

HARDIN VALLEY SUBDIVISION

Traffic Impact Study

Hardin Valley Road

Knoxville, TN

A Traffic Impact Study for the Proposed Hardin Valley Subdivision

Submitted to

Knoxville – Knox County Metropolitan Planning Commission

Revised August 24, 2015

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FMA Project No. 330.009

Submitted By:



TABLE OF CONTENTS

EXECUTIVE SUMMARY 3

1 INTRODUCTION 4

1.1 PROJECT DESCRIPTION 4

1.2 EXISTING SITE CONDITIONS 4

2 EXISTING TRAFFIC VOLUMES 7

3 BACKGROUND GROWTH..... 10

4 TRIP GENERATION AND TRIP DISTRIBUTION 12

5 PROJECTED CAPACITY AND LEVEL OF SERVICE..... 16

6 TURN LANE WARRANT ANALYSIS..... 21

7 SIGNAL WARRANT ANALYSIS 21

8 CONCLUSIONS AND RECOMMENDATIONS 22

8.1 HARDIN VALLEY ROAD @ WESTCOTT BOULEVARD 22

8.2 HARDIN VALLEY ROAD @ PROJECT ENTRANCE 22

8.3 HARDIN VALLEY ROAD @ BALL CAMP BYINGTON ROAD..... 23

FIGURES

- 1 LOCATION MAP**
- 2 SITE PLAN**
- 3 2015 EXISTING PEAK HOUR TRAFFIC**
- 4 2015 EXISTING PEAK HOUR TRAFFIC ADJUSTED FOR PSTCC TRAFFIC**
- 5 2018 BACKGROUND PEAK HOUR TRAFFIC**
- 6 AM PEAK HOUR TRIP DISTRIBUTION**
- 7 PM PEAK HOUR TRIP DISTRIBUTION**
- 8 PEAK HOUR APARTMENT TRAFFIC**
- 9 PEAK HOUR SINGLE FAMILY TRAFFIC**
- 10 2018 PEAK HOUR TRAFFIC FULL BUILDOUT**

ATTACHMENTS

- 1 TRAFFIC COUNTS**
- 2 ADT TRENDS**
- 3 TRIP GENERATION**
- 4 SIGNAL TIMING**
- 5 INTERSECTION WORKSHEETS – EXISTING AM/PM PEAKS**
- 6 INTERSECTION WORKSHEETS – BACKGROUND AM/PM PEAKS**
- 7 INTERSECTION WORKSHEETS – BACKGROUND AM/PM PEAKS + DEVELOPMENT**
- 8 TURN LANE WARRANT ANALYSIS**
- 9 SIGNAL WARRANT ANALYSIS**

Executive Summary

Shady Glen, LLC proposes a residential development with apartments and single family homes. The project is located at 10105 Hardin Valley Road near the intersection of Hardin Valley Road and Westcott Boulevard in West Knox County, Tennessee. The development will consist of 248 apartment units and 170 single family homes. Construction is proposed to take place this year and this study assumes full build out for the development will occur in 2018.

The public street for the proposed development will tie into Hardin Valley Road 805-ft east of the intersection of Hardin Valley Road and Westcott Boulevard. The proposed lane configuration is a right and left turn lane out of the development.

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

Hardin Valley Road @ Project Entrance

An eastbound right turn lane is warranted at the intersection of Hardin Valley Road and the proposed project entrance. This warrant is met only during the PM peak hour due to the high volume of traffic on Hardin Valley Road. For a right turn lane on an arterial road the AASHTO "A Policy on Geometric Design of Highways and Streets" recommends the installation of a minimum 100-ft right-turn taper and a minimum storage length of 50-ft.

A westbound left turn lane is warranted at the intersection of Hardin Valley Road and the proposed project entrance. The existing left turn lane has a taper length of 175-ft and a storage length of 100-ft.

Signal Warrants 1 eight-hr vehicular volume, 2 four-hr vehicular volume and 3 peak hour were all met after the full build out of the Hardin Valley Subdivision. It was determined that the Hardin Valley Subdivision will not meet Warrant 2 until it reaches 60% build out and it will not meet Warrant 3 until it reaches 75% build out. FMA recommends that the need for a signal at the project entrance be re-evaluated after the Hardin Valley Subdivision reaches 75% build out.

Hardin Valley Road @ Westcott Boulevard

The intersection is expected to operate at a LOS D during the AM peak hour and a LOS C during the PM peak hour after the completion of the Hardin Valley Subdivision. FMA recommends that the signal timing at this intersection be monitored.

Hardin Valley Road @ Ball Camp Byington Road

The intersection is expected to operate at a LOS D after the completion of the Hardin Valley Subdivision. FMA recommends that the signal timing at this intersection be monitored.

1 Introduction

1.1 Project Description

This report provides a summary of a traffic impact study that was performed for the proposed Hardin Valley Subdivision on Hardin Valley Road. The project site is located east of Pellissippi Parkway (Highway 162) near the intersection of Hardin Valley Road and Westcott Boulevard in west Knox County. The location of the site is shown in Figure 1.

The proposed Hardin Valley Subdivision will consist of 170 single family lots and 248 apartment units. Full Buildout is expected to occur within three years, or by the year 2018. 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.

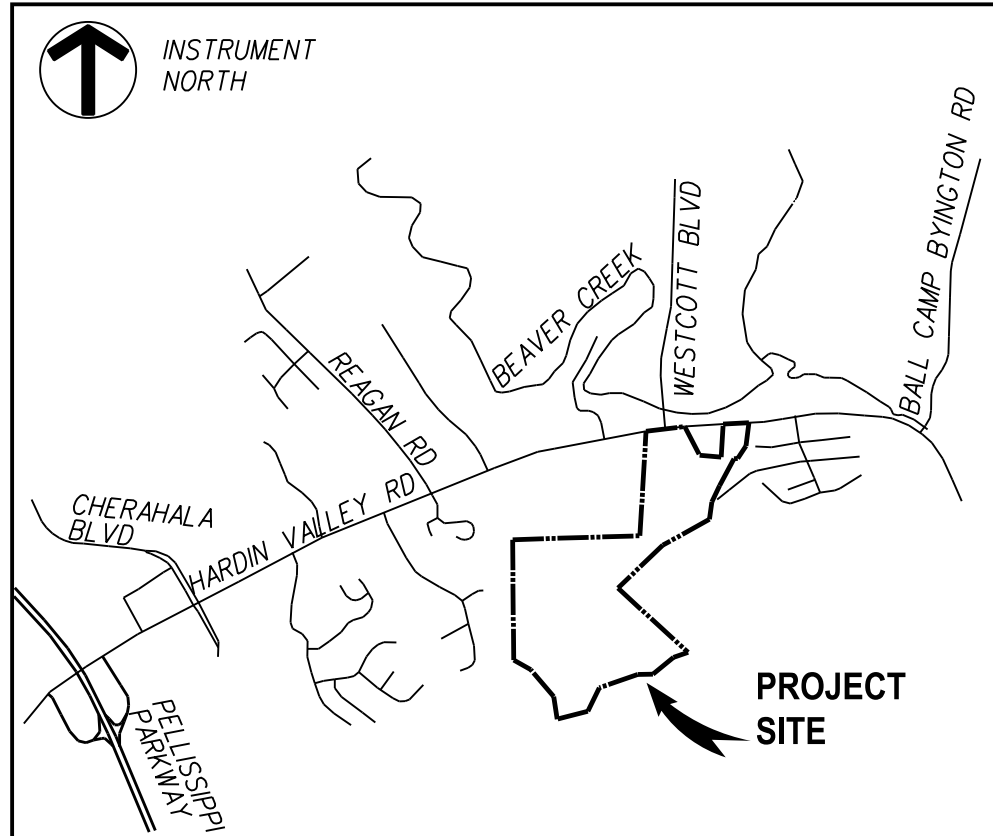
1.2 Existing Site Conditions

The proposed subdivision site access will tie into Hardin Valley Road approximately 805 feet east of the signalized intersection of Hardin Valley Road and Westcott Boulevard and approximately 2,035 feet west of the signalized intersection of Hardin Valley Road and Ball Camp Byington Road. There are existing eastbound and westbound left turn lanes from Hardin Valley Road at the proposed project entrance. Both have approximately 100-ft in storage length and have a 175-ft taper length.

During a site visit it was determined that Hardin Valley Road is a four-lane road with a 16-ft raised median at the proposed project entrance. The Knoxville-Knox County Metropolitan Planning Commission classifies Hardin Valley Road as a minor arterial per the Major Road Plan. The posted speed limit on Hardin Valley Road is 45 mph. The intersection sight distance at the proposed public street was measured to be in excess of 450-ft east and west of the intersection.

Westcott Boulevard is a three-lane road with a two-way left turn lane and has a posted speed limit of 30 mph. The Knoxville-Knox County Metropolitan Planning Commission classifies Westcott Boulevard as a major arterial per the Major Road Plan.

FIGURE 1

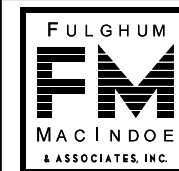


LOCATION MAP
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LOCATION MAP

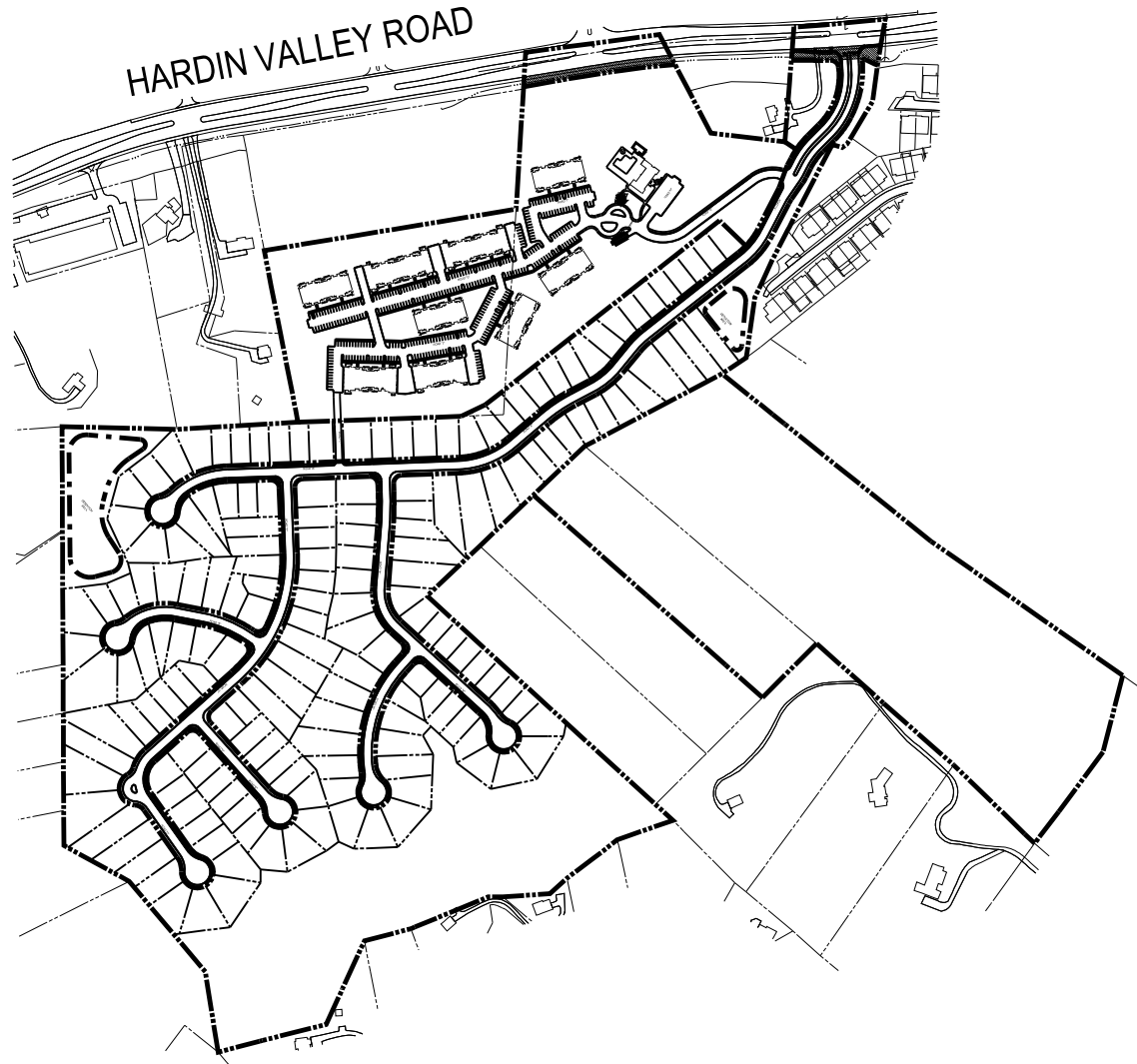
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FIGURE 2



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SITE PLAN

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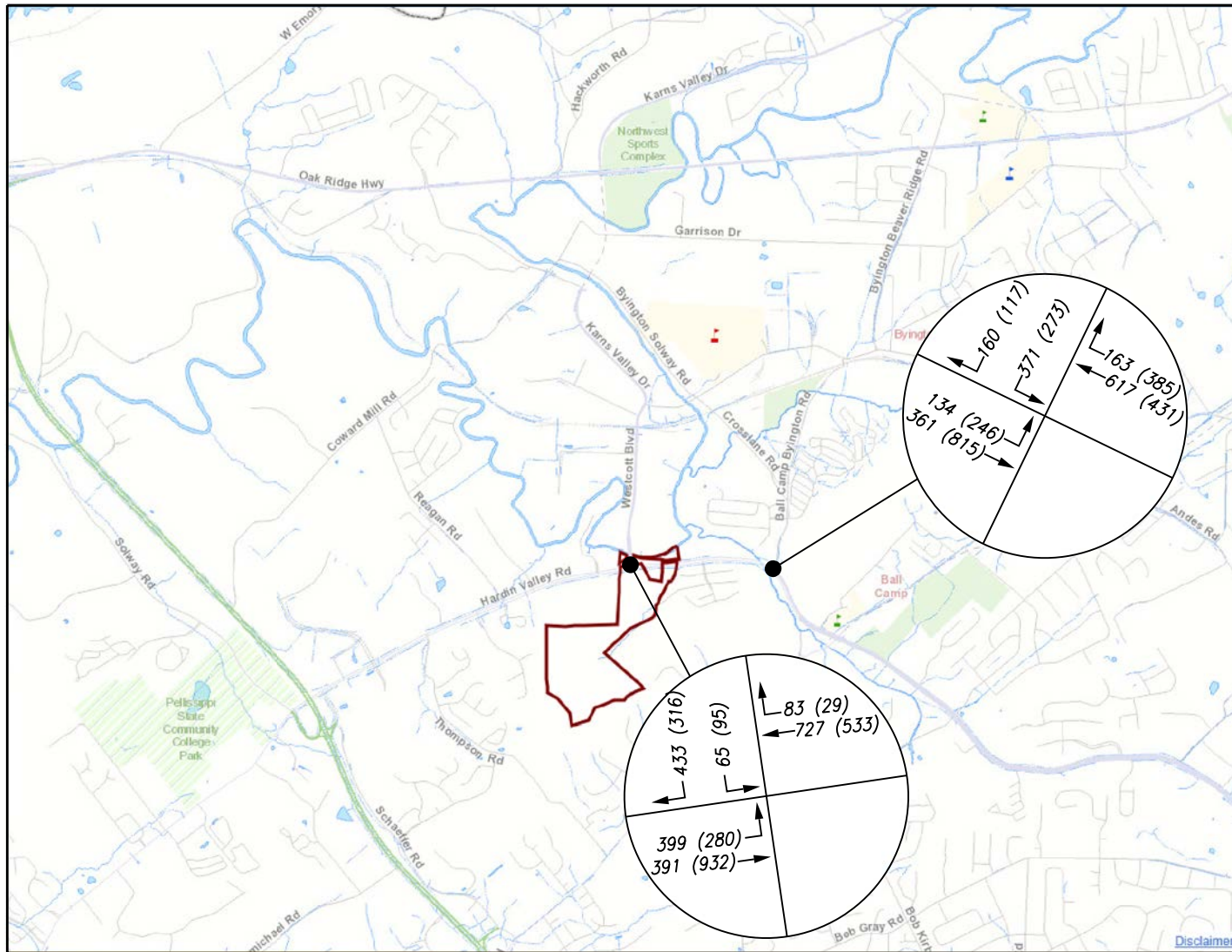
Ball Camp Byington Road is a two-lane road and has a posted speed limit of 35 mph. The grade on the southbound approach of Ball Camp Byington Road is 4%. The Knoxville-Knox County Metropolitan Planning Commission classifies Ball Camp Byington Road as a major collector from Byington Beaver Ridge Road to Hardin Valley Road and as a minor arterial from Hardin Valley Road to Middlebrook Pike per the Major Road Plan.

