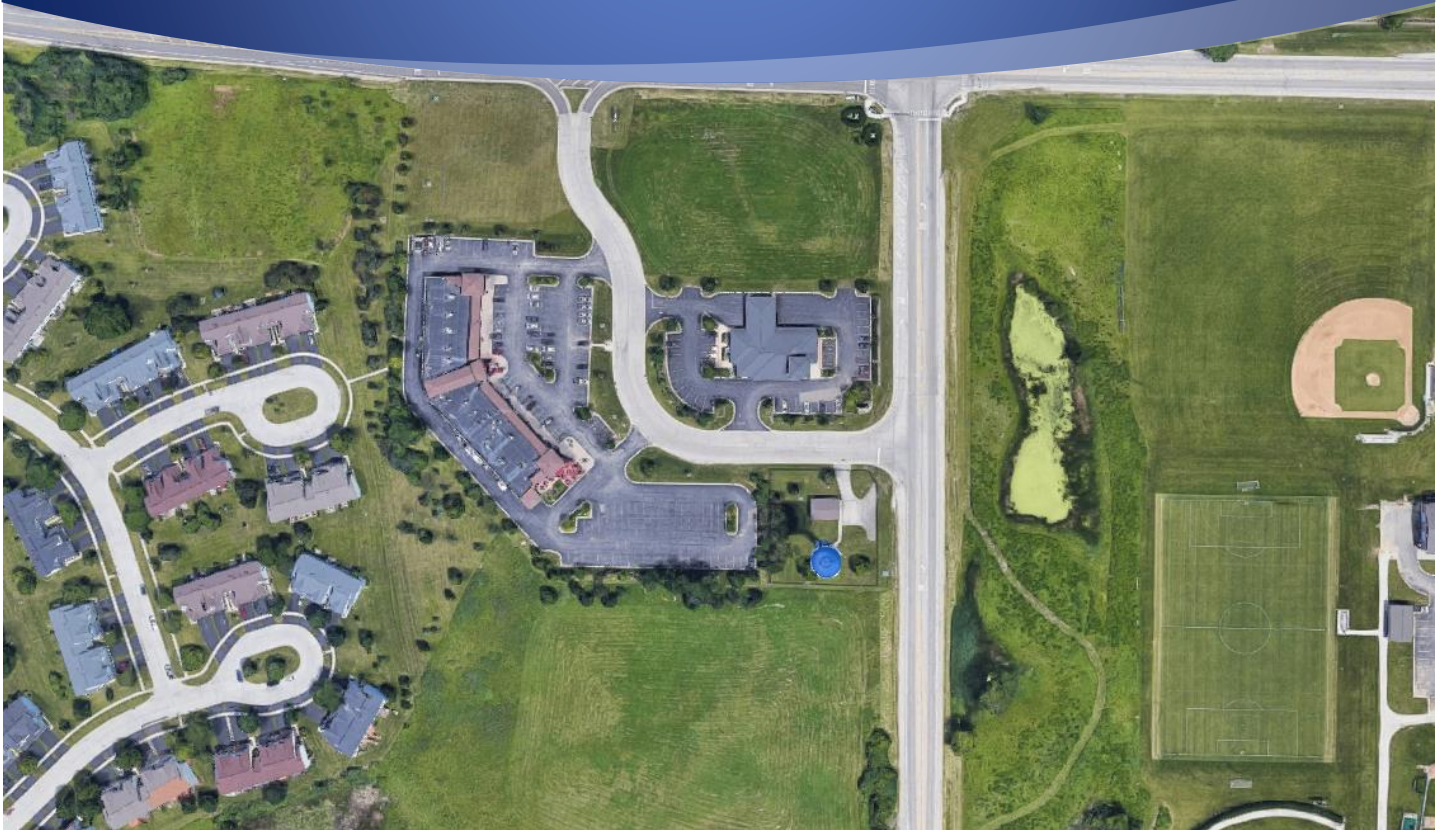


# Traffic Impact Study Proposed Mixed-Use Development

Lake Villa, Illinois



Prepared For:



Prepared By:



October 9, 2019

# 1. Introduction

This report summarizes the methodologies, results, and findings of a traffic impact study conducted by Kenig, Lindgren, O'Hara, Aboona, Inc. (KLOA, Inc.) for a proposed mixed-use development to be located in Lake Villa, Illinois. The site, which is currently vacant, is to consist of two parcels located in the southwest quadrant of the intersection of Deep Lake Road with Grass Lake Road divided by Tower Drive and the Lake Tower Crossings retail center. As proposed, the northern parcel will contain a full-service fuel center with 12 fueling positions, an approximate 3,900 square-foot convenience store, an approximate 1,000 square-foot coffee shop with a drive-through window, and a multi-tenant retail building consisting of an approximate 1,500 square-foot quick service restaurant with drive-through window and approximately 3,020 square feet of retail space. The southern parcel will contain 89 apartment units in six buildings including 60 two-bedroom apartments and 29 one-bedroom apartments, and a multi-tenant retail building consisting of an approximate 2,000 square-foot quick service restaurant with drive-through window and approximately 5,270 square feet of retail space. Access to the development will be provided via Tower drive, which provides a right-in/right-out access off Grass Lake Road and a full movement access off Deep Lake Road.

The purpose of this study was to examine background traffic conditions, assess the impact that the proposed development will have on traffic conditions in the area, and determine if any roadway or access improvements are necessary to accommodate the traffic generated by the proposed development.

**Figure 1** shows the location of the site in relation to the area roadway system. **Figure 2** shows an aerial view of the site.

The sections of this report present the following:

- Existing roadway conditions
- A description of the proposed development
- Directional distribution of the development traffic
- Vehicle trip generation for the development
- Future traffic conditions including access to the development
- Traffic analyses for the weekday morning and weekday evening peak hours
- Recommendations with respect to adequacy of the site access and adjacent roadway system

Traffic capacity analyses were conducted for the weekday morning and weekday evening peak hours for the following conditions:

1. Existing Conditions – Analyze the capacity of the existing roadway system using existing peak hour traffic volumes in the surrounding area.
2. Projected Conditions – Analyze the capacity of the future roadway system using the projected traffic volumes that include the existing traffic volumes, ambient traffic growth, and the traffic estimated to be generated by the full buildout of the proposed development.



**Site Location**

**Figure 1**





Aerial View of Site

Figure 2

## 2. Existing Conditions

Existing transportation conditions in the vicinity of the site were documented based on field visits conducted by KLOA, Inc. in order to obtain a database for projecting future conditions. The following provides a description of the geographical location of the site, physical characteristics of the area roadway system including lane usage and traffic control devices, and existing peak hour traffic volumes.

### Site Location

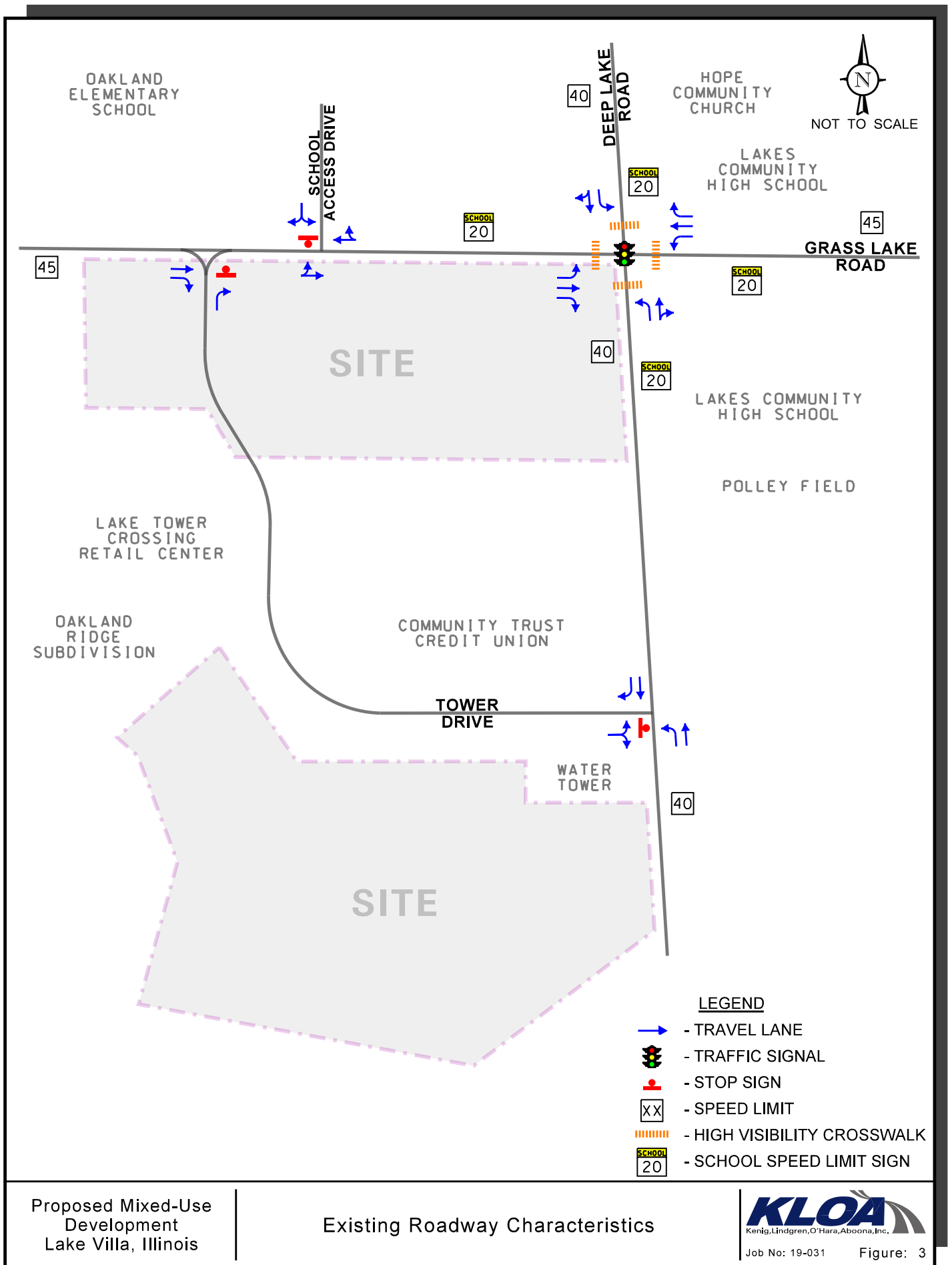
The site, which is currently vacant, is located in the southwest quadrant of the intersection of Grass Lake Road with Deep Lake Road and is divided into two parcels by Tower Drive and the Tower Crossings retail center. Land uses in the vicinity of the site include Oakland Elementary School to the north, Lake Community High School to the east, and the Oakland Ridge subdivision to the west and south.

### Existing Roadway System Characteristics

The characteristics of the existing roadways near the development are described below and illustrated in **Figure 3**.

*Grass Lake Road* is an east-west minor arterial that in the vicinity of the site provides one through lane in each direction. At its signalized intersection with Deep Lake Road, Grass Lake Road provides an exclusive left-turn lane, a through lane, and an exclusive right-turn lane on both approaches. Additionally, Grass Lake Road provides high visibility crosswalks on both legs of its intersection with Deep Lake Road. At its unsignalized intersection with Tower Drive, Grass Lake Road provides an exclusive right-turn lane and one through lane on the eastbound approach and one through lane on the westbound approach. Grass Lake Road is under the jurisdiction of the Lake County Division of Transportation (LCDOT) and carries an annual average daily traffic (AADT) volume of 8,750 vehicles west of Deep Lake Road and 7,300 vehicles east of Deep Lake Road (IDOT AADT 2015). Grass Lake Road has a posted speed limit of 45 miles per hour and has a posted school zone speed limit of 20 miles per hour throughout the study area.

*Deep Lake Road* is a north-south minor arterial that in the vicinity of the site provides one through lane in each direction. At its signalized intersection with Grass Lake Road, Deep Lake Road provides an exclusive left-turn lane and a combined through/right-turn lane on both approaches. Additionally, Deep Lake Road provides high visibility crosswalks on both legs of its intersection with Grass Lake Road. At its unsignalized intersection with Tower Drive, Deep Lake Road provides an exclusive left-turn lane and a through lane on the northbound approach and an exclusive right-turn lane and a through lane on the southbound approach. Deep Lake Road is under the jurisdiction of LCDOT and carries an AADT volume of 7,900 vehicles north of Grass Lake Road and 7,200 vehicles south of Grass Lake Road (IDOT AADT 2015). Deep Lake Road has a posted speed limit of 40 miles per hour and has a posted school zone speed limit of 20 miles per hour north of Grass Lake Road.



Proposed Mixed-Use  
Development  
Lake Villa, Illinois

## Existing Roadway Characteristics

*Tower Drive* is a local roadway that extends between Grass Lake Road to the north and Deep Lake Road to the east. At its unsignalized intersection with Grass Lake Road, Tower Drive is physically restricted to right-in/right-out movements only with outbound movements under stop sign control. At its unsignalized intersection with Deep Lake Road, Tower Drive provides a combined left-turn/right-turn lane on the eastbound approach that is under stop sign control. Tower Drive is under the jurisdiction of the Village of Lake Villa and has no posted speed limit.

## Existing Traffic Volumes

In order to determine current traffic conditions in the vicinity of the site, KLOA, Inc. conducted peak period traffic counts utilizing Miovision Scout Collection Units on Tuesday, March 19, 2019 during the weekday morning (7:00 to 9:00 A.M.) and evening (2:30 to 6:00 P.M.) peak periods at the following intersections:

- Grass Lake Road with Deep Lake Road
- Grass Lake Road with Tower Drive
- Deep Lake Road with Tower Drive

The results of the traffic counts indicated that the weekday morning peak hour of traffic occurs from 7:00 A.M. to 8:00 A.M. and the weekday evening peak hour of traffic occurs from 4:45 P.M. to 5:45 P.M. **Figure 4** illustrates the existing peak hour traffic volumes. Copies of the traffic count summary sheets are included in the Appendix.

