

TOWERING OAKS VILLAGE
Traffic Impact Study
Hatmaker Lane
Knoxville, TN

A Traffic Impact Study for the Proposed Towering Oaks Village

Submitted to

**Knoxville – Knox County Metropolitan
Planning Commission**

March 29, 2016
FMA Project No. 564.001

Submitted By:



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Executive Summary

New Destiny, LLC proposes a residential development with single family homes. The project is located south of N Campbell Station Road on Hatmaker Lane in Knox County. The development will consist of 75 single family homes in Phase I and 35 single family homes in Phase II for a total of 110 single family lots. Construction is proposed to take place this year and this study assumes full build out for the development will occur in 2019.

The driveway for the proposed development will tie into Hatmaker Lane east of the intersection of Hatmaker Lane and Hopper Lane. The proposed lane configuration is a single lane out of the development.

In order to maintain or provide an acceptable level-of-service for each of the intersections studied, the following recommendations are presented:

N Campbell Station Road @ Fretz Road

A westbound left turn lane is warranted during the PM Peak hour. Per AASHTO "A Policy on Geometric Design of Highways and Streets" the recommended storage length is two car lengths (approximately 50 feet) and the recommended taper length is 100 feet.

The intersection will continue to operate at a LOS B or higher after the completion of the Towering Oaks Village.

Fretz Road

The width of Fretz Road between the intersection with Hatmaker Lane and the intersection with Woodhollow Lane varies from approximately 14 feet to 22 feet. The recommended road width per AASHTO's "A Policy on Geometric Design of Highways and Streets" for a local road with a posted speed limit of 30 mph with ADT between 1,500 and 2,200 trips per day is 22 feet.

Hatmaker Lane @ Project Entrance

The proposed intersection geometry will be one lane entering and one lane exiting the subdivision. The project entrance is expected to operate at a LOS A during both the AM and PM peak hours.

1 Introduction

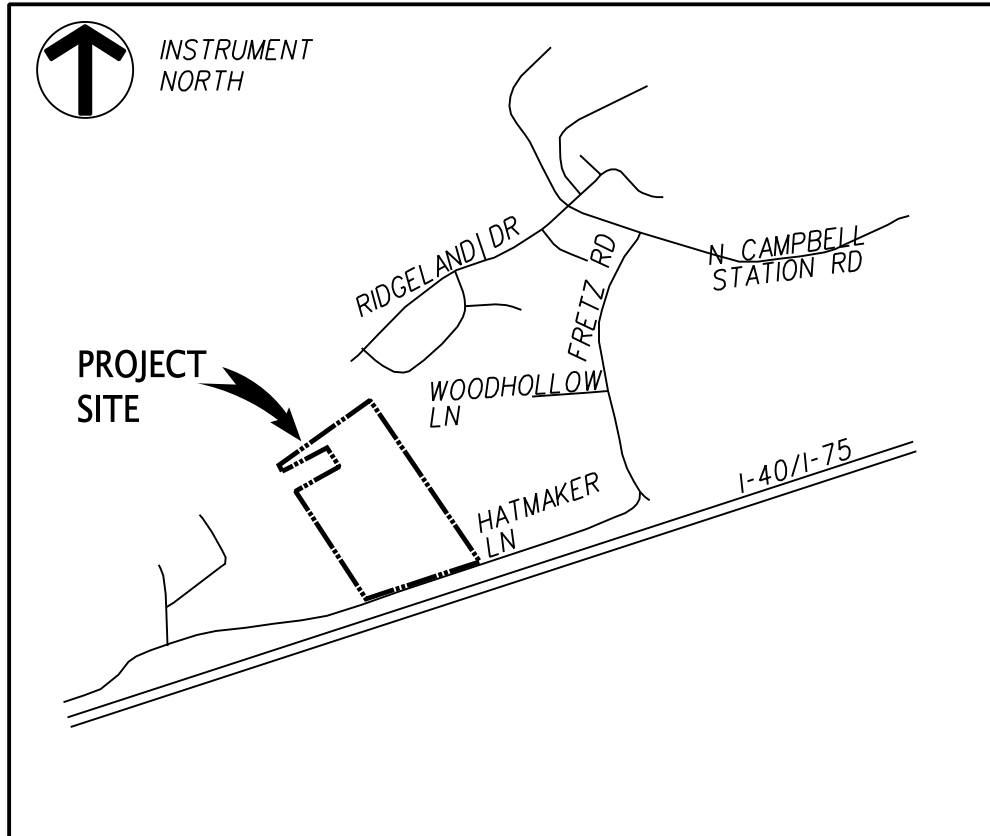
1.1 Project Description

This report provides a summary of a traffic impact study that was performed for the proposed Towering Oaks Village on Hatmaker Lane. The project site is located south of the intersection of Fretz Road and N Campbell Station Road in Knox County. The location of the site is shown in Figure 1.

The proposed Towering Oaks Village will consist of 75 single family lots in Phase I and approximately 35 single family lots in Phase II for a total proposed 110 single family lots. Full Buildout is expected to occur within three years, or by the year 2019. The proposed site layout is shown in Figure 2.


The purpose of this study is to evaluate the impacts to the traffic conditions caused by the development of the proposed subdivision.

FIGURE 1



LOCATION MAP
(NOT TO SCALE)

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FIGURE 1		No.	Revision/Issue	Date	

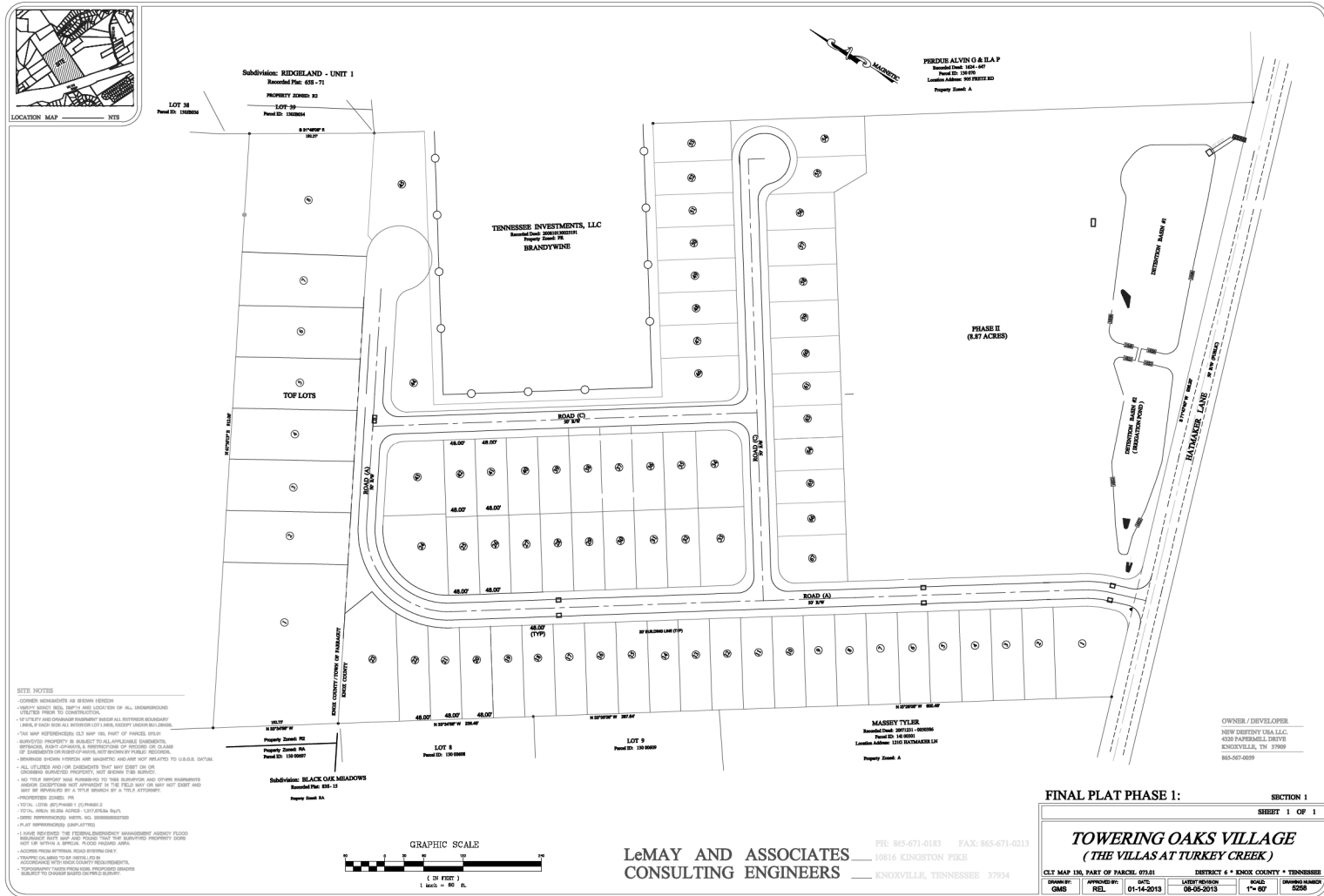
LOCATION MAP

TOWERING OAKS VILLAGE
KNOX COUNTY, TN



10330 HARDIN VALLEY ROAD
SUITE 201
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FIGURE 2



File Name: J:\564\564.001\Calculations\Traffic Impact Study\564.001_crp001.dgn

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SITE PLAN

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1.2 Existing Site Conditions

The proposed subdivision site access will tie into Hatmaker Lane approximately 1,850 feet east of the intersection of Hopper Lane and Hatmaker Lane and approximately 3,200 feet southwest of the intersection of Woodhollow Lane and Fretz Road.