2 Existing Traffic Volumes

FMA conducted an eight-hour turning movement count at the intersection of Hardin Valley Road and Westcott Boulevard on Wednesday, May 13, 2015 and at the intersection of Hardin Valley Road and Ball Camp Byington Road on Thursday May 14, 2015. CDM Smith, Inc. conducted a five-hour turning movement count at the intersection of Hardin Valley Road and Westcott Boulevard on May 7, 2014. 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. Because the counts were taken on three separate days the intersection volumes shown in Figure 3 do not correlate between intersections.

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 7:15 am and 8:15 am and the PM peak hour occurred between 5:00 pm and 6:00 pm.

The FMA turning movement count was conducted after Pellissippi State Community College (PSTCC) located nearby on Hardin Valley Road completed the spring semester on May 2, 2015. In order to adjust for the PSTCC traffic the two counts at the intersection of Hardin Valley Road and Westcott Boulevard were compared. First a 4% annual growth rate was applied to the CDM Smith traffic count data from 2014 to 2015. It was determined that PSTCC increased traffic 16% during the AM peak hour and 32% during the PM Peak hour. The global growth rate of 16% during the AM Peak and 32% during the PM peak hour was applied to the existing traffic conditions for both the intersections of Hardin Valley Road and Westcott Boulevard and Hardin Valley Road and Ball Camp Byington Road. The results are shown in Figure 4.



LEGEND:

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TURNING MOVEMENT VOLUME AM (PM)

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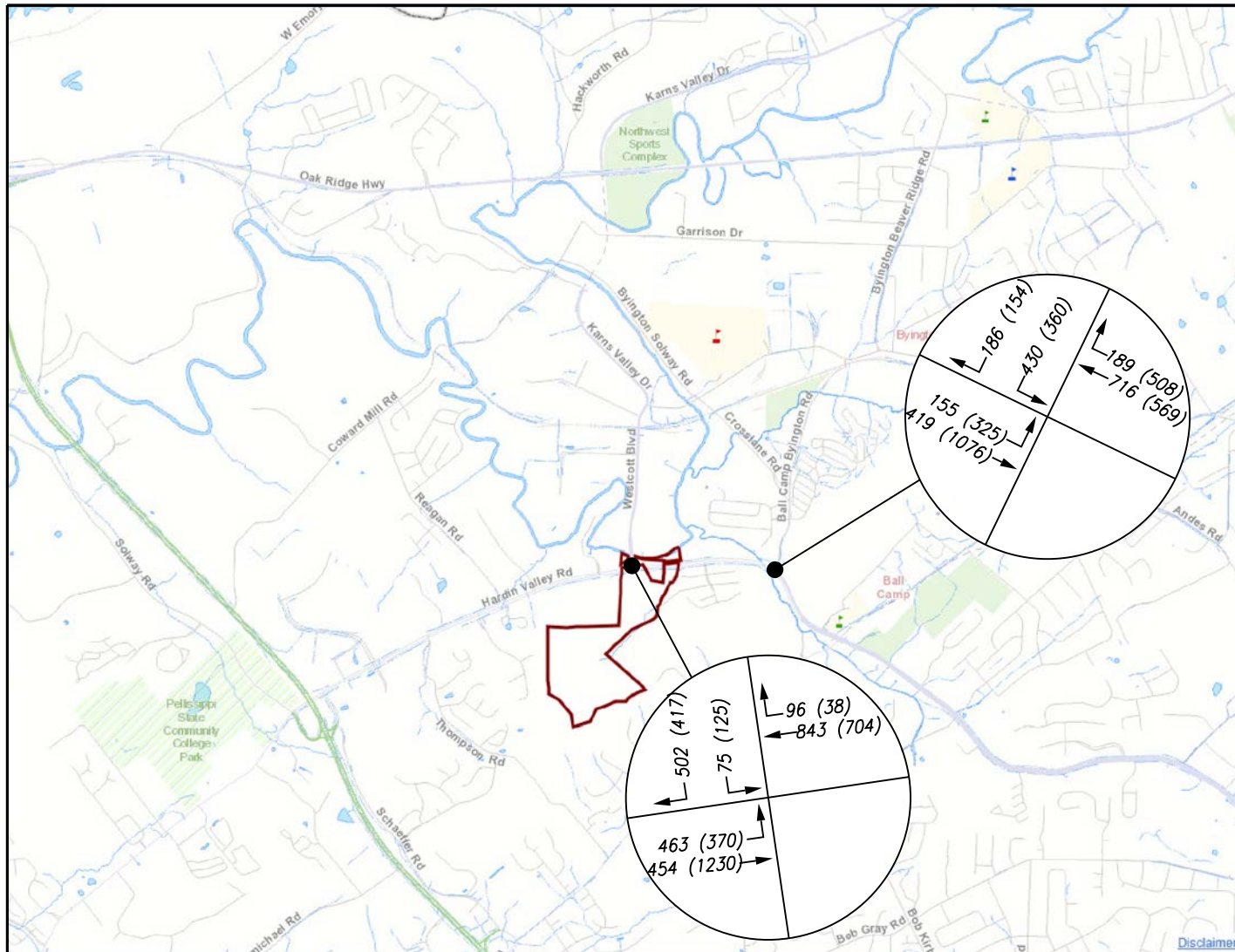
2015 EXISTING PEAK HOUR TRAFFIC

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LEGEND:

- ← 5 (16) TURNING MOVEMENT VOLUME AM (PM)
- ← 16% (32%) PSTCC ADJUSTMENT FACTOR AM (PM)

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FIGURE 4		No.	Revision/Issue	Date	

**2015 EXISTING PEAK HOUR
ADJUSTED FOR PSTCC TRAFFIC**

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3 Background Growth

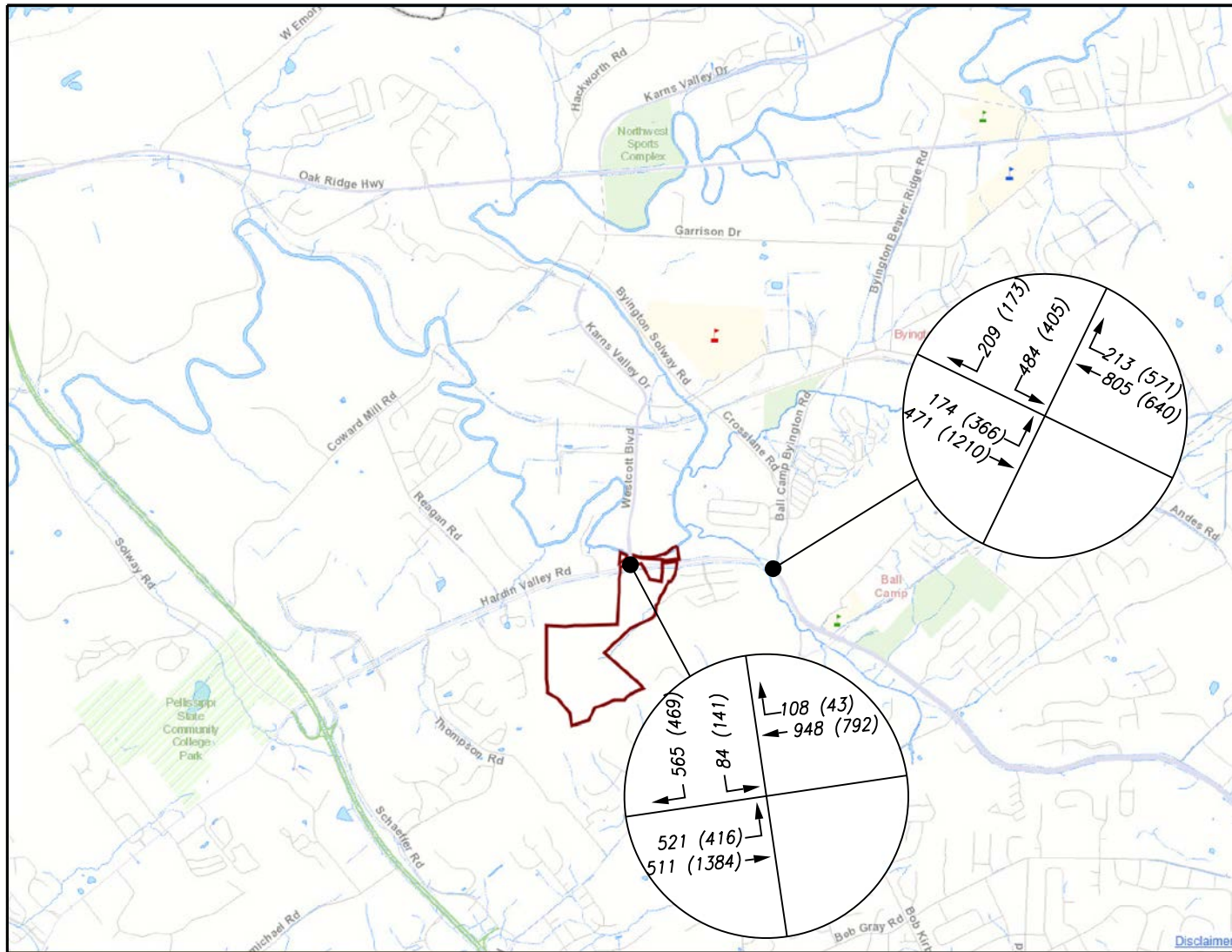
The Tennessee Department of Transportation (TDOT) maintains count Station #000088 on Middlebrook Pike (SR 169) near Ball Camp Pike. The annual traffic growth rate for Station #000088 between 2010 and 2013 is approximately 3.56%.

TDOT also maintains count Station #000086 on Ball Camp Byington Road north of Ball Camp Road (SR 131). The annual traffic growth rate for Station #000086 between 2003 and 2013 is approximately 2.15%.

The Knoxville-Knox County Metropolitan Planning Commission (MPC) and the Transportation Planning Organization (TPO) maintains count station M381 on Hardin Valley Road east of Schaeffer Road and count station M360 on Westcott Boulevard north of Hardin Valley Road. The annual traffic growth rate for Station M381 between 2010 and 2013 is approximately 3.57% and the annual traffic growth rate for Station M360 between 2010 and 2013 is approximately 3.71%.

For the purpose of this study, an annual growth rate of 4% for traffic at the intersections of Hardin Valley Road and Westcott Boulevard and Hardin Valley Road and Ball Camp Byington Road were assumed until full occupancy is reached in 2018.

Attachment 2 shows the trend line growth charts for the TDOT count stations and for the MPC/TPO count stations. Figure 5 demonstrates the projected future peak hour volumes at the intersections after applying this background growth rate to the existing conditions.



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TURNING MOVEMENT VOLUME AM (PM)

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No.	Revision/Issue	Date									
FIGURE 5											

**2018 BACKGROUND
PEAK HOUR TRAFFIC**

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4 Trip Generation and Trip Distribution

The *Trip Generation, 7th Edition*, published by the Institute of Transportation Engineers, was used to estimate volumes based on locally gathered trip generation data. The Knoxville-Knox County Metropolitan Planning Commission published a memorandum ("Local Trip Generation Rates for Multi-Family Residential Uses", August 14, 2000, contained in Attachment 3) for the purpose of providing locally collected data for all multi-family residential developments. The fitted curve equations from the local study were used to calculate site trips.

The total number of trips generated by the proposed Hardin Valley Subdivision Apartments was estimated to be 2,159 daily trips. During the peak hour the estimated trips are 124 trips during the AM peak hour and 176 trips during the PM peak hour.

Single-Family Detached Housing or Land Use 210 was used to calculate site trips for the proposed single family housing using the fitted curve equation from *The Trip Generation, 7th Edition*, published by the Institute of Transportation Engineers. The land use worksheets are included in Attachment 3.

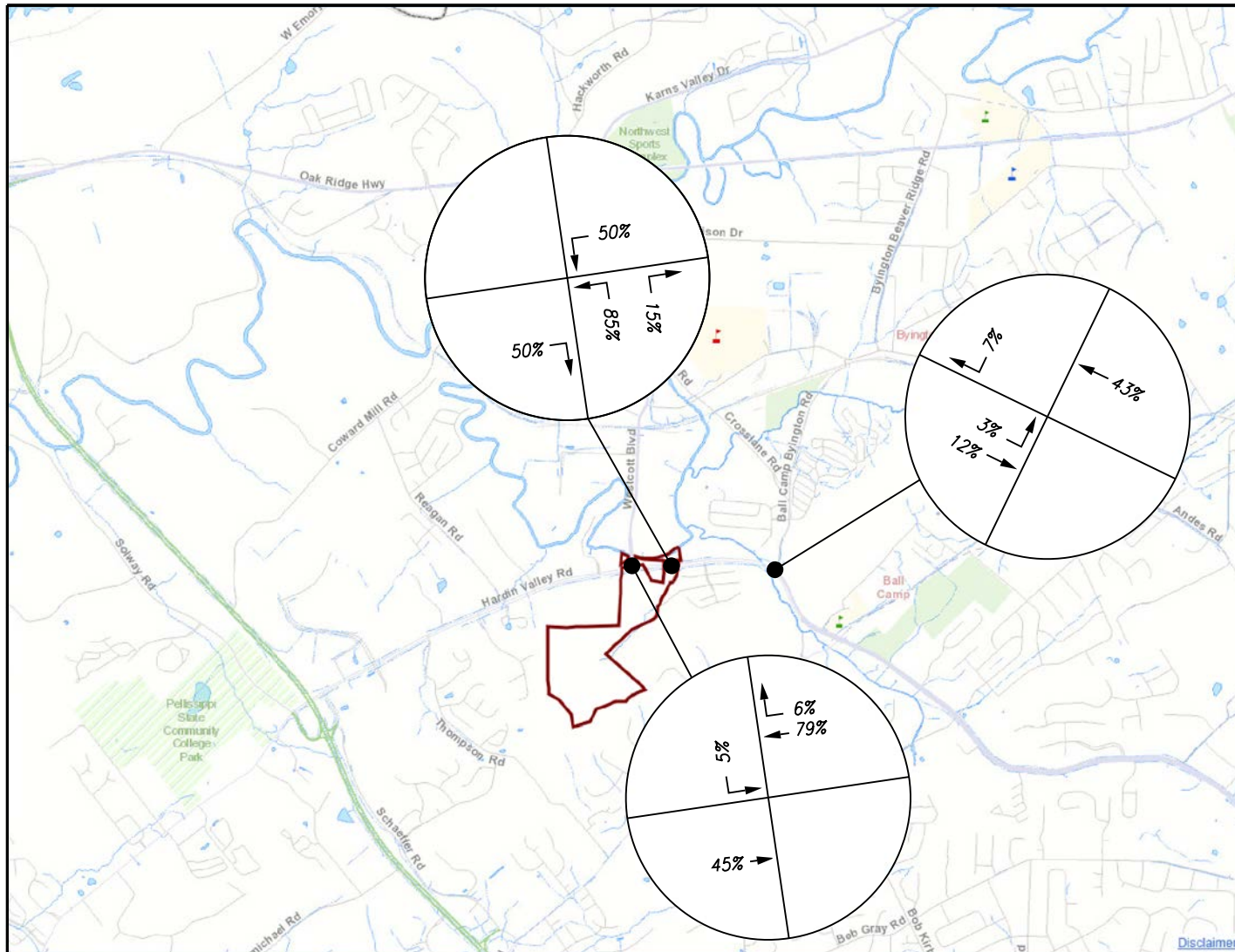
The total number of trips generated by the proposed single family housing was estimated to be 1,694 daily trips. During the peak hour the estimated trips are 128 trips during the AM peak hour and 173 trips during the PM peak hour. A trip generation summary is shown in Table 4-1.