## Crash Analysis

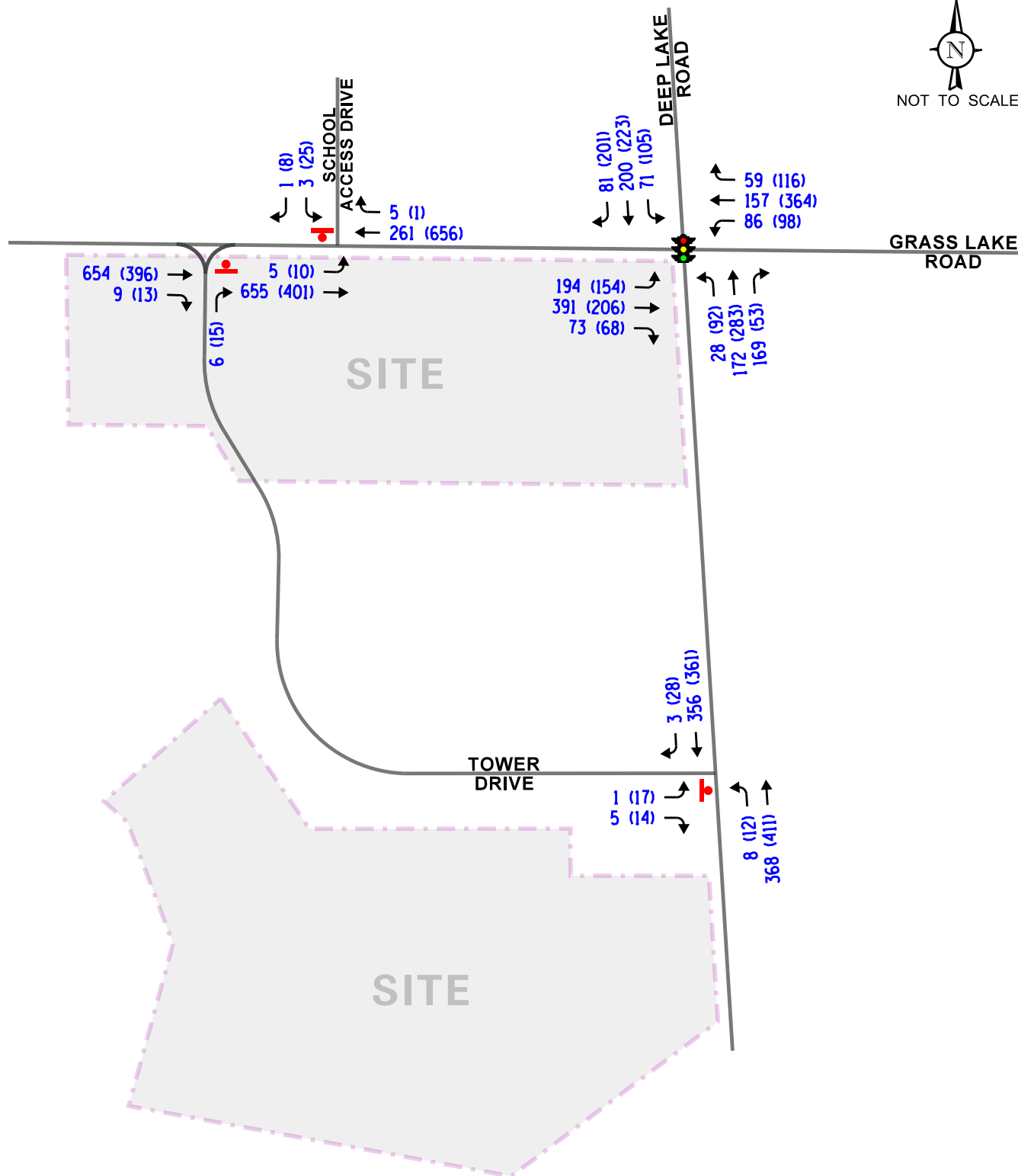
KLOA, Inc. obtained crash data<sup>1</sup> for the most recent available past five years (2013 to 2017) for the intersection of Grass Lake Road with Deep Lake Road. **Table 1** summarizes the crash data for the intersection. A review of the crash data indicated that no fatalities were reported at this intersection between 2013 and 2017.

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<sup>1</sup> IDOT DISCLAIMER: The motor vehicle crash data referenced herein was provided by the Illinois Department of Transportation. Any conclusions drawn from analysis of the aforementioned data are the sole responsibility of the data recipient(s). Additionally, for coding years 2015 to present, the Bureau of Data Collection uses the exact latitude/longitude supplied by the investigating law enforcement agency to locate crashes. Therefore, location data may vary in previous years since data prior to 2015 was physically located by bureau personnel.



NOT TO SCALE



LEGEND

00 - AM PEAK HOUR (7:00-8:00 AM)

(00) - PM PEAK HOUR (4:45-5:45 PM)

Proposed Mixed-Use  
Development  
Lake Villa, Illinois

Existing Traffic Volumes



Job No: 19-031

Figure: 4



Table 1

## GRASS LAKE ROAD WITH DEEP LAKE ROAD - CRASH SUMMARY

Year	Type of Accident Frequency						Total
	Angle	Object	Rear End	Sideswipe	Turning	Other	
2013	0	0	0	0	0	0	0
2014	1	0	2	0	0	0	3
2015	0	0	0	0	0	0	0
2016	0	0	0	0	0	0	0
2017	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>
<b>Total</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>Average/Year</b>	<b>&lt;1.0</b>	<b>0</b>	<b>&lt;1.0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>&lt;1.0</b>

### 3. Traffic Characteristics of the Proposed Development

In order to properly evaluate future traffic conditions in the surrounding area, it was necessary to determine the traffic characteristics of the proposed development, including the directional distribution and volumes of traffic that it will generate.

#### Proposed Site and Development Plan

As proposed, the north and south parcels will be developed to contain the following uses:

##### North Parcel:

- A full-service fuel center with 12 fueling positions, an approximate 3,900 square-foot convenience store and an approximate 1,000 square-foot coffee shop with a drive-through
- A multi-tenant retail building consisting of an approximate 1,500 square-foot quick service restaurant with a drive-through and approximately 3,020 square feet of retail space

##### South Parcel:

- Six low-rise buildings with a total of 89 apartment units
- A multi-tenant retail building consisting of an approximate 2,000 square-foot quick service restaurant with a drive-through and approximately 5,270 square feet of retail space

Access to the development will be provided internally via Tower Drive which provides a connection to the area roadway system as follows:

- *Tower Drive/Grass Lake Road.* Tower Drive's intersection with Grass Lake Road is located approximately 415 feet west of Deep Lake Road and will continue to provide one inbound lane and one outbound lane signed and physically restricted to right-turn movements only. An eastbound right-turn lane is provided on Grass Lake Road at this intersection.
- *Tower Drive/Deep Lake Road.* This intersection is located approximately 450 feet south of Grass Lake Road. A southbound right-turn lane and a northbound left-turn lane are currently provided on Deep Lake Road serving this intersection. Tower Drive will continue to provide one inbound lane and one outbound lane with outbound movements under stop sign control.

A site plan depicting the proposed development layout and access is included in the Appendix.

## Directional Distribution

The directions from which residents, patrons, and employees will approach and depart the site were estimated based on existing travel patterns, as determined from the traffic counts. **Figure 5** illustrates the directional distribution of the development-generated traffic.

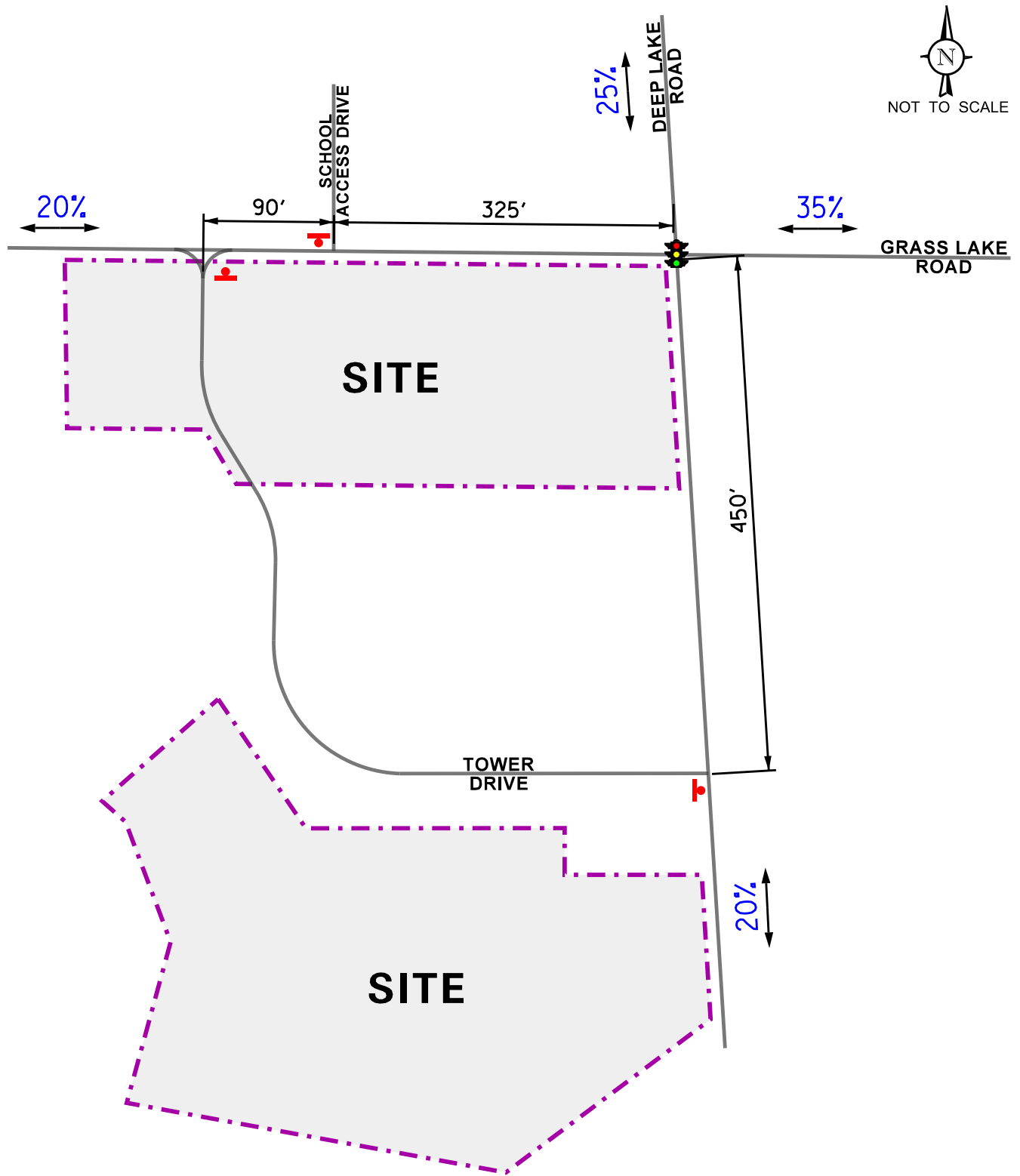
## Peak Hour Traffic Volumes

The number of peak hour trips estimated to be generated by the proposed development was based on vehicle trip generation rates contained in *Trip Generation Manual*, 10<sup>th</sup> Edition, published by the Institute of Transportation Engineers (ITE). As previously indicated, the site will be developed with a gas station with a convenience store, a multi-tenant building including a quick service restaurant with a drive-through window and retail space, apartments, and a multi-tenant building containing a coffee shop with a drive-through window and retail space.

The “Multifamily Housing (Low-Rise)” (Land-Use Code 220) rate was used for the 89 apartments units. The “Gas Station with Convenience Store” (Land-Use Code 945) rate was used for the passenger vehicle fueling positions. Based on the description provided by ITE, this land use includes convenience stores. As such, this rate was utilized for the proposed gas station and the proposed convenience store. The “Fast Food Restaurant with Drive-Through Window” (Land-Use Code 934) was used for the quick service restaurant with drive-through window, the “Coffee/Donut Shop with Drive-Through Window” (Land-Use Code 934) was used for the coffee shop with drive-through window and the “Shopping Center” (Land-Use Code 820) was utilized for the proposed retail space. It is important to note that surveys conducted by ITE have shown that approximately 60, 50 and 70 percent of trips made to gas stations, fast-food and coffee shops, respectively, are diverted from the existing traffic on the roadway system. This is particularly true during the weekday morning and evening peak hours when traffic is diverted from the home-to-work and work-to-home trips. Such diverted trips are referred to as pass-by traffic. As such, these pass-by percentages were applied to the trips estimated to be generated by these uses.

Furthermore, given the various types of uses proposed for the development, it is expected that the number of trips will be reduced due the potential interaction between the various uses. As such, a 10 percent interaction reduction was applied to the projected trip generation estimates.

**Table 2** summarizes the number of trips estimated to be generated by the proposed development.



#### LEGEND

00% - PERCENT DISTRIBUTION

00' - DISTANCE IN FEET

Proposed Mixed-Use  
Development  
Lake Villa, Illinois

Estimated Directional Distribution

**KLOA**  
Kenig, Lindgren, O'Hara, Aboona, Inc.  
Job No: 19-031 Figure: 5



Table 2

## ESTIMATED PEAK HOUR SITE-GENERATED TRAFFIC VOLUMES

ITE Land -Use Code	Type/Size	Weekday Morning Peak Hour			Weekday Evening Peak Hour			Daily Two- Way Trips
		In	Out	Total	In	Out	Total	
Northern Parcel								
945	Gas Station with Convenience Store (12 fueling positions)	76	74	150	86	82	168	2,464
937	Coffee Shop with Drive-Through Window (1,000 s.f.)	45	44	89	22	22	44	820
820	Retail Space (3,020 s.f.)	2	1	3	6	6	12	114
934	Fast Food Restaurant with Drive-Through Window (1,500 s.f.)	<u>31</u>	<u>29</u>	<u>60</u>	<u>25</u>	<u>24</u>	<u>49</u>	<u>706</u>
	Subtotal	154	148	302	139	134	273	4,104
	10% Internal Capture	-15	-15	-30	-14	-13	-27	-410
	60% Pass-By Reduction (Gas Station with Convenience Store)	-45	-45	-90	-50	-50	-100	-1,478
	70% Pass-By Reduction (Coffee Shop with Drive Through Window)	-31	-31	-62	-15	-15	-30	-574
	50% Pass-By Reduction (Fast Food Restaurant with Drive-Through Window)	<u>-15</u>	<u>-15</u>	<u>-30</u>	<u>-12</u>	<u>-12</u>	<u>-24</u>	<u>-353</u>
	Subtotal Pass-By Trips	-91	-91	-182	-77	-77	-154	-2,405
	Subtotal New Trips	48	42	90	48	44	92	1289
Southern Parcel								
220	Multifamily Housing (Low-Rise) (89 units)	10	33	43	33	20	53	652
820	Retail Space (5,270 s.f.)	3	2	5	10	10	20	119
934	Fast Food Restaurant with Drive-Through Window (2,000 s.f.)	<u>41</u>	<u>39</u>	<u>80</u>	<u>34</u>	<u>31</u>	<u>65</u>	<u>942</u>
	Subtotal	54	74	128	77	61	138	1,713
	10% Internal Capture	-5	-7	-12	-8	-6	-14	-172
	50% Pass-By Reduction (Fast Food Restaurant with Drive-Through Window)	<u>-20</u>	<u>-20</u>	<u>-40</u>	<u>-16</u>	<u>-16</u>	<u>-32</u>	<u>-471</u>
	Subtotal Pass-By Trips	-20	-20	-40	-16	-16	-32	-471
	Subtotal New Trips	<u>29</u>	<u>47</u>	<u>76</u>	<u>53</u>	<u>39</u>	<u>92</u>	<u>1,070</u>
	Total Pass-By Trips	-111	-111	-222	-93	-93	-186	-2,876
	Total New Trips	77	89	166	101	83	184	2,359
	Total Development Trips	188	200	388	194	176	370	5,235

## 4. Projected Traffic Conditions

The total projected traffic volumes include the existing traffic volumes, increase in background traffic due to growth, and the traffic estimated to be generated by the proposed subject development.

