	17	0	4	28	6	0	24	14	13	0	5	11	1	129		0	0	0	0
5:30 PM	0	0	6	20	0	6	22	7	0	23	16	9	0	5	13	0	127		0	0	0	0
5:45 PM	0	0	9	14	0	2	21	13	0	29	23	13	0	2	7	1	134		0	0	0	0
Count Total	0	1	73	135	0	64	219	62	0	180	154	95	0	30	89	2	1,104		0	0	0	0
Peak Hour	0	0	45	69	0	44	109	22	0	86	79	43	0	14	52	0	563		0	0	0	0



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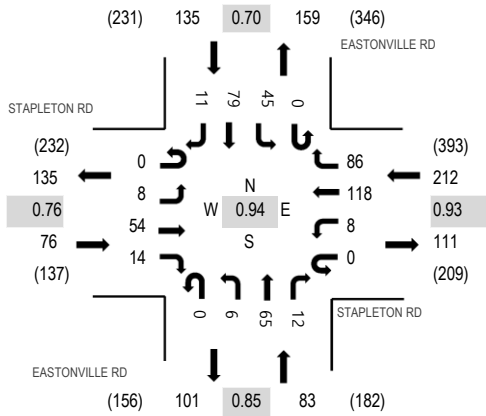
Location: 2 EASTONVILLE RD & STAPLETON RD PM

Date and Start Time: Tuesday, June 19, 2018

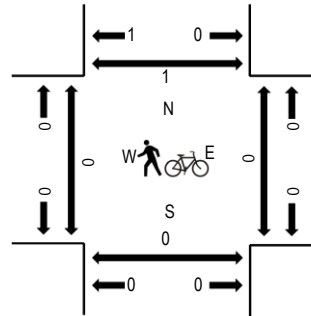
Peak Hour: 05:00 PM - 06:00 PM

Peak 15-Minutes: 05:00 PM - 05:15 PM

**Peak Hour - All Vehicles**



**Peak Hour - Pedestrians/Bicycles on Crosswalk**



Note: Total study counts contained in parentheses.

**Traffic Counts**

Interval Start Time	STAPLETON RD Eastbound				STAPLETON RD Westbound				EASTONVILLE RD Northbound				EASTONVILLE RD Southbound				Total	Rolling Hour	Pedestrian Crossings				
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right			West	East	South	North	
4:00 PM	0	3	11	0	0	0	1	14	20	0	0	28	1	0	12	14	4	108	437	0	0	0	0
4:15 PM	0	3	12	2	0	2	20	21	0	1	19	1	0	6	6	3	96	463	0	0	0	0	
4:30 PM	0	2	12	2	0	3	26	20	0	7	19	2	0	15	10	1	119	497	0	0	0	0	
4:45 PM	0	4	8	2	0	4	18	32	0	3	16	2	0	16	9	0	114	505	0	0	0	0	
5:00 PM	0	2	11	1	0	3	31	17	0	2	15	4	0	15	25	8	134	506	0	0	0	0	
5:15 PM	0	2	11	3	0	1	32	26	0	2	21	2	0	11	18	1	130		0	0	0	0	
5:30 PM	0	1	19	1	0	1	28	27	0	0	17	5	0	11	15	2	127		0	0	0	0	
5:45 PM	0	3	13	9	0	3	27	16	0	2	12	1	0	8	21	0	115		0	0	0	0	
Count Total	0	20	97	20	0	18	196	179	0	17	147	18	0	94	118	19	943		0	0	0	0	
Peak Hour	0	8	54	14	0	8	118	86	0	6	65	12	0	45	79	11	506		0	0	0	0	

**Appendix B:**  
**2018 Level of Service Output**  
**Existing Traffic**

Intersection						
Int Delay, s/veh	0.2					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔		↔	↑	↑	
Traffic Vol, veh/h	1	6	1	173	148	1
Future Vol, veh/h	1	6	1	173	148	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	0	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	1	7	1	188	161	1

Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	351	161	162	0	-	0
Stage 1	161	-	-	-	-	-
Stage 2	190	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	646	884	1417	-	-	-
Stage 1	868	-	-	-	-	-
Stage 2	842	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	646	884	1417	-	-	-
Mov Cap-2 Maneuver	646	-	-	-	-	-
Stage 1	868	-	-	-	-	-
Stage 2	841	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	9.3	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1417	-	840	-	-
HCM Lane V/C Ratio	0.001	-	0.009	-	-
HCM Control Delay (s)	7.5	-	9.3	-	-
HCM Lane LOS	A	-	A	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

Intersection	
Intersection Delay, s/veh	9
Intersection LOS	A

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↵	↵		↵	↑	↗	↵	↵		↵	↵	
Traffic Vol, veh/h	0	114	70	13	20	24	23	28	20	47	37	0
Future Vol, veh/h	0	114	70	13	20	24	23	28	20	47	37	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	124	76	14	22	26	25	30	22	51	40	0
Number of Lanes	1	1	0	1	1	1	1	1	0	1	1	0

