FRETZ ROAD SUBDIVISION (905 FRETZ ROAD)

TRAFFIC IMPACT STUDY

FRETZ ROAD SUBDIVISION
AT 905 FRETZ ROAD

KNOX COUNTY, TN

CCI PROJECT NO. 00545-0011

CANNON & CANNON INC
CONSULTING ENGINEERS
FIELD SURVEYORS

PREPARED FOR:
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SUBMITTED BY
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REVISED
DECEMBER 21
2017

REV I.

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KNOX COUNTY, TN

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REVISION 1 (12/21/17)
This report replaces the original traffic impact study dated 11/27/17 prepared for this project in its entirety. The associated changes are a result of MPC comments.

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REV 1.

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EXECUTIVE SUMMARY

This report provides a summary of a traffic impact study that was performed for a proposed residential subdivision development to be located off Fretz Road in west Knox County, just north of the Town of Farragut. The project site is located approximately one thousand feet north of Interstate 40/75 and is typically accessed from the I-40/75 interchange with N. Campbell Station Road via N. Campbell Station Road and Fretz Road. The current plans for this proposed subdivision development provide for a maximum of 112 single family lots at full build-out. The development entrance will be a new three-leg intersection located on Fretz Road approximately 1500 feet south of the N. Campbell Station Road/Fretz Road intersection.

The purpose of this study was to provide a thorough evaluation of the traffic operational and safety impacts of the proposed development upon the adjacent portion of Fretz Road, as well as the intersection of Fretz Road with N. Campbell Station Road. This evaluation was performed assuming full build-out of all units of the subdivision with existing and background growth conditions also evaluated for purposes of comparison.

The primary conclusion of this study is that the traffic generated by the proposed development will not result in significant traffic operational impacts in the project area. However, the increase in left-turn traffic at the study intersection of N. Campbell Station Road and Fretz Road will in all likelihood create warranting conditions for construction of a northbound left-turn lane on N. Campbell Station Road. Regarding the timing of when the northbound left-turn lane would be expected to be warranted, analyses using trip generation data indicate that when 47 housing units are constructed and occupied, the left-turn lane warranting value of 50 left-turns would be satisfied.

The improvement recommendations that resulted from this study are summarized below:

1. Widen the existing Fretz Road pavement between Woodhollow Lane and the proposed site entrance to match the existing pavement north of the project entrance. The length of this widening would be approximately 200 feet, and the minimum width would be 20 feet.

2. Construct a northbound left-turn lane on N. Campbell Station Road at Fretz Road to be open no later than when the forty-seventh housing unit is built and occupied. This lane should have a minimum of 75 feet of turn lane storage and bay and approach taper lengths consistent with Knox County and T.D.O.T. standard procedures based on actual prevailing (85th percentile) traffic speeds.

3. Maintain corner sight distance at the proposed site entrance intersection by eliminating any obstructing vegetation and ensuring that new site signage and landscaping is properly positioned to not impede lines of sight.

INTRODUCTION & PURPOSE OF STUDY

This report provides a summary of a traffic impact study that was performed for a proposed residential subdivision development to be located off Fretz Road in west Knox County, just north of the Town of Farragut. The project site is located approximately one thousand feet north of Interstate 40/75 and is typically accessed from the I-40/75 interchange with N. Campbell Station Road via N. Campbell Station Road and Fretz Road. FIGURE 1 is a location map that identifies the project site in relation to the roadways in the vicinity of the proposed development.

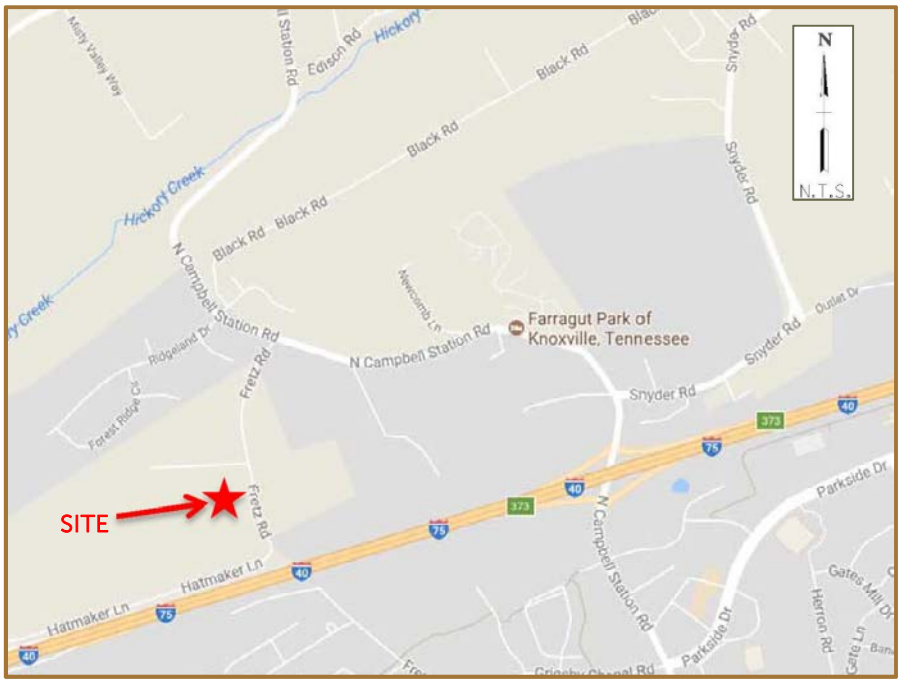

FIGURE 1
LOCATION MAP

The current plans for this proposed subdivision development provide for a maximum of 112 single family lots at full build-out. FIGURE 2 is a conceptual site plan showing the proposed site layout, which will have one access point onto Fretz Road. The development entrance will be a new three-leg intersection located on Fretz Road approximately 1500 feet south of the Campbell Station Road/Fretz Road intersection.

The purpose of this study was to provide a thorough evaluation of the traffic operational and safety impacts of the proposed development upon the adjacent portion of Fretz Road, as well as the intersection of Fretz Road with N. Campbell Station Road. This evaluation was performed assuming full build-out of all units of the subdivision with existing and background growth conditions also evaluated for purposes of comparison.

FIGURE 2
CONCEPTUAL SITE PLAN

EXISTING CONDITIONS

EXISTING ROADWAY CONDITIONS

Fretz Road is classified as a Local roadway and is maintained by Knox County, although the first three hundred feet south of N. Campbell Station Road is maintained by the Town of Farragut. The roadway pavement varies in width, although the Brandywine at Turkey Creek development adjacent to the proposed development performed widening that provided approximately 22 feet of pavement from N. Campbell Station Road to within two hundred feet of the proposed project entrance. This widened pavement is striped with a double solid yellow centerline delineating two traffic lanes of approximately 11 feet each. The posted speed limit on Fretz Road is 30 mph, although a southbound sign between N. Campbell Station Road and the project entrance is missing.

N. Campbell Station Road is also a two lane roadway, and at the study intersection with Fretz Road, it is maintained by the Town of Farragut. It is classified as a Minor Arterial roadway, and the posted speed limit is 35 mph. There are no separate right or left turn lanes at the study intersection, but the roadway pavement of approximately 22 feet is striped with a double yellow solid centerline and white edgelines.

EXISTING TRAFFIC DATA

A traffic count station for collecting annual average daily traffic data (AADT) is located on N. Campbell Station Road, just south of Yarnell Road and approximately 0.9 miles north of the study intersection. The most recent data from this station was provided by the Tennessee Department of Transportation with resulting AADTs shown in TABLE 1.

TABLE 1: ANNUAL AVERAGE DAILY TRAFFIC COUNT SUMMARY

COUNT YEAR	TDOT COUNT STATION 0303 N. CAMPBELL STATION ROAD SOUTH OF YARNELL ROAD
2016	5583
2015	4779
2014	4332
2013	4271
2012	4385
2011	4256
2010	3759
2009	4176

In order to collect more refined data for analyses and to establish a basis for trip distribution patterns, turning movement traffic counts were collected at the study intersection of N. Campbell Station Road and Fretz Road. These counts were conducted during the AM and PM peak traffic periods of a typical weekday, and the peak hours were found to be 7:30 to 8:30 AM and 4:45 to 5:45 PM. Raw data count summaries of this data are contained in APPENDIX A along with additional TDOT AADT data for Count Station 0303. In addition to helping establish trip distribution patterns, these turning movement counts were used to establish the existing traffic volumes for this study, as displayed in FIGURE 3. They were also used to determine the peak hour factors for the counts as 0.92 for the AM peak and 0.93 for the PM peak.

EXISTING CAPACITY ANALYSES / LEVELS-OF-SERVICE

Intersection capacity analyses employing the methods of the latest edition of the Highway Capacity Manual and companion software (HCS7) were used to evaluate the study intersection of N. Campbell Station Road and Fretz Road for the existing roadway, existing traffic control, and existing (2017) traffic conditions, as shown on FIGURE 3. The results indicate that the critical Fretz Road side street approach is currently operating at level-of-service (LOS) "B" during both the AM and PM peak traffic hours. These results are summarized in detail on the "HCS7 Two-Way Stop-Control Report" printouts contained in APPENDIX C. Also see APPENDIX C for a discussion of Intersection Capacity and Level of Service Concepts.