### Development Traffic Assignment

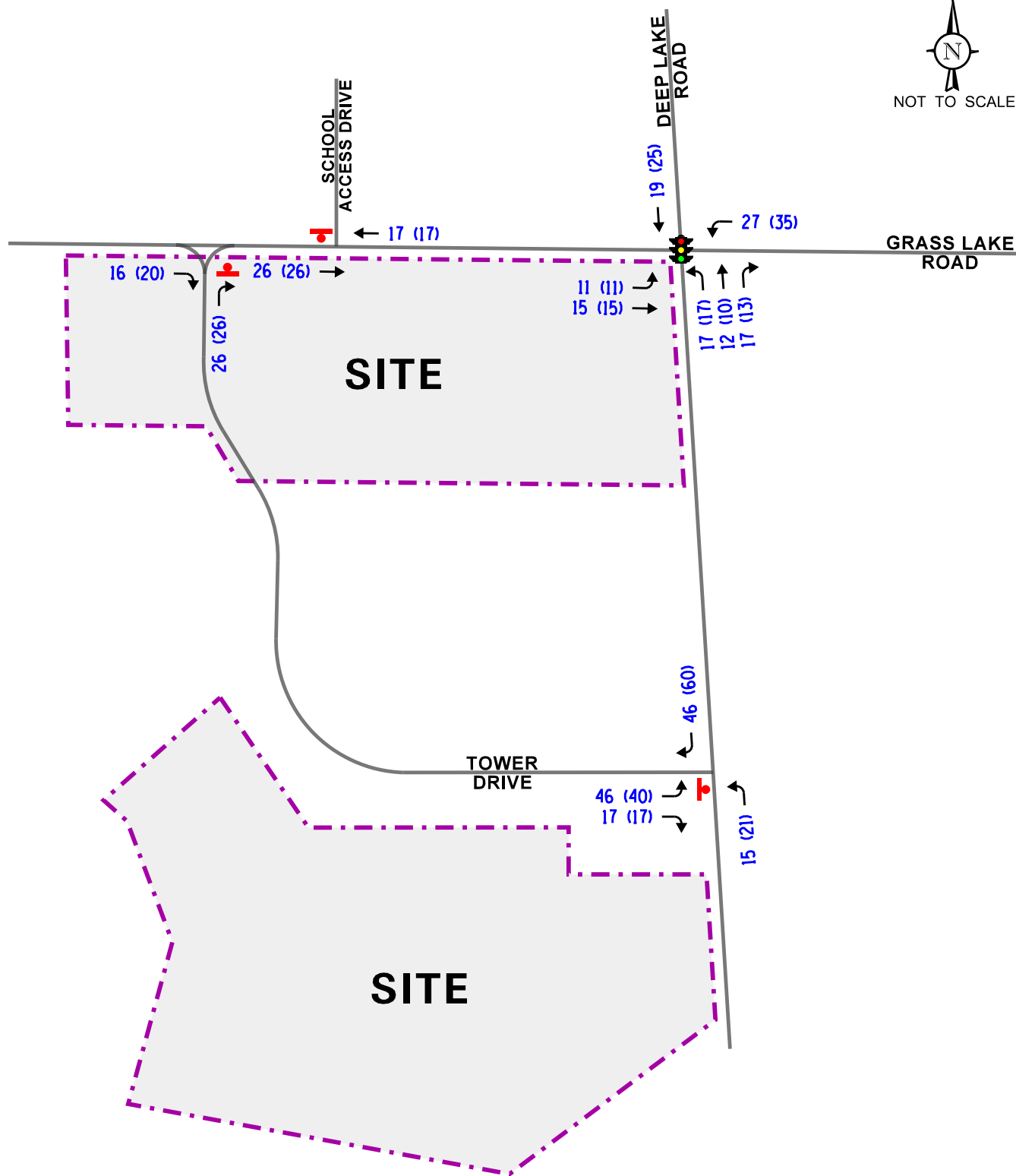
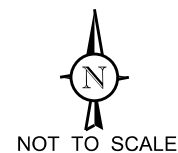
The estimated weekday morning and weekday evening peak hour traffic volumes that will be generated by the proposed development were assigned to the roadway system in accordance with the previously described directional distribution (Figure 5). **Figure 6** illustrates the traffic assignment of the new passenger vehicle trips and **Figure 7** illustrates the traffic assignment of the pass-by passenger vehicle trips.

### Background Traffic Conditions

The existing traffic volumes (Figure 4) were increased by a regional growth factor to account for the increase in existing traffic related to regional growth in the area (i.e., not attributable to any particular planned development). Per Lake County regulations, the existing volumes were increased by three percent per year for two years in order to reflect Year 2021 conditions.

### Total Projected Traffic Volumes

The new and pass-by development-generated traffic (Figures 6 and 7) was added to the existing traffic volumes taking into account background growth to determine the Year 2021 total projected traffic volumes. **Figure 8** illustrates the Year 2021 total projected traffic volumes.



#### LEGEND

- 00 - AM PEAK HOUR (7:00-8:00 AM)
- (00) - PM PEAK HOUR (4:45-5:45 PM)

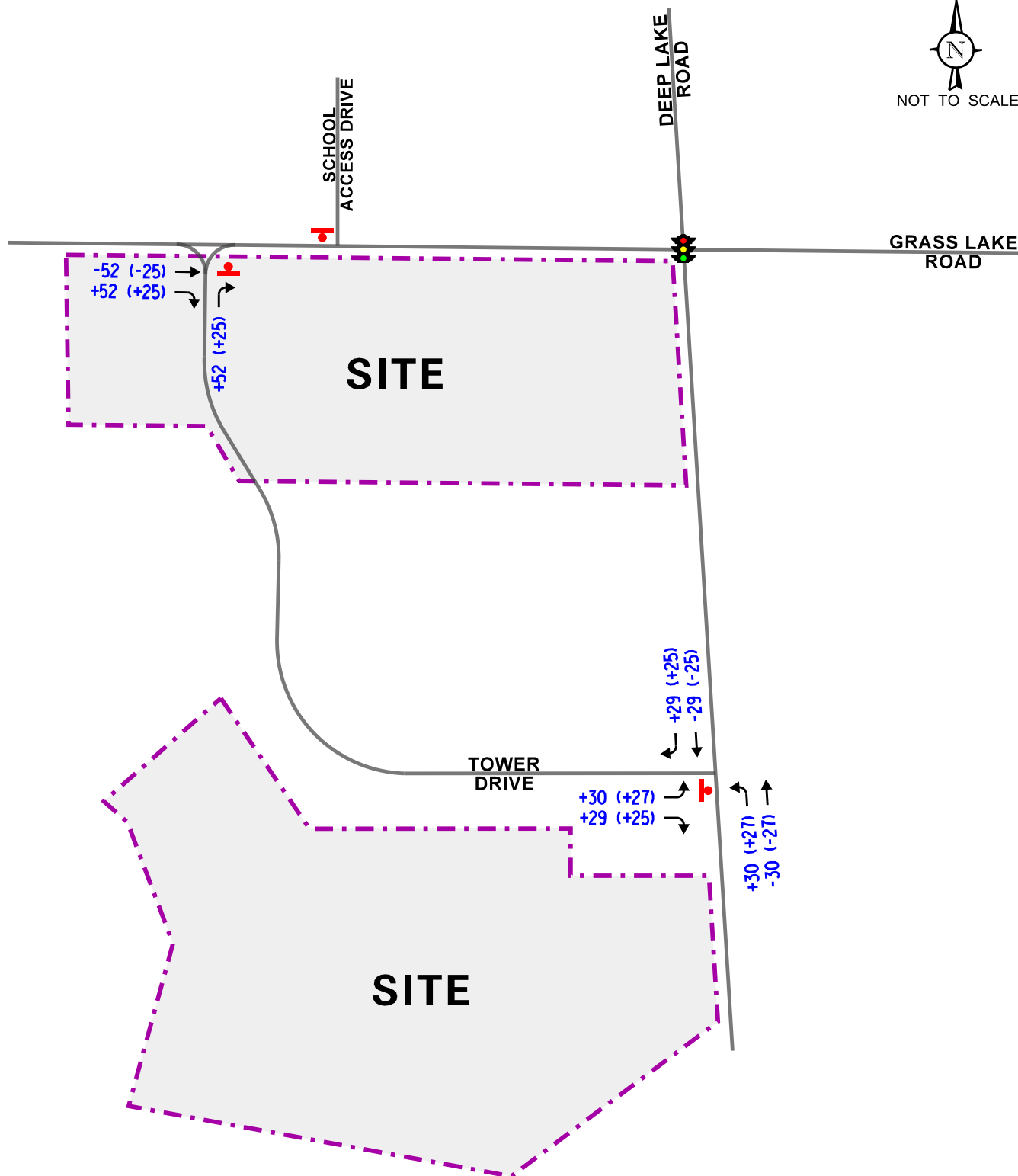
Proposed Mixed-Use  
Development  
Lake Villa, Illinois

#### New Site Traffic Assignment

**KLOA**  
Kenig, Lindgren, O'Hara, Aboona, Inc.  
Job No: 19-031 Figure: 6



NOT TO SCALE



LEGEND

- 00 - AM PEAK HOUR (7:00-8:00 AM)
- (00) - PM PEAK HOUR (4:45-5:45 PM)

Proposed Mixed-Use  
Development  
Lake Villa, Illinois

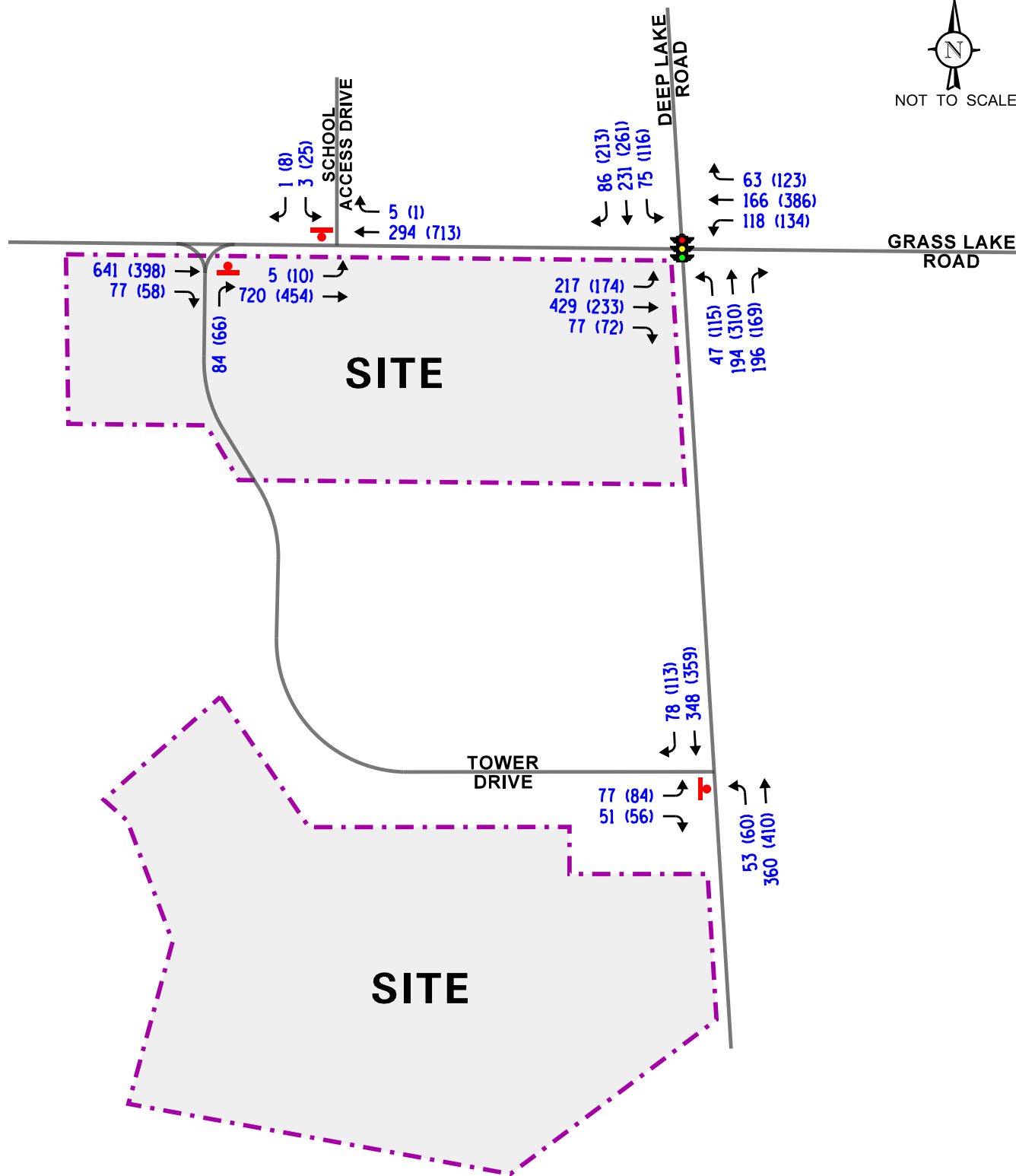
Pass-By Traffic Assignment

**KLOA**  
Kenig, Lindgren, O'Hara, Aboona, Inc.  
Job No: 19-031 Figure: 7





NOT TO SCALE



LEGEND

00 - AM PEAK HOUR (7:00-8:00 AM)

(00) - PM PEAK HOUR (4:45-5:45 PM)

Proposed Mixed-Use  
Development  
Lake Villa, Illinois

Year 2021 Total Projected Traffic Volumes



Job No: 19-031

Figure: 8

## 5. Traffic Analysis and Recommendations

The following provides an evaluation conducted for the weekday morning and weekday evening peak hours. The analysis includes conducting capacity analyses to determine how well the roadway system and access drives are projected to operate and whether any roadway improvements or modifications are required.

### Traffic Analyses

Roadway and adjacent or nearby intersection analyses were performed for the weekday morning and weekday evening peak hours for the existing (Year 2019) and Year 2021 total projected traffic volumes.

The traffic analyses were performed using the methodologies outlined in the Transportation Research Board's *Highway Capacity Manual (HCM)*, 6<sup>th</sup> Edition and analyzed using the Synchro/SimTraffic 10 software. The analysis for the traffic-signal controlled intersections were accomplished using actual cycle lengths, phasings, and offsets to determine the average overall vehicle delay and levels of service.