Approach	SE	NW	NE	SW
Opposing Approach	NW	SE	SW	NE
Opposing Lanes	3	2	2	2
Conflicting Approach Left	SW	NE	SE	NW
Conflicting Lanes Left	2	2	2	3
Conflicting Approach Right	NE	SW	NW	SE
Conflicting Lanes Right	2	2	3	2
HCM Control Delay	9.5	8.2	8.5	8.9
HCM LOS	A	A	A	A

Lane	NELn1	NELn2	NWLn1	NWLn2	NWLn3	SELn1	SELn2	SWLn1	SWLn2
Vol Left, %	100%	0%	100%	0%	0%	0%	0%	100%	0%
Vol Thru, %	0%	58%	0%	100%	0%	100%	62%	0%	100%
Vol Right, %	0%	42%	0%	0%	100%	0%	38%	0%	0%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	23	48	13	20	24	0	184	47	37
LT Vol	23	0	13	0	0	0	0	47	0
Through Vol	0	28	0	20	0	0	114	0	37
RT Vol	0	20	0	0	24	0	70	0	0
Lane Flow Rate	25	52	14	22	26	0	200	51	40
Geometry Grp	8	8	8	8	8	8	8	8	8
Degree of Util (X)	0.041	0.075	0.023	0.033	0.034	0	0.273	0.084	0.06
Departure Headway (Hd)	5.954	5.159	5.943	5.44	4.737	5.174	4.906	5.912	5.41
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	600	692	601	656	753	0	732	605	660
Service Time	3.704	2.908	3.693	3.19	2.486	2.909	2.642	3.661	3.159
HCM Lane V/C Ratio	0.042	0.075	0.023	0.034	0.035	0	0.273	0.084	0.061
HCM Control Delay	9	8.3	8.8	8.4	7.7	7.9	9.5	9.2	8.5
HCM Lane LOS	A	A	A	A	A	N	A	A	A
HCM 95th-tile Q	0.1	0.2	0.1	0.1	0.1	0	1.1	0.3	0.2

Intersection												
Int Delay, s/veh	6.8											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕		↕	↕			↕			↕	
Traffic Vol, veh/h	13	77	0	3	34	33	1	46	3	79	62	12
Future Vol, veh/h	13	77	0	3	34	33	1	46	3	79	62	12
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	0	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	14	84	0	3	37	36	1	50	3	86	67	13

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	336	301	74	342	306	52	80	0	0	53	0	0
Stage 1	246	246	-	54	54	-	-	-	-	-	-	-
Stage 2	90	55	-	288	252	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	618	612	988	612	608	1016	1518	-	-	1553	-	-
Stage 1	758	703	-	958	850	-	-	-	-	-	-	-
Stage 2	917	849	-	720	698	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	541	576	988	520	572	1016	1518	-	-	1553	-	-
Mov Cap-2 Maneuver	541	576	-	520	572	-	-	-	-	-	-	-
Stage 1	757	662	-	957	849	-	-	-	-	-	-	-
Stage 2	845	848	-	592	658	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	12.6		10.6		0.1		3.8	
HCM LOS	B		B					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1518	-	-	571	520	729	1553	-	-
HCM Lane V/C Ratio	0.001	-	-	0.171	0.006	0.1	0.055	-	-
HCM Control Delay (s)	7.4	0	-	12.6	12	10.5	7.5	0	-
HCM Lane LOS	A	A	-	B	B	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.6	0	0.3	0.2	-	-

Intersection						
Int Delay, s/veh	0.3					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔		↔	↑	↑	
Traffic Vol, veh/h	2	3	6	150	108	0
Future Vol, veh/h	2	3	6	150	108	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	0	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	2	3	7	163	117	0

Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	293	117	117	0	-	0
Stage 1	117	-	-	-	-	-
Stage 2	176	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	698	935	1471	-	-	-
Stage 1	908	-	-	-	-	-
Stage 2	855	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	695	935	1471	-	-	-
Mov Cap-2 Maneuver	695	-	-	-	-	-
Stage 1	908	-	-	-	-	-
Stage 2	851	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	9.4	0.3	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1471	-	822	-	-
HCM Lane V/C Ratio	0.004	-	0.007	-	-
HCM Control Delay (s)	7.5	-	9.4	-	-
HCM Lane LOS	A	-	A	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-



Intersection	
Intersection Delay, s/veh	9.6
Intersection LOS	A

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↵	↵		↵	↶	↶	↵	↵		↵	↶	
Traffic Vol, veh/h	0	45	69	44	109	22	86	79	43	14	52	0
Future Vol, veh/h	0	45	69	44	109	22	86	79	43	14	52	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	49	75	48	118	24	93	86	47	15	57	0
Number of Lanes	1	1	0	1	1	1	1	1	0	1	1	0