**Table 4-1
Trip Generation Summary**

Hardin Valley Subdivision Apartments Rates for Local Apartment Trip Generation Study					
	Total New Trips	% Entering	%Exiting	Number Entering	Number Exiting
Weekday	2159	50	50	1080	1080
A.M. Peak	124	22	78	27	97
P.M. Peak	176	55	45	97	79
Single-Family Detached Housing (Land Use 210)					
	Total New Trips	% Entering	%Exiting	Number Entering	Number Exiting
Weekday	1694	50	50	847	847
A.M. Peak	128	25	75	32	96
P.M. Peak	173	63	37	109	64

The total number of trips for the Hardin Valley Subdivision was estimated to be 3,853 daily trips.

The directional distribution of the traffic generated by the proposed Hardin Valley Subdivision 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. Hardin Valley Road at Westcott Boulevard had a trip distribution of 50% Eastbound and 50% Westbound during the AM peak hour and 70% Eastbound and 30% Westbound during the PM peak hour. Westcott Boulevard had a trip distribution of 85% Westbound right turns and 15% Eastbound left turns during the AM peak hour and 75% Westbound right turns and 25% Eastbound left turns during the PM peak hour. The trip distribution for the Hardin Valley Subdivision is shown in Figure 6 and Figure 7.



LEGEND:

← 50% (50%)

TRIP DISTRIBUTION AM (PM)

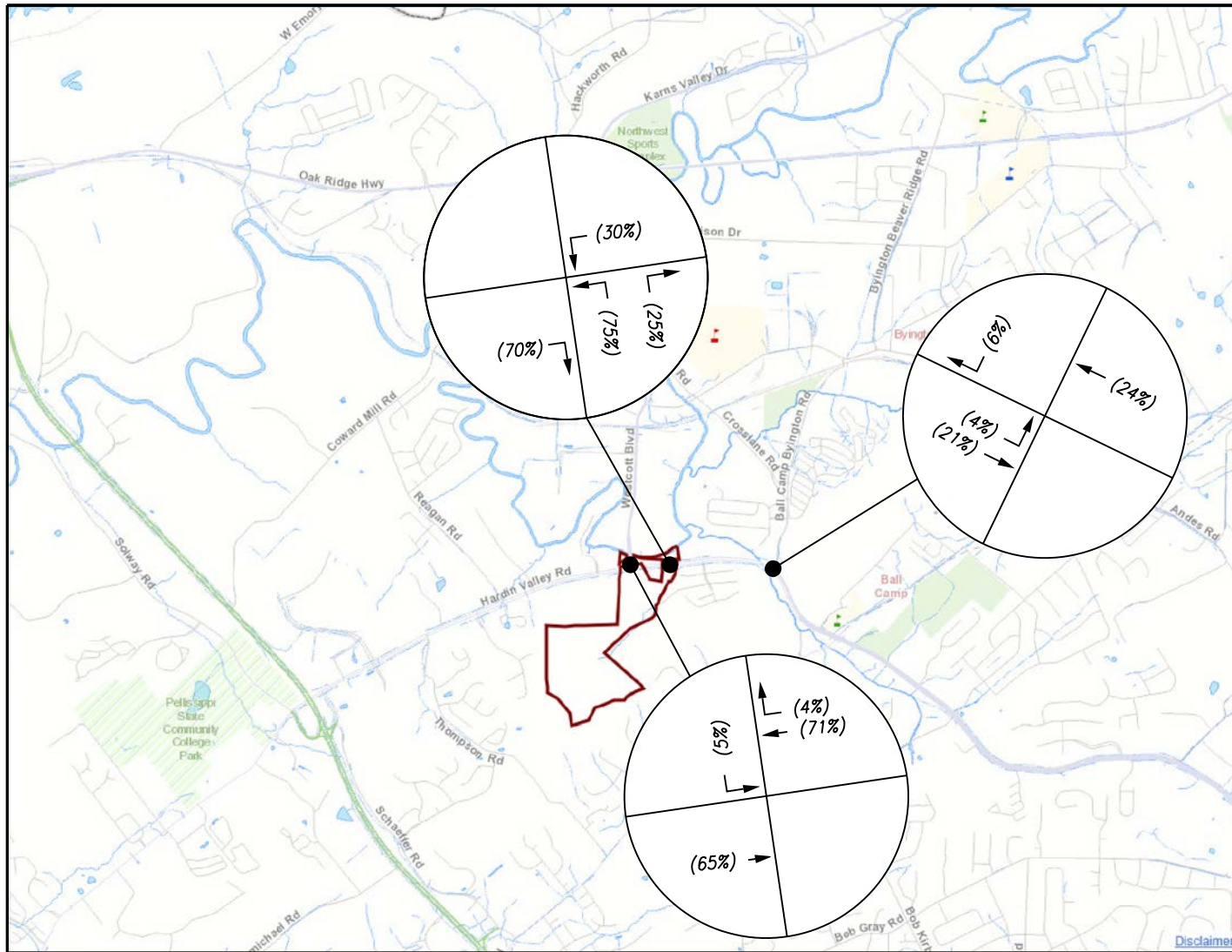
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FIGURE 6											

**AM PEAK HOUR
TRIP DISTRIBUTION**

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LEGEND:

← 50% (50%)

TRIP DISTRIBUTION AM (PM)

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**PM PEAK HOUR
TRIP DISTRIBUTION**

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Using the existing trip distribution the trips generated from the Hardin Valley Subdivision Apartments are shown in Figure 8 and the trips generated from the Hardin Valley Subdivision Single Family Housing are shown in Figure 9. Figure 10 shows the combined peak hour traffic from the background growth and the full build out of the Hardin Valley Subdivision.

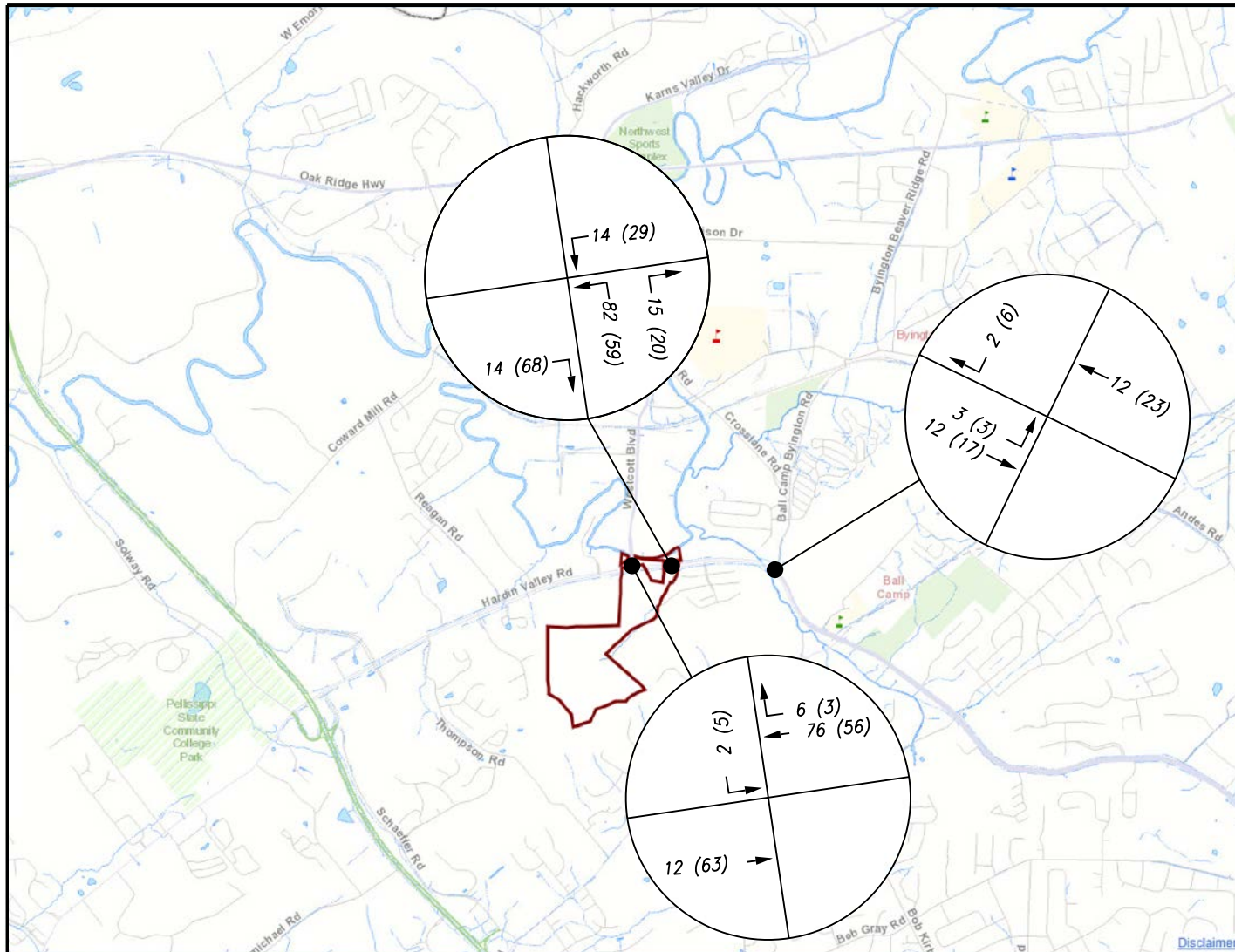
5 Projected Capacity and Level of Service

Unsignalized intersection capacity analyses were performed for the AM and PM peak hours to evaluate the traffic conditions at the intersection of Hardin Valley Road and the proposed project entrance.

Signalized intersection analyses were performed for the AM and PM peak hours to evaluate traffic conditions at the intersections of Hardin Valley Road and Westcott Boulevard and Hardin Valley Road and Ball Camp Byington Road. Signal timing information was provided by Knox County and can be found in Attachment 4. The signal timing was optimized for each scenario using the Highway Capacity Software (HCS 2010) which is based on the *2010 Highway Capacity Manual*.

Based on observations made in the field right turning movements were estimated based on a percentage of the total peak hour volume. At the intersection of Hardin Valley Road and Westcott Boulevard the southbound traffic had 33% and the westbound traffic had 25% of vehicles turning right on red. At the intersection of Hardin Valley Road and Ball Camp Byington Road the southbound traffic had 20% and westbound traffic had 15% of vehicles turning right on red.

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.



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TURNING MOVEMENT VOLUME AM (PM)

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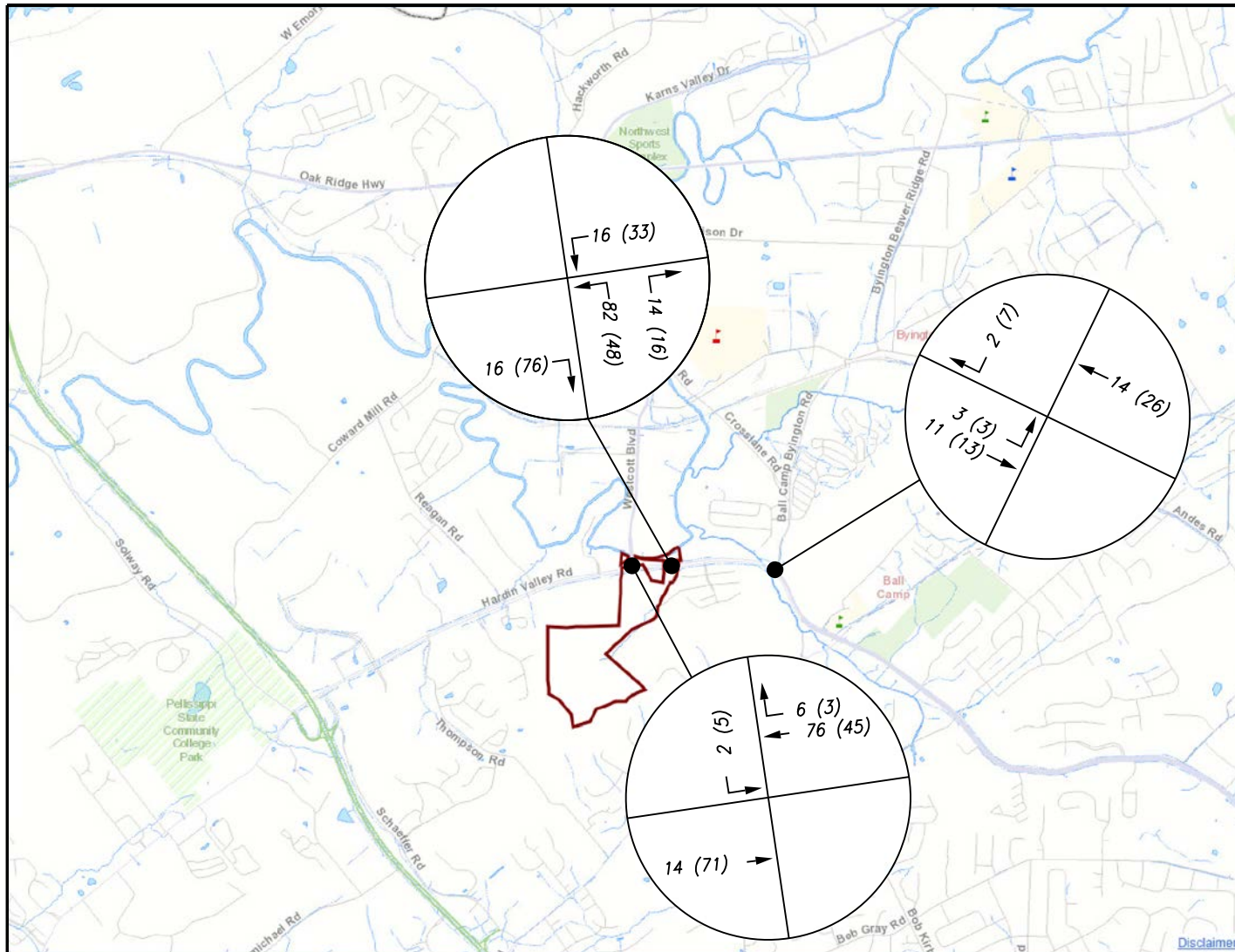
PEAK HOUR APARTMENT TRAFFIC

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LEGEND:

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TURNING MOVEMENT VOLUME AM (PM)

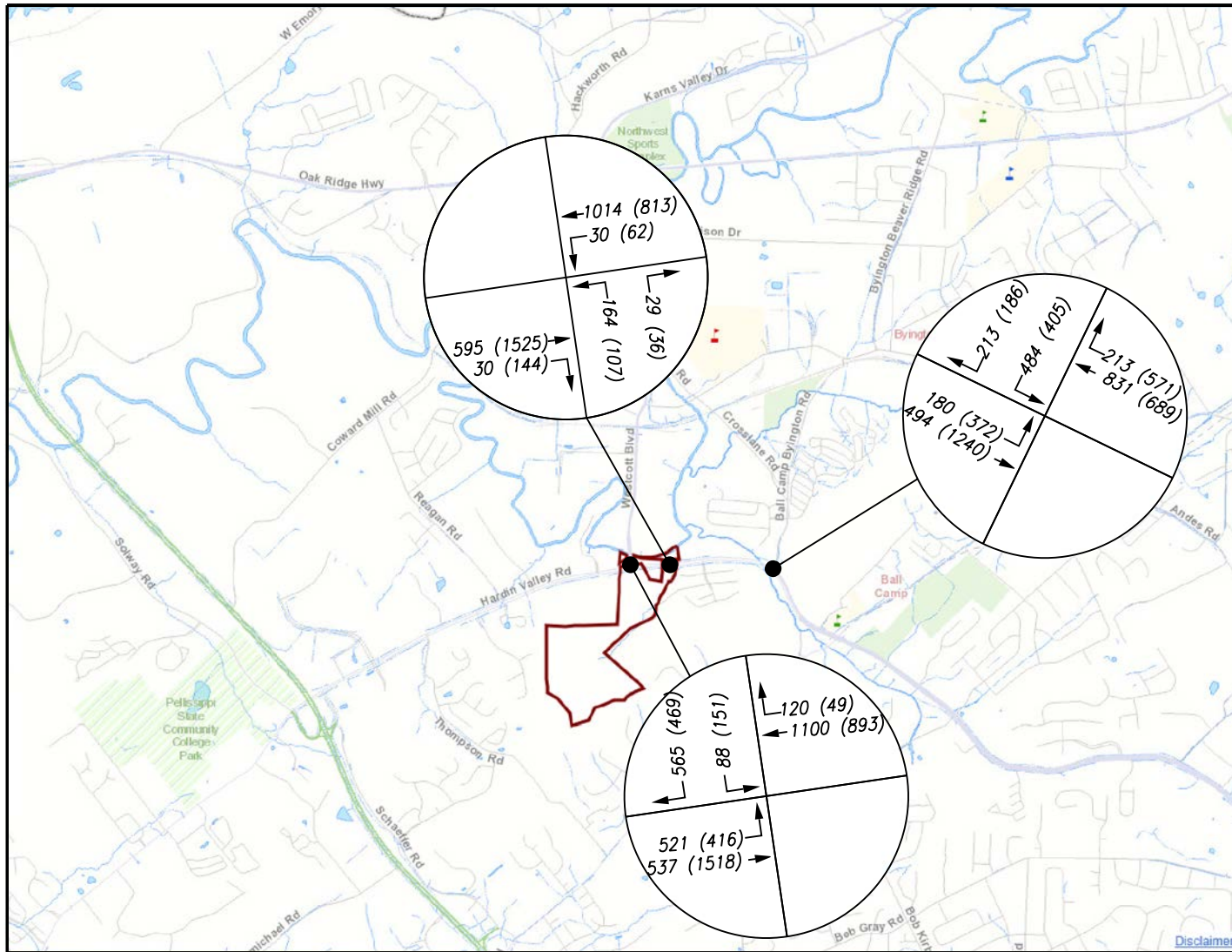
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PEAK HOUR SINGLE FAMILY TRAFFIC