The analyses for the unsignalized intersections determine the average control delay to vehicles at an intersection. Control delay is the elapsed time from a vehicle joining the queue at a stop sign (includes the time required to decelerate to a stop) until its departure from the stop sign and resumption of free flow speed. The methodology analyzes each intersection approach controlled by a stop sign and considers traffic volumes on all approaches and lane characteristics.

The ability of an intersection to accommodate traffic flow is expressed in terms of level of service, which is assigned a letter from A to F based on the average control delay experienced by vehicles passing through the intersection. The *Highway Capacity Manual* definitions for levels of service and the corresponding control delay for signalized intersections and unsignalized intersections are included in the Appendix of this report.

Summaries of the traffic analysis results showing the level of service and overall intersection delay (measured in seconds) for the existing and total projected conditions are presented in **Tables 3** through **5**. A discussion of each intersection follows. Summary sheets for the capacity analyses are included in the Appendix.

Table 3

## CAPACITY ANALYSIS RESULTS – GRASS LAKE ROAD WITH DEEP LAKE ROAD - SIGNALIZED

	Peak Hour	Eastbound			Westbound			Northbound		Southbound		Overall
		L	T	R	L	T	R	L	T/R	L	T/R	
Year 2019 Existing Traffic Volumes	Weekday Morning Peak Hour	B 14.6	C 29.4	A 1.4	B 13.6	C 24.2	A 0.4	B 17.3	E 56.5	C 21.3	D 36.2	C 30.3
		C – 21.9			B – 16.6			D – 53.5		C – 33.2		
	Weekday Evening Peak Hour	B 15.9	C 23.6	A 0.8	B 13.1	C 29.9	A 4.5	C 21.5	D 39.9	B 19.9	D 51.4	C 30.2
		B – 17.2			C – 22.0			D – 35.9		D – 45.2		
Year 2021 Projected Traffic Volumes	Weekday Morning Peak Hour	B 16.3	D 39.3	A 1.8	B 17.6	C 25.5	A 0.8	B 18.2	E 59.6	C 22.2	D 42.5	C 34.8
		C – 28.4			B – 18.3			E – 55.2		D – 38.6		
	Weekday Evening Peak Hour	B 19.0	C 26.7	A 1.3	B 14.5	C 34.4	A 5.1	C 23.0	D 44.5	C 20.6	E 69.9	D 36.5
		C – 20.1			C – 24.6			D – 39.4		E – 60.6		
Letter denotes Level of Service Delay is measured in seconds.		L – Left Turns T – Through			R – Right Turns							

Table 4  
CAPACITY ANALYSIS RESULTS  
EXISTING CONDITIONS – UNSIGNALIZED

Intersection	Weekday Morning Peak Hour		Weekday Evening Peak Hour	
	LOS	Delay	LOS	Delay
<b>Grass Lake Road with Tower Drive and the Easterly Oakland Elementary Access Drive</b>				
• Eastbound Left Turns	A	7.9	A	9.2
• Northbound Approach	B	14.3	B	11.0
• Southbound Approach	A	9.8	B	13.8
<b>Deep Lake Road with Tower Drive</b>				
• Eastbound Approach	B	12.4	B	14.1
• Northbound Left Turns	A	8.4	B	8.1
LOS = Level of Service Delay is measured in seconds.				

Table 5  
CAPACITY ANALYSIS RESULTS  
PROJECTED CONDITIONS – UNSIGNALIZED

Intersection	Weekday Morning Peak Hour		Weekday Evening Peak Hour	
	LOS	Delay	LOS	Delay
<b>Grass Lake Road with Tower Drive and the Easterly Oakland Elementary Access Drive</b>				
• Eastbound Left Turns	A	7.9	A	9.4
• Northbound Approach	C	16.7	B	11.6
• Southbound Approach	C	17.2	C	20.3
<b>Deep Lake Road with Tower Drive</b>				
• Eastbound Approach	D	27.8	C	21.9
• Northbound Left Turns	A	8.9	A	8.6
LOS = Level of Service Delay is measured in seconds.				



## Discussion and Recommendations

The following summarizes how the intersections are projected to operate and identifies any roadway and traffic control improvements necessary to accommodate the development-generated traffic.

### *Grass Lake Road with Deep Lake Road*

The results of the capacity analysis indicate that this intersection currently operates at LOS C during the weekday morning and weekday evening peak hours. Additionally, all approaches currently operate at LOS D or better during both peak hours. Observations at this intersection conducted by KLOA, Inc. indicated that eastbound queues at this intersection occasionally (one time during the morning peak hour) extended beyond the location of the proposed relocated Tower Drive connection on Grass Lake Road. During the weekday evening peak hour, the queues did not extend to or past the location of the proposed relocated access drive.

Under total projected conditions, this intersection is projected to operate at LOS C during the weekday morning and at LOS D during weekday evening peak hours with increases in delay of less than six seconds during both peak hours. Additionally, the eastbound and westbound approaches are projected to operate at LOS C or better during the peak hours with increases in delay of less than six seconds for both peak hours. Furthermore, the northbound approach is projected to operate at LOS E during the weekday morning peak hour and at LOS D during the weekday evening peak hour with increases of delay of less than four seconds and the southbound approach is projected to operate at LOS C during the weekday morning peak hour and at LOS E during the weekday evening peak hour.

Further inspection of the capacity analyses indicates that under projected conditions, the eastbound 95<sup>th</sup> percentile queues at this intersection are projected to be 384 feet during the weekday morning peak hour and 174 feet during the weekday evening peak hour. As such, eastbound traffic is projected to continue to generally not extend past the intersection of Grass Lake Road with Tower Drive.

Overall, this intersection has sufficient reserve capacity to accommodate the traffic projected to be generated by the proposed development and no signal modifications or geometric improvements will be required in conjunction with the proposed development.

### *Grass Lake Road with Tower Drive and the Easterly Oakland Elementary School Access Drive*

The results of the capacity analysis indicate that all critical movements at this intersection currently operate at LOS B or better during the weekday morning and weekday evening peak hours. Under total projected conditions, the southbound approach from the elementary school easterly access drive will operate at LOS C during both peak hours with increases in delay of approximately seven seconds or less. Furthermore, the eastbound left-turn movement into the elementary school access drive will operate at LOS A during the peak hours with increases in delay of less than one second for both peak hours. Outbound traffic from Tower Drive is projected to operate at LOS C or better during the peak hours with 95<sup>th</sup> percentile queues of one to two vehicles. As such, Tower Drive will have sufficient capacity to accommodate the site-generated traffic.

### *Deep Lake Road with Tower Drive*

The results of the capacity analyses indicate that all critical movements at this intersection currently operate at LOS B or better during the weekday morning and weekday evening peak hours. Under total projected conditions, the eastbound approach is projected to operate at LOS D or better during both peak hours with 95<sup>th</sup> percentile queues of one to two vehicles. As such, this intersection has sufficient reserve capacity to accommodate the development-generated traffic and no roadway improvements or traffic control modifications are required in conjunction with the proposed development.

## 6. Conclusion

Based on the preceding analyses and recommendations, the following conclusions have been made:

- The volume of traffic estimated by the proposed mixed-use development will be reduced due to internal capture and pass-by trips.
- Access to the proposed mixed-use development will be provided internally via Tower Drive which provides a connection to the area roadway system as follows:
  - *Tower Drive/Grass Lake Road.* Tower Drive is located approximately 415 feet west of Deep Lake Road and provides one inbound lane and one outbound lane signed and physically restricted to right-turn movements only. An eastbound right-turn lane is provided on Grass Lake Road.
  - *Tower Drive/Deep Lake Road.* This intersection is located approximately 450 feet south of Grass Lake Road. A southbound right-turn lane and a northbound left-turn lane are currently provided on Deep Lake Road serving this intersection. Tower Drive provides one inbound lane and one outbound lane with outbound movements under stop sign control.
- The results of the capacity analyses indicate that the existing roadway system has adequate capacity to accommodate the traffic that will be generated by the proposed development.

# Appendix

Traffic Count Summary Sheets  
Preliminary Site Plan  
Level of Service Criteria  
Capacity Analysis Summary Sheets



## Traffic Count Summary Sheets



Kenig Lindgren O'Hara Aboona, Inc.  
9575 W. Higgins Rd., Suite 400  
Rosemont, Illinois, United States 60018  
(847)518-9990

Count Name: Deep Lake Road and Tower Drive  
Site Code:  
Start Date: 03/19/2019  
Page No: 1

## Turning Movement Data

Start Time	Tower Drive Eastbound					Deep Lake Road Northbound					Deep Lake Road Southbound				
	U-Turn	Left	Right	Peds	App. Total	U-Turn	Left	Thru	Peds	App. Total	U-Turn	Thru	Right	Peds	Int. Total
6:00 AM	0	0	2	0	2	0	1	140	0	141	0	80	3	0	226
6:15 AM	0	0	2	0	2	0	3	117	0	120	0	111	0	0	233
6:30 AM	0	1	0	0	1	0	2	63	0	65	0	93	0	0	159
6:45 AM	0	0	1	1	1	0	2	46	0	48	0	72	0	0	121
Hourly Total	0	1	5	1	6	0	8	366	0	374	0	356	3	0	739
7:00 AM	0	1	1	0	2	0	0	55	0	55	0	62	3	0	122
7:15 AM	0	2	1	0	3	0	0	62	0	62	0	72	0	0	137
7:30 AM	0	1	2	0	3	0	4	47	0	51	0	68	2	0	124
7:45 AM	0	1	0	0	1	0	0	46	0	46	0	68	6	0	121
Hourly Total	0	5	4	0	9	0	4	210	0	214	0	270	11	0	504
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1:30 PM	0	3	1	0	4	0	0	84	0	84	0	60	1	0	149
1:45 PM	0	5	2	1	7	0	3	70	0	73	0	104	4	0	188
Hourly Total	0	8	3	1	11	0	3	154	0	157	0	164	5	0	337
2:00 PM	0	2	6	0	8	0	0	103	0	103	0	102	5	0	218
2:15 PM	0	1	3	0	4	0	1	86	0	87	0	62	2	0	155
2:30 PM	0	3	5	0	8	0	5	73	0	78	0	96	5	0	187
2:45 PM	0	2	5	0	7	0	3	98	0	101	0	83	7	0	198
Hourly Total	0	8	19	0	27	0	9	360	0	369	0	343	19	0	758
3:00 PM	0	3	3	0	6	0	4	100	0	104	0	97	4	0	211
3:15 PM	0	0	3	0	3	0	2	85	0	87	0	80	8	0	178
3:30 PM	0	7	2	0	9	0	5	87	0	92	0	85	4	0	190
3:45 PM	0	4	4	0	8	0	2	112	0	114	0	79	8	0	209
Hourly Total	0	14	12	0	26	0	13	384	0	397	0	341	24	0	788
4:00 PM	0	7	4	0	11	0	2	107	0	109	0	96	8	0	224
4:15 PM	1	3	3	0	7	1	5	85	0	91	0	89	5	0	192
4:30 PM	0	2	3	0	5	0	2	107	0	109	0	94	7	0	215
4:45 PM	0	2	3	0	5	0	0	91	0	91	0	88	2	0	186
Hourly Total	1	14	13	0	28	1	9	390	0	400	0	367	22	0	817
Grand Total	1	50	56	2	107	1	46	1864	0	1911	0	1841	84	0	3943
Approach %	0.9	46.7	52.3	-	-	0.1	2.4	97.5	-	-	0.0	95.6	4.4	-	-
Total %	0.0	1.3	1.4	-	2.7	0.0	1.2	47.3	-	48.5	0.0	46.7	2.1	-	48.8
Lights	1	49	54	-	104	1	45	1804	-	1850	0	1810	83	-	1993
% Lights	100.0	98.0	96.4	-	97.2	100.0	97.8	96.8	-	96.8	-	98.3	98.8	-	97.6
Buses	0	1	0	-	1	0	1	26	-	27	0	19	1	-	48
% Buses	0.0	2.0	0.0	-	0.9	0.0	2.2	1.4	-	1.4	-	1.0	1.2	-	1.0
Single-Unit Trucks	0	0	1	-	1	0	0	33	-	33	0	8	0	-	42
% Single-Unit Trucks	0.0	0.0	1.8	-	0.9	0.0	0.0	1.8	-	1.7	-	0.4	0.0	-	1.1

Rosemont, Illinois, United States 60018  
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## Turning Movement Peak Hour Data (6:00 AM)

Start Time	Tower Drive Eastbound				Deep Lake Road Northbound				Deep Lake Road Southbound				Int. Total	
	U-Turn	Left	Right	App. Total	U-Turn	Left	Thru	Peds	App. Total	U-Turn	Thru	Right		Peds
6:00 AM	0	0	2	2	0	1	140	0	141	0	80	3	0	83
6:15 AM	0	0	2	2	0	3	117	0	120	0	111	0	0	111
6:30 AM	0	1	0	1	0	2	63	0	65	0	93	0	0	93
6:45 AM	0	0	1	1	0	2	46	0	48	0	72	0	0	72
Total	0	1	5	6	0	8	366	0	374	0	356	3	0	359
Approach %	0.0	16.7	83.3	-	0.0	2.1	97.9	-	-	0.0	99.2	0.8	-	-
Total %	0.0	0.1	0.7	0.8	0.0	1.1	49.5	-	50.6	0.0	48.2	0.4	-	48.6
PHF	0.000	0.250	0.625	0.750	0.000	0.667	0.654	-	0.663	0.000	0.802	0.250	-	0.809
Lights	0	1	4	5	0	7	353	-	360	0	345	3	-	348
% Lights	-	100.0	80.0	83.3	-	87.5	96.4	-	96.3	-	96.9	100.0	-	96.5
Buses	0	0	0	0	0	1	9	-	10	0	6	0	-	6
% Buses	-	0.0	0.0	0.0	-	12.5	2.5	-	2.7	-	1.7	0.0	-	1.7
Single-Unit Trucks	0	0	1	1	0	0	4	-	4	0	3	0	-	3
% Single-Unit Trucks	-	0.0	20.0	16.7	-	0.0	1.1	-	1.1	-	0.8	0.0	-	0.8
Articulated Trucks	0	0	0	0	0	0	0	-	0	0	2	0	-	2
% Articulated Trucks	-	0.0	0.0	0.0	-	0.0	0.0	-	0.0	-	0.6	0.0	-	0.6
Bicycles on Road	0	0	0	0	0	0	0	-	0	0	0	0	-	0
% Bicycles on Road	-	0.0	0.0	0.0	-	0.0	0.0	-	0.0	-	0.0	0.0	-	0.0
Pedestrians	-	-	-	-	-	-	-	0	-	-	-	-	0	-
% Pedestrians	-	-	-	-	-	-	-	100.0	-	-	-	-	-	-

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(847)518-9990

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## Turning Movement Peak Hour Data (3:45 PM)