Approach	SE	NW	NE	SW
Opposing Approach	NW	SE	SW	NE
Opposing Lanes	3	2	2	2
Conflicting Approach Left	SW	NE	SE	NW
Conflicting Lanes Left	2	2	2	3
Conflicting Approach Right	NE	SW	NW	SE
Conflicting Lanes Right	2	2	3	2
HCM Control Delay	9.5	9.5	9.7	9.4
HCM LOS	A	A	A	A

Lane	NELn1	NELn2	NWLn1	NWLn2	NWLn3	SELn1	SELn2	SWLn1	SWLn2
Vol Left, %	100%	0%	100%	0%	0%	0%	0%	100%	0%
Vol Thru, %	0%	65%	0%	100%	0%	100%	39%	0%	100%
Vol Right, %	0%	35%	0%	0%	100%	0%	61%	0%	0%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	86	122	44	109	22	0	114	14	52
LT Vol	86	0	44	0	0	0	0	14	0
Through Vol	0	79	0	109	0	0	45	0	52
RT Vol	0	43	0	0	22	0	69	0	0
Lane Flow Rate	93	133	48	118	24	0	124	15	57
Geometry Grp	8	8	8	8	8	8	8	8	8
Degree of Util (X)	0.158	0.197	0.082	0.187	0.033	0	0.19	0.028	0.095
Departure Headway (Hd)	6.203	5.452	6.28	5.777	5.072	5.938	5.51	6.54	6.036
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	581	662	574	624	710	0	656	550	596
Service Time	3.903	3.152	3.98	3.477	2.772	3.638	3.21	4.248	3.744
HCM Lane V/C Ratio	0.16	0.201	0.084	0.189	0.034	0	0.189	0.027	0.096
HCM Control Delay	10.1	9.5	9.5	9.8	7.9	8.6	9.5	9.4	9.4
HCM Lane LOS	B	A	A	A	A	N	A	A	A
HCM 95th-tile Q	0.6	0.7	0.3	0.7	0.1	0	0.7	0.1	0.3

**Intersection**

Int Delay, s/veh 7.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕		↕	↕			↕			↕	
Traffic Vol, veh/h	8	54	14	8	118	86	6	65	12	45	79	11
Future Vol, veh/h	8	54	14	8	118	86	6	65	12	45	79	11
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	0	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	9	59	15	9	128	93	7	71	13	49	86	12

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	391	287	92	317	286	77	98	0	0	84	0	0
Stage 1	190	190	-	90	90	-	-	-	-	-	-	-
Stage 2	201	97	-	227	196	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	568	623	965	636	623	984	1495	-	-	1513	-	-
Stage 1	812	743	-	917	820	-	-	-	-	-	-	-
Stage 2	801	815	-	776	739	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	417	599	965	562	599	984	1495	-	-	1513	-	-
Mov Cap-2 Maneuver	417	599	-	562	599	-	-	-	-	-	-	-
Stage 1	808	718	-	912	816	-	-	-	-	-	-	-
Stage 2	608	811	-	677	714	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	11.8		12.3		0.5		2.5	
HCM LOS	B		B					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1495	-	-	614	562	717	1513	-	-
HCM Lane V/C Ratio	0.004	-	-	0.135	0.015	0.309	0.032	-	-
HCM Control Delay (s)	7.4	0	-	11.8	11.5	12.3	7.5	0	-
HCM Lane LOS	A	A	-	B	B	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.5	0	1.3	0.1	-	-

**Appendix C:**  
**2019 Level of Service Output**  
**Total Traffic**

Intersection												
Int Delay, s/veh	51.7											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕	↕	↕	↕		↕	↕	
Traffic Vol, veh/h	1	14	6	111	11	99	1	176	135	122	150	1
Future Vol, veh/h	1	14	6	111	11	99	1	176	135	122	150	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	0	0	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	50	50	50	92	92	50	50	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	15	7	222	22	198	1	191	270	244	163	1

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	991	1115	164	990	980	326	164	0	0	461	0	0
Stage 1	652	652	-	328	328	-	-	-	-	-	-	-
Stage 2	339	463	-	662	652	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	225	208	881	225	250	715	1414	-	-	1100	-	-
Stage 1	457	464	-	685	647	-	-	-	-	-	-	-
Stage 2	676	564	-	451	464	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	124	162	881	~ 172	194	715	1414	-	-	1100	-	-
Mov Cap-2 Maneuver	124	162	-	~ 172	194	-	-	-	-	-	-	-
Stage 1	457	361	-	685	647	-	-	-	-	-	-	-
Stage 2	472	564	-	334	361	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	24.5		150		0		5.5	
HCM LOS	C		F					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1414	-	-	207	174	715	1100	-	-
HCM Lane V/C Ratio	0.001	-	-	0.11	1.402	0.277	0.222	-	-
HCM Control Delay (s)	7.5	-	-	24.5	262	12	9.2	-	-
HCM Lane LOS	A	-	-	C	F	B	A	-	-
HCM 95th %tile Q(veh)	0	-	-	0.4	14.9	1.1	0.8	-	-