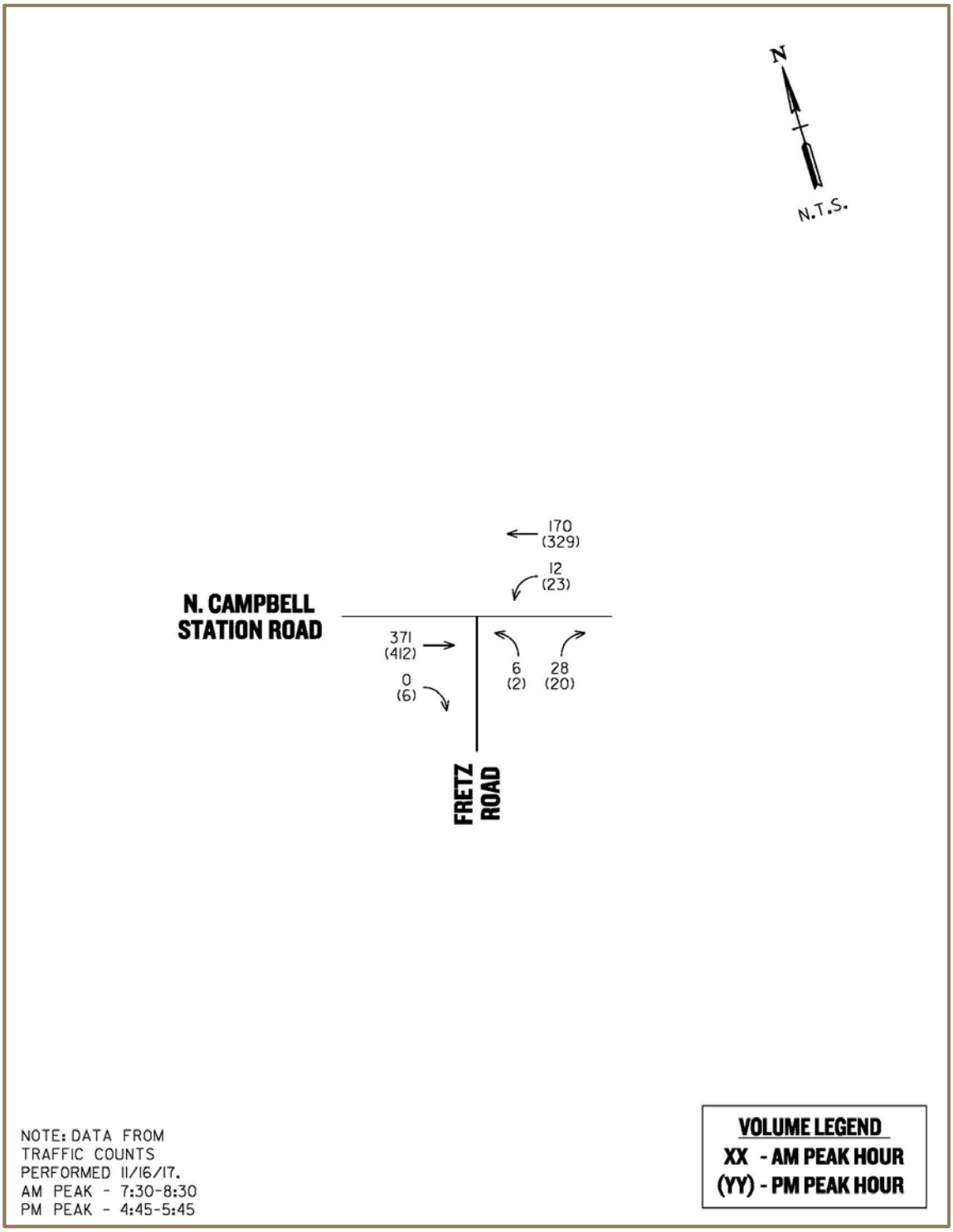

FIGURE 3
2017 EXISTING TRAFFIC VOLUMES

BACKGROUND CONDITIONS

BACKGROUND TRAFFIC GROWTH

The anticipated time for full build-out of the proposed Fretz Road subdivision project is estimated as three years. Therefore, year 2020 was established as the appropriate design/analysis year for this study. In order to determine traffic volumes resulting solely from background traffic growth to year 2020, it was necessary to establish an annual growth rate for existing traffic. The ADT values given previously in TABLE 1, along with engineering judgment, were used to arrive at a rate of 3.0 percent per year for this development. FIGURE 4 contains the background traffic volumes that would result from this 3.0 percent annual growth rate to year 2020.

BACKGROUND CAPACITY ANALYSES / LEVELS-OF-SERVICE

Intersection Capacity Analyses employing the methods of the Highway Capacity Manual and companion software (HCS7) were used to evaluate the study intersection of N. Campbell Station Road and Fretz Road for the existing roadway, existing traffic control, and background (2020) traffic conditions, as shown on FIGURE 4. The results indicate that the critical Fretz Road side street approach will be expected to continue to operate at level-of-service (LOS) "B" during both the AM and PM peak traffic hours. These results are summarized in detail on the "HCS7 Two-Way Stop-Control Report" printouts contained in APPENDIX C. Also see APPENDIX C for a discussion of Intersection Capacity and Level-of-Service Concepts.

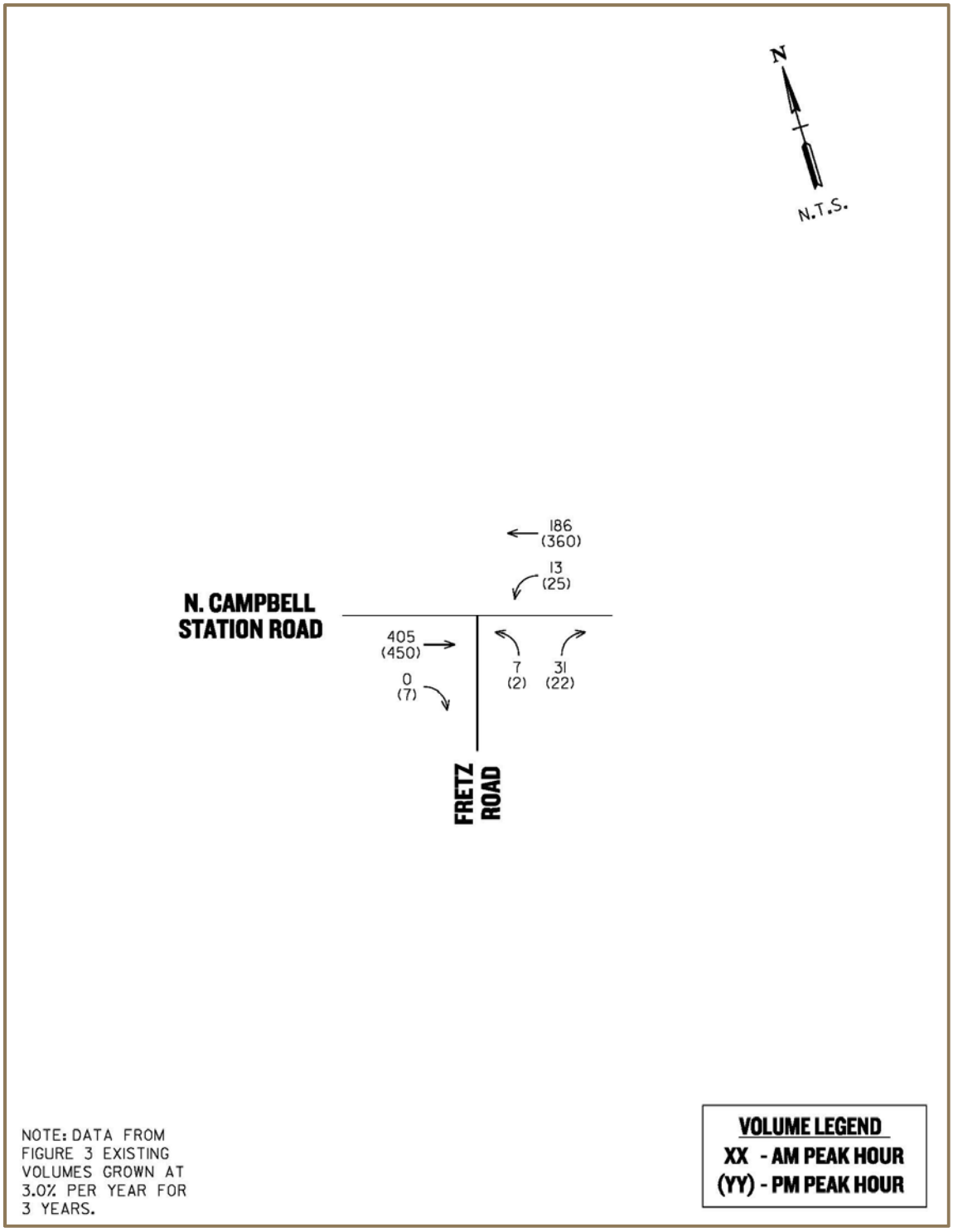

FIGURE 4
2020 BACKGROUND TRAFFIC VOLUMES

FUTURE CONDITIONS

TRIP GENERATION

In order to estimate the expected traffic volumes to be generated by full build-out of the proposed development, the data and procedures of *Trip Generation, Tenth Edition* (Institute of Transportation Engineers, 2017) were utilized. The generated traffic volumes were determined based on the total weekday morning and evening peak hour of adjacent street traffic trip generation rates for single-family detached housing (Land Use Code 210). As noted earlier in this report, the anticipated maximum number of units upon full build-out is 112, which was used to determine the number of new trips generated. TABLE 2 summarizes the number and directional split of entering and exiting trips for the proposed development.

TABLE 2: TRIP GENERATION SUMMARY

LAND USE	ITE CODE	SIZE	WEEKDAY (TRIPS/DAY)	AM PEAK HOUR (TRIPS/HR)	PM PEAK HOUR (TRIPS/HR)
Single-Family Detached Housing					
Entering Trips	210	112 units	577	21	71
Exiting Trips			577	63	42
TOTAL					
Entering Trips	-	-	577	21	71
Exiting Trips			577	63	42

TRIP DISTRIBUTION AND ASSIGNMENT

FIGURE 5 provides a summary of the trip distribution patterns developed for the study intersection, which were derived from the existing traffic counts. In addition, FIGURE 6 provides the generated traffic volumes as assigned to the local roadway network in accordance with these distribution patterns. FIGURE 7 shows the combined year 2020 volumes reflecting the existing traffic, the background traffic growth, and the newly generated traffic from the proposed Fretz Road subdivision development. These are the volumes used in the analysis of full build-out conditions.

FUTURE CAPACITY ANALYSES / LEVELS-OF-SERVICE

Intersection Capacity Analyses employing the methods of the Highway Capacity Manual and companion software (HCS7) were used to evaluate the study intersection of N. Campbell Station Road and Fretz Road for the existing roadway, existing traffic control, and combined (2020) traffic conditions, as shown on FIGURE 5. The results indicate that the critical Fretz Road side street approach will be expected to continue to operate at level-of-service (LOS) "B" during both the AM and PM peak traffic hours. These results are summarized in detail on the "HCS7 Two-Way Stop-Control Report" printouts contained in APPENDIX C. Also see APPENDIX C for a discussion of Intersection Capacity and Level of Service Concepts.