	Tower Drive Eastbound						Deep Lake Road Northbound						Deep Lake Road Southbound					
Start Time	U-Turn	Left	Right	Peds	App. Total		U-Turn	Left	Thru	Peds	App. Total		U-Turn	Thru	Right	Peds	App. Total	Int. Total
3:45 PM	0	4	4	0	8		0	2	112	0	114		0	79	8	0	87	209
4:00 PM	0	7	4	0	11		0	2	107	0	109		0	96	8	0	104	224
4:15 PM	1	3	3	0	7		1	5	85	0	91		0	89	5	0	94	192
4:30 PM	0	2	3	0	5		0	2	107	0	109		0	94	7	0	101	215
Total	1	16	14	0	31		1	11	411	0	423		0	358	28	0	386	840
Approach %	3.2	51.6	45.2	-	-		0.2	2.6	97.2	-	-		0.0	92.7	7.3	-	-	-
Total %	0.1	1.9	1.7	-	3.7		0.1	1.3	48.9	-	50.4		0.0	42.6	3.3	-	46.0	-
PHF	0.250	0.571	0.875	-	0.705		0.250	0.550	0.917	-	0.928		0.000	0.932	0.875	-	0.928	0.938
Lights	1	16	14	-	31		1	11	407	-	419		0	356	28	-	384	834
% Lights	100.0	100.0	100.0	-	100.0		100.0	100.0	99.0	-	99.1		-	99.4	100.0	-	99.5	99.3
Buses	0	0	0	-	0		0	0	1	-	1		0	0	0	-	0	1
% Buses	0.0	0.0	0.0	-	0.0		0.0	0.0	0.2	-	0.2		-	0.0	0.0	-	0.0	0.1
Single-Unit Trucks	0	0	0	-	0		0	0	3	-	3		0	2	0	-	2	5
% Single-Unit Trucks	0.0	0.0	0.0	-	0.0		0.0	0.0	0.7	-	0.7		-	0.6	0.0	-	0.5	0.6
Articulated Trucks	0	0	0	-	0		0	0	0	-	0		0	0	0	-	0	0
% Articulated Trucks	0.0	0.0	0.0	-	0.0		0.0	0.0	0.0	-	0.0		-	0.0	0.0	-	0.0	0.0
Bicycles on Road	0	0	0	-	0		0	0	0	-	0		0	0	0	-	0	0
% Bicycles on Road	0.0	0.0	0.0	-	0.0		0.0	0.0	0.0	-	0.0		-	0.0	0.0	-	0.0	0.0
Pedestrians	-	-	-	0	-		-	-	-	0	-		-	-	-	0	-	-
% Pedestrians	-	-	-	-	-		-	-	-	-	-		-	-	-	-	-	-



Kenig Lindgren O'Hara Aboona, Inc.  
9575 W. Higgins Rd., Suite 400  
Rosemont, Illinois, United States 60018  
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Count Name: Grass Lake Road and Tower Drive  
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### Turning Movement Data

Start Time	Grass Lake Road Eastbound						Grass Lake Road Westbound						Tower Drive Northbound						School Access Southbound							
	U-Turn	Left	Thru	Right	Peds	App. Total	U-Turn	Left	Thru	Right	Peds	App. Total	U-Turn	Left	Thru	Right	Peds	App. Total	U-Turn	Left	Thru	Right	Peds	App. Total	Int. Total	
6:00 AM	0	1	200	1	0	202	0	0	65	0	0	65	0	0	0	0	0	0	0	0	0	0	0	0	0	267
6:15 AM	0	2	156	1	0	159	0	0	85	0	0	85	0	0	0	2	0	2	0	1	0	0	0	0	1	247
6:30 AM	0	0	164	0	0	164	0	0	63	2	0	65	0	0	0	2	0	2	0	1	0	0	0	0	1	232
6:45 AM	0	2	124	7	0	133	0	0	48	3	0	51	0	0	0	2	0	2	0	1	0	1	0	0	2	188
Hourly Total	0	5	644	9	0	658	0	0	261	5	0	266	0	0	0	6	0	6	0	3	0	1	0	0	4	934
7:00 AM	0	5	100	1	0	106	0	0	55	8	0	63	0	2	0	0	0	2	0	0	0	2	0	0	2	173
7:15 AM	0	1	117	1	0	119	0	0	66	0	0	66	0	0	0	1	0	1	0	28	0	7	0	35	221	
7:30 AM	0	1	106	1	0	108	0	0	65	0	0	65	0	0	0	3	0	3	0	15	0	9	0	24	200	
7:45 AM	0	0	97	2	0	99	0	0	69	0	0	69	0	0	0	3	0	3	0	0	0	1	0	1	172	
Hourly Total	0	7	420	5	0	432	0	0	255	8	0	263	0	2	0	7	0	9	0	43	0	19	0	62	766	
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
1:30 PM	0	0	75	0	0	75	0	0	94	0	0	94	0	0	0	2	0	2	0	2	0	1	0	0	3	174
1:45 PM	0	1	70	4	0	75	0	1	143	1	0	145	0	1	0	2	0	2	0	1	0	1	0	0	2	225
Hourly Total	0	1	145	4	0	150	0	1	237	1	0	239	0	1	0	4	0	5	0	3	0	2	0	0	5	389
2:00 PM	0	0	75	3	0	78	0	0	125	0	0	125	0	0	0	5	0	5	0	4	0	2	0	0	6	214
2:15 PM	0	0	82	6	0	88	0	0	137	0	0	137	0	1	0	2	0	3	0	1	0	2	0	0	3	231
2:30 PM	0	0	85	0	0	85	0	0	172	0	0	172	0	1	0	4	0	5	0	18	0	10	1	28	290	
2:45 PM	0	0	99	3	0	102	0	1	172	1	0	174	0	0	0	2	0	2	0	4	0	11	0	15	293	
Hourly Total	0	0	341	12	0	353	0	1	606	1	0	608	0	2	0	13	0	15	0	27	0	25	1	52	1028	
3:00 PM	0	1	100	3	0	104	0	1	164	1	0	166	0	0	0	1	0	1	0	0	0	1	0	0	1	272
3:15 PM	0	0	100	3	0	103	0	0	139	2	0	141	0	1	0	4	0	5	0	2	0	2	0	4	253	
3:30 PM	0	0	90	1	0	91	0	1	137	0	0	138	0	0	0	1	0	1	0	0	0	2	0	2	232	
3:45 PM	0	4	88	2	0	94	0	0	177	0	0	177	0	0	1	3	0	4	0	1	0	0	0	0	1	276
Hourly Total	0	5	378	9	0	392	0	2	617	3	0	622	0	1	1	9	0	11	0	3	0	5	0	8	1033	
4:00 PM	0	1	120	5	0	126	0	0	163	0	0	163	0	0	0	4	0	4	0	21	0	4	0	25	318	
4:15 PM	0	3	74	4	0	81	0	0	146	0	0	146	0	0	1	5	0	6	0	1	0	3	0	4	237	
4:30 PM	0	0	106	2	0	108	0	1	170	1	0	172	0	0	0	1	0	1	0	2	0	1	0	3	284	
4:45 PM	0	0	77	5	0	82	0	0	153	1	0	154	0	0	0	2	0	2	0	1	0	0	0	1	239	
Hourly Total	0	4	377	16	0	397	0	1	632	2	0	635	0	0	1	12	0	13	0	25	0	8	0	33	1078	
Grand Total	0	22	2305	55	0	2382	0	5	2608	20	0	2633	0	6	2	51	0	59	0	104	0	60	1	164	5238	
Approach %	0.0	0.9	96.8	2.3	-	-	0.0	0.2	99.1	0.8	-	-	0.0	10.2	3.4	86.4	-	-	0.0	63.4	0.0	36.6	-	-	-	-
Total %	0.0	0.4	44.0	1.1	-	45.5	0.0	0.1	49.8	0.4	-	50.3	0.0	0.1	0.0	1.0	-	1.1	0.0	2.0	0.0	1.1	-	3.1	-	-
Lights	0	22	2164	55	-	2241	0	5	2419	19	-	2443	0	6	2	50	-	58	0	99	0	49	-	148	4890	
% Lights	-	100.0	93.9	100.0	-	94.1	-	100.0	92.8	95.0	-	92.8	-	100.0	100.0	98.0	-	98.3	-	95.2	-	81.7	-	90.2	93.4	-
Buses	0	0	50	0	-	50	0	0	64	0	-	64	0	0	0	1	-	1	0	5	0	10	-	15	130	
% Buses	-	0.0	2.2	0.0	-	2.1	-	0.0	2.5	0.0	-	2.4	-	-	0.0	2.0	-	1.7	-	4.8	0	16.7	-	9.1	2.5	-
Single-Unit Trucks	0	0	21	0	-	21	0	0	36	1	-	37	0	0	0	0	-	0	0	0	0	1	-	1	59	-

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## Turning Movement Peak Hour Data (6:00 AM)

[illegible]

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## Turning Movement Peak Hour Data (3:45 PM)

[illegible]





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Count Name: Deep Lake Road and Grass Lake  
Road  
Site Code:  
Start Date: 03/19/2019  
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### Turning Movement Data

Start Time	Grass Lake Road Eastbound						Grass Lake Road Westbound						Deep Lake Road Northbound						Deep Lake Road Southbound							
	U-Turn	Left	Thru	Right	Peds	App. Total	U-Turn	Left	Thru	Right	Peds	App. Total	U-Turn	Left	Thru	Right	Peds	App. Total	U-Turn	Left	Thru	Right	Peds	App. Total	Int. Total	
6:00 AM	0	61	119	19	0	199	0	22	36	14	1	72	0	5	39	94	1	138	0	17	40	26	0	83	492	
6:15 AM	0	45	101	13	0	159	0	46	55	16	0	117	0	11	52	54	0	117	0	14	50	22	0	86	479	
6:30 AM	0	53	91	26	0	170	0	8	36	8	0	52	0	5	38	15	0	58	0	20	49	18	0	87	367	
6:45 AM	0	35	80	15	0	130	0	10	25	21	0	56	0	7	43	6	0	56	0	20	50	15	0	85	327	
Hourly Total	0	194	391	73	0	658	0	86	152	59	1	297	0	28	172	169	1	369	0	71	189	81	0	341	1665	
7:00 AM	0	32	51	9	0	92	0	14	35	20	0	69	0	9	42	12	0	63	0	15	38	24	0	77	301	
7:15 AM	0	47	77	23	0	147	0	11	25	27	0	63	0	6	41	5	0	52	0	24	42	27	0	93	355	
7:30 AM	0	37	69	15	0	121	0	8	30	26	0	64	0	8	36	4	0	48	0	17	48	30	0	95	328	
7:45 AM	0	34	50	14	0	98	0	12	31	15	0	58	0	13	27	6	0	46	0	6	47	27	0	80	282	
Hourly Total	0	150	247	61	0	458	0	45	121	88	0	254	0	36	146	27	0	209	0	62	175	108	0	345	1266	
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
1:30 PM	0	23	46	6	0	75	0	3	48	19	0	70	0	26	53	13	0	92	0	18	47	22	0	87	324	
1:45 PM	0	28	35	11	0	74	0	56	95	37	0	188	0	17	39	13	0	69	0	15	53	27	2	95	426	
Hourly Total	0	51	81	17	0	149	0	59	143	56	0	258	0	43	92	26	0	161	0	33	100	49	2	182	750	
2:00 PM	0	31	41	10	0	82	0	48	82	30	0	160	0	21	75	9	0	105	0	21	39	21	0	81	428	
2:15 PM	0	45	33	7	0	85	0	20	88	23	0	131	0	24	51	10	0	85	0	19	46	32	0	97	398	
2:30 PM	0	34	61	15	0	110	0	20	104	20	0	144	0	16	54	8	0	78	0	19	59	47	0	125	457	
2:45 PM	0	33	46	17	0	96	0	19	102	34	0	155	0	20	62	13	0	95	0	27	56	54	0	137	483	
Hourly Total	0	143	181	49	0	373	0	107	376	107	0	590	0	81	242	40	0	363	0	86	200	154	0	440	1766	
3:00 PM	0	44	50	10	0	104	0	29	98	42	0	169	0	23	66	10	0	99	0	17	61	47	0	125	497	
3:15 PM	0	52	42	9	0	103	0	21	79	34	0	134	0	15	63	10	0	88	0	25	59	41	0	125	450	
3:30 PM	0	45	33	13	0	91	0	16	80	35	0	131	0	21	55	13	0	89	0	29	55	32	0	116	427	
3:45 PM	0	33	57	10	0	100	0	20	88	27	0	135	0	26	78	15	0	119	0	32	57	54	0	143	497	
Hourly Total	0	174	182	42	0	398	0	86	345	138	0	569	0	85	262	48	0	395	0	103	232	174	0	509	1871	
4:00 PM	0	51	61	20	0	132	0	32	96	26	0	154	0	19	76	14	0	109	0	25	53	48	0	126	521	
4:15 PM	0	30	39	16	0	85	0	33	84	37	0	154	0	17	64	10	0	91	0	26	52	48	0	126	456	
4:30 PM	0	40	43	22	0	105	0	13	89	26	0	128	0	30	61	14	0	105	0	22	61	51	0	134	472	
4:45 PM	0	26	38	14	0	78	0	18	78	33	0	129	0	24	66	13	0	103	0	23	62	45	0	130	440	
Hourly Total	0	147	181	72	0	400	0	96	347	122	0	565	0	90	267	51	0	408	0	96	228	192	0	516	1889	
Grand Total	0	859	1263	314	0	2436	0	479	1484	570	1	2533	0	363	1181	361	1	1905	0	451	1124	758	2	2333	9207	
Approach %	0.0	35.3	51.8	12.9	-	-	0.0	18.9	58.6	22.5	-	-	0.0	19.1	62.0	19.0	-	-	0.0	19.3	48.2	32.5	-	-	-	
Total %	0.0	9.3	13.7	3.4	-	26.5	0.0	5.2	16.1	6.2	-	27.5	0.0	3.9	12.8	3.9	-	20.7	0.0	4.9	12.2	8.2	-	25.3	-	
Lights	0	822	1163	308	-	2293	0	474	1350	542	-	2366	0	354	1133	357	-	1844	0	431	1104	717	-	2252	8755	
% Lights	-	95.7	92.1	98.1	-	94.1	-	99.0	91.0	95.1	-	93.4	-	-	97.5	95.9	98.9	-	96.8	-	95.6	98.2	94.6	-	96.5	95.1
Buses	0	22	26	5	-	53	0	3	31	25	-	59	0	7	21	1	-	29	0	16	13	28	-	57	198	
% Buses	-	2.6	2.1	1.6	-	2.2	-	0.6	2.1	4.4	-	2.3	-	1.9	1.8	0.3	-	1.5	-	3.5	1.2	3.7	-	2.4	2.2	
Single-Unit Trucks	0	10	10	0	-	20	0	0	16	1	-	17	0	2	26	2	-	30	0	3	7	11	-	21	88	



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9575 W. Higgins Rd., Suite 400