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

Intersection	
Intersection Delay, s/veh	10.7
Intersection LOS	B

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↵	↵		↵	↑	↗	↵	↵		↵	↑	
Traffic Vol, veh/h	7	146	71	13	20	92	23	89	20	53	87	56
Future Vol, veh/h	7	146	71	13	20	92	23	89	20	53	87	56
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	8	159	77	14	22	100	25	97	22	58	95	61
Number of Lanes	1	1	0	1	1	1	1	1	0	1	1	0

Approach	SE	NW	NE	SW
Opposing Approach	NW	SE	SW	NE
Opposing Lanes	3	2	2	2
Conflicting Approach Left	SW	NE	SE	NW
Conflicting Lanes Left	2	2	2	3
Conflicting Approach Right	NE	SW	NW	SE
Conflicting Lanes Right	2	2	3	2
HCM Control Delay	12	9.4	10.3	10.4
HCM LOS	B	A	B	B

Lane	NELn1	NELn2	NWLn1	NWLn2	NWLn3	SELn1	SELn2	SWLn1	SWLn2
Vol Left, %	100%	0%	100%	0%	0%	100%	0%	100%	0%
Vol Thru, %	0%	82%	0%	100%	0%	0%	67%	0%	61%
Vol Right, %	0%	18%	0%	0%	100%	0%	33%	0%	39%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	23	109	13	20	92	7	217	53	143
LT Vol	23	0	13	0	0	7	0	53	0
Through Vol	0	89	0	20	0	0	146	0	87
RT Vol	0	20	0	0	92	0	71	0	56
Lane Flow Rate	25	118	14	22	100	8	236	58	155
Geometry Grp	8	8	8	8	8	8	8	8	8
Degree of Util (X)	0.047	0.201	0.027	0.038	0.156	0.014	0.38	0.106	0.251
Departure Headway (Hd)	6.751	6.118	6.816	6.31	5.601	6.544	5.807	6.596	5.816
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	530	586	525	567	640	547	620	544	617
Service Time	4.493	3.859	4.557	4.051	3.342	4.283	3.545	4.333	3.554
HCM Lane V/C Ratio	0.047	0.201	0.027	0.039	0.156	0.015	0.381	0.107	0.251
HCM Control Delay	9.8	10.4	9.7	9.3	9.4	9.4	12.1	10.1	10.5
HCM Lane LOS	A	B	A	A	A	A	B	B	B
HCM 95th-tile Q	0.1	0.7	0.1	0.1	0.6	0	1.8	0.4	1

Intersection												
Int Delay, s/veh	6.6											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕		↕	↕			↕			↕	
Traffic Vol, veh/h	13	78	18	40	35	33	16	100	33	80	129	12
Future Vol, veh/h	13	78	18	40	35	33	16	100	33	80	129	12
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	0	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	14	85	20	43	38	36	17	109	36	87	140	13

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	519	500	147	534	488	127	153	0	0	145	0	0
Stage 1	321	321	-	161	161	-	-	-	-	-	-	-
Stage 2	198	179	-	373	327	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	467	473	900	457	480	923	1428	-	-	1437	-	-
Stage 1	691	652	-	841	765	-	-	-	-	-	-	-
Stage 2	804	751	-	648	648	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	395	436	900	358	442	923	1428	-	-	1437	-	-
Mov Cap-2 Maneuver	395	436	-	358	442	-	-	-	-	-	-	-
Stage 1	682	609	-	830	755	-	-	-	-	-	-	-
Stage 2	724	741	-	510	605	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	15.2		13.6		0.8		2.8	
HCM LOS	C		B					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1428	-	-	470	358	592	1437	-	-
HCM Lane V/C Ratio	0.012	-	-	0.252	0.121	0.125	0.061	-	-
HCM Control Delay (s)	7.6	0	-	15.2	16.4	11.9	7.7	0	-
HCM Lane LOS	A	A	-	C	C	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	1	0.4	0.4	0.2	-	-

Intersection												
Int Delay, s/veh	4.1											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔	↔	↔	↔		↔	↔	
Traffic Vol, veh/h	2	3	3	38	4	34	6	152	32	26	110	0
Future Vol, veh/h	2	3	3	38	4	34	6	152	32	26	110	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	0	0	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	50	50	50	92	92	50	50	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	2	3	3	76	8	68	7	165	64	52	120	0