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TURNING MOVEMENT VOLUME AM (PM)

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**2018 PEAK HOUR TRAFFIC
FULL BUILDOUT**

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Table 5-1

**Intersection Analysis
Level of Service (LOS) Summary**

Delay (sec)/LOS		
Hardin Valley Road @ Westcott Boulevard (Existing 2015)		
AM Peak	Intersection	26.7 / C
PM Peak	Intersection	11.8 / B
Hardin Valley Road @ Ball Camp Byington Road (Existing 2015)		
AM Peak	Intersection	27.5 / C
PM Peak	Intersection	27.6 / C
Hardin Valley Road @ Westcott Boulevard (Background Growth 2018)		
AM Peak	Intersection	41.2 / D
PM Peak	Intersection	14.8 / B
Hardin Valley Road @ Ball Camp Byington Road (Background Growth 2018)		
AM Peak	Intersection	39.5 / D
PM Peak	Intersection	37.4 / D
Hardin Valley Road @ Project Entrance (Background Growth + Full Buildout 2018)		
AM Peak	WB L	9.1 / A
	NB L	36.5 / E
	NB R	10.3 / B
PM Peak	WB L	18.7 / C
	NB L	210.9 / F
	NB R	16.1 / C
Hardin Valley Road @ Westcott Boulevard (Background Growth + Full Buildout 2018)		
AM Peak	Intersection	45.7 / D
PM Peak	Intersection	16.6 / B

Hardin Valley Road @ Ball Camp Byington Road (Background Growth + Full Buildout 2018)

AM Peak	Intersection	36.3 / D
PM Peak	Intersection	40.2 / D

6 Turn Lane Warrant Analysis

The intersection of Hardin Valley Road and the Project Entrance was evaluated to determine if an eastbound right turn lane or a westbound left turn on Hardin Valley 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 Hardin Valley Road is warranted during the PM peak hour. A westbound left turn on Hardin Valley Road is warranted during both the AM and PM peak hours. The turn lane warrant worksheets and analysis are included in Attachment 8.

7 Signal Warrant Analysis

The intersection of Hardin Valley Road and the proposed project entrance was evaluated to determine if signalization was warranted for the proposed traffic generated by the Hardin Valley Subdivision. Warrants for traffic signals can be found in Chapter 4C of the *2003 Manual on Uniform Traffic Control Devices (MUTCD)*, published by the Federal Highway Administration (FHWA). There are three volume-based warrants that were evaluated.

- Warrant 1, Eight-Hour Vehicular Volume
- Warrant 2, Four-Hour Vehicular Volume
- Warrant 3, Peak Hour

Signal Warrants 1 eight-hr vehicular volume, 2 four-hr vehicular volume and 3 peak hour were all met after the full build out of the Hardin Valley Subdivision. It was determined that the Hardin Valley Subdivision will not meet Warrant 2 until it reaches 60% build out and it will not meet Warrant 3 until it reaches 75% build out. The signal warrant worksheet is included in Attachment 9.

8 Conclusions and Recommendations

8.1 Hardin Valley Road @ Westcott Boulevard

The intersection of Hardin Valley Road and Westcott Boulevard currently operates at a LOS C during the AM peak hour and a LOS B during the PM peak hour. The intersection is expected to operate at a LOS D during the AM peak hour and a LOS B during the PM peak hour after the completion of the Hardin Valley Subdivision. All approaches will continue to operate at an acceptable LOS except the Westcott Boulevard southbound right turning movement which will operate at a LOS F both before and after the completion of the Hardin Valley Subdivision. FMA recommends that the signal timing at this intersection be monitored.

8.2 Hardin Valley Road @ Project Entrance

Hardin Valley Road is classified as a minor arterial. The minimum intersection spacing required for an arterial is 400-ft per the "Minimum Subdivision Regulations" for Knoxville and Knox County. The nearest road intersection to the project entrance is currently 650-ft east at the intersection of Hardin Valley Road and Windflower Way. This intersection exceeds the typical minimum separation of 400 feet between roads on an arterial; therefore, no change is necessary.

An eastbound right turn lane is warranted at the intersection of Hardin Valley Road and the proposed project entrance. This warrant is met only during the PM peak hour due to the high volume of traffic on Hardin Valley Road. For a right turn lane on an arterial road the AASHTO "A Policy on Geometric Design of Highways and Streets" recommends the installation of a minimum 100-ft right-turn taper and a minimum storage length of 50-ft.

A westbound left turn lane is warranted at the intersection of Hardin Valley Road and the proposed project entrance. The existing left turn lane has a taper length of 175-ft and a storage length of 100-ft. The Unsignalized intersection capacity analyses show a 95% queue length for the westbound left turning movement of less than one car length during both the AM and PM peak hours; therefore the existing storage length will be adequate.

The minimum required sight distance for a road with a posted speed limit of 45 mph is 450 feet in each direction in accordance with the "Minimum Subdivision Regulations" for Knoxville and Knox County. The existing intersection of Hardin Valley Road and the project entrance has a measured sight distance that exceeds 450-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 Northbound approach of the proposed intersection of Hardin Valley Road and the Project Entrance is expected to operate at a LOS E during the AM peak hour and a LOS F during PM peak hour after the completion of the Hardin Valley Subdivision. The proposed lane configuration is a right and left turn out of the subdivision.

Signal Warrants 1 eight-hr vehicular volume, 2 four-hr vehicular volume and 3 peak hour were all met after the full build out of the Hardin Valley Subdivision. It was determined that the Hardin Valley Subdivision will not meet Warrant 2 until it reaches 60% build out and it will not meet Warrant 3 until it reaches 75% build out. FMA recommends that the need for a signal at the project entrance be re-evaluated after the Hardin Valley Subdivision reaches 75% build out.

8.3 Hardin Valley Road @ Ball Camp Byington Road

The intersection of Hardin Valley Road and Ball Camp Byington Road currently operates at a LOS C during both the AM and PM peak hours. The intersection is expected to operate at a LOS D during both the AM and PM peak hours after full buildout of the Hardin Valley Subdivision. All approaches will continue to operate at an acceptable LOS except the Ball Camp Byington Road southbound left turning movement which will operate at a LOS F both before and after the completion of the Hardin Valley Subdivision. FMA recommends that the signal timing at this intersection be monitored.

Attachment 1
Traffic Counts

**Attachment 1
Traffic Counts**

Project: Hardin Valley Subdivision
Date Conducted: 5/13/2015

Start	Hardin Valley Road Eastbound			Hardin Valley Road Westbound			Westcott Boulevard Southbound			Int. Total
	Left	Thru	Total	Thru	Right	Total	Left	Right	Total	
7:00 AM	54	71	125	120	7	127	13	63	76	328
7:15 AM	83	79	162	171	21	192	9	100	109	463
7:30 AM	98	91	189	184	16	200	18	130	148	537
7:45 AM	137	103	240	180	29	209	23	108	131	580
Total	372	344	716	655	73	728	63	401	464	1908
8:00 AM	81	118	199	192	17	209	15	95	110	518
8:15 AM	54	103	157	169	16	185	19	70	89	431
8:30 AM	39	90	129	130	10	140	12	58	70	339
8:45 AM	32	78	110	114	13	127	11	48	59	296
Total	206	389	595	605	56	661	57	271	328	1584
11:00 AM	31	71	102	87	6	93	11	50	61	256
11:15 AM	32	80	112	64	7	71	17	60	77	260
11:30 AM	40	84	124	81	7	88	23	88	111	323
11:45 AM	55	97	152	74	10	84	10	78	88	324
Total	158	332	490	306	30	336	61	276	337	1163
12:00 PM	53	91	144	94	10	104	17	68	85	333
12:15 PM	42	103	145	85	9	94	15	58	73	312
12:30 PM	59	88	147	100	14	114	13	37	50	311
12:45 PM	56	90	146	72	21	93	11	39	50	289
Total	210	372	582	351	54	405	56	202	258	1245
2:00 PM	34	93	127	84	8	92	9	39	48	267
2:15 PM	47	94	141	107	8	115	8	37	45	301
2:30 PM	48	102	150	76	8	84	12	52	64	298
2:45 PM	51	110	161	76	9	85	14	52	66	312
Total	180	399	579	343	33	376	43	180	223	1178
3:00 PM	49	99	148	58	12	70	15	52	67	285
3:15 PM	50	112	162	99	8	107	7	52	59	328
3:30 PM	45	180	225	102	10	112	43	105	148	485
3:45 PM	52	215	267	121	15	136	16	76	92	495
Total	196	606	802	380	45	425	81	285	366	1593
4:00 PM	47	170	217	83	6	89	30	96	126	432
4:15 PM	42	175	217	92	9	101	11	68	79	397
4:30 PM	54	165	219	92	4	96	20	62	82	397
4:45 PM	42	176	218	116	9	125	17	81	98	441
Total	185	686	871	383	28	411	78	307	385	1667
5:00 PM	75	245	320	137	4	141	32	93	125	586
5:15 PM	67	270	337	122	11	133	23	94	117	587
5:30 PM	66	219	285	132	8	140	28	83	111	536
5:45 PM	72	198	270	142	6	148	12	46	58	476
Total	280	932	1212	533	29	562	95	316	411	2185
Grand Total	1787	4060	5847	3556	348	3904	534	2238	2772	12523
Approach %	30.6	69.4		91.1	8.9		19.3	80.7		
Total %	14.3	32.4	46.7	28.4	2.8	31.2	4.3	17.9	22.1	

Project: Hardin Valley Subdivision

Date Conducted: 5/13/2015

AM Peak Hour	7:15-8:15	2098
Lunch Peak Hour	11:30-12:30	1292
PM Peak Hour	5:00-6:00	2185

Start	Hardin Valley Road Eastbound			Hardin Valley Road Westbound			Westcott Boulevard Southbound			Int. Total
	Left	Thru	App. Total	Thru	Right	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										
7:15 AM	83	79	162	171	21	192	9	100	109	463
7:30 AM	98	91	189	184	16	200	18	130	148	537
7:45 AM	137	103	240	180	29	209	23	108	131	580
8:00 AM	81	118	199	192	17	209	15	95	110	518
Total Volume	399	391	790	727	83	810	65	433	498	2098
Future (4% over 3 yrs)	449	440		818	93		73	487		2360
PHF	0.73	0.83		0.95	0.72		0.71	0.83		0.90
Peak Hour Analysis from 11:00 AM to 1:00 PM										
Lunch Peak Hour begins at 11:30 PM										
11:30 AM	40	84	124	81	7	88	23	88	111	323
11:45 PM	55	97	152	74	10	84	10	78	88	324
12:00 PM	53	91	144	94	10	104	17	68	85	333
12:15 PM	42	103	145	85	9	94	15	58	73	312
Total Volume	190	375	565	334	36	370	65	292	357	1292
Future (4% over 3 yrs)	214	422		376	40		73	328		1453
PHF	0.86	0.91		0.89	0.90		0.71	0.83		0.97
Peak Hour Analysis from 2:00 PM to 6:00 PM										
PM Peak Hour begins at 5:00 PM										
5:00 PM	75	245	320	137	4	141	32	93	125	586
5:15 PM	67	270	337	122	11	133	23	94	117	587
5:30 PM	66	219	285	132	8	140	28	83	111	536
5:45 PM	72	198	270	142	6	148	12	46	58	476
Total Volume	280	932	1212	533	29	562	95	316	411	2185
Future (4% over 3 yrs)	315	1048		600	33		107	355		2458
PHF	0.93	0.86		0.94	0.66		0.74	0.84		0.93

Project: Hardin Valley Subdivision

Date Conducted: 5/14/2015

Start	Hardin Valley Road Eastbound			Ball Camp Byington Road Westbound			Ball Camp Byington Road Southbound			Int. Total
	Left	Thru	Total	Thru	Right	Total	Left	Right	Total	
7:00 AM	13	50	63	93	21	114	50	34	84	261
7:15 AM	29	79	108	133	32	165	89	48	137	410
7:30 AM	28	108	136	137	38	175	90	48	138	449
7:45 AM	49	94	143	184	44	228	100	36	136	507
Total	119	331	450	547	135	682	329	166	495	1627
8:00 AM	28	80	108	163	49	212	92	28	120	440
8:15 AM	17	95	112	157	44	201	69	27	96	409
8:30 AM	17	76	93	98	22	120	85	23	108	321
8:45 AM	21	69	90	96	35	131	77	31	108	329
Total	83	320	403	514	150	664	323	109	432	1499
11:00 AM	14	66	80	76	22	98	49	18	67	245
11:15 AM	10	75	85	63	49	112	48	9	57	254
11:30 AM	8	74	82	75	37	112	48	14	62	256
11:45 AM	23	73	96	64	36	100	58	18	76	272
Total	55	288	343	278	144	422	203	59	262	1027
12:00 PM	16	97	113	90	34	124	49	19	68	305
12:15 PM	22	72	94	75	48	123	61	23	84	301
12:30 PM	21	84	105	93	54	147	57	13	70	322
12:45 PM	22	56	78	83	51	134	59	19	78	290
Total	81	309	390	341	187	528	226	74	300	1218
2:00 PM	19	68	87	61	44	105	68	10	78	270
2:15 PM	22	67	89	82	53	135	48	18	66	290
2:30 PM	39	105	144	78	48	126	45	24	69	339
2:45 PM	32	89	121	76	53	129	48	16	64	314
Total	112	329	441	297	198	495	209	68	277	1213
3:00 PM	39	93	132	62	54	116	54	24	78	326
3:15 PM	34	81	115	111	62	173	56	26	82	370
3:30 PM	48	170	218	90	62	152	83	30	113	483
3:45 PM	23	184	207	90	67	157	74	31	105	469
Total	144	528	672	353	245	598	267	111	378	1648
4:00 PM	40	156	196	67	61	128	60	16	76	400
4:15 PM	31	155	186	82	61	143	63	20	83	412
4:30 PM	33	138	171	77	63	140	76	16	92	403
4:45 PM	45	159	204	93	83	176	67	16	83	463
Total	149	608	757	319	268	587	266	68	334	1678
5:00 PM	50	232	282	108	99	207	64	25	89	578
5:15 PM	65	202	267	116	94	210	74	20	94	571
5:30 PM	60	233	293	102	109	211	70	36	106	610
5:45 PM	71	148	219	105	83	188	65	36	101	508
Total	246	815	1061	431	385	816	273	117	390	2267
Grand Total	989	3528	4517	3080	1712	4792	2096	772	2868	12177
Approach %	21.9	78.1		64.3	35.7		73.1	26.9		
Total %	8.1	29.0	37.1	25.3	14.1	39.4	17.2	6.3	23.6	

Project: Hardin Valley Subdivision

Date Conducted: 5/14/2015

AM Peak Hour	7:15-8:15	1806
Lunch Peak Hour	12:00-1:00	1218
PM Peak Hour	5:00-6:00	2267