Rosemont, Illinois, United States 60018  
(847)518-9990

Count Name: Deep Lake Road and Grass Lake  
Road  
Site Code:  
Start Date: 03/19/2019  
Page No: 3

### Turning Movement Peak Hour Data (6:00 AM)

Start Time	Grass Lake Road Eastbound						Grass Lake Road Westbound						Deep Lake Road Northbound						Deep Lake Road Southbound						
	U-Turn	Left	Thru	Right	Peds	App. Total	U-Turn	Left	Thru	Right	Peds	App. Total	U-Turn	Left	Thru	Right	Peds	App. Total	U-Turn	Left	Thru	Right	Peds	App. Total	Int. Total
6:00 AM	0	61	119	19	0	199	0	22	36	14	1	72	0	5	39	94	1	138	0	17	40	26	0	83	492
6:15 AM	0	45	101	13	0	159	0	46	55	16	0	117	0	11	52	54	0	117	0	14	50	22	0	86	479
6:30 AM	0	53	91	26	0	170	0	8	36	8	0	52	0	5	38	15	0	58	0	20	49	18	0	87	367
6:45 AM	0	35	80	15	0	130	0	10	25	21	0	56	0	7	43	6	0	56	0	20	50	15	0	85	327
Total	0	194	391	73	0	658	0	86	152	59	1	297	0	28	172	169	1	369	0	71	189	81	0	341	1665
Approach %	0.0	29.5	59.4	11.1	-	-	0.0	29.0	51.2	19.9	-	-	0.0	7.6	46.6	45.8	-	-	0.0	20.8	55.4	23.8	-	-	-
Total %	0.0	11.7	23.5	4.4	-	39.5	0.0	5.2	9.1	3.5	-	17.8	0.0	1.7	10.3	10.2	-	22.2	0.0	4.3	11.4	4.9	-	20.5	-
PHF	0.000	0.795	0.821	0.702	-	0.827	0.000	0.467	0.691	0.702	-	0.635	0.000	0.636	0.827	0.449	-	0.668	0.000	0.888	0.945	0.779	-	0.980	0.846
Lights	0	183	362	71	-	616	0	83	120	48	-	251	0	26	161	168	-	355	0	63	183	70	-	316	1538
% Lights	-	94.3	92.6	97.3	-	93.6	-	96.5	78.9	81.4	-	84.5	-	92.9	93.6	99.4	-	96.2	-	88.7	96.8	86.4	-	92.7	92.4
Buses	0	7	10	2	-	19	0	2	4	10	-	16	0	1	7	1	-	9	0	7	3	10	-	20	64
% Buses	-	3.6	2.6	2.7	-	2.9	-	2.3	2.6	16.9	-	5.4	-	3.6	4.1	0.6	-	2.4	-	9.9	1.6	12.3	-	5.9	3.8
Single-Unit Trucks	0	3	4	0	-	7	0	0	1	0	-	1	0	1	3	0	-	4	0	1	3	0	-	4	16
% Single-Unit Trucks	-	1.5	1.0	0.0	-	1.1	-	0.0	0.7	0.0	-	0.3	-	3.6	1.7	0.0	-	1.1	-	1.4	1.6	0.0	-	1.2	1.0
Articulated Trucks	0	1	15	0	-	16	0	1	27	1	-	29	0	0	1	0	-	1	0	0	0	1	-	1	47
% Articulated Trucks	-	0.5	3.8	0.0	-	2.4	-	1.2	17.8	1.7	-	9.8	-	0.0	0.6	0.0	-	0.3	-	0.0	0.0	1.2	-	0.3	2.8
Bicycles on Road	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Bicycles on Road	-	0.0	0.0	0.0	-	0.0	-	0.0	0.0	0.0	-	0.0	-	0.0	0.0	0.0	-	0.0	-	0.0	0.0	0.0	-	0.0	0.0
Pedestrians	-	-	-	-	0	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-	-	-	-	-	-	-



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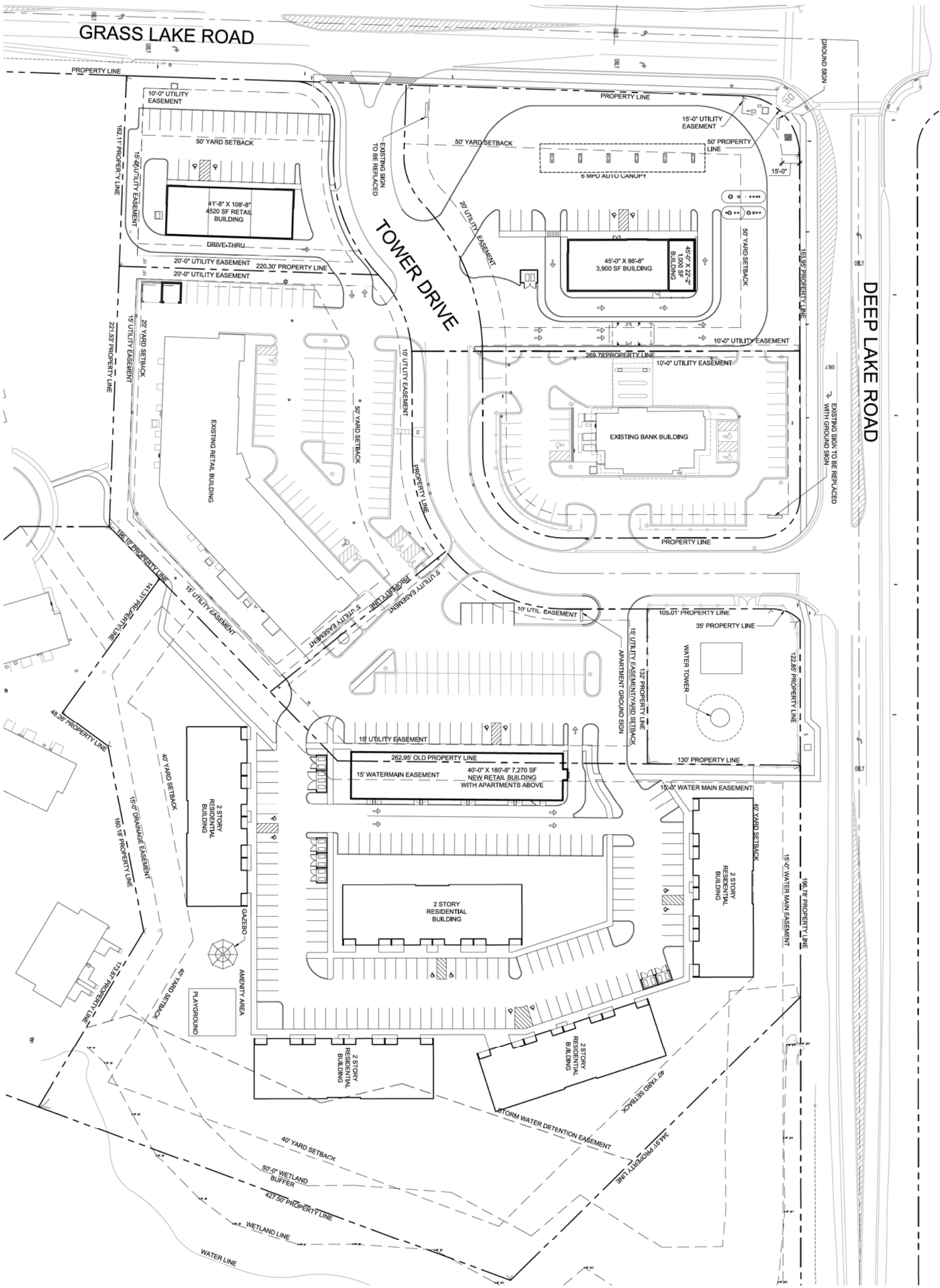
Rosemont, Illinois, United States 60018  
(847)518-9990

Count Name: Deep Lake Road and Grass Lake Road  
Site Code:  
Start Date: 03/19/2019  
Page No: 4

### Turning Movement Peak Hour Data (3:45 PM)

Start Time	Grass Lake Road Eastbound							Grass Lake Road Westbound							Deep Lake Road Northbound							Deep Lake Road Southbound						
	U-Turn	Left	Thru	Right	Peds	App. Total		U-Turn	Left	Thru	Right	Peds	App. Total		U-Turn	Left	Thru	Right	Peds	App. Total		U-Turn	Left	Thru	Right	Peds	App. Total	Int. Total
3:45 PM	0	33	57	10	0	100		0	20	88	27	0	135		0	26	78	15	0	119		0	32	57	54	0	143	497
4:00 PM	0	51	61	20	0	132		0	32	96	26	0	154		0	19	76	14	0	109		0	25	53	48	0	126	521
4:15 PM	0	30	39	16	0	85		0	33	84	37	0	154		0	17	64	10	0	91		0	26	52	48	0	126	456
4:30 PM	0	40	43	22	0	105		0	13	89	26	0	128		0	30	61	14	0	105		0	22	61	51	0	134	472
Total	0	154	200	68	0	422		0	98	357	116	0	571		0	92	279	53	0	424		0	105	223	201	0	529	1946
Approach %	0.0	36.5	47.4	16.1	-	-		0.0	17.2	62.5	20.3	-	-		0.0	21.7	65.8	12.5	-	-		0.0	19.8	42.2	38.0	-	-	-
Total %	0.0	7.9	10.3	3.5	-	21.7		0.0	5.0	18.3	6.0	-	29.3		0.0	4.7	14.3	2.7	-	21.8		0.0	5.4	11.5	10.3	-	27.2	-
PHF	0.000	0.755	0.820	0.773	-	0.799		0.000	0.742	0.930	0.784	-	0.927		0.000	0.767	0.894	0.883	-	0.891		0.000	0.820	0.914	0.931	-	0.925	0.934
Lights	0	153	199	68	-	420		0	98	355	116	-	569		0	92	276	53	-	421		0	104	222	200	-	526	1936
% Lights	-	99.4	99.5	100.0	-	99.5		-	100.0	99.4	100.0	-	99.6		-	100.0	98.9	100.0	-	99.3		-	99.0	99.6	99.5	-	99.4	99.5
Buses	0	0	0	0	-	0		0	0	1	0	-	1		0	0	2	0	-	2		0	0	0	0	-	0	3
% Buses	-	0.0	0.0	0.0	-	0.0		-	0.0	0.3	0.0	-	0.2		-	0.0	0.7	0.0	-	0.5		-	0.0	0.0	0.0	-	0.0	0.2
Single-Unit Trucks	0	1	1	0	-	2		0	0	1	0	-	1		0	0	1	0	-	1		0	1	1	1	-	3	7
% Single-Unit Trucks	-	0.6	0.5	0.0	-	0.5		-	0.0	0.3	0.0	-	0.2		-	0.0	0.4	0.0	-	0.2		-	1.0	0.4	0.5	-	0.6	0.4
Articulated Trucks	0	0	0	0	-	0		0	0	0	0	-	0		0	0	0	0	-	0		0	0	0	0	-	0	0
% Articulated Trucks	-	0.0	0.0	0.0	-	0.0		-	0.0	0.0	0.0	-	0.0		-	0.0	0.0	0.0	-	0.0		-	0.0	0.0	0.0	-	0.0	0.0
Bicycles on Road	0	0	0	0	-	0		0	0	0	0	-	0		0	0	0	0	-	0		0	0	0	0	-	0	0
% Bicycles on Road	-	0.0	0.0	0.0	-	0.0		-	0.0	0.0	0.0	-	0.0		-	0.0	0.0	0.0	-	0.0		-	0.0	0.0	0.0	-	0.0	0.0
Pedestrians	-	-	-	-	0	-		-	-	-	-	0	-		-	-	-	-	-	-		-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	-

# Preliminary Site Plan



1 SITE PLAN  
SCALE: 1" = 40'-0"



AQUATIC \ CIVIL \ MECHANICAL \ ELECTRICAL \ PLUMBING \ TELECOMMUNICATION \ STRUCTURAL \ ACCESSIBILITY CONSULTING \ DESIGN & PROGRAM MANAGEMENT \ LAND SURVEY

ISSUE	
TO	DATE
ZONING	4/5/19
REVIEW	7/23/19
REVIEW	9/16/19
REVIEW	9/26/19

LAKE TOWER CROSSING  
GRASS LAKE RD. & DEEP LAKE ROAD  
LAKE VILLA, IL 60046

CHRIS KHAYAT



WT GROUP  
Engineering with Precision, Pace and Passion.

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A001

SITE PLAN

CHECK: CW  
DRAWN: MA  
ML, CP, NR  
JOB: 018657

## Level of Service Criteria

## LEVEL OF SERVICE CRITERIA

Signalized Intersections		
Level of Service	Interpretation	Average Control Delay (seconds per vehicle)
A	Favorable progression. Most vehicles arrive during the green indication and travel through the intersection without stopping.	≤10
B	Good progression, with more vehicles stopping than for Level of Service A.	>10 - 20
C	Individual cycle failures (i.e., one or more queued vehicles are not able to depart as a result of insufficient capacity during the cycle) may begin to appear. Number of vehicles stopping is significant, although many vehicles still pass through the intersection without stopping.	>20 - 35
D	The volume-to-capacity ratio is high and either progression is ineffective or the cycle length is too long. Many vehicles stop and individual cycle failures are noticeable.	>35 - 55
E	Progression is unfavorable. The volume-to-capacity ratio is high and the cycle length is long. Individual cycle failures are frequent.	>55 - 80
F	The volume-to-capacity ratio is very high, progression is very poor, and the cycle length is long. Most cycles fail to clear the queue.	>80.0
Unsignalized Intersections		
Level of Service	Average Total Delay (SEC/VEH)	
A	0 - 10	
B	> 10 - 15	
C	> 15 - 25	
D	> 25 - 35	
E	> 35 - 50	
F	> 50	
Source: <i>Highway Capacity Manual</i> , 2010.		

