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	438	466	120	437	434	197	120	0	0	229	0	0
Stage 1	224	224	-	210	210	-	-	-	-	-	-	-
Stage 2	214	242	-	227	224	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	529	494	931	530	515	844	1468	-	-	1339	-	-
Stage 1	779	718	-	792	728	-	-	-	-	-	-	-
Stage 2	788	705	-	776	718	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	464	473	931	508	493	844	1468	-	-	1339	-	-
Mov Cap-2 Maneuver	464	473	-	508	493	-	-	-	-	-	-	-
Stage 1	775	690	-	788	725	-	-	-	-	-	-	-
Stage 2	713	702	-	740	690	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	11.3		11.8		0.2		2.4	
HCM LOS	B		B					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1468	-	-	577	507	844	1339	-	-
HCM Lane V/C Ratio	0.004	-	-	0.015	0.166	0.081	0.039	-	-
HCM Control Delay (s)	7.5	-	-	11.3	13.5	9.6	7.8	-	-
HCM Lane LOS	A	-	-	B	B	A	A	-	-
HCM 95th %tile Q(veh)	0	-	-	0	0.6	0.3	0.1	-	-

Intersection	
Intersection Delay, s/veh	9.9
Intersection LOS	A

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↵	↵		↵	↶	↶	↵	↵		↵	↶	
Traffic Vol, veh/h	2	46	70	45	111	38	87	93	44	16	68	17
Future Vol, veh/h	2	46	70	45	111	38	87	93	44	16	68	17
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	2	50	76	49	121	41	95	101	48	17	74	18
Number of Lanes	1	1	0	1	1	1	1	1	0	1	1	0

Approach	SE	NW	NE	SW
Opposing Approach	NW	SE	SW	NE
Opposing Lanes	3	2	2	2
Conflicting Approach Left	SW	NE	SE	NW
Conflicting Lanes Left	2	2	2	3
Conflicting Approach Right	NE	SW	NW	SE
Conflicting Lanes Right	2	2	3	2
HCM Control Delay	9.9	9.7	10.2	9.9
HCM LOS	A	A	B	A

Lane	NELn1	NELn2	NWLn1	NWLn2	NWLn3	SELn1	SELn2	SWLn1	SWLn2
Vol Left, %	100%	0%	100%	0%	0%	100%	0%	100%	0%
Vol Thru, %	0%	68%	0%	100%	0%	0%	40%	0%	80%
Vol Right, %	0%	32%	0%	0%	100%	0%	60%	0%	20%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	87	137	45	111	38	2	116	16	85
LT Vol	87	0	45	0	0	2	0	16	0
Through Vol	0	93	0	111	0	0	46	0	68
RT Vol	0	44	0	0	38	0	70	0	17
Lane Flow Rate	95	149	49	121	41	2	126	17	92
Geometry Grp	8	8	8	8	8	8	8	8	8
Degree of Util (X)	0.167	0.233	0.088	0.2	0.061	0.004	0.201	0.032	0.155
Departure Headway (Hd)	6.366	5.637	6.486	5.981	5.274	6.684	5.751	6.67	6.025
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	565	637	553	601	679	536	624	537	596
Service Time	4.094	3.365	4.214	3.709	3.003	4.418	3.485	4.403	3.758
HCM Lane V/C Ratio	0.168	0.234	0.089	0.201	0.06	0.004	0.202	0.032	0.154
HCM Control Delay	10.4	10.1	9.8	10.2	8.3	9.4	9.9	9.6	9.9
HCM Lane LOS	B	B	A	B	A	A	A	A	A
HCM 95th-tile Q	0.6	0.9	0.3	0.7	0.2	0	0.7	0.1	0.5



Intersection												
Int Delay, s/veh	7.6											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕		↕	↕			↕			↕	
Traffic Vol, veh/h	8	55	18	17	120	87	11	84	22	46	95	11
Future Vol, veh/h	8	55	18	17	120	87	11	84	22	46	95	11
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	0	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	9	60	20	18	130	95	12	91	24	50	103	12

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	449	348	109	376	342	103	115	0	0	115	0	0
Stage 1	209	209	-	127	127	-	-	-	-	-	-	-
Stage 2	240	139	-	249	215	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	520	576	945	581	580	952	1474	-	-	1474	-	-
Stage 1	793	729	-	877	791	-	-	-	-	-	-	-
Stage 2	763	782	-	755	725	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	371	550	945	504	554	952	1474	-	-	1474	-	-
Mov Cap-2 Maneuver	371	550	-	504	554	-	-	-	-	-	-	-
Stage 1	786	703	-	869	784	-	-	-	-	-	-	-
Stage 2	568	775	-	652	699	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	12.4		13		0.7		2.3	
HCM LOS	B		B					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1474	-	-	576	504	672	1474	-	-
HCM Lane V/C Ratio	0.008	-	-	0.153	0.037	0.335	0.034	-	-
HCM Control Delay (s)	7.5	0	-	12.4	12.4	13	7.5	0	-
HCM Lane LOS	A	A	-	B	B	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.5	0.1	1.5	0.1	-	-