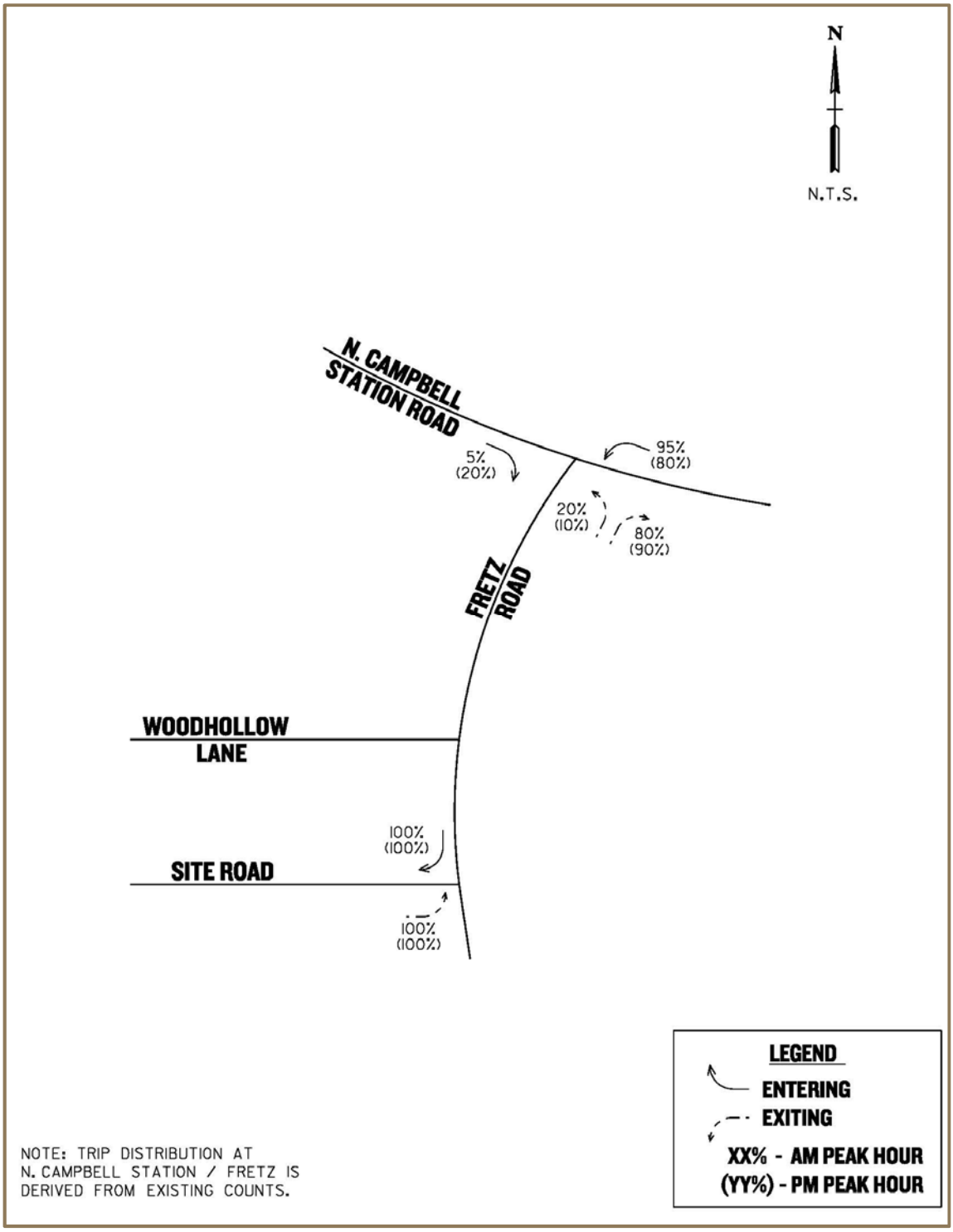

FIGURE 5
TRIP DISTRIBUTION PATTERNS (%)

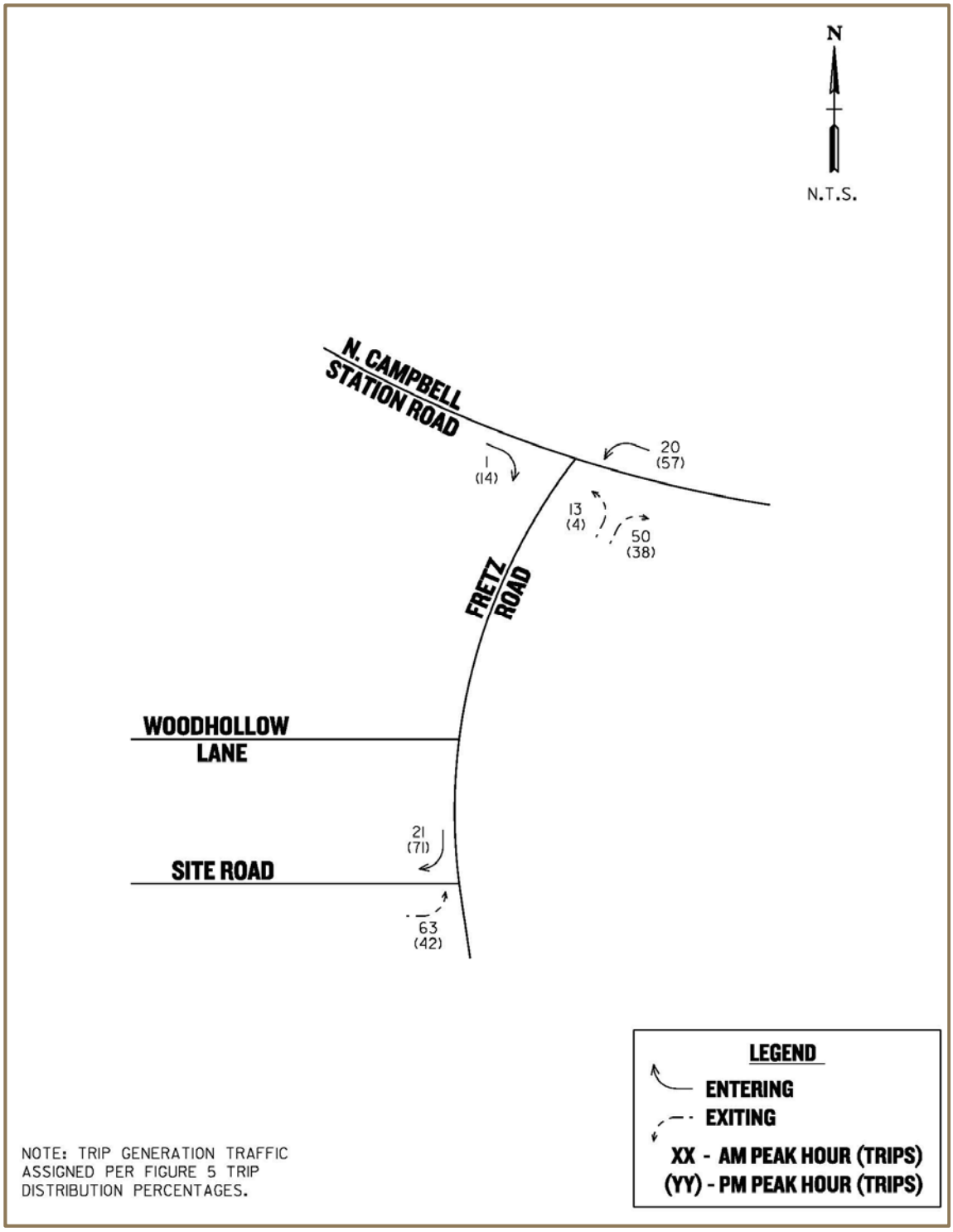

FIGURE 6
TRIP ASSIGNMENT

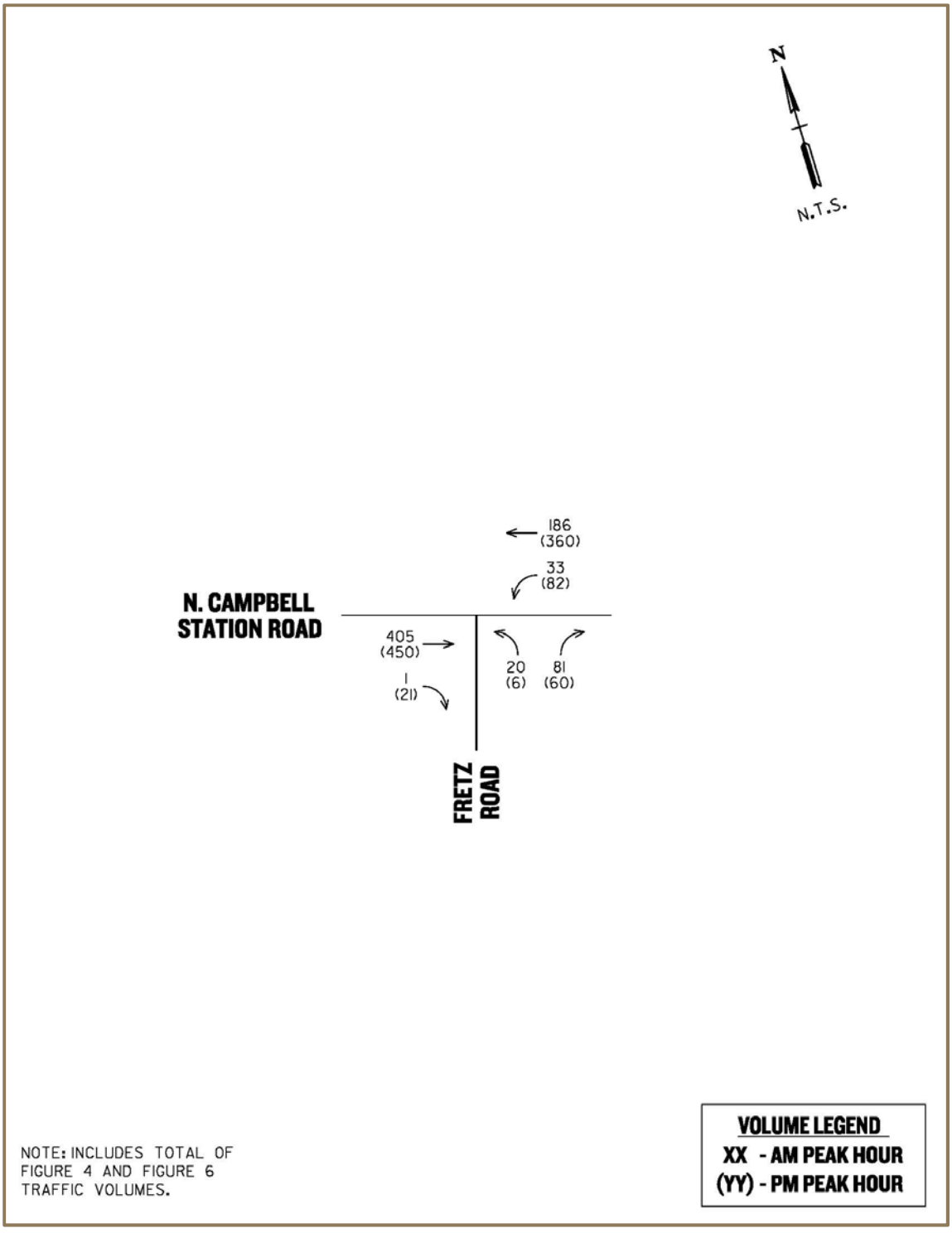

FIGURE 7
2020 COMBINED TRAFFIC VOLUMES

EVALUATIONS

INTERSECTION CAPACITY ANALYSES

As discussed in the preceding sections of this report, capacity analyses employing the methods of the Highway Capacity Manual and companion software (HCS7) were conducted for the study intersection of N. Campbell Station Road and Fretz Road. These analyses were performed for existing, background, and combined traffic conditions using existing geometry and existing traffic control. In addition, the intersection was also evaluated with the addition of a northbound left-turn lane on N. Campbell Station Road for the combined 2020 traffic conditions. A summary of the capacity analyses results is shown in TABLE 3.