# Capacity Analysis Summary Sheets

Existing Weekday Morning Peak Hour Conditions

# Lanes, Volumes, Timings

## 1: Deep Lake Road & Grass Lake Road













04/04/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	194	391	73	86	157	59	28	172	169	71	200	81
Future Volume (vph)	194	391	73	86	157	59	28	172	169	71	200	81
Ideal Flow (vphpl)	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	12
Grade (%)		0%			0%			0%			0%	
Storage Length (ft)	150		150	0		150	140		0	145		0
Storage Lanes	1		1	1		1	1		0	1		0
Taper Length (ft)	160			25			135			150		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850			0.850		0.926			0.957	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1703	1869	1568	1736	1653	1357	1687	1700	0	1626	1713	0
Flt Permitted	0.591			0.323			0.423			0.194		
Satd. Flow (perm)	1059	1869	1568	590	1653	1357	751	1700	0	332	1713	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			139			139		51			21	
Link Speed (mph)		20			20			20			20	
Link Distance (ft)		402			477			458			415	
Travel Time (s)		13.7			16.3			15.6			14.1	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	6%	7%	3%	4%	21%	19%	7%	6%	1%	11%	3%	14%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Shared Lane Traffic (%)												
Lane Group Flow (vph)	228	460	86	101	185	69	33	401	0	84	330	0
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2		2	6		6	8			4		
Detector Phase	5	2	2	1	6	6	3	8		7	4	
Switch Phase												
Minimum Initial (s)	3.0	15.0	15.0	3.0	15.0	15.0	3.0	8.0		3.0	8.0	
Minimum Split (s)	9.5	33.5	33.5	9.5	33.5	33.5	10.0	27.0		10.0	27.0	
Total Split (s)	13.5	36.0	36.0	13.5	36.0	36.0	13.5	27.0		13.5	27.0	
Total Split (%)	15.0%	40.0%	40.0%	15.0%	40.0%	40.0%	15.0%	30.0%		15.0%	30.0%	
Yellow Time (s)	3.0	4.5	4.5	3.0	4.5	4.5	3.0	4.5		3.0	4.5	
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.0	6.5	6.5	4.0	6.5	6.5	4.0	6.5		4.0	6.5	
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Recall Mode	None	C-Min	C-Min	None	C-Min	C-Min	None	None		None	None	
Act Effect Green (s)	45.5	35.4	35.4	42.8	32.3	32.3	29.3	21.3		32.8	24.8	
Actuated g/C Ratio	0.51	0.39	0.39	0.48	0.36	0.36	0.33	0.24		0.36	0.28	

# Lanes, Volumes, Timings

## 1: Deep Lake Road & Grass Lake Road

04/04/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.38	0.63	0.12	0.26	0.31	0.12	0.11	0.91		0.35	0.68	
Control Delay	14.6	29.4	1.4	13.6	24.2	0.4	17.3	56.5		21.3	36.2	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	14.6	29.4	1.4	13.6	24.2	0.4	17.3	56.5		21.3	36.2	
LOS	B	C	A	B	C	A	B	E		C	D	
Approach Delay		21.9			16.6			53.5			33.2	
Approach LOS		C			B			D			C	
Queue Length 50th (ft)	70	225	0	29	79	0	11	196		29	160	
Queue Length 95th (ft)	108	319	6	52	127	0	27	#342		55	#250	
Internal Link Dist (ft)		322			397			378			335	
Turn Bay Length (ft)	150		150			150	140			145		
Base Capacity (vph)	603	735	701	411	598	580	360	441		258	487	
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Reduced v/c Ratio	0.38	0.63	0.12	0.25	0.31	0.12	0.09	0.91		0.33	0.68	

### Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of 1st Green

Natural Cycle: 80

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.91

Intersection Signal Delay: 30.3

Intersection LOS: C

Intersection Capacity Utilization 65.1%










ICU Level of Service C

Analysis Period (min) 15

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Deep Lake Road & Grass Lake Road

					
Ø1	Ø2 (R)		Ø3	Ø4	
13.5 s	36 s		13.5 s	27 s	
					
Ø5	Ø6 (R)		Ø7	Ø8	
13.5 s	36 s		13.5 s	27 s	

# HCM 6th TWSC

## 2: Tower Drive/School Access & Grass Lake Road






04/08/2019

Intersection												
Int Delay, s/veh	0.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰	↱		↰				↱		↰	
Traffic Vol, veh/h	5	649	9	0	261	5	0	0	6	3	0	1
Future Vol, veh/h	5	649	9	0	261	5	0	0	6	3	0	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	Free	-	-	None	-	-	Stop	-	-	None
Storage Length	-	-	150	-	-	-	-	-	0	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	88	88	88	88	88	88	88	88	88
Heavy Vehicles, %	0	6	0	0	16	20	0	0	17	0	0	0
Mvmt Flow	6	738	10	0	297	6	0	0	7	3	0	1
Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	303	0	-	-	-	0	-	-	738	1050	1050	300
Stage 1	-	-	-	-	-	-	-	-	-	300	300	-
Stage 2	-	-	-	-	-	-	-	-	-	750	750	-
Critical Hdwy	4.1	-	-	-	-	-	-	-	6.37	7.1	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	-	-	-	6.1	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	-	-	-	6.1	5.5	-
Follow-up Hdwy	2.2	-	-	-	-	-	-	-	3.453	3.5	4	3.3
Pot Cap-1 Maneuver	1269	-	0	0	-	-	0	0	394	207	229	744
Stage 1	-	-	0	0	-	-	0	0	-	713	669	-
Stage 2	-	-	0	0	-	-	0	0	-	407	422	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1269	-	-	-	-	-	-	-	394	202	227	744
Mov Cap-2 Maneuver	-	-	-	-	-	-	-	-	-	202	227	-
Stage 1	-	-	-	-	-	-	-	-	-	707	669	-
Stage 2	-	-	-	-	-	-	-	-	-	397	419	-
Approach	EB			WB			NB			SB		
HCM Control Delay, s	0.1			0			14.3			9.8		
HCM LOS							B			A		
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	WBL	WBT	WBR	SBLn1					
Capacity (veh/h)	394	1269	-	-	-	-	744					
HCM Lane V/C Ratio	0.017	0.004	-	-	-	-	0.002					
HCM Control Delay (s)	14.3	7.9	0	-	-	-	9.8					
HCM Lane LOS	B	A	A	-	-	-	A					
HCM 95th %tile Q(veh)	0.1	0	-	-	-	-	0					

# HCM 6th TWSC

## 3: Deep Lake Road & Tower Drive

04/08/2019

Intersection						
Int Delay, s/veh	0.2					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	1	5	8	368	356	3
Future Vol, veh/h	1	5	8	368	356	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	125	-	-	125
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	79	79	79	79	79	79
Heavy Vehicles, %	0	20	12	4	3	0
Mvmt Flow	1	6	10	466	451	4
Major/Minor	Minor2	Major1		Major2		
Conflicting Flow All	937	451	455	0	-	0
Stage 1	451	-	-	-	-	-
Stage 2	486	-	-	-	-	-
Critical Hdwy	6.4	6.4	4.22	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.48	2.308	-	-	-
Pot Cap-1 Maneuver	296	572	1055	-	-	-
Stage 1	646	-	-	-	-	-
Stage 2	623	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	293	572	1055	-	-	-
Mov Cap-2 Maneuver	293	-	-	-	-	-
Stage 1	640	-	-	-	-	-
Stage 2	623	-	-	-	-	-
Approach	EB	NB		SB		
HCM Control Delay, s	12.4	0.2		0		
HCM LOS	B					
Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR	
Capacity (veh/h)	1055	-	494	-	-	
HCM Lane V/C Ratio	0.01	-	0.015	-	-	
HCM Control Delay (s)	8.4	-	12.4	-	-	
HCM Lane LOS	A	-	B	-	-	
HCM 95th %tile Q(veh)	0	-	0	-	-	























# Capacity Analysis Summary Sheets

Existing Weekday Evening Peak Hour Conditions

# Lanes, Volumes, Timings

## 1: Deep Lake Road & Grass Lake Road

04/04/2019













												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	154	206	68	98	364	116	92	283	53	105	223	201
Future Volume (vph)	154	206	68	98	364	116	92	283	53	105	223	201
Ideal Flow (vphpl)	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	12
Grade (%)		0%			0%			0%			0%	
Storage Length (ft)	150		150	0		150	140		0	145		0
Storage Lanes	1		1	1		1	1		0	1		0
Taper Length (ft)	160			25			135			150		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850			0.850		0.976			0.929	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1787	2000	1615	1805	1980	1615	1805	1839	0	1787	1765	0
Flt Permitted	0.320			0.620			0.168			0.309		
Satd. Flow (perm)	602	2000	1615	1178	1980	1615	319	1839	0	581	1765	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			133			133		10			47	
Link Speed (mph)		20			20			20			20	
Link Distance (ft)		402			477			458			415	
Travel Time (s)		13.7			16.3			15.6			14.1	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	1%	0%	0%	0%	1%	0%	0%	1%	0%	1%	0%	0%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Shared Lane Traffic (%)												
Lane Group Flow (vph)	166	222	73	105	391	125	99	361	0	113	456	0
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2		2	6		6	8			4		
Detector Phase	5	2	2	1	6	6	3	8		7	4	
Switch Phase												
Minimum Initial (s)	3.0	15.0	15.0	3.0	15.0	15.0	3.0	8.0		3.0	8.0	
Minimum Split (s)	9.5	33.5	33.5	9.5	33.5	33.5	10.0	26.5		10.0	26.5	
Total Split (s)	13.5	36.0	36.0	13.5	36.0	36.0	13.5	27.0		13.5	27.0	
Total Split (%)	15.0%	40.0%	40.0%	15.0%	40.0%	40.0%	15.0%	30.0%		15.0%	30.0%	
Yellow Time (s)	3.0	4.5	4.5	3.0	4.5	4.5	3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.0	6.5	6.5	4.0	6.5	6.5	4.0	6.0		4.0	6.0	
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Recall Mode	None	C-Min	C-Min	None	C-Min	C-Min	None	None		None	None	
Act Effect Green (s)	42.8	32.8	32.8	40.6	30.0	30.0	33.2	24.2		33.6	24.4	
Actuated g/C Ratio	0.48	0.36	0.36	0.45	0.33	0.33	0.37	0.27		0.37	0.27	



# Lanes, Volumes, Timings

## 1: Deep Lake Road & Grass Lake Road

04/04/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.41	0.30	0.11	0.18	0.59	0.20	0.39	0.72		0.34	0.89	
Control Delay	15.9	23.6	0.8	13.1	29.9	4.5	21.5	39.9		19.9	51.4	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	15.9	23.6	0.8	13.1	29.9	4.5	21.5	39.9		19.9	51.4	
LOS	B	C	A	B	C	A	C	D		B	D	
Approach Delay		17.2			22.0			35.9			45.2	
Approach LOS		B			C			D			D	
Queue Length 50th (ft)	50	95	0	31	188	0	34	185		39	230	
Queue Length 95th (ft)	85	155	5	57	279	34	67	#337		75	#443	
Internal Link Dist (ft)		322			397			378			335	
Turn Bay Length (ft)	150		150			150	140			145		
Base Capacity (vph)	412	741	682	616	685	645	277	502		347	512	
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Reduced v/c Ratio	0.40	0.30	0.11	0.17	0.57	0.19	0.36	0.72		0.33	0.89	

### Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 3 (3%), Referenced to phase 2:EBTL and 6:WBTL, Start of 1st Green

Natural Cycle: 80

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.89

Intersection Signal Delay: 30.2

Intersection LOS: C

Intersection Capacity Utilization 72.9%












ICU Level of Service C

Analysis Period (min) 15

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Deep Lake Road & Grass Lake Road

					
Ø1	Ø2 (R)		Ø3	Ø4	
13.5 s	36 s		13.5 s	27 s	
					
Ø5	Ø6 (R)		Ø7	Ø8	
13.5 s	36 s		13.5 s	27 s	

# HCM 6th TWSC

## 2: Tower Drive/School Access & Grass Lake Road






04/08/2019

Intersection												
Int Delay, s/veh	0.6											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗		↖				↗		↖	
Traffic Vol, veh/h	8	388	13	0	656	1	0	0	15	25	0	8
Future Vol, veh/h	8	388	13	0	656	1	0	0	15	25	0	8
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	Free	-	-	None	-	-	Stop	-	-	None
Storage Length	-	-	150	-	-	-	-	-	0	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	88	88	88	88	88	88	88	88	88
Heavy Vehicles, %	0	1	0	0	1	0	0	0	0	0	0	0
Mvmt Flow	9	441	15	0	745	1	0	0	17	28	0	9
Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	746	0	-	-	-	0	-	-	441	1205	1205	746
Stage 1	-	-	-	-	-	-	-	-	-	746	746	-
Stage 2	-	-	-	-	-	-	-	-	-	459	459	-
Critical Hdwy	4.1	-	-	-	-	-	-	-	6.2	7.1	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	-	-	-	6.1	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	-	-	-	6.1	5.5	-
Follow-up Hdwy	2.2	-	-	-	-	-	-	-	3.3	3.5	4	3.3
Pot Cap-1 Maneuver	871	-	0	0	-	-	0	0	621	162	185	417
Stage 1	-	-	0	0	-	-	0	0	-	409	424	-
Stage 2	-	-	0	0	-	-	0	0	-	586	570	-
Platoon blocked, %		-			-	-						
Mov Cap-1 Maneuver	871	-	-	-	-	-	-	-	621	156	182	417
Mov Cap-2 Maneuver	-	-	-	-	-	-	-	-	-	156	182	-
Stage 1	-	-	-	-	-	-	-	-	-	403	424	-
Stage 2	-	-	-	-	-	-	-	-	-	562	562	-
Approach	EB			WB			NB			SB		
HCM Control Delay, s	0.2			0			11			13.8		
HCM LOS							B			B		
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	WBT	WBR	SBLn1						
Capacity (veh/h)	621	871	-	-	-	417						
HCM Lane V/C Ratio	0.027	0.01	-	-	-	0.022						
HCM Control Delay (s)	11	9.2	0	-	-	13.8						
HCM Lane LOS	B	A	A	-	-	B						
HCM 95th %tile Q(veh)	0.1	0	-	-	-	0.1						

# HCM 6th TWSC

## 3: Deep Lake Road & Tower Drive

04/08/2019

Intersection						
Int Delay, s/veh	0.6					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	17	14	12	411	361	28
Future Vol, veh/h	17	14	12	411	361	28
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	-	125	-	-	125
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	0	0	0	1	1	0
Mvmt Flow	18	15	13	437	384	30

Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	847	384	414	0	-	0
Stage 1	384	-	-	-	-	-
Stage 2	463	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.1	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.2	-	-	-
Pot Cap-1 Maneuver	335	668	1156	-	-	-
Stage 1	693	-	-	-	-	-
Stage 2	638	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	331	668	1156	-	-	-
Mov Cap-2 Maneuver	331	-	-	-	-	-
Stage 1	685	-	-	-	-	-
Stage 2	638	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	14.1	0.2	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1156	-	429	-	-
HCM Lane V/C Ratio	0.011	-	0.077	-	-
HCM Control Delay (s)	8.1	-	14.1	-	-
HCM Lane LOS	A	-	B	-	-
HCM 95th %tile Q(veh)	0	-	0.2	-	-