Start	Hardin Valley Road Eastbound			Ball Camp Byington Road Westbound			Ball Camp Byington Road Southbound			Int. Total
	Left	Thru	App. Total	Thru	Right	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										
7:15 AM	29	79	108	133	32	165	89	48	137	410
7:30 AM	28	108	136	137	38	175	90	48	138	449
7:45 AM	49	94	143	184	44	228	100	36	136	507
8:00 AM	28	80	108	163	49	212	92	28	120	440
Total Volume	134	361	495	617	163	780	371	160	531	1806
Future (4% over 3 yrs)	151	406		694	183		417	180		2032
PHF	0.68	0.84		0.84	0.83		0.93	0.83		0.89
Peak Hour Analysis from 11:00 AM to 1:00 PM										
Lunch Peak Hour begins at 11:30 PM										
12:00 PM	16	97	113	90	34	124	49	19	68	305
12:15 PM	22	72	94	75	48	123	61	23	84	301
12:30 PM	21	84	105	93	54	147	57	13	70	322
12:45 PM	22	56	78	83	51	134	59	19	78	290
Total Volume	81	309	390	341	187	528	226	74	300	1218
Future (4% over 3 yrs)	91	348		384	210		254	83		1370
PHF	0.92	0.80		0.92	0.87		0.93	0.80		0.95
Peak Hour Analysis from 2:00 PM to 6:00 PM										
PM Peak Hour begins at 5:00 PM										
5:00 PM	50	232	282	108	99	207	64	25	89	578
5:15 PM	65	202	267	116	94	210	74	20	94	571
5:30 PM	60	233	293	102	109	211	70	36	106	610
5:45 PM	71	148	219	105	83	188	65	36	101	508
Total Volume	246	815	1061	431	385	816	273	117	390	2267
Future (4% over 3 yrs)	277	917		485	433		307	132		2550
PHF	0.87	0.87		0.93	0.88		0.92	0.81		0.93

CDM SMITH Inc.
 1100 Marion Street, Suite 200
 Knoxville, TN 37921
 (865) 963-4300

Counted by: Allyson Foster

File Name : hv at westcott
 Site Code : 00000001
 Start Date : 5/7/2014
 Page No : 1

Groups Printed- Unshifted

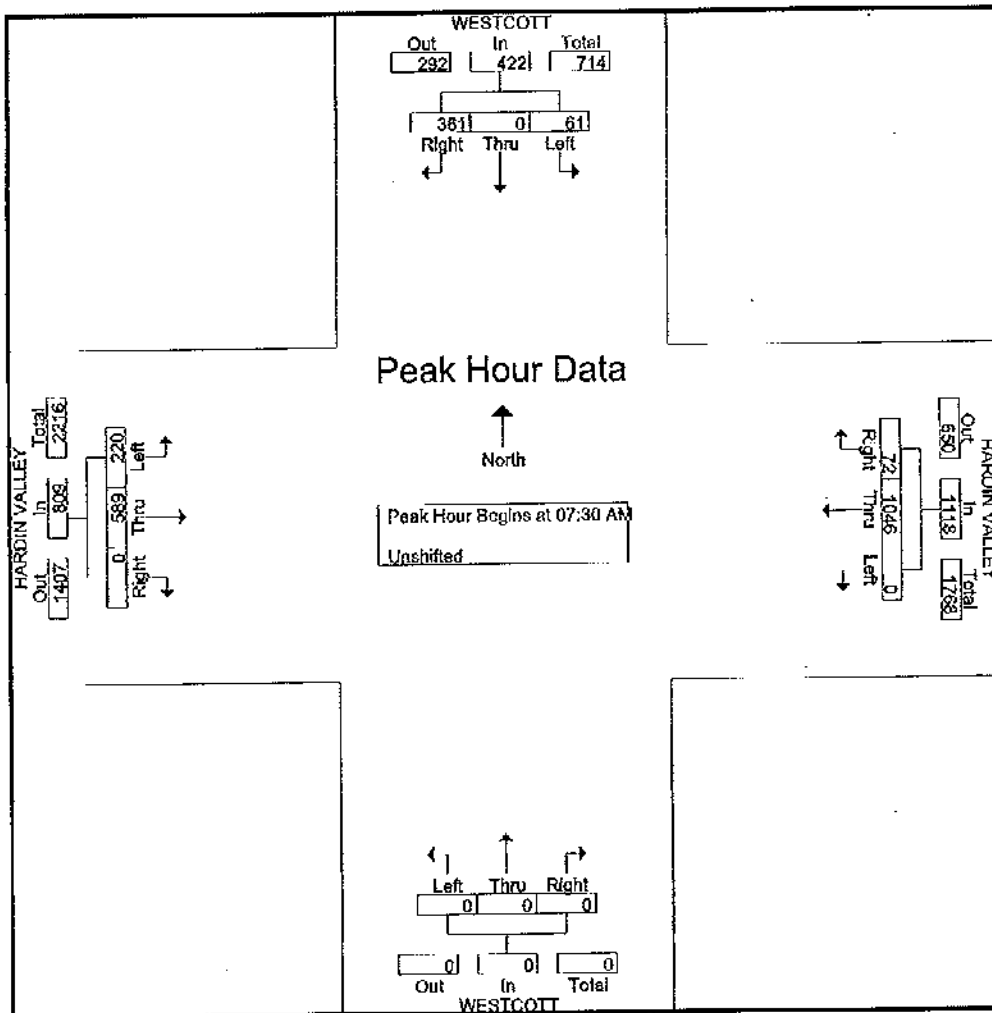
Start Time	WESTCOTT Southbound				HARDIN VALLEY Westbound				WESTCOTT Northbound				HARDIN VALLEY Eastbound				Int. Total
	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	
07:00 AM	33	0	6	39	3	81	0	84	0	0	0	0	0	64	35	99	222
07:15 AM	66	0	13	79	7	142	0	149	0	0	0	0	0	71	29	100	328
07:30 AM	81	0	17	98	28	220	0	248	0	0	0	0	0	123	18	141	487
07:45 AM	96	0	16	112	19	240	0	259	0	0	0	0	0	176	63	229	600
Total	276	0	52	328	57	683	0	740	0	0	0	0	0	434	135	569	1637
08:00 AM	90	0	14	104	13	280	0	293	0	0	0	0	0	131	63	194	591
08:15 AM	94	0	14	108	12	306	0	318	0	0	0	0	0	159	86	245	671
08:30 AM	93	0	26	119	11	175	0	186	0	0	0	0	0	107	68	175	480
08:45 AM	52	0	18	70	9	174	0	183	0	0	0	0	0	105	32	137	390
Total	329	0	72	401	45	935	0	980	0	0	0	0	0	502	249	751	2132
** BREAK **																	
03:00 PM	38	0	19	57	18	108	0	126	0	0	0	0	0	125	37	162	345
03:15 PM	50	0	5	55	6	129	0	135	0	0	0	0	0	142	53	195	385
03:30 PM	61	0	52	113	11	148	0	159	0	0	0	0	0	177	64	241	513
03:45 PM	43	0	20	63	12	104	0	116	0	0	0	0	0	243	55	298	477
Total	192	0	96	288	47	489	0	536	0	0	0	0	0	687	209	896	1720
04:00 PM	70	0	20	90	18	97	0	115	0	0	0	0	0	139	92	231	436
04:15 PM	45	0	20	65	5	113	0	118	0	0	0	0	0	209	41	250	433
04:30 PM	44	0	43	87	4	104	0	108	0	0	0	0	0	255	80	335	530
04:45 PM	31	0	25	56	7	116	0	123	0	0	0	0	0	267	50	317	496
Total	190	0	108	298	34	430	0	464	0	0	0	0	0	870	283	1133	1895
05:00 PM	98	0	53	151	12	135	0	147	0	0	0	0	0	386	60	446	744
05:15 PM	75	0	32	107	12	183	0	195	0	0	0	0	0	326	70	396	696
05:30 PM	112	0	26	138	8	130	0	138	0	0	0	0	0	321	83	404	680
05:45 PM	42	0	14	56	19	165	0	184	0	0	0	0	0	336	72	408	648
Total	327	0	125	452	51	613	0	664	0	0	0	0	0	1369	285	1654	2770
Grand Total	1314	0	453	1767	234	3150	0	3384	0	0	0	0	0	3862	1141	5003	10154
Apprch %	74.4	0	25.6		6.9	93.1	0		0	0	0	0	0	77.2	22.8		
Total %	12.9	0	4.5	17.4	2.3	31	0	33.3	0	0	0	0	0	38	11.2	49.3	

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File Name : hv at westcott
 Site Code : 00000001
 Start Date : 5/7/2014
 Page No : 3

Start Time	WESTCOTT Southbound				HARDIN VALLEY Westbound				WESTCOTT Northbound				HARDIN VALLEY Eastbound				Int. Total
	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:30 AM																	
07:30 AM	81	0	17	98	28	220	0	248	0	0	0	0	0	123	18	141	487
07:45 AM	96	0	18	112	19	240	0	259	0	0	0	0	0	176	53	229	600
08:00 AM	90	0	14	104	13	280	0	293	0	0	0	0	0	131	63	194	591
08:15 AM	94	0	14	108	12	306	0	318	0	0	0	0	0	159	86	245	671
Total Volume	361	0	61	422	72	1046	0	1118	0	0	0	0	0	589	220	809	2349
% App. Total	85.5	0	14.5		6.4	93.6	0		0	0	0	0	0	72.8	27.2		
PHF	.940	.000	.897	.942	.643	.855	.000	.879	.000	.000	.000	.000	.000	.837	.640	.826	.875

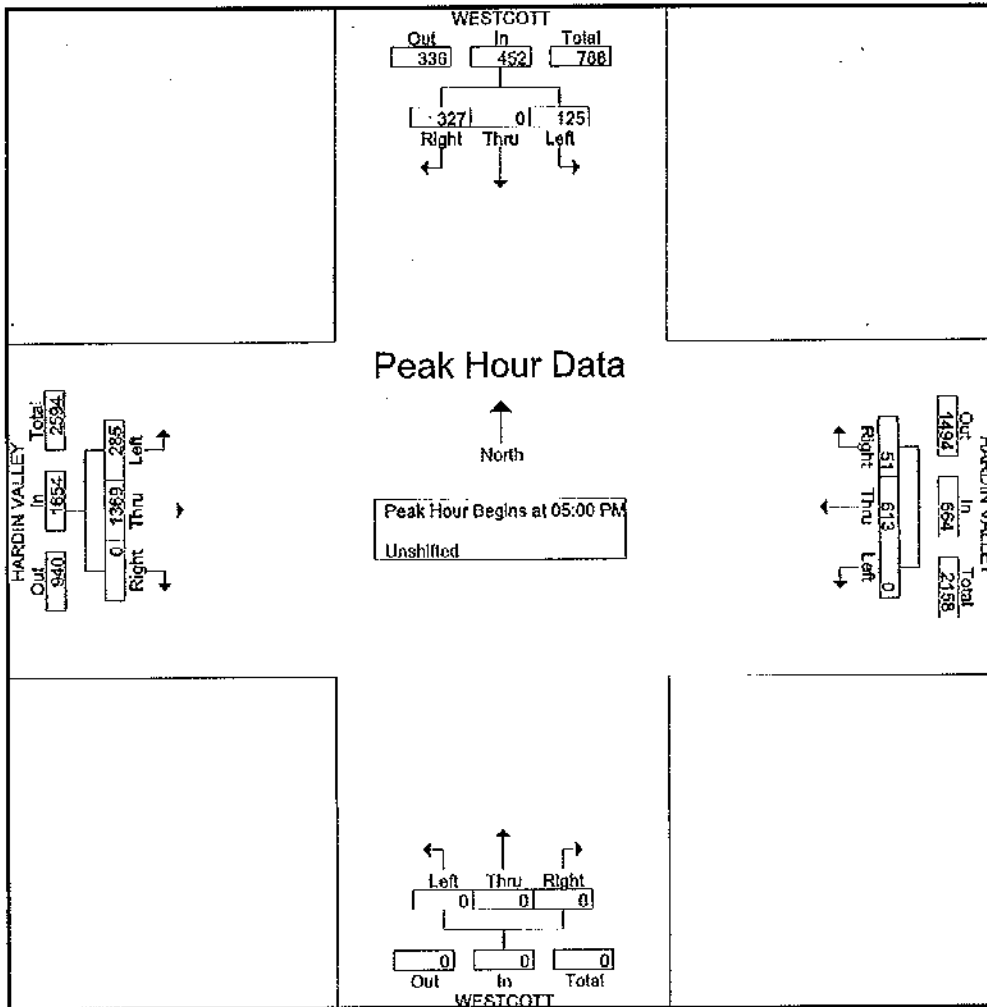


CDM SMITH Inc.
 1100 Marion Street, Suite 200
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 (865) 963-4300

Counted by: Allyson Foster

File Name : hv at westcott
 Site Code : 00000001
 Start Date : 5/7/2014
 Page No : 4

Start Time	WESTCOTT Southbound				HARDIN VALLEY Westbound				WESTCOTT Northbound				HARDIN VALLEY Eastbound				Int. Total
	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 05:00 PM																	
05:00 PM	98	0	53	151	12	135	0	147	0	0	0	0	0	386	60	446	744
05:15 PM	75	0	32	107	12	183	0	195	0	0	0	0	0	326	70	396	698
05:30 PM	112	0	26	138	8	130	0	138	0	0	0	0	0	321	83	404	680
05:45 PM	42	0	14	56	19	165	0	184	0	0	0	0	0	336	72	408	648
Total Volume	327	0	125	452	51	613	0	664	0	0	0	0	0	1369	285	1654	2770
% App. Total	72.3	0	27.7		7.7	92.3	0		0	0	0	0	0	62.8	17.2		
PHF	.730	.000	.590	.748	.671	.837	.000	.851	.000	.000	.000	.000	.000	.887	.858	.927	.931

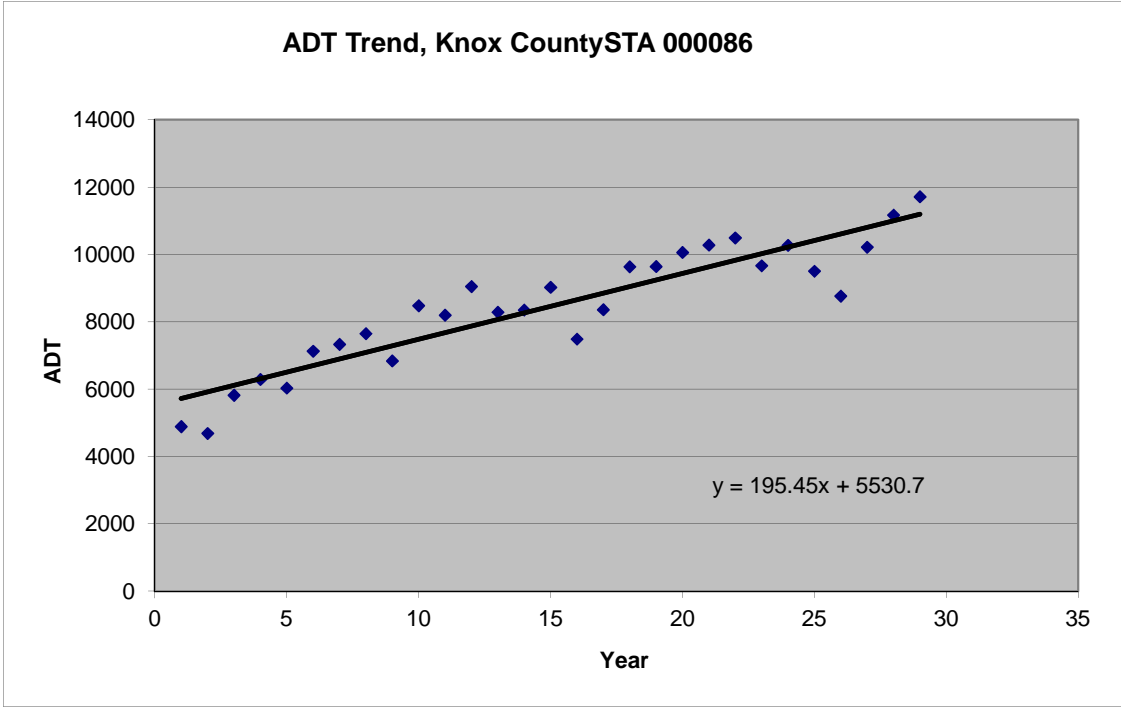


Attachment 2
ADT Trends

**Attachment 2
ADT Trends**

	Year	Adjusted Average Daily Traffic
1	1985	4892
2	1986	4690
3	1987	5824
4	1988	6291
5	1989	6035
6	1990	7133
7	1991	7335
8	1992	7652
9	1993	6843
10	1994	8483
11	1995	8200
12	1996	9053
13	1997	8290
14	1998	8352
15	1999	9028
16	2000	7492
17	2001	8362
18	2002	9638
19	2003	9645
20	2004	10063
21	2005	10283
22	2006	10496
23	2007	9669
24	2008	10274
25	2009	9507
26	2010	8768
27	2011	10221
28	2012	11172
29	2013	11717