TABLE 3: CAPACITY ANALYSES SUMMARY

EVALUATION CONDITION	LEVEL-OF-SERVICE (AVG. DELAY IN SECONDS)*	
	FRETZ ROAD APPROACH (LEFT AND RIGHT TURNS)	N. CAMPBELL STA. ROAD NORTHBOUND APPROACH (LEFT AND THROUGH)
Existing (2017) – AM	B (11.9)	A (0.6)
Existing (2017) – PM	B (12.1)	A (0.8)
Background (2020) – AM	B (12.5)	A (0.6)
Background (2020) – PM	B (12.7)	A (0.8)
Combined w/ Existing Lanes (2020) – AM	B (14.1)	A (1.5)
Combined w/ Existing Lanes (2020) – PM	B (14.2)	A (2.4)
Combined w/ added NBLT Lane (2020) – AM	B (14.1)	A (1.3)
Combined w/ added NBLT Lane (2020) – PM	B (14.2)	A (1.6)

* Side Street Stop Control – Level-of-Service and Average Vehicular Delay (seconds) for side street movements and main street left-turn and through movements utilizing HCM methodology.

As shown in TABLE 3, all levels-of-service are expected to remain the same in all evaluated conditions. The addition of a northbound left-turn lane will improve the average delay on the northbound approach to a small degree.

SIGHT DISTANCE ASSESSMENT

The proposed project development entrance on Fretz Road was evaluated for corner sight distance. Based on the posted 30 mph speed limit, the required minimum sight distance in accordance with Knox County regulations would be 300 feet. Field reviews indicate that this requirement will be met at this intersection, as available sight distance was measured in excess of 400 feet looking north and in excess of 350 feet looking south. The photos in FIGURE 8 present the measured sight distances to the north and south along Fretz Road from the proposed development entrance.

Sight distance looking north along Fretz Road is in excess of 400 feet.

Sight distance looking south along Fretz Road is in excess of 350 feet.

FIGURE 8
SIGHT DISTANCE ASSESSMENT

TURN LANE ASSESSMENT

Turn lane warrant analyses were conducted for the study intersection of N. Campbell Station Road and Fretz Road under proposed combined development conditions. These analyses employed Tables 4A and 4B from the Knox County Access Control and Driveway Design Policy, which are based on turn lane warrants developed by Harmelink. The results are that a northbound left-turn lane on N. Campbell Station Road is expected to be warranted during the PM peak traffic hour. A southbound right-turn lane on N. Campbell Station Road was also evaluated and found to not be warranted. Regarding the timing of when the northbound left-turn lane would be expected to be warranted, analyses using trip generation data indicate that when 47 housing units are constructed and occupied, the left-turn lane warranting value of 50 left-turns would be satisfied. Copies of Knox County Tables 4A and 4B are located in APPENDIX C for review, and a sheet documenting how the 47 unit threshold was determined is located in APPENDIX D.

CONCLUSIONS & RECOMMENDATIONS

The primary conclusion of this study is that the traffic generated by the proposed development will not result in significant traffic operational impacts in the project area. However, the increase in left-turn traffic at the study intersection of N. Campbell Station Road and Fretz Road will in all likelihood create warranting conditions for construction of a northbound left-turn lane on N. Campbell Station Road. Regarding the timing of when the northbound left-turn lane would be expected to be warranted, analyses using trip generation data indicate that when 47 housing units are constructed and occupied, the left-turn lane warranting value of 50 left-turns would be satisfied.

The improvement recommendations that resulted from this study are summarized below:

1. Widen the existing Fretz Road pavement between Woodhollow Lane and the proposed site entrance to match the existing pavement north of the project entrance. The length of this widening would be approximately 200 feet, and the minimum width would be 20 feet.

2. Construct a northbound left-turn lane on N. Campbell Station Road at Fretz Road to be open no later than when the forty-seventh housing unit is built and occupied. This lane should have a minimum of 75 feet of turn lane storage and bay and approach taper lengths consistent with Knox County and T.D.O.T. standard procedures based on actual prevailing (85^{th} percentile) traffic speeds.

3. Maintain corner sight distance at the proposed site entrance intersection by eliminating any obstructing vegetation and ensuring that new site signage and landscaping is properly positioned to not impede lines of sight.

APPENDIX

APPENDIX A – TRAFFIC DATA

APPENDIX B – TRIP GENERATION

APPENDIX C – ANALYSES

APPENDIX D – COMMENT LETTER AND RESPONSES

APPENDIX A – TRAFFIC DATA

ADT on Campell Station South of Yarnell

Station #	County	Location	Route #
000303	Knox	NEAR LOUDON CO LINE	01277

Record	Year	AADT
1	2016	5583
2	2015	4779
3	2014	4332
4	2013	4271
5	2012	4385
6	2011	4256
7	2010	3759
8	2009	4176
9	2008	3860
10	2007	3436
11	2006	3169
12	2005	2978
13	2004	2623
14	2003	2907
15	2002	3067
16	2001	2367
17	2000	3378
18	1999	1940
19	1998	2103
20	1997	2599
21	1996	2550
22	1995	2048
23	1994	1742
24	1993	2819
25	1992	1721
26	1991	1694
27	1990	1960
28	1989	1742

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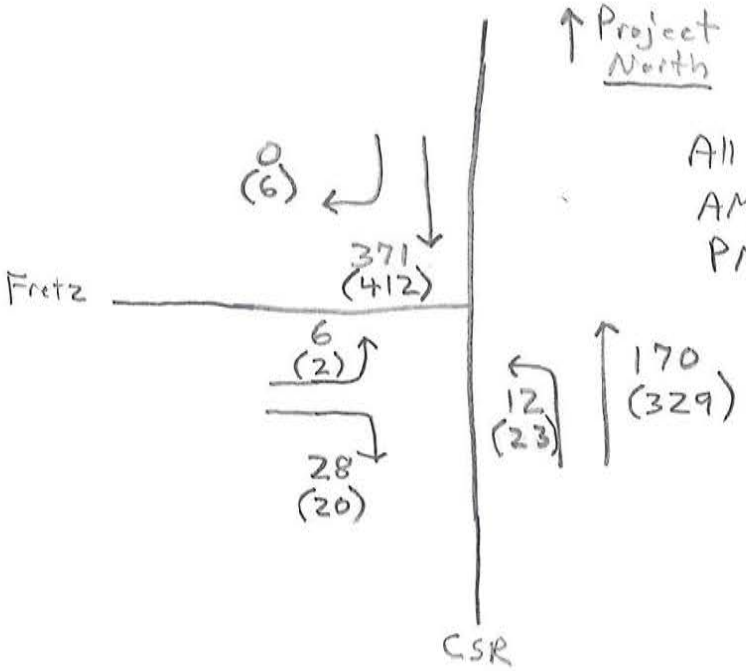
CCI Project Name: Fretz Subdivision TIS
CCI Project Number: 545-0011
Intersection: Camp Sta at Fretz
Counted By: CCI

File Name : Campbell Station_Fretz_11-16-17
Site Code : 00000001
Start Date : 11/16/2017
Page No : 1

Groups Printed- Unshifted

	Campbell Station Road Southbound					Westbound					Campbell Station Road Northbound					Fretz Road Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:30 AM	0	93	0	0	93	0	0	0	0	0	4	43	0	0	47	3	0	8	0	11	151
07:45 AM	0	97	0	0	97	0	0	0	0	0	5	46	0	0	51	1	0	6	0	7	155
Total	0	190	0	0	190	0	0	0	0	0	9	89	0	0	98	4	0	14	0	18	306
08:00 AM	0	110	0	0	110	0	0	0	0	0	2	43	0	0	45	0	0	5	0	5	160
08:15 AM	0	71	0	0	71	0	0	0	0	0	1	38	0	0	39	2	0	9	0	11	121
08:30 AM	0	71	1	0	72	0	0	0	0	0	3	45	0	0	48	1	0	5	0	6	126
08:45 AM	0	57	0	0	57	0	0	0	0	0	4	54	0	0	58	1	0	4	0	5	120
Total	0	309	1	0	310	0	0	0	0	0	10	180	0	0	190	4	0	23	0	27	527
*** BREAK ***																					
04:30 PM	0	120	0	0	120	0	0	0	0	0	6	69	0	0	75	0	0	5	0	5	200
04:45 PM	0	113	1	0	114	0	0	0	0	0	3	76	0	0	79	0	0	2	0	2	195
Total	0	233	1	0	234	0	0	0	0	0	9	145	0	0	154	0	0	7	0	7	395
05:00 PM	0	98	0	0	98	0	0	0	0	0	6	71	0	0	77	1	0	3	0	4	179
05:15 PM	0	90	4	0	94	0	0	0	0	0	6	96	0	0	102	1	0	8	0	9	205
05:30 PM	0	111	1	0	112	0	0	0	0	0	8	86	0	0	94	0	0	7	0	7	213
05:45 PM	0	76	2	0	78	0	0	0	0	0	11	69	0	0	80	0	0	5	0	5	163
Total	0	375	7	0	382	0	0	0	0	0	31	322	0	0	353	2	0	23	0	25	760
Grand Total	0	1107	9	0	1116	0	0	0	0	0	59	736	0	0	795	10	0	67	0	77	1988
Apprch %	0.0	99.2	0.8	0.0		0.0	0.0	0.0	0.0		7.4	92.6	0.0	0.0		13.0	0.0	87.0	0.0		
Total %	0.0	55.7	0.5	0.0	56.1	0.0	0.0	0.0	0.0	0.0	3.0	37.0	0.0	0.0	40.0	0.5	0.0	3.4	0.0	3.9	