During a site visit it was determined that Hatmaker Lane is a two-lane road with a width of 20-ft at the proposed project entrance. The posted speed limit on Hatmaker Lane is 30 mph. The Knoxville-Knox County Metropolitan Planning Commission does not list a classification for Hatmaker Lane per the Major Road Plan; therefore it is considered a local street. The intersection sight distance at the proposed driveway was measured to be in excess of 300-ft east and west of the intersection.

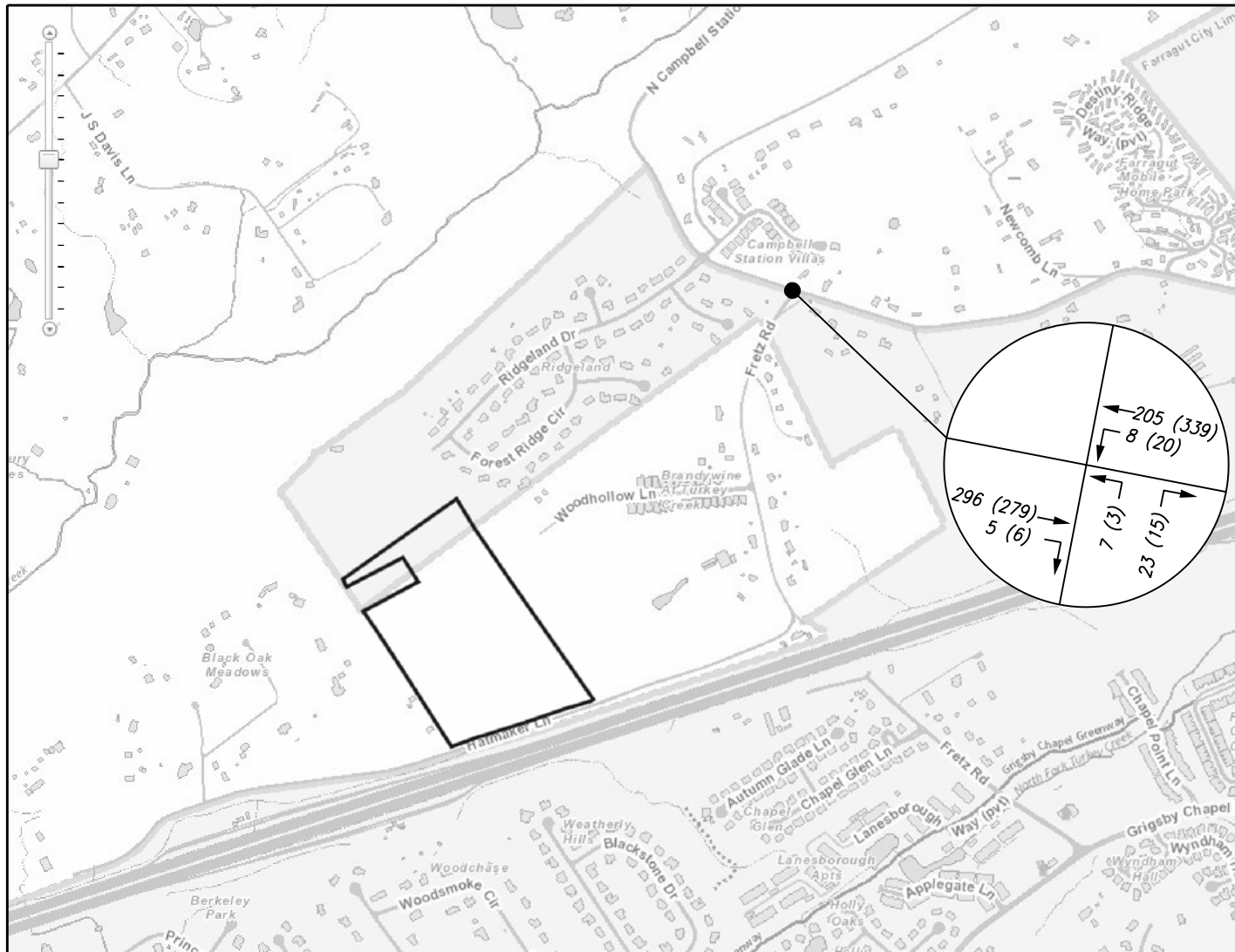
Fretz Road is a two-lane road with a posted speed limit of 30 mph. The width of Fretz Road between the intersection with Hatmaker Lane and the intersection with Woodhollow Lane varies from approximately 14 feet to 22 feet. The Knoxville-Knox County Metropolitan Planning Commission does not list a classification for Fretz Road per the Major Road Plan; therefore it is considered a local street.

N Campbell Station Road is a two-lane road and has a posted speed limit of 35 mph. The Knoxville-Knox County Metropolitan Planning Commission classifies N Campbell Station Road as a minor arterial per the Major Road Plan.

2 Existing Traffic Volumes

FMA conducted an eight-hour turning movement count at the intersection of N Campbell Station Road and Fretz Road on Tuesday February 23, 2016. The weather conditions at the count location were intermittent light rain. The existing volume including the AM and PM peak hour traffic volumes at the count locations are shown in Figure 3 and the count data collected is included in Attachment 1.

The current AM peak hour, and PM peak hour were determined using the eight-hour turning movement count that FMA conducted. The AM peak hour occurred between 7:30 am and 8:30 am and the PM peak hour occurred between 5:00 pm and 6:00 pm.



LEGEND:

← 5 (16)

TURNING MOVEMENT VOLUME AM (PM)

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2016 EXISTING PEAK HOUR TRAFFIC

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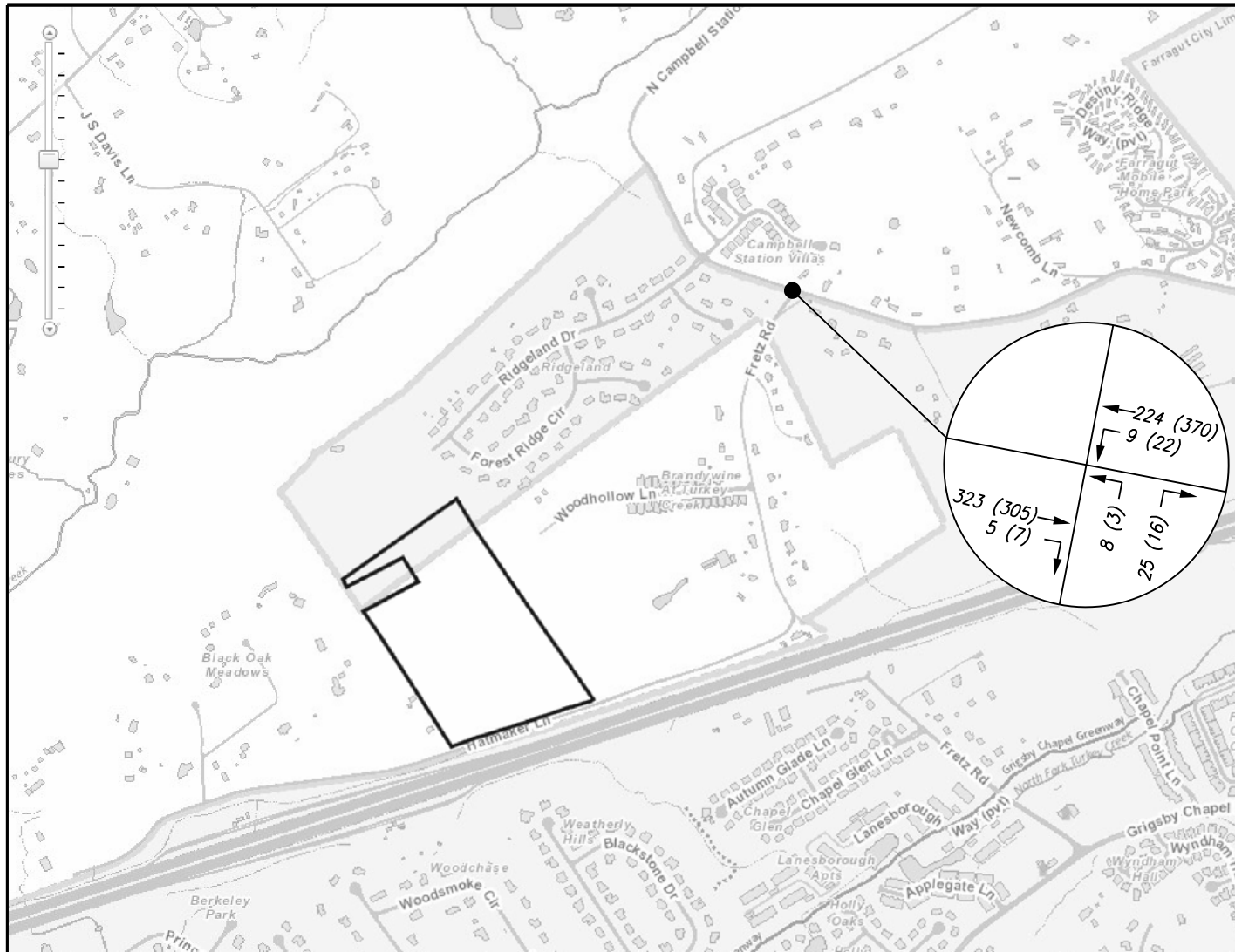
3 Background Growth

The Tennessee Department of Transportation (TDOT) maintains a count station on N Campbell Station Road south of Yarnell Road. The annual traffic growth rate for this station between 2000 and 2014 is approximately 1.88%.