**Appendix D:**  
**2040 Level of Service Output**  
**Total Traffic TWSC**

**Intersection**

Int Delay, s/veh 61.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕	↕	↕	↕		↕	↕	
Traffic Vol, veh/h	1	14	8	111	11	99	1	240	135	109	205	1
Future Vol, veh/h	1	14	8	111	11	99	1	240	135	109	205	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	0	0	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	50	50	50	92	92	50	50	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	15	9	222	22	198	1	261	270	218	223	1

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	1068	1192	223	1069	1058	396	224	0	0	531	0	0
Stage 1	659	659	-	398	398	-	-	-	-	-	-	-
Stage 2	409	533	-	671	660	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	199	187	817	~ 199	225	653	1345	-	-	1036	-	-
Stage 1	453	461	-	628	603	-	-	-	-	-	-	-
Stage 2	619	525	-	446	460	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	106	148	817	~ 152	178	653	1345	-	-	1036	-	-
Mov Cap-2 Maneuver	106	148	-	~ 152	178	-	-	-	-	-	-	-
Stage 1	453	364	-	628	603	-	-	-	-	-	-	-
Stage 2	415	525	-	334	363	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	25.3	195.7	0	4.6
HCM LOS	D	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1345	-	-	202 154 653	1036	-	-
HCM Lane V/C Ratio	0.001	-	-	0.124 1.584 0.303	0.21	-	-
HCM Control Delay (s)	7.7	-	-	25.3\$ 344.1 12.9	9.4	-	-
HCM Lane LOS	A	-	-	D F B	A	-	-
HCM 95th %tile Q(veh)	0	-	-	0.4 16.7 1.3	0.8	-	-

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

Intersection	
Intersection Delay, s/veh	13.2
Intersection LOS	B

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↵	↵		↵	↶	↶	↵	↵		↵	↶	
Traffic Vol, veh/h	7	200	97	18	28	111	32	99	28	70	101	56
Future Vol, veh/h	7	200	97	18	28	111	32	99	28	70	101	56
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	8	217	105	20	30	121	35	108	30	76	110	61
Number of Lanes	1	1	0	1	1	1	1	1	0	1	1	0

Approach	SE	NW	NE	SW
Opposing Approach	NW	SE	SW	NE
Opposing Lanes	3	2	2	2
Conflicting Approach Left	SW	NE	SE	NW
Conflicting Lanes Left	2	2	2	3
Conflicting Approach Right	NE	SW	NW	SE
Conflicting Lanes Right	2	2	3	2
HCM Control Delay	16.4	10.5	11.6	11.8
HCM LOS	C	B	B	B

Lane	NELn1	NELn2	NWLn1	NWLn2	NWLn3	SELn1	SELn2	SWLn1	SWLn2
Vol Left, %	100%	0%	100%	0%	0%	100%	0%	100%	0%
Vol Thru, %	0%	78%	0%	100%	0%	0%	67%	0%	64%
Vol Right, %	0%	22%	0%	0%	100%	0%	33%	0%	36%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	32	127	18	28	111	7	297	70	157
LT Vol	32	0	18	0	0	7	0	70	0
Through Vol	0	99	0	28	0	0	200	0	101
RT Vol	0	28	0	0	111	0	97	0	56
Lane Flow Rate	35	138	20	30	121	8	323	76	171
Geometry Grp	8	8	8	8	8	8	8	8	8
Degree of Util (X)	0.071	0.257	0.04	0.058	0.206	0.015	0.557	0.152	0.304
Departure Headway (Hd)	7.352	6.69	7.379	6.871	6.159	6.956	6.216	7.172	6.414
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	485	533	482	517	578	512	578	498	556
Service Time	5.139	4.476	5.172	4.663	3.951	4.73	3.99	4.953	4.195
HCM Lane V/C Ratio	0.072	0.259	0.041	0.058	0.209	0.016	0.559	0.153	0.308
HCM Control Delay	10.7	11.8	10.5	10.1	10.6	9.8	16.6	11.2	12
HCM Lane LOS	B	B	B	B	B	A	C	B	B
HCM 95th-tile Q	0.2	1	0.1	0.2	0.8	0	3.4	0.5	1.3

Intersection												
Int Delay, s/veh	8.5											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕		↕	↕			↕			↕	
Traffic Vol, veh/h	18	107	18	41	47	46	16	117	34	110	152	17
Future Vol, veh/h	18	107	18	41	47	46	16	117	34	110	152	17
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	0	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	20	116	20	45	51	50	17	127	37	120	165	18

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	645	613	174	662	603	146	184	0	0	164	0	0
Stage 1	414	414	-	180	180	-	-	-	-	-	-	-
Stage 2	231	199	-	482	423	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	385	408	869	375	413	901	1391	-	-	1414	-	-
Stage 1	616	593	-	822	750	-	-	-	-	-	-	-
Stage 2	772	736	-	565	588	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	299	364	869	254	369	901	1391	-	-	1414	-	-
Mov Cap-2 Maneuver	299	364	-	254	369	-	-	-	-	-	-	-
Stage 1	607	537	-	810	740	-	-	-	-	-	-	-
Stage 2	669	726	-	392	532	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	20.8		16.2		0.7		3.1	
HCM LOS	C		C					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1391	-	-	381	254	521	1414	-	-
HCM Lane V/C Ratio	0.013	-	-	0.408	0.175	0.194	0.085	-	-
HCM Control Delay (s)	7.6	0	-	20.8	22.2	13.6	7.8	0	-
HCM Lane LOS	A	A	-	C	C	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	1.9	0.6	0.7	0.3	-	-