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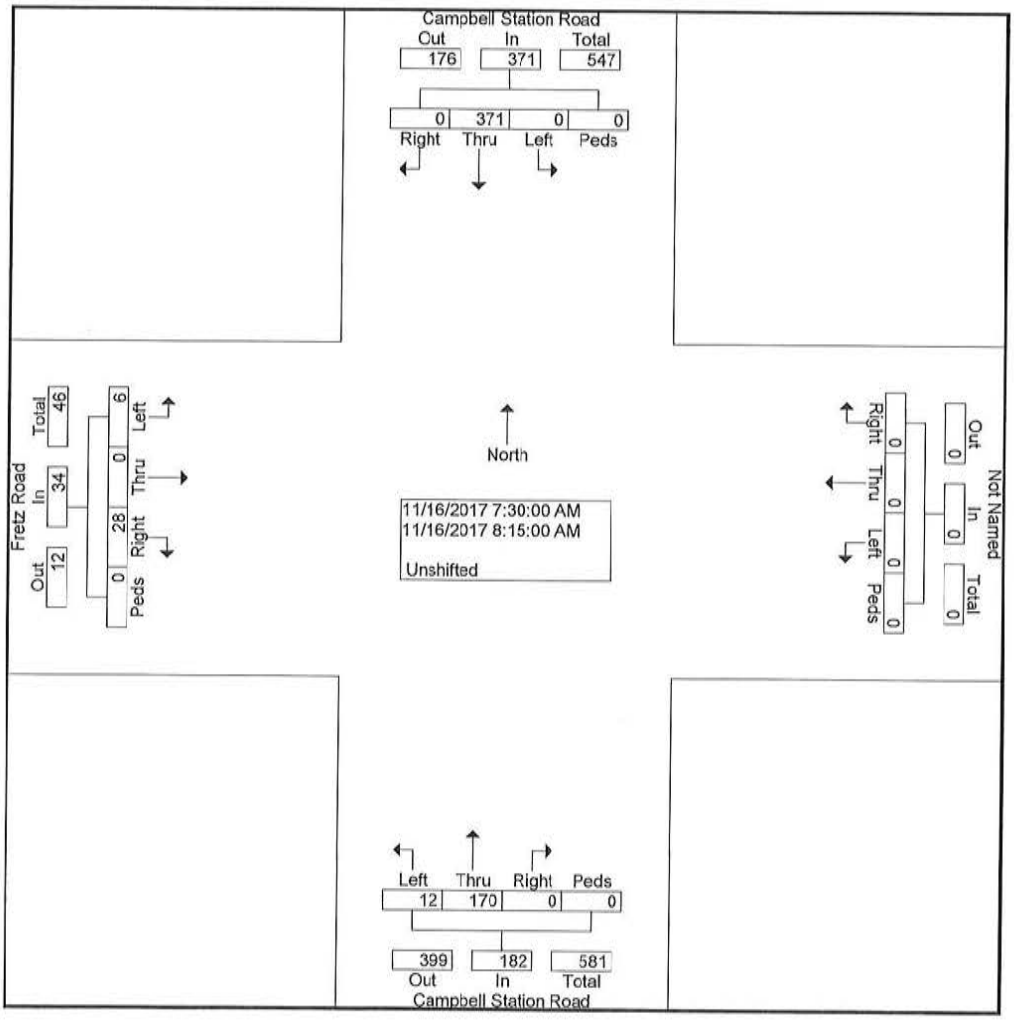
File Name : Campbell Station_Fretz_11-16-17
Site Code : 00000001
Start Date : 11/16/2017

	Campbell Station Road Southbound					Westbound					Campbell Station Road Northbound					Fretz Road Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 07:30 AM to 08:45 AM - Peak 1 of 1																					
Intersection	07:30 AM																				
Volume	0	371	0	0	371	0	0	0	0	0	12	170	0	0	182	6	0	28	0	34	587
Percent	0.0	100.0	0.0	0.0		0.0	0.0	0.0	0.0		6.6	93.4	0.0	0.0		17.6	0.0	82.4	0.0		
08:00 Volume	0	110	0	0	110	0	0	0	0	0	2	43	0	0	45	0	0	5	0	5	160
Peak Factor																					0.917
High Int.	08:00 AM					7:15:00 AM					07:45 AM					07:30 AM					
Volume	0	110	0	0	110	0	0	0	0	0	5	46	0	0	51	3	0	8	0	11	
Peak Factor					0.843										0.892					0.773	



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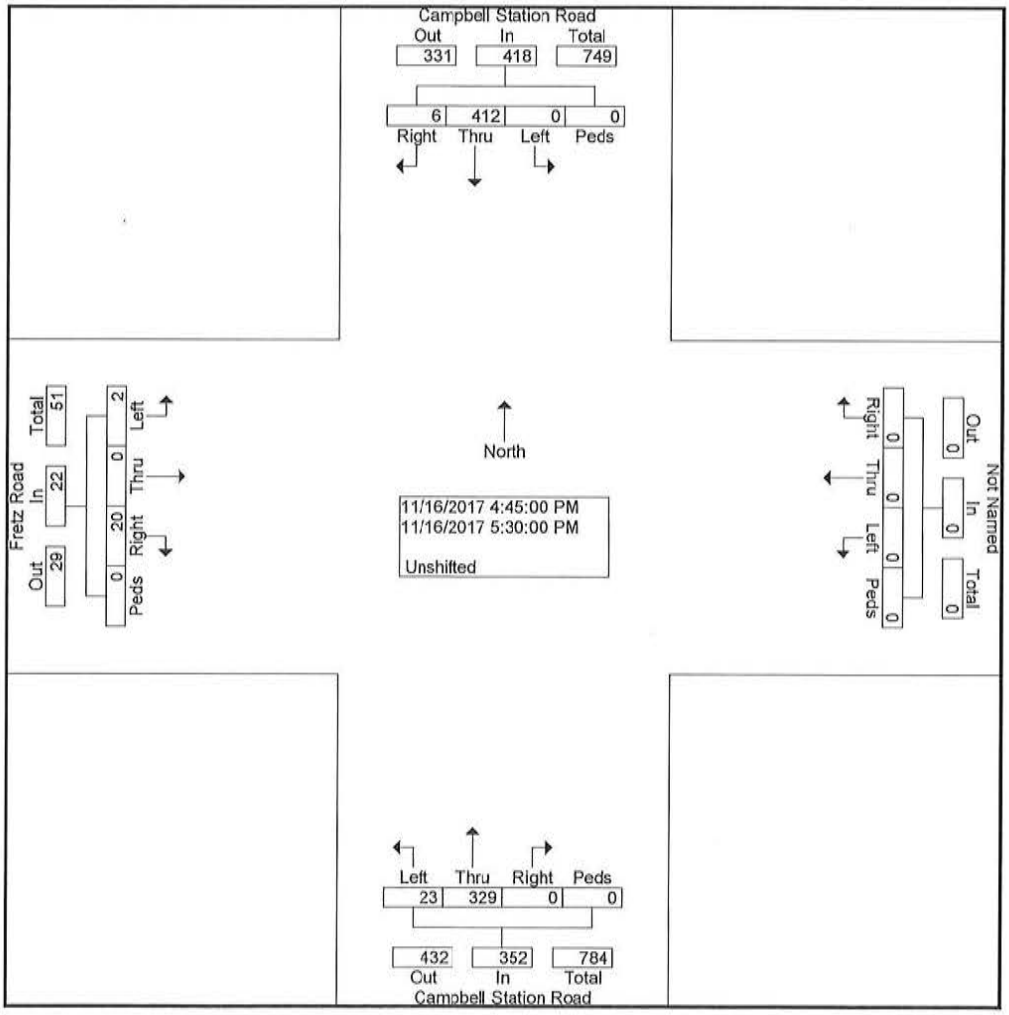
File Name : Campbell Station_Fretz_11-16-17
Site Code : 00000001
Start Date : 11/16/2017
Page No : 3

	Campbell Station Road Southbound					Westbound					Campbell Station Road Northbound					Fretz Road Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection	04:45 PM																				
Volume	0	412	6	0	418	0	0	0	0	0	23	329	0	0	352	2	0	20	0	22	792
Percent	0.0	98.6	1.4	0.0		0.0	0.0	0.0	0.0		6.5	93.5	0.0	0.0		9.1	0.0	90.9	0.0		
05:30 Volume	0	111	1	0	112	0	0	0	0	0	8	86	0	0	94	0	0	7	0	7	213
Peak Factor																					0.930
High Int.	04:45 PM										05:15 PM					05:15 PM					
Volume	0	113	1	0	114	0	0	0	0	0	6	96	0	0	102	1	0	8	0	9	
Peak Factor					0.917										0.863					0.611	



APPENDIX B – TRIP GENERATION

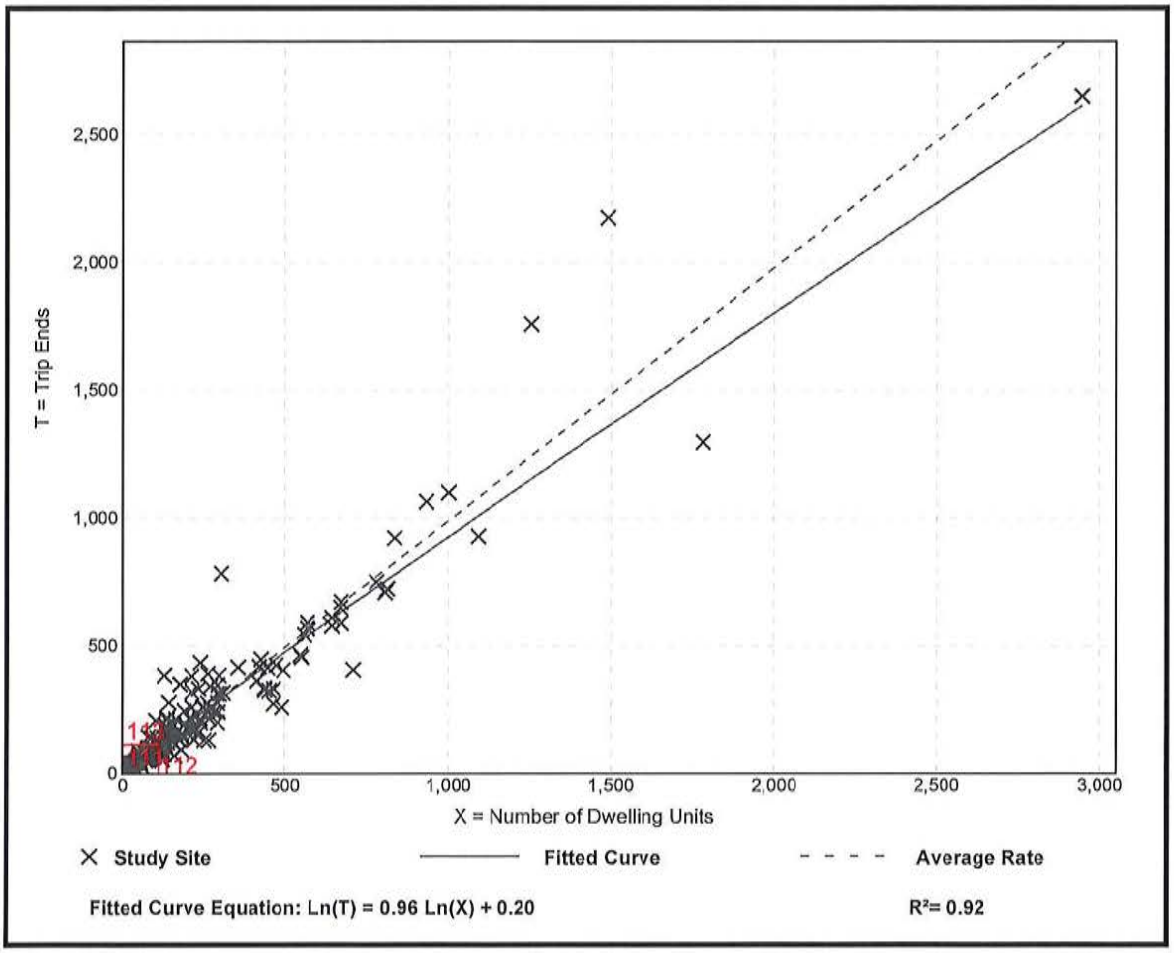
Single-Family Detached Housing
(210)