Station #	County	Location	Route #	Route Name
86	Knox	North of Ball Camp	SR 131	Ball Camp Byington Rd



Most Recent Trend Line Growth

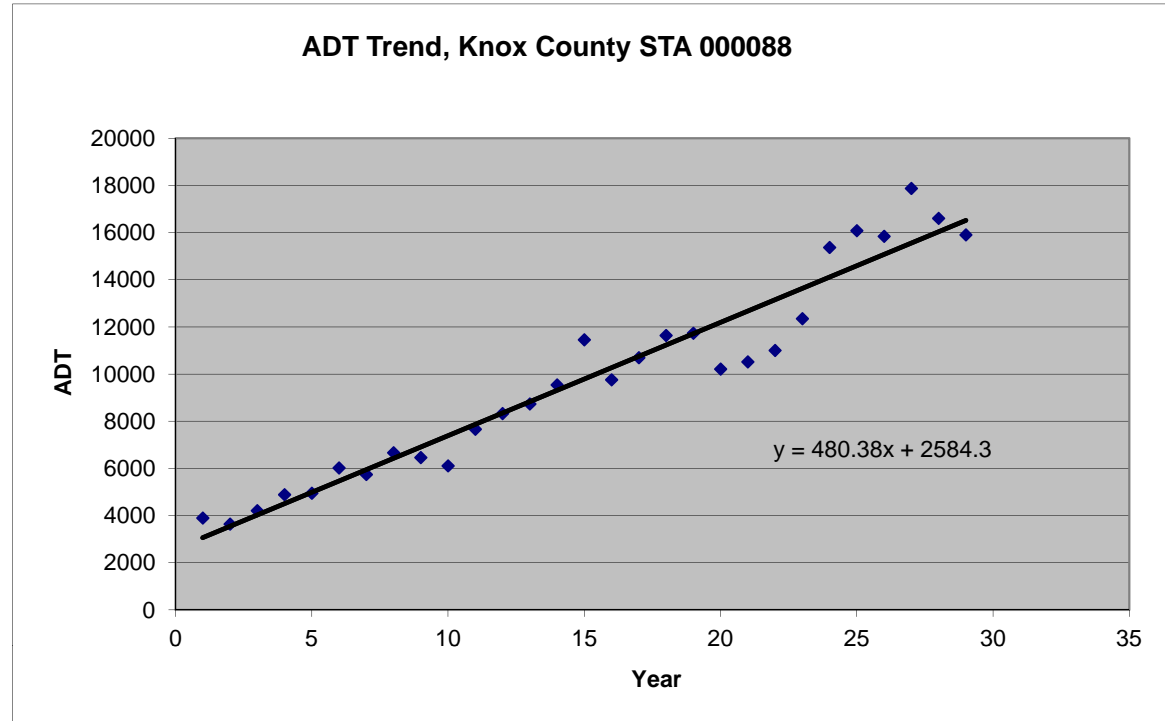
Year	ADT
2003	9645
2013	11717

Annual Percent Growth 2.15%

**Attachment 2
ADT Trends**

	Year	Adjusted Average Daily Traffic
1	1985	3897
2	1986	3640
3	1987	4208
4	1988	4889
5	1989	4950
6	1990	6020
7	1991	5744
8	1992	6667
9	1993	6460
10	1994	6110
11	1995	7662
12	1996	8328
13	1997	8736
14	1998	9541
15	1999	11455
16	2000	9757
17	2001	10698
18	2002	11637
19	2003	11732
20	2004	10214
21	2005	10520
22	2006	11005
23	2007	12351
24	2008	15373
25	2009	16083
26	2010	15844
27	2011	17877
28	2012	16607
29	2013	15905

Station #	County	Location	Route #	Route Name
88	Knox	Near Ball Camp	SR169	Middlebrook Pike



Most Recent Trend Line Growth

Year	ADT
2003	11732
2013	15905

Annual Percent Growth 3.56%

Annual Average Daily Traffic County Summary

Count Year	Count Station M381 Hardin Valley Road E of Shaeffer Rd	Count Station M360 Westcott Blvd N of Hardin Valley Rd
2010	18130	-
2011	18720	6910
2012	20620	-
2013	20820	7650

Growth Rate

3.71%

3.57%

**Attachment 3
Trip Generation**



MEMORANDUM

To: Traffic Impact Study Reviewers and Preparers (see attached list)

From: Mike Conger *ADC*

Date: August 14, 2000

Subject: Local Trip Generation Rates for Multi-Family Residential Uses

Attached please find a summary of the final report with data plots for the Knox County Local Apartment Trip Generation Study. As you will recall, this report was discussed when the traffic impact study group last convened this past February. A consensus was reached at that meeting that the trip generation rates developed in the local study should be used for new apartment complexes and any other "multi-family" residential uses that are being proposed.

The MPC voted at its July 2000 meeting to officially amend the Traffic Impact Study Guidelines with language which reads that "trip generation rates for proposed uses shall be calculated using the latest edition of the ITE Trip Generation Manual, or using local data when it is available". This amendment allows the full implementation of the new rates, and they should be used for future proposed multi-family developments unless it can be demonstrated otherwise.

Thanks for your assistance and cooperation in this matter, if there are any questions or comments, please let me know.

TRAFFIC IMPACT STUDY REVIEWER & PREPARER GROUP

Name	Organization	Phone Number
Daniel Armstrong	Wilbur Smith	584-8584
Rusty Baksa	Land Dev. Solutions	671-2281
Kim Henry Begg	SITE, inc.	693-5010
Mark Best	TDOT	594-9170
Alan Childers	Cannon & Cannon	988-4818
Steve Drummer	Barge Waggoner	637-2810
Mark Geldmeier	City of Knoxville	215-6100
John Gould	Wilbur Smith	584-8584
Barbara Hatcher	SITE, inc.	693-5010
John Heid	AR/TEC	681-8848
Bill Kervin	Allen Hoshall	694-1834
Hollis Loveday	Wilbur Smith	584-8584
David McGinley	City of Knoxville	215-2148
David Moore	TDOT	594-9170
Linda Mosch	Consultant	777-2025
Amanda Rule	TDOT	594-9170
Cindy Pionke	Knox County	215-5800
Pam Porter	TDOT	594-9170
John Sexton	Allen Hoshall	694-1834
Jim Snowden	Knox County	215-5800
Darcy Sullivan	SITE, inc.	693-5010
Jeff Welch	MPC	215-2500

KNOX COUNTY
LOCAL APARTMENT TRIP GENERATION STUDY

PURPOSE

A Traffic Impact Study (TIS) is currently required in Knox County when a proposed development is projected to generate in excess of 750 trips per day. The determinations of when the threshold is met as well as all subsequent analyses in the TIS are performed using the rates and equations given in the Institute of Transportation Engineers (ITE) Trip Generation Manual. Local governmental agencies rely heavily on the accuracy of these trip generation rates in order to correctly predict the impacts of a proposed development on the transportation system. Therefore, in certain instances, it is logical to verify whether the “national” rates and equations given in the ITE Trip Generation Manual are appropriate for use in a specific local area or region.

The decision was made to study the local trip-making characteristics of apartments because of the discrepancy between the trip generation rates for apartments and single family residential land uses as given in the ITE Trip Generation Manual. While these two land uses are similar in nature, the Trip Generation Manual predicts about three less trips per dwelling unit generated by apartments for the average weekday. Additionally the Trip Generation Manual points out that due to the age of their database, which dates back to the 1960’s, “the rates for apartments probably had changed over time”. It is also assumed that some of the ITE data had come from larger metropolitan areas with denser development and greater transit use than Knox County, which would contribute to lower trip generation rates. Therefore, this study will be used to either verify the rates given in the Trip Generation Manual or generate new ones that can be applied to locally proposed apartment developments.

PROCEDURE

The procedures recommended by ITE in conducting local trip generation studies were generally followed for this study, along with some important assumptions that have made. ITE has published a proposed recommended practice entitled “Trip Generation Handbook” which specifically outlines procedures for conducting local trip generation studies and establishing new rates and equations.

The first step in the study was to define the number and location of the sites to be studied, as well as the counting methodology. Initially 14 sites were selected, although one apartment complex – the College Park Apartments – was later omitted due to uncharacteristically high traffic generation numbers. The number of sites used in this study far exceeds the recommended minimum amount suggested by ITE, which is five sites. Traffic counts were taken for week-long periods at 15-minute intervals between July 22, 1996 and August 9, 1996 at the access points to the apartment complexes. A Technical Appendix to this report contains the traffic count data collected at each apartment complex.

RESULTS

The traffic count data was analyzed using spreadsheets in order to determine the weighted average rates and regression equations. In order to be considered valid, the local rates and equations for each time period of analysis that were generated must meet certain statistical criteria. First, the standard deviation of the independent variable (dwelling units) should be no more than 110 percent of the weighted average rate; and secondly, the regression equations require a computed coefficient of determination (R^2) value of at least 0.75 before good data fit is indicated. This statistical criteria is met by the local data results, and in fact it often exceeds the level of data fit given by their counterparts in the ITE Trip Generation Manual. Finally, in order to simplify the use of the local data, plots were generated that appear identical to the actual ones in the ITE Trip Generation Manual.

The resulting rates and equations calculated from the local data indicate that the average weekday trip generation of apartments in this area is well above the national rates reported in the ITE manual. For example, the locally computed average rate for number of trips generated during a weekday is 35% higher than the rate given by ITE (increase from 6.63 trips per dwelling unit to 9.03 trips per dwelling unit). The trip generation rates do not increase as much for the AM and PM peak hours however. The local rate is roughly 8% higher for the AM peak, and 16% higher for the PM peak. The plots from the ITE Trip Generation Manual are included in the Technical Appendix for comparison purposes.

ASSUMPTIONS MADE

Some important assumptions have been made which may affect the results of the local data that was collected:

- It is important to note that the local trip generation rates were computed for the *total* number of dwelling units in the apartment complex, and not necessarily for the number of *occupied* dwelling units. There are several reasons why this was done, chiefly because of the need for comparability with the rates given in ITE Trip Generation Manual, as it does not specify whether the dwelling units are occupied. According to ITE procedures the selected sites must only be of “reasonably full occupancy (i.e. at least 85%)”. The Apartment Association of Greater Knoxville (AAGK) publishes quarterly reports on occupancy levels of apartment complexes, and the report covering the period of the data collection was reviewed to determine occupancy levels. According to the AAGK report from July 1, 1996 – September 30, 1996 all of the apartment complexes surveyed in this study met the minimum 85% occupancy level, with an average occupancy rate for all sites studied of 94%.
- The count data that was collected at each apartment complex was used “raw” meaning that it was not factored for possible daily or seasonal variations. Once again, according to an ITE representative it is not known whether the data used in the Trip Generation Manual was factored or not, so therefore in order to be able to compare

local rates to those in the manual you must assume that count data should not be factored. Additionally, it was felt that apartment complexes would generally not be as susceptible to major seasonal fluctuations as other land uses might be. The local rates were also developed using count data that was collected and averaged over an entire week, which should limit some of the daily variations. Finally, reliable local daily and seasonal variation factors do not truly exist.

CONCLUSION

The local apartment study methodology and results were distributed for comment to a group of local transportation professionals who are directly responsible for either preparing or reviewing traffic impact studies. A meeting was held between this group on February 16, 2000 in order to gather comments and discuss the study in greater detail. The following conclusions are based on the discussion and consensus reached at this meeting:

1. The trip generation rates and equations meet statistical requirements and resulted from a study that followed accepted procedures; therefore they should be adopted for future use. Furthermore, the rates and equations are recommended for use in reviewing the traffic impact of any development termed as “multi-family”, such as townhouse and condominium developments due to their similarity to apartment complexes.
2. The Traffic Access and Impact Study Guidelines and Procedures adopted by MPC should be amended with the language that local data should be used when available, which will allow the implementation of these new multi-family trip generation rates.
3. The following suggestions were made for future consideration:
 - This study should be updated with data collected from local townhouse and condominium developments in order to further justify the use of the new trip generation rates.
 - A statistical comparison should be made between any newly developed rates and the ITE single family trip generation rates to determine if there is a significant difference. If there is no difference then perhaps ITE single-family rates could be used for any residential development proposed in Knox County.

Local Apartment Trip Generation Study

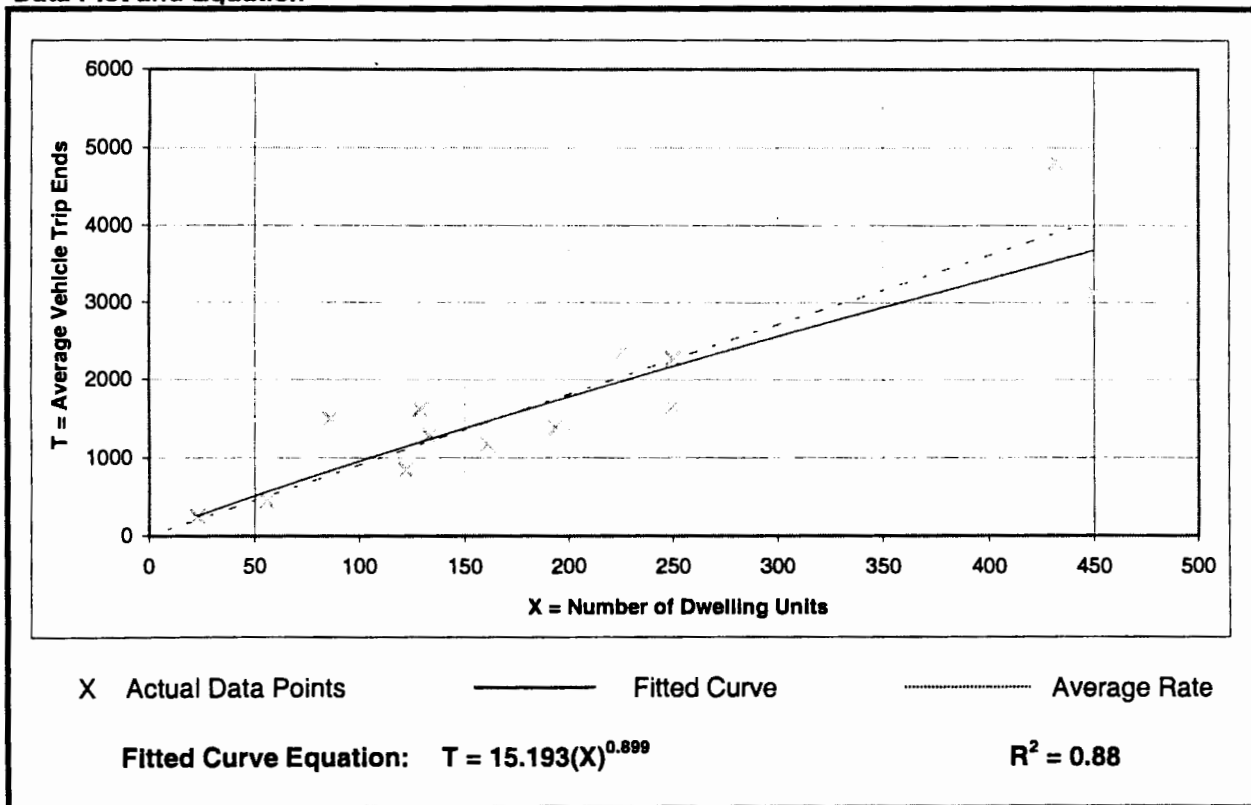
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

Number of Studies: 13
Average Number of Dwelling Units: 193
Directional Distribution: 50% entering, 50% exiting