The Transportation Planning Organization (TPO) maintains a count station on N Campbell Station Road north of Interstate 40. The annual traffic growth rate for this station between 2000 and 2014 is approximately 3.62%.

For the purpose of this study, an annual growth rate of 3.0% for traffic at the intersection of N Campbell Station Road and Fretz Road was assumed until full occupancy is reached in 2019.

Attachment 2 shows the trend line growth charts for the TDOT count station and the TPO count station. Figure 4 demonstrates the projected future peak hour volumes at the intersections after applying this background growth rate to the existing conditions.



LEGEND:

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TURNING MOVEMENT VOLUME AM (PM)

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FIGURE 4					
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**2019 BACKGROUND
PEAK HOUR TRAFFIC**

**TOWERING OAKS VILLAGE
KNOX COUNTY, TN**

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4 Trip Generation and Trip Distribution

Single-Family Detached Housing or Land Use 210 was used to calculate site trips for the proposed single family housing using the fitted curve equations from *The Trip Generation, 9th Edition*, published by the Institute of Transportation Engineers.

The total number of trips generated by the proposed Towering Oaks Village was estimated to be 1146 daily trips. During the peak hours the estimated trips are 87 trips during the AM peak hour and 114 trips during the PM peak hour.

A trip generation summary is shown in Table 4-1.

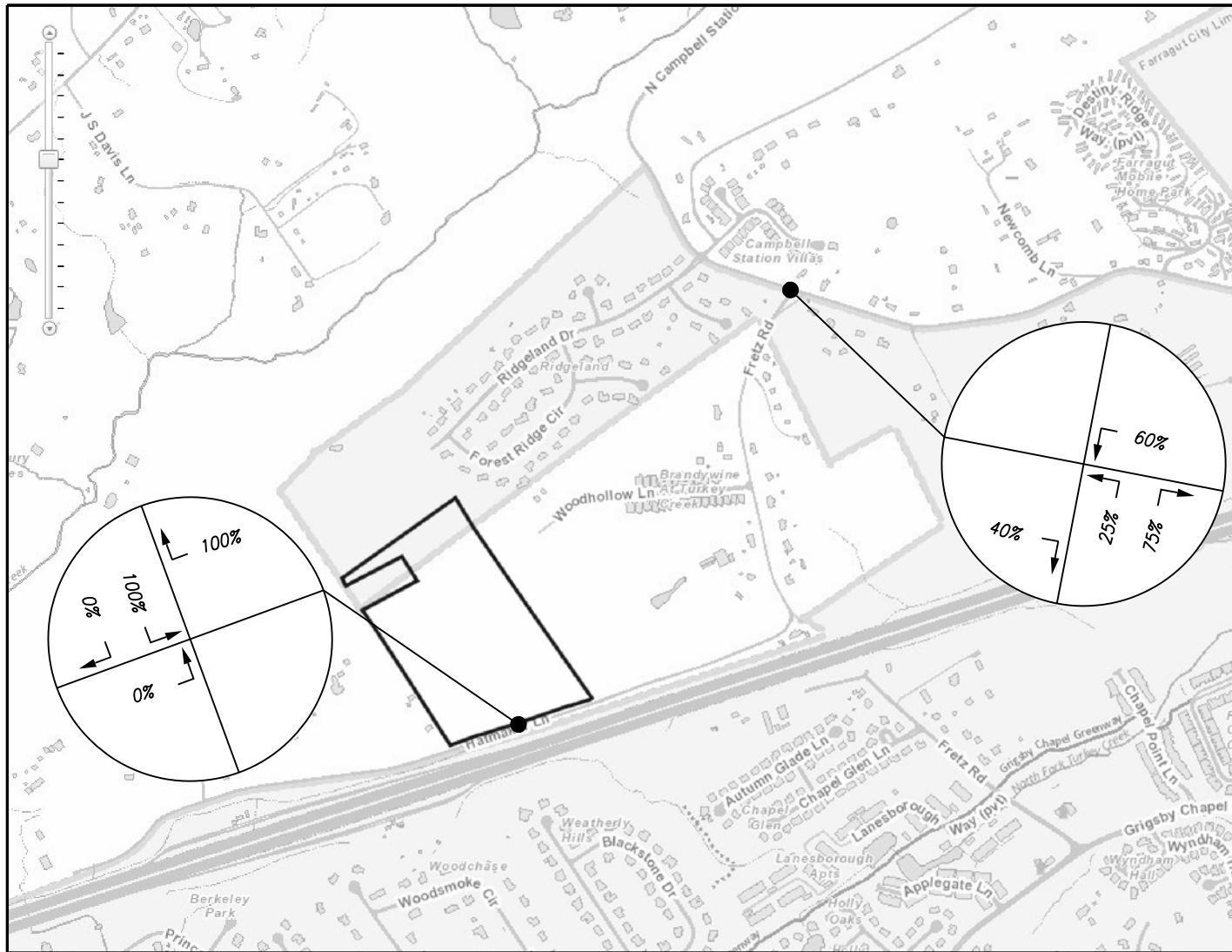
**Table 4-1
Trip Generation Summary**

Towering Oaks Village – Phase I & II Single-Family Detached Housing (Land Use 210)					
	Total New Trips	% Entering	%Exiting	Number Entering	Number Exiting
Weekday	1146	50	50	573	573
A.M. Peak	87	25	75	22	65
P.M. Peak	114	63	37	72	42

The directional distribution of the traffic generated by the proposed Towering Oaks Village was determined using the traffic data collected for the existing conditions. The typical weekday traffic pattern is for traffic to flow heavier in one direction in the morning peak period and then for the traffic to be heavier in the opposite direction during the evening peak period. Hatmaker Lane at the proposed Project Entrance has a trip distribution of 70% Eastbound and 30% Westbound during the AM peak hour and 40% Eastbound and 60% Westbound during the PM peak hour.

Fretz Road has a trip distribution for exiting traffic of 75% right turns and 25% left turns during the AM peak hour and 85% right turns and 15% left turns during the PM peak hour. N Campbell Station Road has a trip distribution for entering traffic onto Fretz Road of 40% Eastbound right turns and 60% Westbound left turns during the AM peak hour and 25% Eastbound right turns and 75% Westbound left turns during the PM peak hour. The trip distribution for the Towering Oaks Village is shown in Figure 5 and Figure 6.

Using the existing trip distribution the trips generated from the Towering Oaks Village are shown in Figure 7. Figure 8 shows the combined peak hour traffic from the background growth and the full build out of the Towering Oaks Village.