Intersection												
Int Delay, s/veh	3.8											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕	↕	↕	↕		↕	↕	
Traffic Vol, veh/h	3	3	4	38	4	34	8	208	32	26	150	0
Future Vol, veh/h	3	3	4	38	4	34	8	208	32	26	150	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	0	0	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	50	50	50	92	92	50	50	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	3	3	4	76	8	68	9	226	64	52	163	0

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	546	574	163	546	542	258	163	0	0	290	0	0
Stage 1	267	267	-	275	275	-	-	-	-	-	-	-
Stage 2	279	307	-	271	267	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	448	429	882	448	447	781	1416	-	-	1272	-	-
Stage 1	738	688	-	731	683	-	-	-	-	-	-	-
Stage 2	728	661	-	735	688	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	389	409	882	427	426	781	1416	-	-	1272	-	-
Mov Cap-2 Maneuver	389	409	-	427	426	-	-	-	-	-	-	-
Stage 1	733	660	-	726	679	-	-	-	-	-	-	-
Stage 2	653	657	-	698	660	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	12.2		13		0.2		1.9	
HCM LOS	B		B					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1416	-	-	511	427	781	1272	-	-
HCM Lane V/C Ratio	0.006	-	-	0.021	0.197	0.087	0.041	-	-
HCM Control Delay (s)	7.6	-	-	12.2	15.5	10	8	-	-
HCM Lane LOS	A	-	-	B	C	B	A	-	-
HCM 95th %tile Q(veh)	0	-	-	0.1	0.7	0.3	0.1	-	-

Intersection	
Intersection Delay, s/veh	11.7
Intersection LOS	B

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↵	↵		↵	↶	↶	↵	↵		↵	↶	
Traffic Vol, veh/h	2	62	96	61	151	46	119	122	60	21	88	19
Future Vol, veh/h	2	62	96	61	151	46	119	122	60	21	88	19
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	2	67	104	66	164	50	129	133	65	23	96	21
Number of Lanes	1	1	0	1	1	1	1	1	0	1	1	0

Approach	SE	NW	NE	SW
Opposing Approach	NW	SE	SW	NE
Opposing Lanes	3	2	2	2
Conflicting Approach Left	SW	NE	SE	NW
Conflicting Lanes Left	2	2	2	3
Conflicting Approach Right	NE	SW	NW	SE
Conflicting Lanes Right	2	2	3	2
HCM Control Delay	12	11.4	12.1	11.3
HCM LOS	B	B	B	B

Lane	NELn1	NELn2	NWLn1	NWLn2	NWLn3	SELn1	SELn2	SWLn1	SWLn2
Vol Left, %	100%	0%	100%	0%	0%	100%	0%	100%	0%
Vol Thru, %	0%	67%	0%	100%	0%	0%	39%	0%	82%
Vol Right, %	0%	33%	0%	0%	100%	0%	61%	0%	18%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	119	182	61	151	46	2	158	21	107
LT Vol	119	0	61	0	0	2	0	21	0
Through Vol	0	122	0	151	0	0	62	0	88
RT Vol	0	60	0	0	46	0	96	0	19
Lane Flow Rate	129	198	66	164	50	2	172	23	116
Geometry Grp	8	8	8	8	8	8	8	8	8
Degree of Util (X)	0.249	0.34	0.13	0.3	0.081	0.004	0.306	0.047	0.218
Departure Headway (Hd)	6.922	6.185	7.083	6.576	5.866	7.346	6.404	7.374	6.742
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	517	578	504	543	607	485	558	483	529
Service Time	4.692	3.955	4.857	4.349	3.639	5.126	4.184	5.156	4.524
HCM Lane V/C Ratio	0.25	0.343	0.131	0.302	0.082	0.004	0.308	0.048	0.219
HCM Control Delay	12	12.1	10.9	12.2	9.2	10.2	12	10.5	11.4
HCM Lane LOS	B	B	B	B	A	B	B	B	B
HCM 95th-tile Q	1	1.5	0.4	1.3	0.3	0	1.3	0.1	0.8

Intersection												
Int Delay, s/veh	9.7											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕		↕	↕			↕			↕	
Traffic Vol, veh/h	11	75	23	19	164	119	13	108	27	62	124	15
Future Vol, veh/h	11	75	23	19	164	119	13	108	27	62	124	15
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	0	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	12	82	25	21	178	129	14	117	29	67	135	16