Trip Generation Per Dwelling Unit

Average Rate	Ranges of Rates	Standard Deviation
9.03	6.59 - 17.41	2.47

Data Plot and Equation



Local Apartment Trip Generation Study

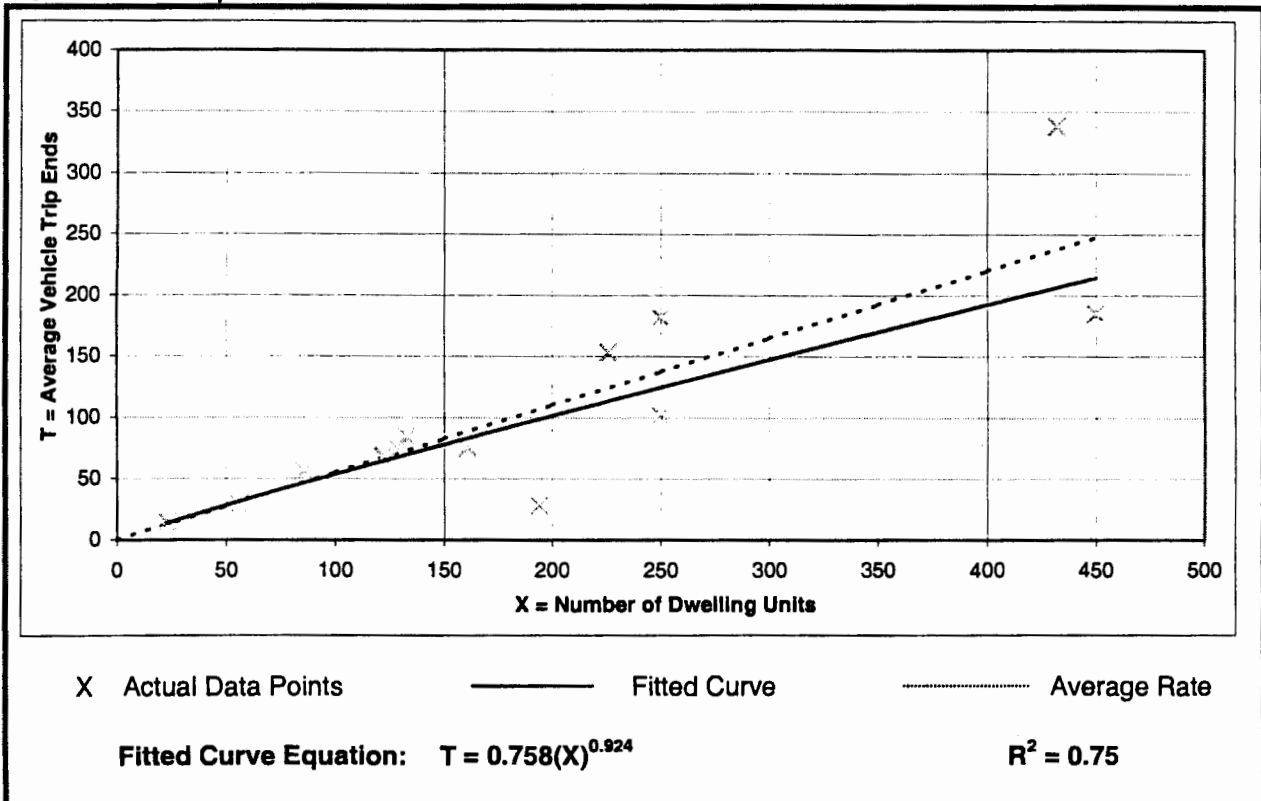
Average Vehicle Trip Ends vs: Dwelling Units
 On a: Weekday,
 Peak Hour of Adjacent Street Traffic,
 One Hour Between 7 and 9 a.m.

Number of Studies: 13
 Average Number of Dwelling Units: 193
 Directional Distribution: 22% entering, 78% exiting

Trip Generation Per Dwelling Unit

Average Rate	Ranges of Rates	Standard Deviation
0.55	0.14 - 0.78	0.18

Data Plot and Equation



Local Apartment Trip Generation Study

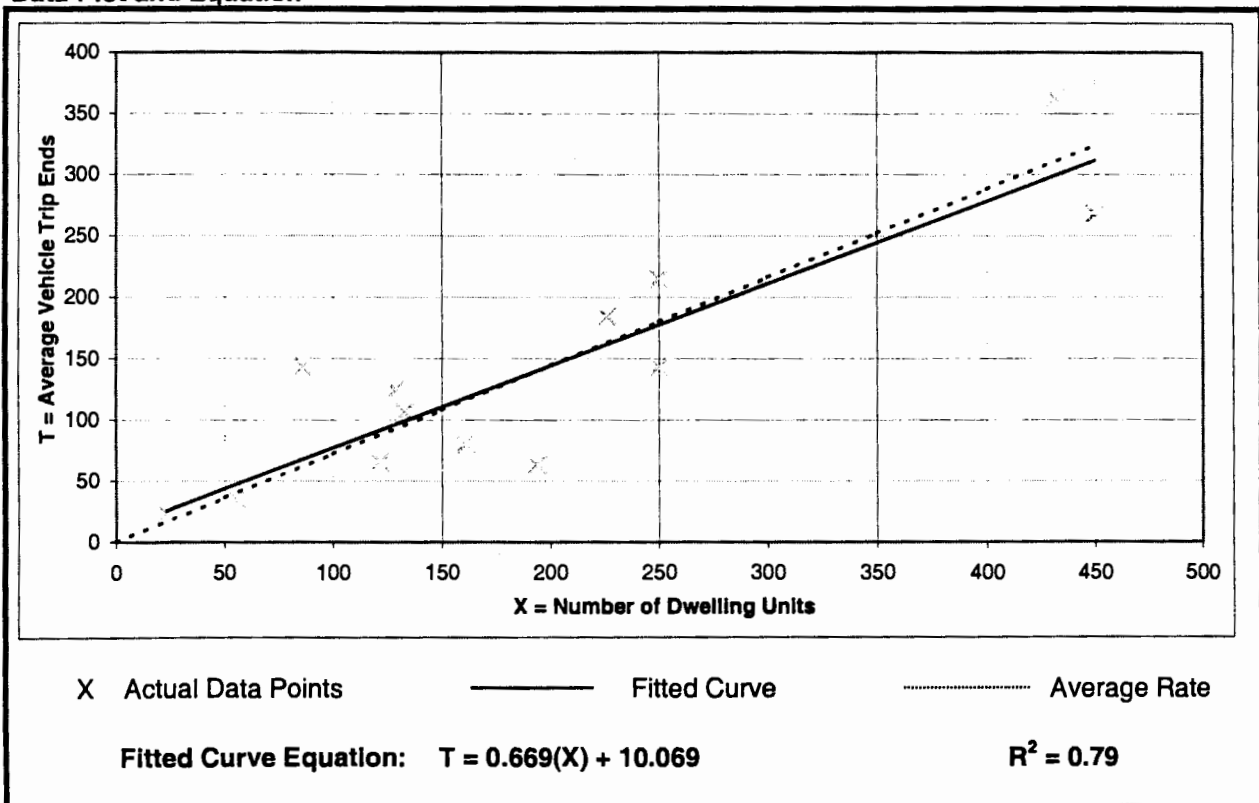
Average Vehicle Trip Ends vs: Dwelling Units
 On a: Weekday,
 Peak Hour of Adjacent Street Traffic,
 One Hour Between 4 and 6 p.m.

Number of Studies: 13
 Average Number of Dwelling Units: 193
 Directional Distribution: 55% entering, 45% exiting

Trip Generation Per Dwelling Unit

Average Rate	Ranges of Rates	Standard Deviation
0.72	0.32 - 1.66	0.25

Data Plot and Equation



Single-Family Detached Housing (210)

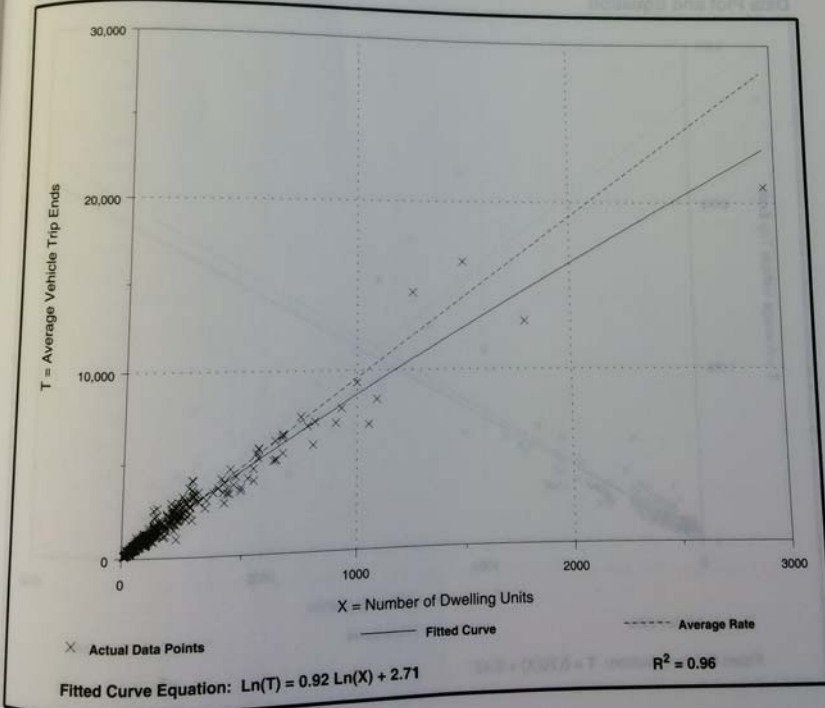
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

Number of Studies: 350
Avg. Number of Dwelling Units: 197
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
9.57	4.31 - 21.85	3.69

Data Plot and Equation



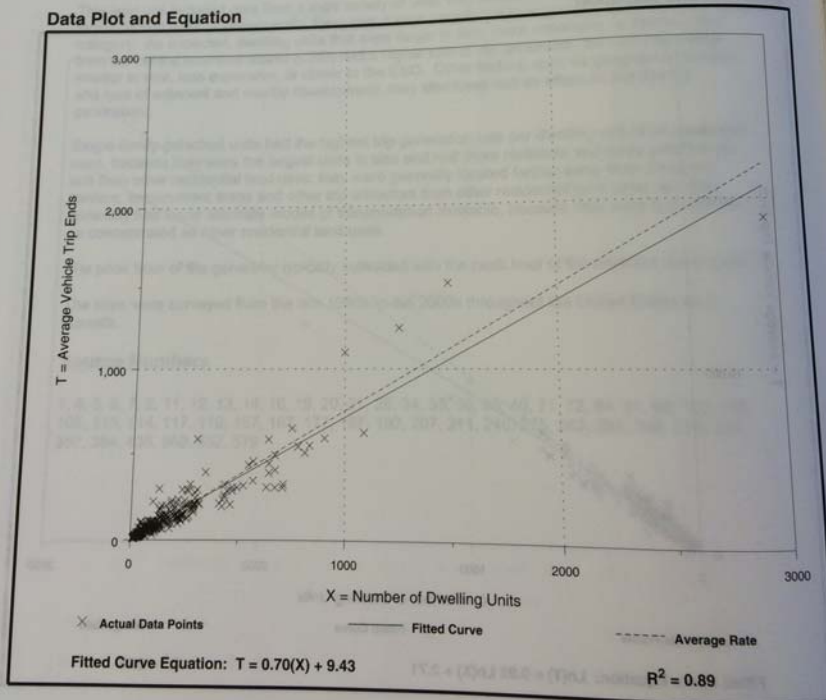
Single-Family Detached Housing (210)

Average Vehicle Trip Ends vs: Dwelling Units
 On a: Weekday,
 Peak Hour of Adjacent Street Traffic,
 One Hour Between 7 and 9 a.m.

Number of Studies: 274
 Avg. Number of Dwelling Units: 201
 Directional Distribution: 25% entering, 75% exiting

Trip Generation per Dwelling Unit			Standard Deviation
Average Rate	Range of Rates		0.90
0.75	0.33 - 2.27		

Data Plot and Equation



Single-Family Detached Housing (210)

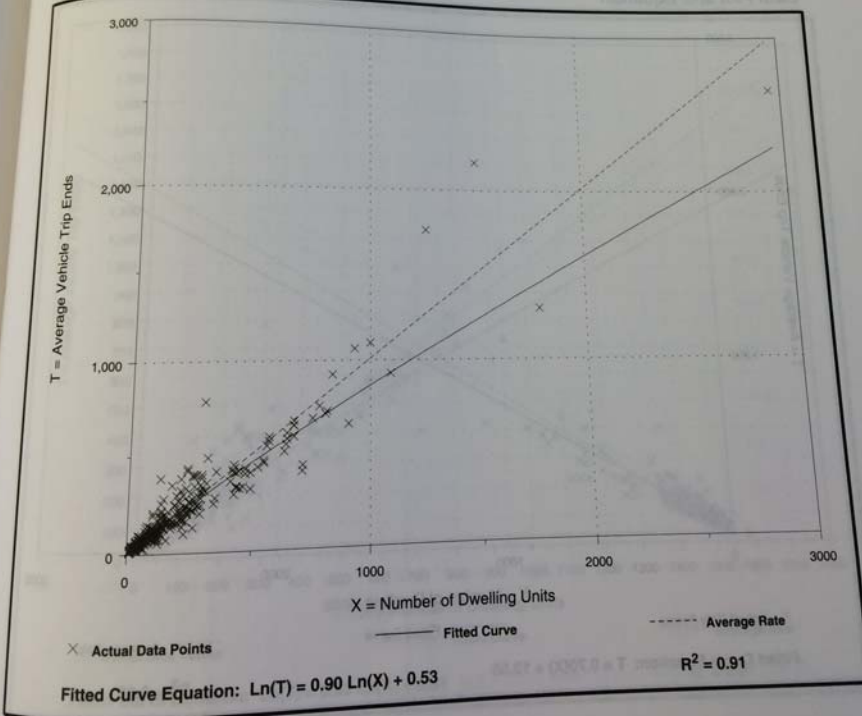
Average Vehicle Trip Ends vs: Dwelling Units
 On a: Weekday,
 Peak Hour of Adjacent Street Traffic,
 One Hour Between 4 and 6 p.m.