LEGEND:

← 50% (50%)

TRIP DISTRIBUTION AM (PM)

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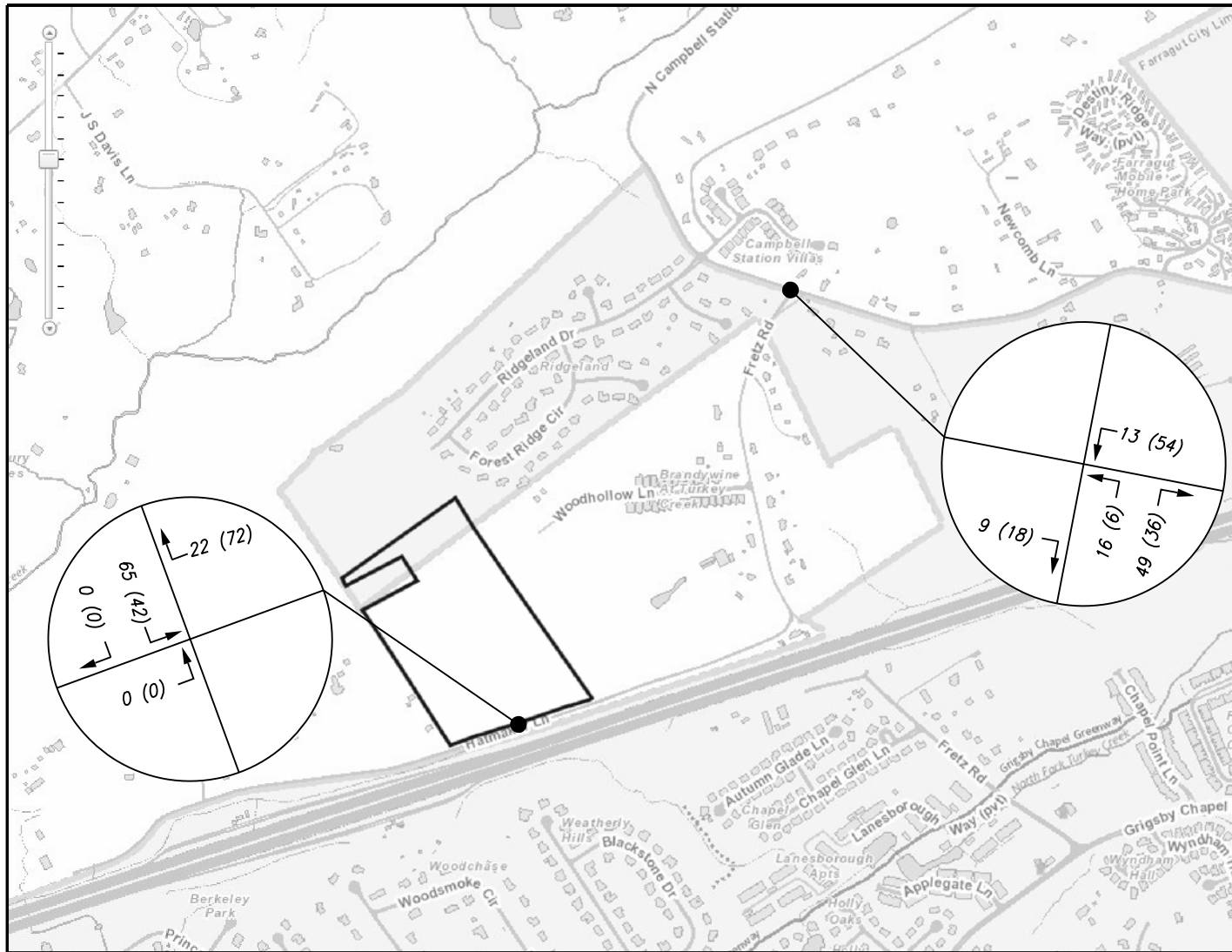
Project	564.001	Proj. Mgr.	Designed By	Drawn By	Reference
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**AM PEAK HOUR
TRIP DISTRIBUTION**

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LEGEND:

← 5 (16)

TURNING MOVEMENT VOLUME AM (PM)

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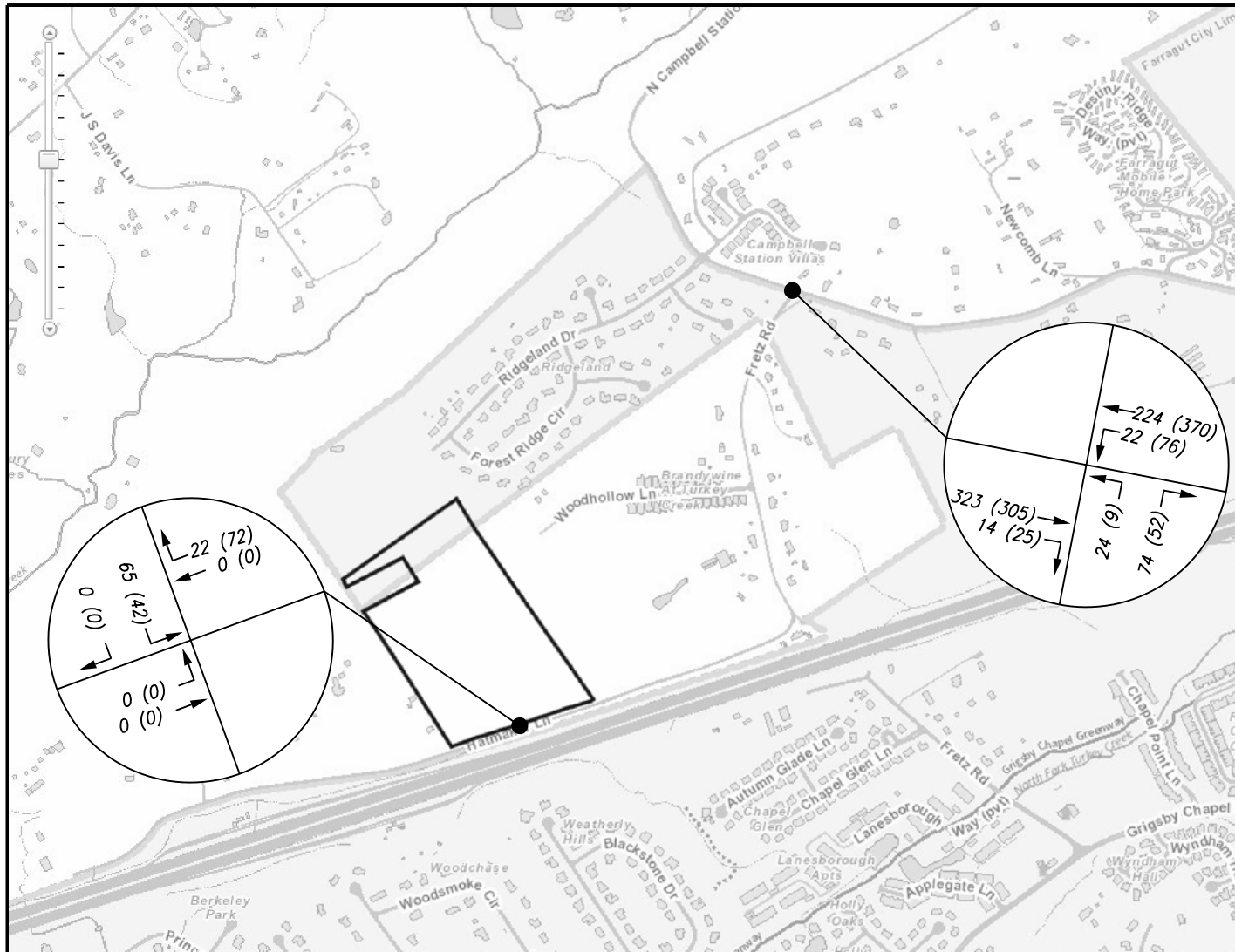
Project	564.001	Proj. Mgr.		Designed By		Drawn By		Reference	
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FIGURE 7		No.	Revision/Issue				Date		

PEAK HOUR SUBDIVISION TRAFFIC

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LEGEND:

← 5 (16)

TURNING MOVEMENT VOLUME AM (PM)

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Project	564.001	Proj. Mgr.	Designed By	Drawn By	Reference
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Scale	N.T.S.				
Sheet	FIGURE 8				
No.	Revision/Issue			Date	

**2019 PEAK HOUR TRAFFIC
FULL BUILDOUT**

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5 Projected Capacity and Level of Service

Unsignalized intersection capacity analyses were performed for the AM and PM peak hours to evaluate the traffic conditions at the intersections of N Campbell Station Road and Fretz Road and the intersection of Hatmaker Lane and the proposed project entrance.

The results from the analyses are measured with a term “level of service” (LOS), which is based on the amount of delay experienced at the intersection. The LOS index ranges from LOS A, indicating excellent traffic conditions with minimal delay, to LOS F indicating very congested conditions with excessive delay. LOS D generally is considered the minimum acceptable condition in urban areas. Table 5-1 shows the results of the capacity analyses.

Table 5-1
Intersection Analysis
Level of Service (LOS) Summary

Delay (sec)/LOS		
N Campbell Station Road @ Fretz Road (Existing 2016)		
AM Peak	WB LT	8.0 / A
	NB LR	11.7 / B
PM Peak	WB LT	8.1 / A
	NB LR	11.3 / B
N Campbell Station Road @ Fretz Road (Background Growth 2019)		
AM Peak	WB LT	8.1 / A
	NB LR	12.1 / B
PM Peak	WB LT	8.2 / A
	NB LR	11.7 / B
N Campbell Station Road @ Fretz Road (Background Growth + Full Buildout 2019)		
AM Peak	WB LT	8.2 / A
	NB LR	14.5 / B
PM Peak	WB LT	8.6 / A
	NB LR	13.5 / B

Hatmaker Lane @ Project Entrance (Background Growth + Full Buildout 2019)

AM Peak	EB LT	7.2 / A
	SB LR	8.8 / A
PM Peak	EB LT	7.4 / A
	SB LR	8.9 / A

6 Turn Lane Warrant Analysis

The intersection of N Campbell Station Road and Fretz Road was evaluated to determine if an eastbound right turn lane or a westbound left turn on N Campbell Station Road was warranted. The Knox County Department of Engineering and Public Works handbook, "Access Control and Driveway Design Policy," was used to analyze the information. An eastbound right turn lane on N Campbell Station Road is not warranted during the AM or PM peak hour. A westbound left turn on N Campbell Station Road is warranted during the PM peak hour. The turn lane warrant worksheets and analysis are included in Attachment 6.