Vehicle Trip Ends vs:	**Dwelling Units**
On a:	**Weekday,**
	Peak Hour of Adjacent Street Traffic,
	One Hour Between 4 and 6 p.m.
Setting/Location:	**General Urban/Suburban**
Number of Studies:	190
Avg. Num. of Dwelling Units:	242
Directional Distribution:	63% entering, 37% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.99	0.44 - 2.98	0.31

Data Plot and Equation



Trip Generation Manual, 10th Edition • Institute of Transportation Engineers

Trips = 113 Enter - 71
Exit - 42

Single-Family Detached Housing
(210)

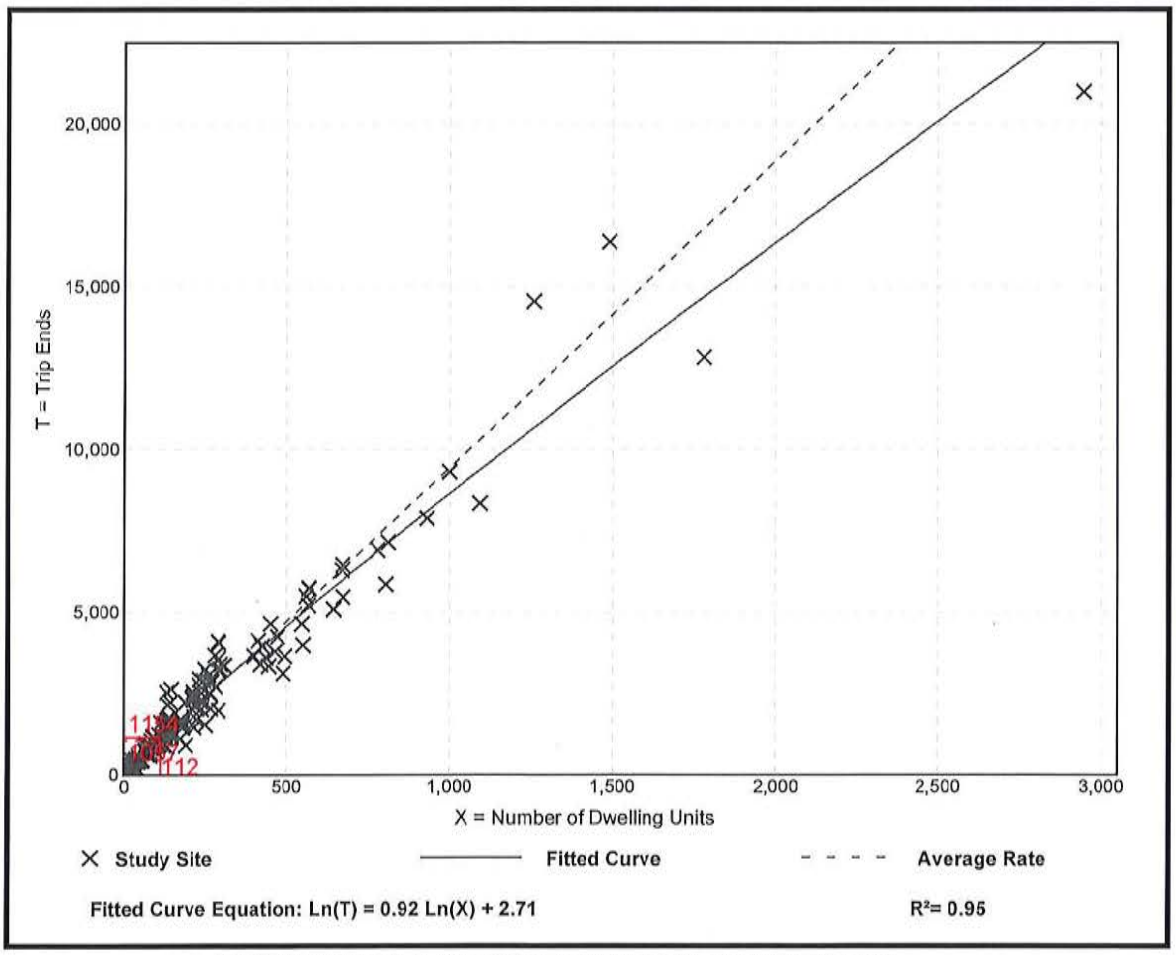
Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday**

Setting/Location: **General Urban/Suburban**
Number of Studies: 159
Avg. Num. of Dwelling Units: 264
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
9.44	4.81 - 19.39	2.10

Data Plot and Equation



Trip Generation Manual, 10th Edition • Institute of Transportation Engineers

Trips = 1154 Enter - 577
Exit - 577

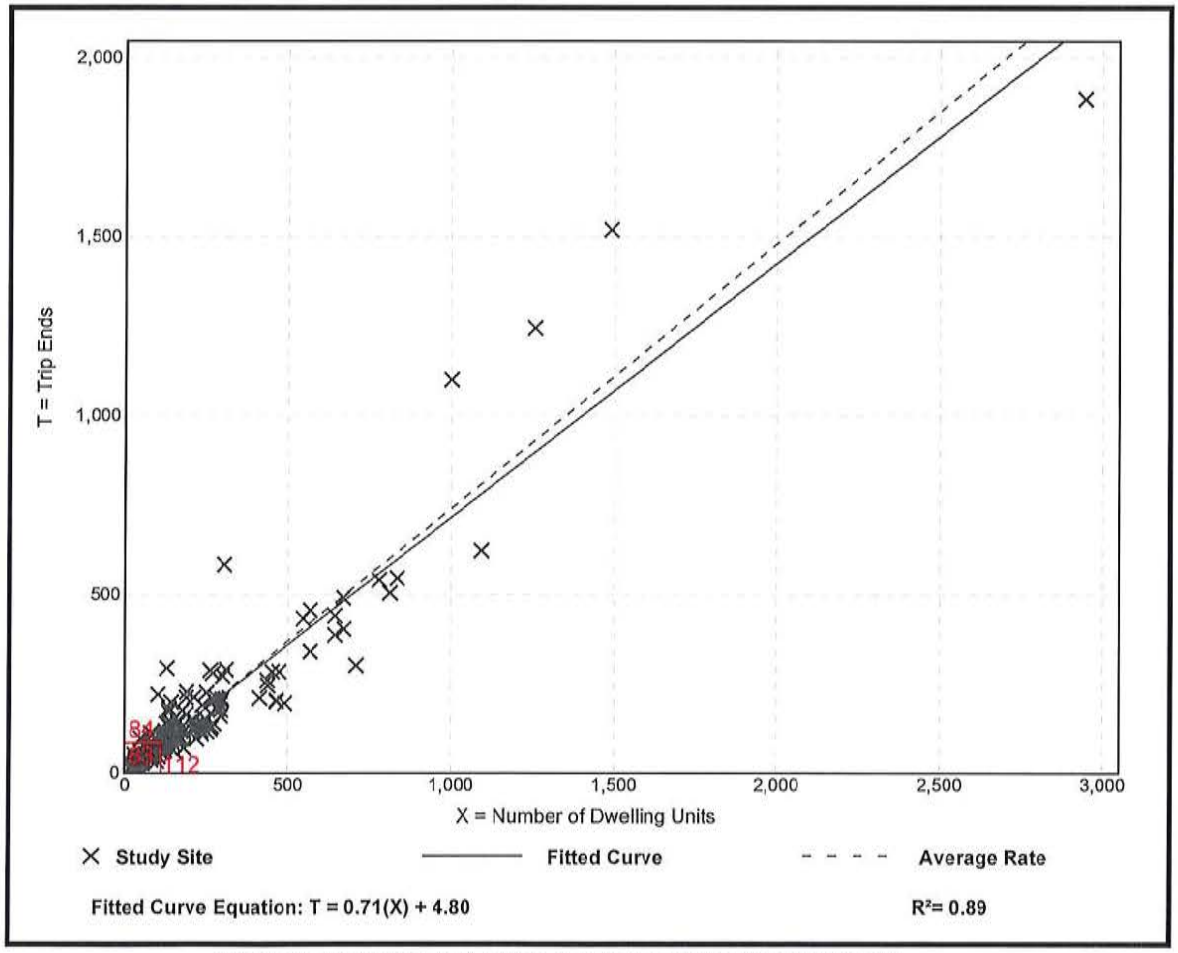
Single-Family Detached Housing
(210)

Vehicle Trip Ends vs: Dwelling Units
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.
Setting/Location: General Urban/Suburban
Number of Studies: 173
Avg. Num. of Dwelling Units: 219
Directional Distribution: 25% entering, 75% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.74	0.33 - 2.27	0.27

Data Plot and Equation



Trip Generation Manual, 10th Edition • Institute of Transportation Engineers

Trips = 84 Enter - 21
Exit - 63

APPENDIX C - ANALYSES

CAPACITY AND LEVEL-OF-SERVICE CONCEPTS

In a general sense, a roadway is similar to a pipeline or other material carrying conduit in that it has a certain capacity for the amount of material (vehicles) that it can efficiently carry. As the number of vehicles in a given time period gradually increases, the quality of traffic flow gradually decreases. On roadway sections this results in increasing turbulence in the traffic stream, and at intersections it results in increasing stops and delay. As the volumes begin to approach the capacity of the facility, these problems rapidly magnify, with resulting serious levels of congestion, stops, delay, excess fuel consumption, pollutant emissions, etc.