# Capacity Analysis Summary Sheets

Projected Weekday Morning Peak Hour Conditions

# Lanes, Volumes, Timings

## 1: Deep Lake Road & Grass Lake Road













10/08/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	217	429	77	118	166	63	47	194	196	75	231	86
Future Volume (vph)	217	429	77	118	166	63	47	194	196	75	231	86
Ideal Flow (vphpl)	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	12
Grade (%)		0%			0%			0%			0%	
Storage Length (ft)	150		150	0		150	140		0	145		0
Storage Lanes	1		1	1		1	1		0	1		0
Taper Length (ft)	160			25			135			150		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850			0.850		0.925			0.959	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1703	1869	1568	1736	1653	1357	1687	1698	0	1626	1719	0
Flt Permitted	0.597			0.205			0.321			0.161		
Satd. Flow (perm)	1070	1869	1568	375	1653	1357	570	1698	0	276	1719	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			139			139		52			19	
Link Speed (mph)		20			20			20			20	
Link Distance (ft)		407			477			458			415	
Travel Time (s)		13.9			16.3			15.6			14.1	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	6%	7%	3%	4%	21%	19%	7%	6%	1%	11%	3%	14%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Shared Lane Traffic (%)												
Lane Group Flow (vph)	255	505	91	139	195	74	55	459	0	88	373	0
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2		2	6		6	8			4		
Detector Phase	5	2	2	1	6	6	3	8		7	4	
Switch Phase												
Minimum Initial (s)	3.0	15.0	15.0	3.0	15.0	15.0	3.0	8.0		3.0	8.0	
Minimum Split (s)	9.5	33.5	33.5	9.5	33.5	33.5	10.0	27.0		10.0	27.0	
Total Split (s)	13.5	36.0	36.0	13.5	36.0	36.0	13.5	27.0		13.5	27.0	
Total Split (%)	15.0%	40.0%	40.0%	15.0%	40.0%	40.0%	15.0%	30.0%		15.0%	30.0%	
Yellow Time (s)	3.0	4.5	4.5	3.0	4.5	4.5	3.0	4.5		3.0	4.5	
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.0	6.5	6.5	4.0	6.5	6.5	4.0	6.5		4.0	6.5	
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Recall Mode	None	C-Min	C-Min	None	C-Min	C-Min	None	None		None	None	
Act Effect Green (s)	42.1	30.2	30.2	40.5	29.4	29.4	32.8	24.0		34.2	24.8	
Actuated g/C Ratio	0.47	0.34	0.34	0.45	0.33	0.33	0.36	0.27		0.38	0.28	

# Lanes, Volumes, Timings

## 1: Deep Lake Road & Grass Lake Road

10/08/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.45	0.81	0.15	0.46	0.36	0.14	0.18	0.93		0.39	0.77	
Control Delay	16.3	39.3	1.8	17.6	25.5	0.8	18.2	59.6		22.2	42.5	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	16.3	39.3	1.8	17.6	25.5	0.8	18.2	59.6		22.2	42.5	
LOS	B	D	A	B	C	A	B	E		C	D	
Approach Delay		28.4			18.3			55.2			38.6	
Approach LOS		C			B			E			D	
Queue Length 50th (ft)	80	261	0	40	84	0	19	~258		31	191	
Queue Length 95th (ft)	121	#384	9	68	133	0	40	#417		58	#332	
Internal Link Dist (ft)		327			397			378			335	
Turn Bay Length (ft)	150		150			150	140			145		
Base Capacity (vph)	568	626	618	316	541	538	334	491		249	486	
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Reduced v/c Ratio	0.45	0.81	0.15	0.44	0.36	0.14	0.16	0.93		0.35	0.77	

### Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of 1st Green

Natural Cycle: 80

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.93

Intersection Signal Delay: 34.8

Intersection LOS: C

Intersection Capacity Utilization 71.8%

ICU Level of Service C

Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.






Splits and Phases: 1: Deep Lake Road & Grass Lake Road

					
Ø1	Ø2 (R)		Ø3	Ø4	
13.5 s	36 s		13.5 s	27 s	
					
Ø5	Ø6 (R)		Ø7	Ø8	
13.5 s	36 s		13.5 s	27 s	

# HCM 6th TWSC

## 3: Deep Lake Road & Tower Drive

10/08/2019

Intersection						
Int Delay, s/veh	4.1					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	77	51	53	360	348	78
Future Vol, veh/h	77	51	53	360	348	78
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	-	125	-	-	125
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	79	79	79	79	79	79
Heavy Vehicles, %	0	20	12	4	3	0
Mvmt Flow	97	65	67	456	441	99
Major/Minor	Minor2	Major1		Major2		
Conflicting Flow All	1031	441	540	0	-	0
Stage 1	441	-	-	-	-	-
Stage 2	590	-	-	-	-	-
Critical Hdwy	6.4	6.4	4.22	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.48	2.308	-	-	-
Pot Cap-1 Maneuver	261	580	980	-	-	-
Stage 1	653	-	-	-	-	-
Stage 2	558	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	243	580	980	-	-	-
Mov Cap-2 Maneuver	243	-	-	-	-	-
Stage 1	609	-	-	-	-	-
Stage 2	558	-	-	-	-	-
Approach	EB	NB		SB		
HCM Control Delay, s	27.8	1.1		0		
HCM LOS	D					
Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR	
Capacity (veh/h)	980	-	316	-	-	
HCM Lane V/C Ratio	0.068	-	0.513	-	-	
HCM Control Delay (s)	8.9	-	27.8	-	-	
HCM Lane LOS	A	-	D	-	-	
HCM 95th %tile Q(veh)	0.2	-	2.8	-	-	

HCM 6th TWSC  
4: Grass Lake Road & School Access (east)

10/08/2019

Intersection												
Int Delay, s/veh	1.5											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔		↔				↔		↔	
Traffic Vol, veh/h	5	636	77	0	294	5	0	0	84	3	0	1
Future Vol, veh/h	5	636	77	0	294	5	0	0	84	3	0	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	Free	-	-	None	-	-	Stop	-	-	None
Storage Length	-	-	150	-	-	-	-	-	0	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	1	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	88	88	88	88	88	88	88	88	88
Heavy Vehicles, %	0	6	0	0	16	20	0	0	17	0	0	0
Mvmt Flow	6	723	88	0	334	6	0	0	95	3	0	1
Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	340	0	-	-	-	0	-	-	723	1072	1072	337
Stage 1	-	-	-	-	-	-	-	-	-	337	337	-
Stage 2	-	-	-	-	-	-	-	-	-	735	735	-
Critical Hdwy	4.1	-	-	-	-	-	-	-	6.37	7.1	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	-	-	-	6.1	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	-	-	-	6.1	5.5	-
Follow-up Hdwy	2.2	-	-	-	-	-	-	-	3.453	3.5	4	3.3
Pot Cap-1 Maneuver	1230	-	0	0	-	-	0	0	402	200	222	710
Stage 1	-	-	0	0	-	-	0	0	-	681	645	-
Stage 2	-	-	0	0	-	-	0	0	-	414	428	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1230	-	-	-	-	-	-	-	402	152	220	710
Mov Cap-2 Maneuver	-	-	-	-	-	-	-	-	-	251	327	-
Stage 1	-	-	-	-	-	-	-	-	-	676	645	-
Stage 2	-	-	-	-	-	-	-	-	-	313	425	-
Approach	EB			WB			NB			SB		
HCM Control Delay, s	0.1			0			16.7			17.2		
HCM LOS							C			C		
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	WBL	WBT	WBR	SBLn1					
Capacity (veh/h)	402	1230	-	-	-	-	299					
HCM Lane V/C Ratio	0.237	0.005	-	-	-	-	0.015					
HCM Control Delay (s)	16.7	7.9	0	-	-	-	17.2					
HCM Lane LOS	C	A	A	-	-	-	C					
HCM 95th %tile Q(veh)	0.9	0	-	-	-	-	0					

























# Capacity Analysis Summary Sheets

Projected Weekday Evening Peak Hour Conditions

# Lanes, Volumes, Timings

## 1: Deep Lake Road & Grass Lake Road













10/08/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	174	233	72	139	386	123	115	310	69	111	261	213
Future Volume (vph)	174	233	72	139	386	123	115	310	69	111	261	213
Ideal Flow (vphpl)	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	12
Grade (%)		0%			0%			0%			0%	
Storage Length (ft)	150		150	0		150	140		0	145		0
Storage Lanes	1		1	1		1	1		0	1		0
Taper Length (ft)	160			25			135			150		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850			0.850		0.973			0.933	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1787	2000	1615	1805	1980	1615	1805	1834	0	1787	1773	0
Flt Permitted	0.277			0.531			0.161			0.248		
Satd. Flow (perm)	521	2000	1615	1009	1980	1615	306	1834	0	467	1773	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			133			133		12			43	
Link Speed (mph)		20			20			20			20	
Link Distance (ft)		410			477			458			415	
Travel Time (s)		14.0			16.3			15.6			14.1	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	1%	0%	0%	0%	1%	0%	0%	1%	0%	1%	0%	0%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Shared Lane Traffic (%)												
Lane Group Flow (vph)	187	251	77	149	415	132	124	407	0	119	510	0
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2		2	6		6	8			4		
Detector Phase	5	2	2	1	6	6	3	8		7	4	
Switch Phase												
Minimum Initial (s)	3.0	15.0	15.0	3.0	15.0	15.0	3.0	8.0		3.0	8.0	
Minimum Split (s)	9.5	33.5	33.5	9.5	33.5	33.5	10.0	26.5		10.0	26.5	
Total Split (s)	13.5	36.0	36.0	13.5	36.0	36.0	13.5	27.0		13.5	27.0	
Total Split (%)	15.0%	40.0%	40.0%	15.0%	40.0%	40.0%	15.0%	30.0%		15.0%	30.0%	
Yellow Time (s)	3.0	4.5	4.5	3.0	4.5	4.5	3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.0	6.5	6.5	4.0	6.5	6.5	4.0	6.0		4.0	6.0	
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Recall Mode	None	C-Min	C-Min	None	C-Min	C-Min	None	None		None	None	
Act Effect Green (s)	39.1	27.5	27.5	38.4	27.1	27.1	35.3	24.8		35.2	24.7	
Actuated g/C Ratio	0.43	0.31	0.31	0.43	0.30	0.30	0.39	0.28		0.39	0.27	

# Lanes, Volumes, Timings

## 1: Deep Lake Road & Grass Lake Road

10/08/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.53	0.41	0.13	0.29	0.70	0.23	0.47	0.79		0.39	0.99	
Control Delay	19.0	26.7	1.3	14.5	34.4	5.1	23.0	44.5		20.6	69.9	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	19.0	26.7	1.3	14.5	34.4	5.1	23.0	44.5		20.6	69.9	
LOS	B	C	A	B	C	A	C	D		C	E	
Approach Delay		20.1			24.6			39.4			60.6	
Approach LOS		C			C			D			E	
Queue Length 50th (ft)	56	109	0	44	200	0	44	219		42	~319	
Queue Length 95th (ft)	95	174	7	77	298	38	81	#400		78	#521	
Internal Link Dist (ft)		330			397			378			335	
Turn Bay Length (ft)	150		150			150	140			145		
Base Capacity (vph)	362	655	618	522	649	618	281	513		326	517	
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Reduced v/c Ratio	0.52	0.38	0.12	0.29	0.64	0.21	0.44	0.79		0.37	0.99	

### Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 3 (3%), Referenced to phase 2:EBTL and 6:WBTL, Start of 1st Green

Natural Cycle: 80

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.99

Intersection Signal Delay: 36.5

Intersection LOS: D

Intersection Capacity Utilization 79.1%

ICU Level of Service D

Analysis Period (min) 15









~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.






Splits and Phases: 1: Deep Lake Road & Grass Lake Road

			
Ø1	Ø2 (R)	Ø3	Ø4
13.5 s	36 s	13.5 s	27 s
			
Ø5	Ø6 (R)	Ø7	Ø8
13.5 s	36 s	13.5 s	27 s

# HCM 6th TWSC

## 3: Deep Lake Road & Tower Drive

10/08/2019

Intersection						
Int Delay, s/veh	3.3					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	84	56	60	410	359	113
Future Vol, veh/h	84	56	60	410	359	113
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	-	125	-	-	125
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	0	0	0	1	1	0
Mvmt Flow	89	60	64	436	382	120
Major/Minor	Minor2	Major1		Major2		
Conflicting Flow All	946	382	502	0	-	0
Stage 1	382	-	-	-	-	-
Stage 2	564	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.1	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.2	-	-	-
Pot Cap-1 Maneuver	293	670	1073	-	-	-
Stage 1	694	-	-	-	-	-
Stage 2	573	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	275	670	1073	-	-	-
Mov Cap-2 Maneuver	275	-	-	-	-	-
Stage 1	652	-	-	-	-	-
Stage 2	573	-	-	-	-	-
Approach	EB	NB		SB		
HCM Control Delay, s	21.9	1.1		0		
HCM LOS	C					
Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR	
Capacity (veh/h)	1073	-	360	-	-	
HCM Lane V/C Ratio	0.059	-	0.414	-	-	
HCM Control Delay (s)	8.6	-	21.9	-	-	
HCM Lane LOS	A	-	C	-	-	
HCM 95th %tile Q(veh)	0.2	-	2	-	-	

Intersection												
Int Delay, s/veh	1.3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰	↱		↰	↱			↰	↱	↰	↱
Traffic Vol, veh/h	10	388	58	0	713	1	0	0	66	25	0	8
Future Vol, veh/h	10	388	58	0	713	1	0	0	66	25	0	8
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	Free	-	-	None	-	-	Stop	-	-	None
Storage Length	-	-	150	-	-	-	-	-	0	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	1	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	88	88	88	88	88	88	88	88	88
Heavy Vehicles, %	0	1	0	0	1	0	0	0	0	0	0	0
Mvmt Flow	11	441	66	0	810	1	0	0	75	28	0	9
Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	811	0	-	-	-	0	-	-	441	1274	1274	811
Stage 1	-	-	-	-	-	-	-	-	-	811	811	-
Stage 2	-	-	-	-	-	-	-	-	-	463	463	-
Critical Hdwy	4.1	-	-	-	-	-	-	-	6.2	7.1	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	-	-	-	6.1	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	-	-	-	6.1	5.5	-
Follow-up Hdwy	2.2	-	-	-	-	-	-	-	3.3	3.5	4	3.3
Pot Cap-1 Maneuver	824	-	0	0	-	-	0	0	621	145	169	383
Stage 1	-	-	0	0	-	-	0	0	-	376	396	-
Stage 2	-	-	0	0	-	-	0	0	-	583	568	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	824	-	-	-	-	-	-	-	621	126	166	383
Mov Cap-2 Maneuver	-	-	-	-	-	-	-	-	-	250	284	-
Stage 1	-	-	-	-	-	-	-	-	-	369	396	-
Stage 2	-	-	-	-	-	-	-	-	-	503	558	-
Approach	EB			WB			NB			SB		
HCM Control Delay, s	0.2			0			11.6			20.3		
HCM LOS							B			C		
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	WBL	WBT	WBR	SBLn1					
Capacity (veh/h)	621	824	-	-	-	-	273					
HCM Lane V/C Ratio	0.121	0.014	-	-	-	-	0.137					
HCM Control Delay (s)	11.6	9.4	0	-	-	-	20.3					
HCM Lane LOS	B	A	A	-	-	-	C					
HCM 95th %tile Q(veh)	0.4	0	-	-	-	-	0.5					