7 Conclusions and Recommendations

7.1 N Campbell Station Road @ Fretz Road

At the intersection of N Campbell Station Road and Fretz Road, all approaches currently operate at an acceptable LOS A or B during both the AM and PM peak hours. The intersection will continue to operate at a LOS A during the AM peak hour and a LOS B during the PM peak hour after the completion of the Towering Oaks Village.

An eastbound right turn lane is not warranted at the intersection of Campbell Station Road and Fretz Road.

A westbound left turn lane is warranted at the intersection of Campbell Station Road and Fretz Road after the full buildout of the Towering Oaks Village, but only during the PM peak hour. The left turn lane warrant is not met during the construction of Phase I, but will be met after 82 of the proposed 110 single family lots is completed.

The unsignalized intersection capacity analyses shows a 95% queue length at the full buildout for the westbound left turning movement of less than one car length

during both the AM and PM peak hours. Per AASHTO "A Policy on Geometric Design of Highways and Streets" the recommended storage length is two car lengths (approximately 50 feet) and the recommended taper length is 100 feet.

7.2 Fretz Road

The width of Fretz Road between the intersection with Hatmaker Lane and the intersection with Woodhollow Lane varies from approximately 14 feet to 22 feet. The recommended road width per AASHTO's "A Policy on Geometric Design of Highways and Streets" for a local road with a posted speed limit of 30 mph with ADT between 1,500 and 2,200 trips per day is 22 feet.

The length of Fretz Road is approximately 2,800 feet therefore; the minimum allowable horizontal radius of curvature at the centerline of the road right-of-way is 250 feet per the "Minimum Subdivision Regulations" for Knoxville and Knox County. The existing curvature on Fretz Road is less than 250 feet, but there does not appear to be sufficient right-of-way to make improvements to this horizontal radius.

7.3 Hatmaker Lane @ Project Entrance

The minimum intersection spacing required for a local street is 125 feet per the "Minimum Subdivision Regulations" for Knoxville and Knox County. The nearest road intersection to the project entrance is currently 1,850 feet west at the intersection of Hatmaker Lane and Hopper Drive. This intersection exceeds the typical minimum separation of 125 feet between roads on a local street; therefore, no change is necessary.

The minimum required sight distance for a road with a posted speed limit of 30 mph is 300 feet in each direction in accordance with the "Minimum Subdivision Regulations" for Knoxville and Knox County. The proposed intersection of Hatmaker Lane and the project entrance has a measured sight distance that exceeds 300-ft east and west of the intersection, which meets the requirement. FMA recommends any necessary landscaping that may be involved to maintain this sight distance and continue to comply with Knox County Engineering & Public Works.

The proposed intersection geometry will be one lane entering and one lane exiting the subdivision. The project entrance is expected to operate at a LOS A during both the AM and PM peak hours.

Attachment 1
Traffic Counts

**Attachment 1
Traffic Counts**

**Project: Towering Oaks Village
Date Conducted: Tuesday 2/23/2016**

Start	N Campbell Station Rd Eastbound			N Campbell Station Rd Westbound			Fretz Road Northbound			Int. Total
	Thru	Right	Total	Left	Thru	Total	Left	Right	Total	
7:00 AM	47	1	48	1	22	23	0	7	7	78
7:15 AM	54	1	55	3	25	28	1	7	8	91
7:30 AM	85	1	86	4	31	35	3	8	11	132
7:45 AM	90	2	92	3	54	57	2	6	8	157
Total	276	5	281	11	132	143	6	28	34	458
8:00 AM	54	1	55	1	68	69	0	7	7	131
8:15 AM	67	1	68	0	52	52	2	2	4	124
8:30 AM	58	0	58	1	50	51	0	2	2	111
8:45 AM	52	2	54	2	61	63	0	3	3	120
Total	231	4	235	4	231	235	2	14	16	486
11:00 AM	33	0	33	2	41	43	1	7	8	84
11:15 AM	47	0	47	4	32	36	1	3	4	87
11:30 AM	35	1	36	0	36	36	0	3	3	75
11:45 AM	47	0	47	0	46	46	0	3	3	96
Total	162	1	163	6	155	161	2	16	18	342
12:00 PM	61	0	61	1	55	56	0	0	0	117
12:15 PM	56	1	57	5	47	52	0	7	7	116
12:30 PM	43	2	45	1	39	40	1	2	3	88
12:45 PM	39	0	39	3	44	47	0	2	2	88
Total	199	3	202	10	185	195	1	11	12	409
2:00 PM	47	1	48	7	52	59	1	1	2	109
2:15 PM	42	2	44	4	46	50	2	3	5	99
2:30 PM	43	0	43	5	52	57	0	3	3	103
2:45 PM	35	0	35	6	53	59	1	3	4	98
Total	167	3	170	22	203	225	4	10	14	409
3:00 PM	67	2	69	5	61	66	1	5	6	141
3:15 PM	48	0	48	3	47	50	0	1	1	99
3:30 PM	74	0	74	2	60	62	0	5	5	141
3:45 PM	80	1	81	15	54	69	0	7	7	157
Total	269	3	272	25	222	247	1	18	19	538
4:00 PM	45	2	47	1	56	57	1	3	4	108
4:15 PM	52	0	52	5	71	76	0	3	3	131
4:30 PM	66	2	68	9	65	74	1	5	6	148
4:45 PM	66	0	66	7	72	79	0	6	6	151
Total	229	4	233	22	264	286	2	17	19	538
5:00 PM	59	3	62	8	85	93	1	5	6	161
5:15 PM	90	1	91	6	78	84	1	3	4	179
5:30 PM	66	0	66	3	91	94	0	3	3	163
5:45 PM	64	2	66	3	85	88	1	4	5	159
Total	279	6	285	20	339	359	3	15	18	662
Grand Total	1812	29	1841	120	1731	1851	21	129	150	3842
Approach %	98.4	1.6		6.5	93.5		14.0	86.0		
Total %	47.2	0.8	47.9	3.1	45.1	48.2	0.5	3.4	3.9	

Project: Towering Oaks Village
Date Conducted: Tuesday 2/23/2016

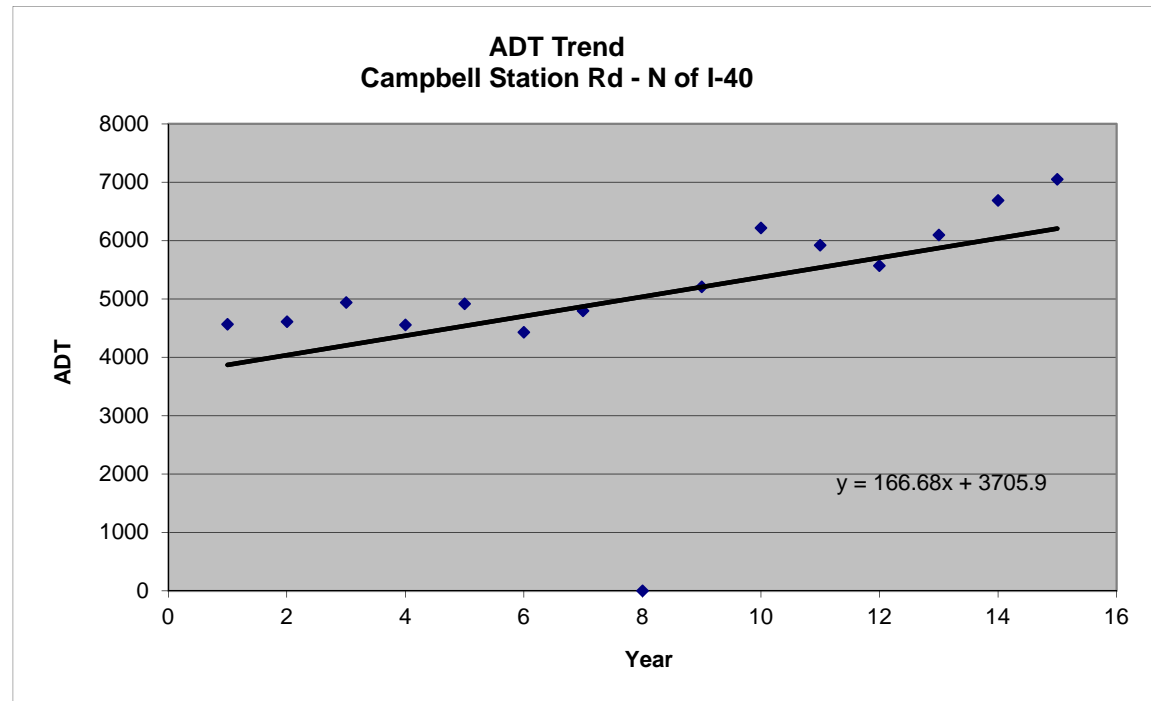
AM Peak Hour	7:30 AM - 8:30 AM	544
Lunch Peak Hour	11:45 AM - 12:45 PM	417
PM Peak Hour	5:00 PM - 6:00 PM	662