The Transportation Research Board has published the Year 2010 Highway Capacity Manual (HCM2010), which establishes theoretical techniques to quantify the capacity conditions on all types of roadways, intersections, ramps, pedestrian facilities, etc. A basic concept that is applicable to most of these techniques is the idea of level of service (LOS). This concept establishes a rating system that quantifies the quality of traffic flow, as perceived by motorists and/or passengers. The general system is similar to a school grade scale, and is outlined as follows:

Level of Service (LOS)	General Quality of Traffic Flow	Description of Corresponding Conditions
A	Excellent	Roadways – Free flow, high maneuverability Intersections – Very few stops, very low delay
B	Very Good	Roadways – Free flow, slightly lower maneuverability Intersections – Minor stops, low delay
C	Good	Roadways – Stable flow, restricted maneuverability Intersections – Significant stops, significant delay
D	Fair	Roadways – Marginally stable flow, congestion seriously restricts maneuverability Intersections – High stops, long but tolerable delay
E	Poor	Roadways – Unstable flow*, lower operating speeds, congestion severely restricts maneuverability Intersections – All vehicles stop, very long queues and very long intolerable delay
F	Very Poor	Roadways – Forced flow, stoppages may be lengthy, congestion severely restricts maneuverability Intersections – All vehicles stop, extensive queues and extremely long intolerable delay

*Unstable flow is such that minor fluctuations or disruptions can result in rapid degradation to LOS F.

LOS CRITERIA: SIGNALIZED & UNSIGNALIZED INTERSECTIONS

LOS	CONTROL DELAY (S/VEH)		
	SIGNALIZED	UNSIGNALIZED	ROUNDABOUT
A	≤10	≤10	≤10
B	>10-20	>10-15	>10-15
C	>20-35	>15-25	>15-25
D	>35-55	>25-35	>25-35
E	>55-80	>35-50	>35-50
F	>80	>50	>50

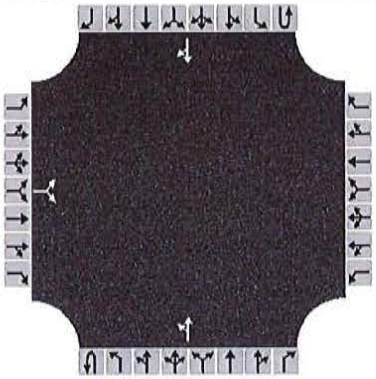
Another measure of intersection capacity that is often used in the evaluation of intersection operations is the volume to capacity (V/C) ratio. This ratio is defined as "the ratio of flow rate to capacity", and is a good measure of how much of an intersection's available capacity has been used up by the analysis volumes. Conversely, it also provides an indication of the reserve capacity available for future growth in traffic volumes.

The Intersection Capacity Utilization (ICU) is another measure that expresses a value similar to the V/C ratio. Specifically, the ICU method "sums the amount of the time required to serve all movements at saturation for a given cycle length and divides by that reference cycle length." The ICU is considered a more accurate measure of volume to capacity conditions for a signalized intersection, primarily because it accounts for the effects of the signal timing on intersection capacity.

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	ALC	Intersection	CSR @ Fretz Rd.
Agency/Co.	CCI	Jurisdiction	Town of Farragut
Date Performed	11/20/2017	East/West Street	Fretz Road
Analysis Year	2017	North/South Street	Campbell Station Road
Time Analyzed	AM Peak	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Fretz Road Subd. @ 905 Fretz Rd.		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		6		28						12	170				371	0
Percent Heavy Vehicles (%)		3		3						3						
Proportion Time Blocked																
Percent Grade (%)		4														
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1		6.2						4.1						
Critical Headway (sec)		7.23		6.63						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			37							13						
Capacity, c (veh/h)			556							1149						
v/c Ratio			0.07							0.01						
95% Queue Length, Q_{95} (veh)			0.2							0.0						
Control Delay (s/veh)			11.9							8.2						
Level of Service, LOS			B							A						
Approach Delay (s/veh)		11.9								0.6						
Approach LOS		B														

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	ALC	Intersection	CSR @ Fretz Rd.
Agency/Co.	CCI	Jurisdiction	Town of Farragut
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Analysis Year	2017	North/South Street	Campbell Station Road
Time Analyzed	PM Peak	Peak Hour Factor	0.93
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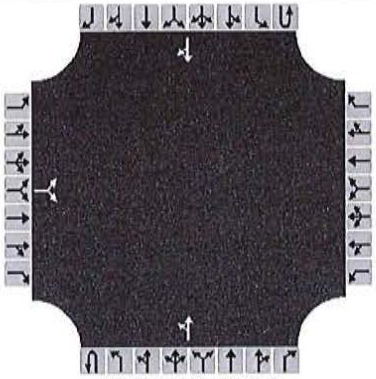
Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		2		20						23	329				412	6
Percent Heavy Vehicles (%)		3		3						3						
Proportion Time Blocked																
Percent Grade (%)		4														
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1		6.2						4.1						
Critical Headway (sec)		7.23		6.63						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			24							25						
Capacity, c (veh/h)			529							1105						
v/c Ratio			0.05							0.02						
95% Queue Length, Q_{95} (veh)			0.1							0.1						
Control Delay (s/veh)			12.1							8.3						
Level of Service, LOS			B							A						
Approach Delay (s/veh)		12.1								0.8						
Approach LOS		B														

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
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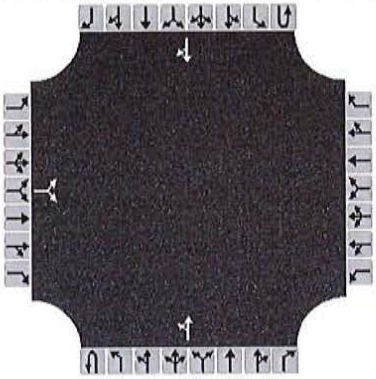
Agency/Co.	CCI	Jurisdiction	Town of Farragut
Date Performed	11/20/2017	East/West Street	Fretz Road
Analysis Year	2020	North/South Street	Campbell Station Road
Time Analyzed	AM Peak Background	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Fretz Road Subd. @ 905 Fretz Rd.		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		7		31						13	186				405	0
Percent Heavy Vehicles (%)		3		3						3						
Proportion Time Blocked																
Percent Grade (%)		4														
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1		6.2						4.1						
Critical Headway (sec)		7.23		6.63						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

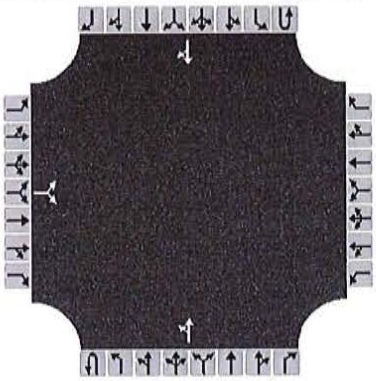
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			42							14						
Capacity, c (veh/h)			522							1113						
v/c Ratio			0.08							0.01						
95% Queue Length, Q_{95} (veh)			0.3							0.0						
Control Delay (s/veh)			12.5							8.3						
Level of Service, LOS			B							A						
Approach Delay (s/veh)		12.5								0.6						
Approach LOS		B														

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	ALC	Intersection	CSR @ Fretz Rd.
Agency/Co.	CCI	Jurisdiction	Town of Farragut
Date Performed	11/20/2017	East/West Street	Fretz Road
Analysis Year	2020	North/South Street	Campbell Station Road
Time Analyzed	PM Peak Background	Peak Hour Factor	0.93
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Fretz Road Subd. @ 905 Fretz Rd.		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		2		22						25	360				450	7
Percent Heavy Vehicles (%)		3		3						3						
Proportion Time Blocked																
Percent Grade (%)		4														
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1		6.2						4.1						
Critical Headway (sec)		7.23		6.63						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

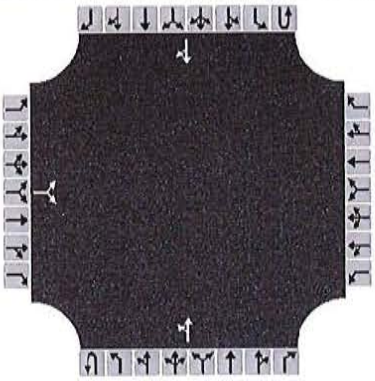
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			26							27						
Capacity, c (veh/h)			496							1065						
v/c Ratio			0.05							0.03						
95% Queue Length, Q_{95} (veh)			0.2							0.1						
Control Delay (s/veh)			12.7							8.5						
Level of Service, LOS			B							A						
Approach Delay (s/veh)		12.7								0.8						
Approach LOS		B														

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	ALC	Intersection	CSR @ Fretz Rd.
Agency/Co.	CCI	Jurisdiction	Town of Farragut
Date Performed	11/20/2017	East/West Street	Fretz Road
Analysis Year	2020	North/South Street	Campbell Station Road
Time Analyzed	AM Peak Combined	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Fretz Road Subd. @ 905 Fretz Rd.		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		20		81						33	186				405	1
Percent Heavy Vehicles (%)		3		3						3						
Proportion Time Blocked																
Percent Grade (%)		4														
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1		6.2						4.1						
Critical Headway (sec)		7.23		6.63						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

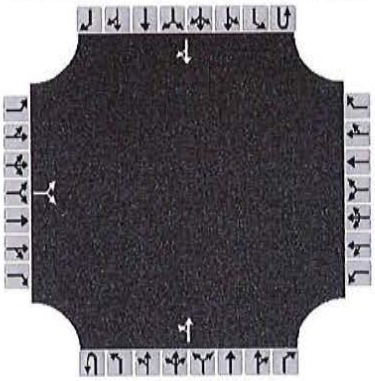
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			110							36						
Capacity, c (veh/h)			506							1113						
v/c Ratio			0.22							0.03						
95% Queue Length, Q_{95} (veh)			0.8							0.1						
Control Delay (s/veh)			14.1							8.3						
Level of Service, LOS			B							A						
Approach Delay (s/veh)		14.1								1.5						
Approach LOS		B														

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	ALC	Intersection	CSR @ Fretz Rd.
Agency/Co.	CCI	Jurisdiction	Town of Farragut
Date Performed	11/20/2017	East/West Street	Fretz Road
Analysis Year	2020	North/South Street	Campbell Station Road
Time Analyzed	PM Peak Combined	Peak Hour Factor	0.93
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Fretz Road Subd. @ 905 Fretz Rd.		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		6		60						82	360				450	21
Percent Heavy Vehicles (%)		3		3						3						
Proportion Time Blocked																
Percent Grade (%)		4														
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1		6.2						4.1						
Critical Headway (sec)		7.23		6.63						4.13						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.53		3.33						2.23						