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	592	453	143	491	446	132	151	0	0	147	0	0
Stage 1	278	278	-	160	160	-	-	-	-	-	-	-
Stage 2	314	175	-	331	286	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	418	503	905	488	507	917	1430	-	-	1435	-	-
Stage 1	728	680	-	842	766	-	-	-	-	-	-	-
Stage 2	697	754	-	682	675	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	243	472	905	393	476	917	1430	-	-	1435	-	-
Mov Cap-2 Maneuver	243	472	-	393	476	-	-	-	-	-	-	-
Stage 1	720	645	-	833	758	-	-	-	-	-	-	-
Stage 2	453	746	-	550	641	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	15.1		17.1		0.7		2.4	
HCM LOS	C		C					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1430	-	-	475	393	597	1435	-	-
HCM Lane V/C Ratio	0.01	-	-	0.249	0.053	0.515	0.047	-	-
HCM Control Delay (s)	7.5	0	-	15.1	14.7	17.3	7.6	0	-
HCM Lane LOS	A	A	-	C	B	C	A	A	-
HCM 95th %tile Q(veh)	0	-	-	1	0.2	2.9	0.1	-	-



**Appendix E:  
Municipal School Transportation Assistance  
(MSTA) Worksheet**

# MSTA School Traffic Calculations

AM and PM Peak Traffic Estimates  
(These numbers do not reflect peak hour traffic volumes)

School Name: **Private / Non-urban Charter** Version: 102816

MSTA School Queue Input						Calculations				
Grade Level	Student Population	Number of Buses	Staff Members	Student Drivers	PM Total Vehicles	PM Peak Vehicles	Average Queue Length	Total AM Trips	Total PM Trips	High Demand Length
Pre-K & K	54	1	2		22	11	244	64	47	30% 317
1-10	436	1	16		128	49	1078	438	273	1401
11th										
12th										
Sum >>	540	2	18		150	60	1322	503	320	1719

Yes - If Pre-K & K students are provided parking spaces at or above their PM Peak Vehicles >>>>>>

Pre-K & K						
Direction	AM Trips Generated			PM Trips Generated		
	Parents	Buses	Staff	Parents	Buses	Staff
IN	30	1	2	22		22
OUT	30	1	31	22	1	25
			<b>64</b>		<b>PM Pre-K Trips</b>	<b>47</b>

1-10						
Direction	AM Trips Generated			PM Trips Generated		
	Parents	Buses	Staff	Parents	Buses	Staff
IN	211	1	16	128		128
OUT	211		211	128	1	145
			<b>438</b>		<b>PM K-10 Trips</b>	<b>273</b>

11th						
Direction	AM Trips Generated			PM Trips Generated		
	Parents	Buses	Staff	Parents	Buses	Staff
IN						
OUT						

12th						
Direction	AM Trips Generated			PM Trips Generated		
	Parents	Buses	Staff	Parents	Buses	Staff
IN						
OUT						

All AM TRIPS	In	261	Out	242	Total	503
--------------	----	-----	-----	-----	-------	-----

All PM TRIPS	In	150	Out	170	Total	320
--------------	----	-----	-----	-----	-------	-----

ADT	111
-----	-----

ADT	711
-----	-----

ADT	823
-----	-----

AM Cars / Student	PM Cars / Student	Avg. Car Length	PM At one Time
55.94%	39.15%	22.19	48.67%
43.35%	26.30%	22.00	37.87%
52.91%	47.50%	22.19	46.12%
50.08%	47.58%	22.83	55.71%

Pre-K & K loading is usually park and walk  
"PM Peak Vehicles" indicates minimum number of parking spaces needed.

Private & Non-Urban Charter data is based on few to no buses and uses the same percentages for all school types except 11th and 12th grades which makes adjustments for student drivers.

## NOTES

- Average Queue Length does not include an alternative traffic pattern required for high traffic demand days which is usually 30% additional length.
- Average Queue Length does not include the Student Loading Zone.
- Peak traffic volumes at schools normally occur within a 30-minute time period. (justifying a PHF of 0.5)

# Markup Summary

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Steve Kuehster (1)

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he proposed development will make the following  
Eastonville Rd/Motley Rd intersection at 2019 build-out:

Left Turn Lane, Shared Thru/Right Turn Lane  
Left Turn Lane, Shared Thru/Right Turn Lane  
Shared Right/Thru/Left Turn Lane, stop controlled  
Shared Thru/Left Turn Lane, Right Turn Lane, stop controlled  
Striping & [school zone speed control](#).

Rd/Motley Rd intersection improvements in the 2019 Short  
rdition and the 2040 Long Range total traffic condition, the  
; movements are expected to operate at LOS C or better with one  
soud shared left/through lane experiences internal traffic queue  
chood traffic patterns. In accordance with MSTFA the site traffic  
xdated internal to the site drive aisle.

↑ queue and delay experienced by the site exiting traffic can be

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& school zone speed control.