Start	N Campbell Station Rd Eastbound			N Campbell Station Rd Westbound			Fretz Road Northbound			Int. Total
	Thru	Right	App. Total	Left	Thru	App. Total	Left	Right	App. Total	
Peak Hour Analysis from 7:00 AM to 9:00 AM										
AM Peak Hour begins at 7:15 AM										
7:30 AM	85	1	86	4	31	35	3	8	11	132
7:45 AM	90	2	92	3	54	57	2	6	8	157
8:00 AM	54	1	55	1	68	69	0	7	7	131
8:15 AM	67	1	68	0	52	52	2	2	4	124
Total Volume	296	5	301	8	205	213	7	23	30	544
Future (3% over 3 yrs)	323	5		9	224		8	25		594
PHF	0.82	0.63		0.50	0.75		0.58	0.72		0.87
Peak Hour Analysis from 11:00 AM to 1:00 PM										
Lunch Peak Hour begins at 11:45 PM										
11:45 PM	47	0	47	0	46	46	0	3	3	96
12:00 PM	61	0	61	1	55	56	0	0	0	117
12:15 PM	56	1	57	5	47	52	0	7	7	116
12:30 PM	43	2	45	1	39	40	1	2	3	88
Total Volume	207	3	210	7	187	194	1	12	13	417
Future (3% over 3 yrs)	226	3		8	204		1	13		456
PHF	0.85	0.38		0.35	0.85		0.25	0.43		0.89
Peak Hour Analysis from 2:00 PM to 6:00 PM										
PM Peak Hour begins at 5:00 PM										
5:00 PM	59	3	62	8	85	93	1	5	6	161
5:15 PM	90	1	91	6	78	84	1	3	4	179
5:30 PM	66	0	66	3	91	94	0	3	3	163
5:45 PM	64	2	66	3	85	88	1	4	5	159
Total Volume	279	6	285	20	339	359	3	15	18	662
Future (3% over 3 yrs)	305	7		22	370		3	16		723
PHF	0.78	0.50		0.63	0.93		0.75	0.75		0.92

Attachment 2
ADT Trends

**Attachment 2
ADT Trends**

	Year	Adjusted Average Daily Traffic
1	2000	4570
2	2001	4610
3	2002	4940
4	2003	4560
5	2004	4920
6	2005	4430
7	2006	4800
8	2007	0
9	2008	5210
10	2009	6220
11	2010	5920
12	2011	5570
13	2012	6100
14	2013	6690
15	2014	7050



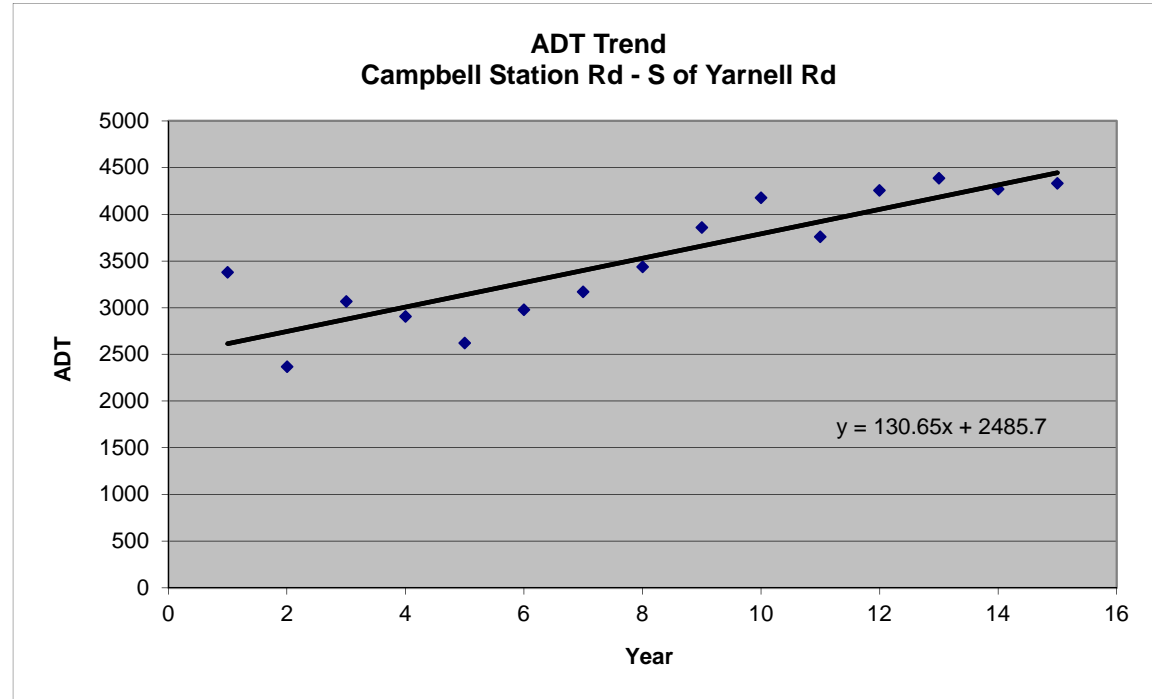
Most Recent Trend Line Growth

Year	ADT
2000	4570
2014	7050

Annual Percent Growth 3.62%

Attachment 2
ADT Trends

	Year	Adjusted Average Daily Traffic
1	2000	3378
2	2001	2367
3	2002	3067
4	2003	2907
5	2004	2623
6	2005	2978
7	2006	3169
8	2007	3436
9	2008	3860
10	2009	4176
11	2010	3759
12	2011	4256
13	2012	4385
14	2013	4271
15	2014	4332



Most Recent Trend Line Growth

Year	ADT
2000	3378
2014	4332

Annual Percent Growth 1.88%

Attachment 3
Intersection Worksheet
Existing AM/PM Peaks

TWO-WAY STOP CONTROL SUMMARY							
General Information				Site Information			
Analyst	Addie Kirkham			Intersection	Campbell Station @ Fretz		
Agency/Co.	FMA			Jurisdiction	Knox County		
Date Performed	2/24/2016			Analysis Year	2016		
Analysis Time Period	AM Peak - Existing						
Project Description 564.001 - Towering Oaks Village							
East/West Street: N Campbell Station Rd				North/South Street: Fretz Rd			
Intersection Orientation: East-West				Study Period (hrs): 0.25			
Vehicle Volumes and Adjustments							
Major Street	Eastbound			Westbound			
Movement	1	2	3	4	5	6	
	L	T	R	L	T	R	
Volume (veh/h)		296	5	8	205		
Peak-Hour Factor, PHF	1.00	0.82	0.63	0.50	0.75	1.00	
Hourly Flow Rate, HFR (veh/h)	0	360	7	16	273	0	
Percent Heavy Vehicles	0	--	--	0	--	--	
Median Type	Undivided						
RT Channelized			0			0	
Lanes	0	1	0	0	1	0	
Configuration			TR	LT			
Upstream Signal		0			0		
Minor Street	Northbound			Southbound			
Movement	7	8	9	10	11	12	
	L	T	R	L	T	R	
Volume (veh/h)	7		23				
Peak-Hour Factor, PHF	0.58	1.00	0.72	1.00	1.00	1.00	
Hourly Flow Rate, HFR (veh/h)	12	0	31	0	0	0	
Percent Heavy Vehicles	0	0	0	0	0	0	
Percent Grade (%)		0			0		
Flared Approach		N			N		
Storage		0			0		
RT Channelized			0			0	
Lanes	0	0	0	0	0	0	
Configuration		LR					
Delay, Queue Length, and Level of Service							
Approach	Eastbound	Westbound	Northbound			Southbound	
Movement	1	4	7	8	9	10	11
Lane Configuration		LT		LR			
v (veh/h)		16		43			
C (m) (veh/h)		1203		582			
v/c		0.01		0.07			
95% queue length		0.04		0.24			
Control Delay (s/veh)		8.0		11.7			
LOS		A		B			
Approach Delay (s/veh)	--	--	11.7				
Approach LOS	--	--	B				