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			71							88						
Capacity, c (veh/h)			462							1052						
v/c Ratio			0.15							0.08						
95% Queue Length, Q_{95} (veh)			0.5							0.3						
Control Delay (s/veh)			14.2							8.7						
Level of Service, LOS			B							A						
Approach Delay (s/veh)		14.2								2.4						
Approach LOS		B														

HCS7 Two-Way Stop-Control Report

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Agency/Co.	CCI	Jurisdiction	Town of Farragut
Date Performed	11/20/2017	East/West Street	Fretz Road
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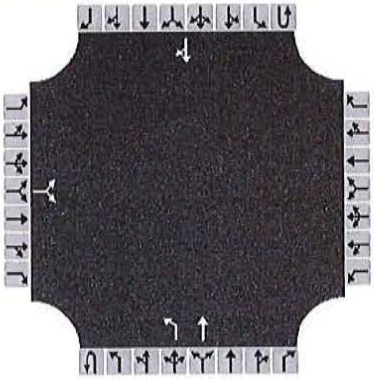
Time Analyzed	AM Peak Combined + NBLT	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Fretz Road Subd. @ 905 Fretz Rd.		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	1	1	0	0	0	1	0
Configuration			LR							L	T					TR
Volume, V (veh/h)		20		81						33	186				405	1
Percent Heavy Vehicles (%)		3		3						3						
Proportion Time Blocked																
Percent Grade (%)		4														
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

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Follow-Up Headway (sec)		3.53		3.33						2.23						

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Approach Delay (s/veh)		14.1								1.3						
Approach LOS		B														

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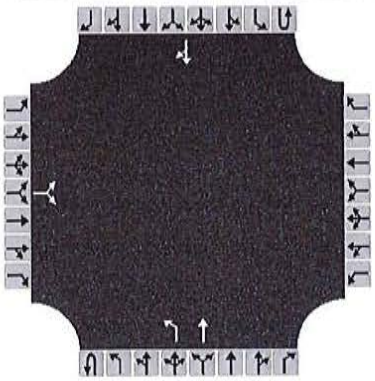
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Fretz Road Subd. @ 905 Fretz Rd.		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	1	1	0	0	0	1	0
Configuration			LR							L	T					TR
Volume, V (veh/h)		6		60						82	360				450	21
Percent Heavy Vehicles (%)		3		3						3						
Proportion Time Blocked																
Percent Grade (%)		4														
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1		6.2						4.1						
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Follow-Up Headway (sec)		3.53		3.33						2.23						

Delay, Queue Length, and Level of Service

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95% Queue Length, Q_{95} (veh)			0.5							0.3						
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Approach Delay (s/veh)		14.2								1.6						
Approach LOS		B														

TABLE 4A KNOX COUNTY LEFT-TURN LANE VOLUME THRESHOLDS FOR 2-LANE ROADWAYS WITH A PREVAILING SPEED OF 0 TO 35 MPH	Project No: 00545-0011 Project Name: Fretz Rd. Subd. @ 905 Fretz Rd Notes:

(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	70	60	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

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

Intersection	Time Period	Opposing Volume	Through Volume	Left-Turn Volume	Warrant Threshold	Left-Turn Lane Warranted (Yes / No)
CSR/Fretz	AM Peak	406	186	33	105	No
	PM Peak	471	360	82	50	Yes

Source: Knox County Department of Engineering and Public Works "Access Control and Driveway Design Policy"

TABLE 4B KNOX COUNTY RIGHT-TURN LANE VOLUME THRESHOLDS FOR 2-LANE ROADWAYS WITH A PREVAILING SPEED OF 0 TO 35 MPH	Project No: 00545-0011 Project Name: Fretz Rd. Subd. @ 905 Fretz Rd. Notes:

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						
100 - 149						
150 - 199						
200 - 249						
250 - 299						Yes
300 - 349					Yes	Yes
350 - 399				Yes	Yes	Yes
400 - 449			Yes	Yes	Yes	Yes
450 - 499			Yes	Yes	Yes	Yes
500 - 549		Yes	Yes	Yes	Yes	Yes
550 - 599		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 - 599	= / > 600
Fewer Than 25		* AM *	* PM *			
25 - 49						Yes
50 - 99					Yes	Yes
100 - 149				Yes	Yes	Yes
150 - 199			Yes	Yes	Yes	Yes
200 - 249		Yes	Yes	Yes	Yes	Yes
250 - 299	Yes	Yes	Yes	Yes	Yes	Yes
300 - 349	Yes	Yes	Yes	Yes	Yes	Yes
350 - 399	Yes	Yes	Yes	Yes	Yes	Yes
400 - 449	Yes	Yes	Yes	Yes	Yes	Yes
450 - 499	Yes	Yes	Yes	Yes	Yes	Yes
500 - 549	Yes	Yes	Yes	Yes	Yes	Yes
550 - 599	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

Intersection	Time Period	Through Volume	Right-Turn Volume	Right-Turn Lane Warranted (Yes / No)
CSR/Fretz	AM Peak	405	1	No
	PM Peak	450	21	No

Source: Knox County Department of Engineering and Public Works "Access Control and Driveway Design Policy"

APPENDIX D – COMMENT LETTER AND RESPONSES

KNOXVILLE·KNOX COUNTY
MPC
METROPOLITAN PLANNING COMMISSION
TENNESSEE

Comment Responses are
Shown in RED below
(by ALC dated 12/20/17)

December 20, 2017

Alan Childers, P.E.
Cannon & Cannon, Inc.
8550 Kingston Pike
Knoxville, TN 37919

SUBJECT: Fretz Road Subdivision – Traffic Impact Study Review

Dear Mr. Childers:

The Traffic Impact Study (TIS) submitted on November 27, 2017 for the referenced proposed development has been reviewed by staff from the Town of Farragut Engineering Department, Knox County Engineering Department, and MPC. We have identified the following issues related to the TIS that need to be further addressed or corrected.

1. Please provide documentation to show how the number of 47 units was derived for triggering the need for a northbound left turn lane on Campbell Station Road at Fretz Road. This analysis showing the calculations can be provided in the appendix of the report.
   A copy of the documentation is attached and will also be provided in the appendix of the revised report.

2. Please provide additional clarification regarding the determination of the recommended storage and bay taper lengths for the northbound left turn lane on Campbell Station Road.

   a) The bay taper length should be based on the prevailing (85th percentile) speed on Campbell Station Road rather than the posted 35 mph limit. A speed study to be conducted at some point prior to submittal of final design plans will be required in order to verify the sufficient taper length required.
   A Speed Study will be conducted and used in design. The study will be provided later.
   b) Provide additional documentation regarding how the 75' minimum storage length was determined and verify whether adequate storage is provided based on the projected vehicle queues from your capacity analysis.
   The recommended 75 foot storage length is the minimum that CCI recommends. This would provide for one school bus and one passenger vehicle stored at the same time. The capacity analyses 95% queue lengths were 0.1 vehicle and 0.3 vehicle respectively for the AM and PM peak hours, for the Combined Analyses. Thus, the storage recommended is more than adequate.

3. The turning movement count data provided in the appendix shows that the AM period count was begun at 7:30 a.m. – please provide justification for not beginning the count at 7:00 a.m. instead in order to capture the entirety of the peak morning elementary school traffic period.
   A previous traffic count at this intersection dated 2/23/16 (copy attached), which was taken from another traffic impact study dated 2/29/16 (Fulghum MacIndoe), showed very clearly that AM peak volumes do not begin until 7:30 AM.
4. There are various minor grammatical corrections needed that will be provided in a separate correspondence of scanned individual marked-up pages.
   These will be addressed in the revised traffic impact study that will be submitted.

Please submit three hard copies and one electronic version of a revised TIS based on the above noted issues by Wednesday, December 27, 2017 so that adequate time is available for review prior to the January MPC meeting. Please also either provide a written statement below each item above using the original Word document sent via email or in a separate memorandum format in order to indicate how they have been addressed. If you have any questions, please do not hesitate to contact me at 215-3813.

Sincerely,

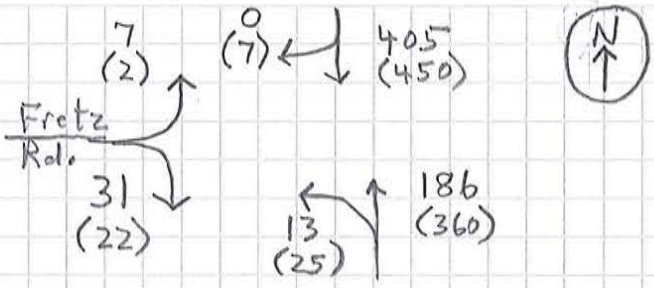
Michael D. Conger, P.E.
Senior Transportation Engineer

C: Tom Brechko, MPC
Tarren Barrett, MPC
Cindy Pionke, Knox County Engineering & Public Works
John Sexton, Knox County Engineering & Public Works
Darryl Smith, Town of Farragut Engineering
Scott Williams, W. Scott Williams & Associates
Terry Patton, Cascade Falls LLC

CANNON & CANNON INC
CONSULTING ENGINEERS
FIELD SURVEYORS

Sheet No. 1 of 1
Project Fretz Rd. Subdivision T.I.S.
Subject Determination of L.T. lane Trigger
Project Number 00545-0001
Designed By ALE Date 12/20/17
Checked By _____ Date _____

Background: Volumes (from report)



Per T.I.S. report, after development, there will be 82 NB left-turns in the PM Peak. The number to satisfy the Left-turn lane volume threshold is 50. The background year number of LT's is 25, so 25 more are needed to meet the threshold.

→ Key Question - How many units will generate 25 NB left-turns? ←

- In P.M., per Trip Distribution, 80% of Entering generated trips are NBLT
- Also, 63% of generated trips are Entering in PM peak

Using Fitted Curve equation for Single Family Detached Housing (Code 210): $[Ln(T) = 0.96\,Ln(X) + 0.20]$

$$Ln\left(\frac{25}{0.80 \times 0.63}\right) = 0.96\,Ln(X) + 0.20$$

$$Ln(X) = 3.8584$$

$$X = 47.4 \text{ units}$$

Use 47 units as Left-turn lane trigger

enhancing community life by design

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

	N Campbell Station Rd Eastbound			N Campbell Station Rd Westbound			Fretz Road Northbound			
Start	Thru	Right	Total	Left	Thru	Total	Left	Right	Total	Int. 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	

7:30 to 9:00

4:30 to 6:00