TWO-WAY STOP CONTROL SUMMARY								
General Information				Site Information				
Analyst	Addie Kirkham			Intersection	Campbell Station @ Fretz			
Agency/Co.	FMA			Jurisdiction	Knox County			
Date Performed	2/24/2016			Analysis Year	2016			
Analysis Time Period	PM Peak - Existing							
Project Description 564.001 - Towering Oaks Village								
East/West Street: N Campbell Station Rd				North/South Street: Fretz Rd				
Intersection Orientation: East-West				Study Period (hrs): 0.25				
Vehicle Volumes and Adjustments								
Major Street	Eastbound			Westbound				
Movement	1	2	3	4	5	6		
	L	T	R	L	T	R		
Volume (veh/h)		279	6	20	339			
Peak-Hour Factor, PHF	1.00	0.78	0.50	0.63	0.93	1.00		
Hourly Flow Rate, HFR (veh/h)	0	357	12	31	364	0		
Percent Heavy Vehicles	0	--	--	0	--	--		
Median Type	Undivided							
RT Channelized			0			0		
Lanes	0	1	0	0	1	0		
Configuration			TR	LT				
Upstream Signal		0			0			
Minor Street	Northbound			Southbound				
Movement	7	8	9	10	11	12		
	L	T	R	L	T	R		
Volume (veh/h)	3		15					
Peak-Hour Factor, PHF	0.75	1.00	0.75	1.00	1.00	1.00		
Hourly Flow Rate, HFR (veh/h)	4	0	20	0	0	0		
Percent Heavy Vehicles	0	0	0	0	0	0		
Percent Grade (%)		0			0			
Flared Approach		N			N			
Storage		0			0			
RT Channelized			0			0		
Lanes	0	0	0	0	0	0		
Configuration		LR						
Delay, Queue Length, and Level of Service								
Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
v (veh/h)		31		24				
C (m) (veh/h)		1201		593				
v/c		0.03		0.04				
95% queue length		0.08		0.13				
Control Delay (s/veh)		8.1		11.3				
LOS		A		B				
Approach Delay (s/veh)	--	--	11.3					
Approach LOS	--	--	B					

Attachment 4
Intersection Worksheet
Background AM/PM Peaks

TWO-WAY STOP CONTROL SUMMARY							
General Information				Site Information			
Analyst	Addie Kirkham			Intersection	Campbell Station @ Fretz		
Agency/Co.	FMA			Jurisdiction	Knox County		
Date Performed	2/24/2016			Analysis Year	2019		
Analysis Time Period	AM Peak - Background						
Project Description 564.001 - Towering Oaks Village							
East/West Street: N Campbell Station Rd				North/South Street: Fretz Rd			
Intersection Orientation: East-West				Study Period (hrs): 0.25			
Vehicle Volumes and Adjustments							
Major Street	Eastbound			Westbound			
Movement	1	2	3	4	5	6	
	L	T	R	L	T	R	
Volume (veh/h)		323	5	9	224		
Peak-Hour Factor, PHF	1.00	0.82	0.63	0.50	0.75	1.00	
Hourly Flow Rate, HFR (veh/h)	0	393	7	18	298	0	
Percent Heavy Vehicles	0	--	--	0	--	--	
Median Type	Undivided						
RT Channelized			0			0	
Lanes	0	1	0	0	1	0	
Configuration			TR	LT			
Upstream Signal		0			0		
Minor Street	Northbound			Southbound			
Movement	7	8	9	10	11	12	
	L	T	R	L	T	R	
Volume (veh/h)	8		25				
Peak-Hour Factor, PHF	0.58	1.00	0.72	1.00	1.00	1.00	
Hourly Flow Rate, HFR (veh/h)	13	0	34	0	0	0	
Percent Heavy Vehicles	0	0	0	0	0	0	
Percent Grade (%)		0			0		
Flared Approach		N			N		
Storage		0			0		
RT Channelized			0			0	
Lanes	0	0	0	0	0	0	
Configuration		LR					
Delay, Queue Length, and Level of Service							
Approach	Eastbound	Westbound	Northbound			Southbound	
Movement	1	4	7	8	9	10	11
Lane Configuration		LT		LR			
v (veh/h)		18		47			
C (m) (veh/h)		1170		551			
v/c		0.02		0.09			
95% queue length		0.05		0.28			
Control Delay (s/veh)		8.1		12.1			
LOS		A		B			
Approach Delay (s/veh)	--	--	12.1				
Approach LOS	--	--	B				

TWO-WAY STOP CONTROL SUMMARY							
General Information				Site Information			
Analyst	Addie Kirkham			Intersection	Campbell Station @ Fretz		
Agency/Co.	FMA			Jurisdiction	Knox County		
Date Performed	2/24/2016			Analysis Year	2019		
Analysis Time Period	PM Peak - Background						
Project Description 564.001 - Towering Oaks Village							
East/West Street: N Campbell Station Rd				North/South Street: Fretz Rd			
Intersection Orientation: East-West				Study Period (hrs): 0.25			
Vehicle Volumes and Adjustments							
Major Street	Eastbound			Westbound			
Movement	1	2	3	4	5	6	
	L	T	R	L	T	R	
Volume (veh/h)		305	7	22	370		
Peak-Hour Factor, PHF	1.00	0.78	0.50	0.63	0.93	1.00	
Hourly Flow Rate, HFR (veh/h)	0	391	14	34	397	0	
Percent Heavy Vehicles	0	--	--	0	--	--	
Median Type	Undivided						
RT Channelized			0				0
Lanes	0	1	0	0	1	0	
Configuration			TR	LT			
Upstream Signal		0			0		
Minor Street	Northbound			Southbound			
Movement	7	8	9	10	11	12	
	L	T	R	L	T	R	
Volume (veh/h)	3		16				
Peak-Hour Factor, PHF	0.75	1.00	0.75	1.00	1.00	1.00	
Hourly Flow Rate, HFR (veh/h)	4	0	21	0	0	0	
Percent Heavy Vehicles	0	0	0	0	0	0	
Percent Grade (%)		0			0		
Flared Approach		N			N		
Storage		0			0		
RT Channelized			0				0
Lanes	0	0	0	0	0	0	
Configuration		LR					
Delay, Queue Length, and Level of Service							
Approach	Eastbound	Westbound	Northbound			Southbound	
Movement	1	4	7	8	9	10	11
Lane Configuration		LT		LR			
v (veh/h)		34		25			
C (m) (veh/h)		1165		561			
v/c		0.03		0.04			
95% queue length		0.09		0.14			
Control Delay (s/veh)		8.2		11.7			
LOS		A		B			
Approach Delay (s/veh)	--	--	11.7				
Approach LOS	--	--	B				

Attachment 5
Intersection Worksheet
Background AM/PM Peaks + Full Buildout

TWO-WAY STOP CONTROL SUMMARY								
General Information				Site Information				
Analyst	Addie Kirkham			Intersection	Campbell Station @ Fretz			
Agency/Co.	FMA			Jurisdiction	Knox County			
Date Performed	3/29/2016			Analysis Year	2019			
Analysis Time Period	AM Peak - Full Buildout							
Project Description 564.001 - Towering Oaks Village								
East/West Street: N Campbell Station Rd				North/South Street: Fretz Rd				
Intersection Orientation: East-West				Study Period (hrs): 0.25				
Vehicle Volumes and Adjustments								
Major Street	Eastbound			Westbound				
Movement	1	2	3	4	5	6		
	L	T	R	L	T	R		
Volume (veh/h)		323	14	22	224			
Peak-Hour Factor, PHF	1.00	0.82	0.63	0.50	0.75	1.00		
Hourly Flow Rate, HFR (veh/h)	0	393	22	44	298	0		
Percent Heavy Vehicles	0	--	--	0	--	--		
Median Type	Undivided							
RT Channelized			0				0	
Lanes	0	1	0	0	1	0		
Configuration			TR	LT				
Upstream Signal		0			0			
Minor Street	Northbound			Southbound				
Movement	7	8	9	10	11	12		
	L	T	R	L	T	R		
Volume (veh/h)	24		74					
Peak-Hour Factor, PHF	0.58	1.00	0.72	1.00	1.00	1.00		
Hourly Flow Rate, HFR (veh/h)	41	0	102	0	0	0		
Percent Heavy Vehicles	0	0	0	0	0	0		
Percent Grade (%)		0			0			
Flared Approach		N			N			
Storage		0			0			
RT Channelized			0			0		
Lanes	0	0	0	0	0	0		
Configuration		LR						
Delay, Queue Length, and Level of Service								
Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
v (veh/h)		44		143				
C (m) (veh/h)		1155		521				
v/c		0.04		0.27				
95% queue length		0.12		1.11				
Control Delay (s/veh)		8.2		14.5				
LOS		A		B				
Approach Delay (s/veh)	--	--	14.5					
Approach LOS	--	--	B					

TWO-WAY STOP CONTROL SUMMARY							
General Information				Site Information			
Analyst	Addie Kirkham			Intersection	Campbell Station @ Fretz		
Agency/Co.	FMA			Jurisdiction	Knox County		
Date Performed	3/29/2016			Analysis Year	2019		
Analysis Time Period	PM Peak - Full Buildout						
Project Description 564.001 - Towering Oaks Village							
East/West Street: N Campbell Station Rd				North/South Street: Fretz Rd			
Intersection Orientation: East-West				Study Period (hrs): 0.25			
Vehicle Volumes and Adjustments							
Major Street	Eastbound			Westbound			
Movement	1	2	3	4	5	6	
	L	T	R	L	T	R	
Volume (veh/h)		305	25	76	370		
Peak-Hour Factor, PHF	1.00	0.78	0.50	0.63	0.93	1.00	
Hourly Flow Rate, HFR (veh/h)	0	391	50	120	397	0	
Percent Heavy Vehicles	0	--	--	0	--	--	
Median Type	Undivided						
RT Channelized			0			0	
Lanes	0	1	0	0	1	0	
Configuration			TR	LT			
Upstream Signal		0			0		
Minor Street	Northbound			Southbound			
Movement	7	8	9	10	11	12	
	L	T	R	L	T	R	
Volume (veh/h)	9		52				
Peak-Hour Factor, PHF	0.75	1.00	0.75	1.00	1.00	1.00	
Hourly Flow Rate, HFR (veh/h)	12	0	69	0	0	0	
Percent Heavy Vehicles	0	0	0	0	0	0	
Percent Grade (%)		0			0		
Flared Approach		N			N		
Storage		0			0		
RT Channelized			0			0	
Lanes	0	0	0	0	0	0	
Configuration		LR					
Delay, Queue Length, and Level of Service							
Approach	Eastbound	Westbound	Northbound			Southbound	
Movement	1	4	7	8	9	10	11
Lane Configuration		LT		LR			
v (veh/h)		120		81			
C (m) (veh/h)		1130		504			
v/c		0.11		0.16			
95% queue length		0.36		0.57			
Control Delay (s/veh)		8.6		13.5			
LOS		A		B			
Approach Delay (s/veh)	--	--	13.5				
Approach LOS	--	--	B				

TWO-WAY STOP CONTROL SUMMARY							
General Information				Site Information			
Analyst	Addie Kirkham			Intersection	Hatmaker @ Project Entrance		
Agency/Co.	FMA			Jurisdiction	Knox County		
Date Performed	3/29/2016			Analysis Year	2019		
Analysis Time Period	AM Peak						
Project Description 564.001 Towering Oaks Village							
East/West Street: Hatmaker Lane				North/South Street: Project Entrance			
Intersection Orientation: East-West				Study Period (hrs): 0.25			
Vehicle Volumes and Adjustments							
Major Street	Eastbound			Westbound			
Movement	1	2	3	4	5	6	
	L	T	R	L	T	R	
Volume (veh/h)	0	0			0	22	
Peak-Hour Factor, PHF	0.90	0.90	1.00	1.00	0.90	0.90	
Hourly Flow Rate, HFR (veh/h)	0	0	0	0	0	24	
Percent Heavy Vehicles	0	--	--	0	--	--	
Median Type	Undivided						
RT Channelized			0			0	
Lanes	0	1	0	0	1	0	
Configuration	LT					TR	
Upstream Signal		0			0		
Minor Street	Northbound			Southbound			
Movement	7	8	9	10	11	12	
	L	T	R	L	T	R	
Volume (veh/h)				65		0	
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.90	1.00	0.90	
Hourly Flow Rate, HFR (veh/h)	0	0	0	72	0	0	
Percent Heavy Vehicles	0	0	0	0	0	0	
Percent Grade (%)		0			0		
Flared Approach		N			N		
Storage		0			0		
RT Channelized			0			0	
Lanes	0	0	0	0	0	0	
Configuration					LR		
Delay, Queue Length, and Level of Service							
Approach	Eastbound	Westbound	Northbound			Southbound	
Movement	1	4	7	8	9	10	11
Lane Configuration	LT						LR
v (veh/h)	0						72
C (m) (veh/h)	1604						1013
v/c	0.00						0.07
95% queue length	0.00						0.23
Control Delay (s/veh)	7.2						8.8
LOS	A						A
Approach Delay (s/veh)	--	--					8.8
Approach LOS	--	--					A

TWO-WAY STOP CONTROL SUMMARY							
General Information				Site Information			
Analyst	Addie Kirkham			Intersection	Hatmaker @ Project Entrance		
Agency/Co.	FMA			Jurisdiction	Knox County		
Date Performed	3/29/2016			Analysis Year	2019		
Analysis Time Period	PM Peak						
Project Description 564.001 Towering Oaks Village							
East/West Street: Hatmaker Lane				North/South Street: Project Entrance			
Intersection Orientation: East-West				Study Period (hrs): 0.25			
Vehicle Volumes and Adjustments							
Major Street	Eastbound			Westbound			
Movement	1	2	3	4	5	6	
	L	T	R	L	T	R	
Volume (veh/h)	0	0			0	72	
Peak-Hour Factor, PHF	0.90	0.90	1.00	1.00	0.90	0.90	
Hourly Flow Rate, HFR (veh/h)	0	0	0	0	0	80	
Percent Heavy Vehicles	0	--	--	0	--	--	
Median Type	Undivided						
RT Channelized			0			0	
Lanes	0	1	0	0	1	0	
Configuration	LT					TR	
Upstream Signal		0			0		
Minor Street	Northbound			Southbound			
Movement	7	8	9	10	11	12	
	L	T	R	L	T	R	
Volume (veh/h)				42		0	
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.90	1.00	0.90	
Hourly Flow Rate, HFR (veh/h)	0	0	0	46	0	0	
Percent Heavy Vehicles	0	0	0	0	0	0	
Percent Grade (%)		0			0		
Flared Approach		N			N		
Storage		0			0		
RT Channelized			0			0	
Lanes	0	0	0	0	0	0	
Configuration					LR		
Delay, Queue Length, and Level of Service							
Approach	Eastbound	Westbound	Northbound			Southbound	
Movement	1	4	7	8	9	10	11
Lane Configuration	LT						LR
v (veh/h)	0						46
C (m) (veh/h)	1531						977
v/c	0.00						0.05
95% queue length	0.00						0.15
Control Delay (s/veh)	7.4						8.9
LOS	A						A
Approach Delay (s/veh)	--	--					8.9
Approach LOS	--	--					A

Attachment 6
Turn Lane Warrant Analysis

**Attachment 6
Turn Lane Warrant Analysis**

Project: Towering Oaks Village

**N Campbell Station Road
at Fretz Road**

VOLUMES

LEFT TURN	Opposing	Thru	LT	LT MAX	Warrant Met
AM	337	224	22	110	NO
PM	330	370	76	65	YES

**N Campbell Station Road
at Fretz Road**

VOLUMES

RIGHT TURN	Thru	RT	RT MAX	Warrant Met
AM	323	14	299	NO
PM	305	25	299	NO

TABLE 4A

LEFT-TURN LANE VOLUME THRESHOLDS
FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 35 MPH OR LESS

(If the left-turn volume exceeds the table value a left -turn lane is needed)

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	350 - 399
100 - 149	300	235	185	145	120	100
150 - 199	245	200	160	130	110	90
200 - 249	205	170	140	115	100	80
250 - 299	175	150	125	105	90	70
300 - 349	155	135	110	95	80	65
350 - 399	135	120	100	85	70	60
400 - 449	120	105	90	75	65	55
450 - 499	105	90	80	65	55	50
500 - 549	95	80	70	65	55	50
550 - 599	85	70	65	60	50	45
600 - 649	75	65	60	55	45	40
650 - 699	70	60	55	50	40	35
700 - 749	65	55	50	45	35	30
750 or More	60	50	45	40	35	30

AM Peak
22 LT

PM Peak
76 LT

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	= / > 600
100 - 149	100	80	70	60	55	50
150 - 199	90	75	65	55	50	45
200 - 249	80	72	60	55	50	45
250 - 299	70	65	55	50	45	40
300 - 349	65	60	50	50	45	40
350 - 399	60	55	50	45	40	40
400 - 449	55	50	45	45	40	35
450 - 499	50	45	45	40	35	35
500 - 549	50	45	40	40	35	35
550 - 599	45	40	40	35	35	35
600 - 649	40	35	35	35	35	30
650 - 699	35	35	35	30	30	30
700 - 749	30	30	30	30	30	30
750 or More	30	30	30	30	30	30

* Or through volume only if a right-turn lane exists.

TABLE 4B
RIGHT-TURN LANE VOLUME THRESHOLDS
FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 35 MPH OR LESS

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	<100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399
Fewer Than 25 25 - 49 50 - 99					AM Peak 14 RT PM Peak 25 RT	
100 - 149 150 - 199						
200 - 249 250 - 299						Yes
300 - 349 350 - 399				Yes	Yes Yes	Yes Yes
400 - 449 450 - 499			Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599		Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 600	+ / > 600
Fewer Than 25 25 - 49 50 - 99					Yes	Yes Yes
100 - 149 150 - 199			Yes	Yes Yes	Yes Yes	Yes Yes
200 - 249 250 - 299	Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
300 - 349 350 - 399	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

* Or through volume only if a left-turn lane exists.