Number of Studies: 302
 Avg. Number of Dwelling Units: 214
 Directional Distribution: 63% entering, 37% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
1.01	0.42 - 2.98	1.05

Data Plot and Equation



Attachment 4
Signal Timing



Intersection Name – Hardin Valley Road at Wescott Blvd Prepared by - BJH Date - 6/17/09

BASIC TIMING (Seconds)	Phase 1 EBL	Phase 2 WBT	Phase 3	Phase 4 SB	Phase 5	Phase 6 EBT	Phase 7	Phase 8
Initial	6	20		8		20		
Passage	3.0	5.0		3.0		5.0		
Yellow Change	4.0	4.5		4.0		4.5		
Red Clearance	1.5	1.5		1.5		1.5		
Walk								
Pedestrian Clearance								
Maximum 1	30	60		30		60		
Maximum 2	30	60		30		60		
Recall		Min				Min		

COORDINATION TIMING

Cycle No. / Split No.	Plan ID	Phase Allocations (%)							
		1	2	3	4	5	6	7	8
Cycle 2, Split 1	AM	31	43		26		74		26
Cycle 3, Split 1	PM	30	45		25		75		25

CYCLE LENGTH / OFFSETS

Cycle	1	2	3	4	5	6
Cycle Length (sec.)		90	100			
Offset 1 (%)		94	3			
Offset 2 (%)						
Offset 3 (%)						
Offset 4 (%)						



Intersection: Hardin Valley Road at Wescott Boulevard

WEEKLY PROGRAM PLAN							
Plan	Sun 1	Mon 2	Tue 3	Wed 4	Thu 5	Fri 6	Sat 7
0	2	1	1	1	1	1	2
1							
2							
3							
4							

DAY PLAN EVENTS					
Day Plan	HH:MM	Cycle	Offset	Split	Plan
1	00:00	-	-	-	FREE
1	06:45	2	1	1	AM
1	09:00	-	-	-	FREE
1	15:00	3	1	1	PM
1	19:00	-	-	-	FREE
2	00:00	-	-	-	FREE



Intersection Name - Hardin Valley Road at Ball Camp Byington Prepared by - BH Date - 6/17/09

BASIC TIMING (seconds)	Phase 1 EBL	Phase 2 E/W	Phase 3	Phase 4 SB	Phase 5	Phase 6	Phase 7	Phase 8
Initial	6	26		8				
Passage	3.5	3.0		3.0				
Yellow Change	4.0	4.5		4.5				
Red Clearance	1.5	1.5		2.0				
Walk		7		7				
Pedestrian Clearance		19		23				
Maximum 1	25	35		35				
Maximum 2								
Recall		Max						

COORDINATION TIMING

Cycle No. / Split No.	Plan ID	Phase Allocations (%)							
		1	2	3	4	5	6	7	8
Cycle 1, Split 1	MD	19	55		26				
Cycle 2, Split 1	AM	18	44		38				
Cycle 3, Split 1	PM	20	51		29				

CYCLE LENGTH/OFFSETS

Cycle	1	2	3	4	5	6
Cycle Length (sec.)	80	90	100			
Offset 1 (%)	55	47	33			
Offset 2 (%)						
Offset 3 (%)						
Offset 4 (%)						



Intersection: Hardin Valley Road at Ball Camp Byington Road

WEEKLY PROGRAM PLAN							
Plan	Sun 1	Mon 2	Tue 3	Wed 4	Thu 5	Fri 6	Sat 7
0	2	1	1	1	1	1	2
1							
2							
3							
4							

DAY PLAN EVENTS					
Day Plan	HH:MM	Cycle	Offset	Split	Plan
1	00:00	-	-	-	FREE
1	06:45	2	1	1	AM
1	09:00	1	1	1	MD
1	15:00	3	1	1	PM
1	19:00	1	1	1	MD
1	22:00	-	-	-	FREE
2	00:00	-	-	-	FREE
2	10:00	1	1	1	MD
2	22:00	-	-	-	FREE

Attachment 5
Intersection Worksheet
Existing AM/PM Peaks

SHORT REPORT												
General Information						Site Information						
Analyst <i>Addie Kirkham</i> Agency or Co. <i>FMA</i> Date Performed <i>5/22/2015</i> Time Period <i>Existing AM Peak</i>						Intersection <i>Hardin @ Westcott</i> Area Type <i>All other areas</i> Jurisdiction <i>Knox County</i> Analysis Year <i>2015</i>						
Volume and Timing Input												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1	2			2	1				1		1
Lane Group	L	T			T	R				L		R
Volume (vph)	463	454			843	72				75		335
% Heavy Vehicles	2	2			2	2				2		2
PHF	0.73	0.83			0.95	0.72				0.71		0.83
Pretimed/Actuated (P/A)	A	A			A	A				A		A
Startup Lost Time	2.0	2.0			2.0	2.0				2.0		2.0
Extension of Effective Green	2.0	2.0			2.0	2.0				2.0		2.0
Arrival Type	3	3			3	3				3		3
Unit Extension	3.0	3.0			3.0	3.0				3.0		3.0
Ped/Bike/RTOR Volume	0	0		0	0	24	0	0		0	0	167
Lane Width	12.0	12.0			12.0	12.0				12.0		12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0	0			0	0				0		0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	
Phasing	EB Only	EW Perm	03	04	SB Only	06	07	08				
Timing	G = 22.3	G = 20.9	G = 0.0	G = 0.0	G = 9.8	G = 0.0	G = 0.0	G = 0.0				
	Y = 5.5	Y = 6	Y = 0	Y = 0	Y = 5.5	Y = 0	Y = 0	Y = 0				
Duration of Analysis (hrs) = 0.25						Cycle Length C = 70.0						
Lane Group Capacity, Control Delay, and LOS Determination												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Adjusted Flow Rate	634	547			887	67				106		202
Lane Group Capacity	670	2468			1059	473				248		222
v/c Ratio	0.95	0.22			0.84	0.14				0.43		0.91
Green Ratio	0.70	0.70			0.30	0.30				0.14		0.14
Uniform Delay d ₁	17.1	3.8			23.0	18.0				27.5		29.7
Delay Factor k	0.46	0.11			0.37	0.11				0.11		0.43
Incremental Delay d ₂	16.7	0.0			4.0	0.1				1.2		36.9
PF Factor	1.000	1.000			1.000	1.000				1.000		1.000
Control Delay	33.8	3.9			27.0	18.1				28.7		66.5
Lane Group LOS	C	A			C	B				C		E
Approach Delay	19.9			26.4						53.5		
Approach LOS	B			C						D		
Intersection Delay	26.7			Intersection LOS						C		

BACK-OF-QUEUE WORKSHEET												
General Information												
Project Description <i>Hardin Valley Subdivision</i>												
Average Back of Queue												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	<i>L</i>	<i>T</i>			<i>T</i>	<i>R</i>				<i>L</i>		<i>R</i>
Initial Queue/Lane	0.0	0.0			0.0	0.0				0.0		0.0
Flow Rate/Lane Group	634	547			887	67				106		202
Satflow/Lane	954	1862			1862	1583				1770		1583
Capacity/Lane Group	670	2468			1059	473				248		222
Flow Ratio	0.7	0.2			0.2	0.0				0.1		0.1
v/c Ratio	0.95	0.22			0.84	0.14				0.43		0.91
I Factor	0.650	0.650			0.650	0.650				1.000		1.000
Arrival Type	3	3			3	3				3		3
Platoon Ratio	1.00	1.00			1.00	1.00				1.00		1.00
PF Factor	1.00	1.00			1.00	1.00				1.00		1.00
Q1	5.2	2.0			8.5	1.0				1.9		3.9
k _B	0.3	0.5			0.3	0.2				0.3		0.2
Q2	3.1	0.1			1.2	0.0				0.2		1.5
Q Average	8.4	2.1			9.7	1.0				2.1		5.4
Percentile Back of Queue (95th percentile)												
f _B %	1.9	2.0			1.9	2.1				2.0		1.9
Back of Queue	15.7	4.3			17.9	2.1				4.2		10.5
Queue Storage Ratio												
Queue Spacing	25.0	25.0			25.0	25.0				25.0		25.0
Queue Storage	170	0			0	210				312		312
Average Queue Storage Ratio	1.2					0.1				0.2		0.4
95% Queue Storage Ratio	2.3					0.2				0.3		0.8

SHORT REPORT												
General Information						Site Information						
Analyst <i>Addie Kirkham</i> Agency or Co. <i>FMA</i> Date Performed <i>5/22/2015</i> Time Period <i>Existing AM Peak</i>						Intersection <i>Hardin @ Ball Camp</i> <i>Byington</i> Area Type <i>All other areas</i> Jurisdiction <i>Knox County</i> Analysis Year <i>2015</i>						
Volume and Timing Input												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1	2			2	0				1		1
Lane Group	L	T			TR					L		R
Volume (vph)	155	419			716	161				430		149
% Heavy Vehicles	2	2			2	2				2		2
PHF	0.68	0.84			0.84	0.83				0.93		0.83
Pretimed/Actuated (P/A)	A	A			A	A				A		A
Startup Lost Time	2.0	2.0			2.0					2.0		2.0
Extension of Effective Green	2.0	2.0			2.0					2.0		2.0
Arrival Type	3	3			3					3		3
Unit Extension	3.0	3.0			3.0					3.0		3.0
Ped/Bike/RTOR Volume	0	0		0	0	28	0	0		0	0	37
Lane Width	12.0	12.0			12.0					12.0		12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	4	N
Parking/Hour												
Bus Stops/Hour	0	0			0					0		0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	
Phasing	EB Only	EW Perm	03	04	SB Only	06	07	08				
Timing	G = 9.5	G = 48.4	G = 0.0	G = 0.0	G = 34.1	G = 0.0	G = 0.0	G = 0.0				
	Y = 5.5	Y = 6	Y = 0	Y = 0	Y = 6.5	Y = 0	Y = 0	Y = 0				
Duration of Analysis (hrs) = 0.25						Cycle Length C = 110.0						
Lane Group Capacity, Control Delay, and LOS Determination												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Adjusted Flow Rate	228	499			1012					462		135
Lane Group Capacity	290	2044			1524					538		481
v/c Ratio	0.79	0.24			0.66					0.86		0.28
Green Ratio	0.58	0.58			0.44					0.31		0.31
Uniform Delay d ₁	16.4	11.5			24.4					35.7		28.7
Delay Factor k	0.33	0.11			0.24					0.39		0.11
Incremental Delay d ₂	11.5	0.1			0.9					13.1		0.3
PF Factor	1.000	1.000			1.000					1.000		1.000
Control Delay	28.0	11.5			25.3					48.8		29.0
Lane Group LOS	C	B			C					D		C
Approach Delay	16.7			25.3						44.3		
Approach LOS	B			C						D		
Intersection Delay	27.5			Intersection LOS						C		

BACK-OF-QUEUE WORKSHEET												
General Information												
Project Description <i>Hardin Valley Subdivision</i>												
Average Back of Queue												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	<i>L</i>	<i>T</i>			<i>TR</i>					<i>L</i>		<i>R</i>
Initial Queue/Lane	<i>0.0</i>	<i>0.0</i>			<i>0.0</i>					<i>0.0</i>		<i>0.0</i>
Flow Rate/Lane Group	<i>228</i>	<i>499</i>			<i>1012</i>					<i>462</i>		<i>135</i>
Satflow/Lane	<i>500</i>	<i>1862</i>			<i>1818</i>					<i>1734</i>		<i>1552</i>
Capacity/Lane Group	<i>290</i>	<i>2044</i>			<i>1524</i>					<i>538</i>		<i>481</i>
Flow Ratio	<i>0.5</i>	<i>0.1</i>			<i>0.3</i>					<i>0.3</i>		<i>0.1</i>
v/c Ratio	<i>0.79</i>	<i>0.24</i>			<i>0.66</i>					<i>0.86</i>		<i>0.28</i>
I Factor	<i>0.850</i>	<i>0.850</i>			<i>0.850</i>					<i>1.000</i>		<i>1.000</i>
Arrival Type	<i>3</i>	<i>3</i>			<i>3</i>					<i>3</i>		<i>3</i>
Platoon Ratio	<i>1.00</i>	<i>1.00</i>			<i>1.00</i>					<i>1.00</i>		<i>1.00</i>
PF Factor	<i>1.00</i>	<i>1.00</i>			<i>1.00</i>					<i>1.00</i>		<i>1.00</i>
Q1	<i>3.1</i>	<i>3.9</i>			<i>12.8</i>					<i>13.3</i>		<i>3.1</i>
k _B	<i>0.3</i>	<i>0.7</i>			<i>0.6</i>					<i>0.5</i>		<i>0.5</i>
Q2	<i>1.0</i>	<i>0.2</i>			<i>1.1</i>					<i>2.6</i>		<i>0.2</i>
Q Average	<i>4.2</i>	<i>4.2</i>			<i>13.9</i>					<i>15.8</i>		<i>3.3</i>
Percentile Back of Queue (95th percentile)												
f _B %	<i>2.0</i>	<i>2.0</i>			<i>1.8</i>					<i>1.7</i>		<i>2.0</i>
Back of Queue	<i>8.2</i>	<i>8.2</i>			<i>24.8</i>					<i>27.7</i>		<i>6.6</i>
Queue Storage Ratio												
Queue Spacing	<i>25.0</i>	<i>25.0</i>			<i>25.0</i>					<i>25.0</i>		<i>25.0</i>
Queue Storage	<i>187</i>	<i>0</i>			<i>0</i>					<i>344</i>		<i>354</i>
Average Queue Storage Ratio	<i>0.6</i>									<i>1.2</i>		<i>0.2</i>
95% Queue Storage Ratio	<i>1.1</i>									<i>2.0</i>		<i>0.5</i>

SHORT REPORT												
General Information						Site Information						
Analyst <i>Addie Kirkham</i> Agency or Co. <i>FMA</i> Date Performed <i>5/22/2015</i> Time Period <i>Existing PM Peak</i>						Intersection <i>Hardin @ Westcott</i> Area Type <i>All other areas</i> Jurisdiction <i>Knox County</i> Analysis Year <i>2015</i>						
Volume and Timing Input												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1	2			2	1				1		1
Lane Group	L	T			T	R				L		R
Volume (vph)	370	1230			704	28				125		279
% Heavy Vehicles	2	2			2	2				2		2
PHF	0.93	0.86			0.94	0.66				0.74		0.84
Pretimed/Actuated (P/A)	A	A			A	A				A		A
Startup Lost Time	2.0	2.0			2.0	2.0				2.0		2.0
Extension of Effective Green	2.0	2.0			2.0	2.0				2.0		2.0
Arrival Type	3	3			3	3				3		3
Unit Extension	3.0	3.0			3.0	3.0				3.0		3.0
Ped/Bike/RTOR Volume	0	0		0	0	10	0	0		0	0	138
Lane Width	12.0	12.0			12.0	12.0				12.0		12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0	0			0	0				0		0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	
Phasing	EB Only	EW Perm	03	04	SB Only	06	07	08				
Timing	G = 10.3	G = 23.4	G = 0.0	G = 0.0	G = 9.3	G = 0.0	G = 0.0	G = 0.0				
	Y = 5.5	Y = 6	Y = 0	Y = 0	Y = 5.5	Y = 0	Y = 0	Y = 0				
Duration of Analysis (hrs) = 0.25						Cycle Length C = 60.0						
Lane Group Capacity, Control Delay, and LOS Determination												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Adjusted Flow Rate	398	1430			749	27				169		168
Lane Group Capacity	523	2317			1383	617				274		245
v/c Ratio	0.76	0.62			0.54	0.04				0.62		0.69
Green Ratio	0.66	0.65			0.39	0.39				0.16		0.16
Uniform Delay d ₁	6.5	6.0			14.2	11.4				23.7		24.0
Delay Factor k	0.31	0.20			0.14	0.11				0.20		0.25
Incremental Delay d ₂	4.3	0.3			0.3	0.0				4.2		7.7
PF Factor	1.000	1.000			1.000	1.000				1.000		1.000
Control Delay	10.8	6.4			14.4	11.4				27.8		31.7
Lane Group LOS	B	A			B	B				C		C
Approach Delay	7.3			14.3						29.8		
Approach LOS	A			B						C		
Intersection Delay	11.8			Intersection LOS						B		

BACK-OF-QUEUE WORKSHEET												
General Information												
Project Description <i>Hardin Valley Subdivision</i>												
Average Back of Queue												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	<i>L</i>	<i>T</i>			<i>T</i>	<i>R</i>				<i>L</i>		<i>R</i>
Initial Queue/Lane	0.0	0.0			0.0	0.0				0.0		0.0
Flow Rate/Lane Group	398	1430			749	27				169		168
Satflow/Lane	790	1862			1862	1583				1770		1583
Capacity/Lane Group	523	2317			1383	617				274		245
Flow Ratio	0.5	0.4			0.2	0.0				0.1		0.1
v/c Ratio	0.76	0.62			0.54	0.04				0.62		0.69
I Factor	0.650	0.650			0.650	0.650				1.000		1.000
Arrival Type	3	3			3	3				3		3
Platoon Ratio	1.00	1.00			1.00	1.00				1.00		1.00
PF Factor	1.00	1.00			1.00	1.00				1.00		1.00
Q ₁	2.6	7.3			5.1	0.3				2.6		2.6
k _B	0.2	0.4			0.3	0.3				0.2		0.2
Q ₂	0.7	0.6			0.3	0.0				0.4		0.5
Q Average	3.3	7.9			5.4	0.3				3.0		3.1
Percentile Back of Queue (95th percentile)												
f _B %	2.0	1.9			1.9	2.1				2.0		2.0
Back of Queue	6.6	14.9			10.5	0.6				6.1		6.3
Queue Storage Ratio												
Queue Spacing	25.0	25.0			25.0	25.0				25.0		25.0
Queue Storage	170	0			0	210				312		312
Average Queue Storage Ratio	0.5					0.0				0.2		0.3
95% Queue Storage Ratio	1.0					0.1				0.5		0.5

SHORT REPORT												
General Information						Site Information						
Analyst <i>Addie Kirkham</i> Agency or Co. <i>FMA</i> Date Performed <i>5/22/2015</i> Time Period <i>Existing PM Peak</i>						Intersection <i>Hardin @ Ball Camp</i> <i>Byington</i> Area Type <i>All other areas</i> Jurisdiction <i>Knox County</i> Analysis Year <i>2015</i>						
Volume and Timing Input												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1	2			2	0				1		1
Lane Group	L	T			TR					L		R
Volume (vph)	325	1076			569	432				360		123
% Heavy Vehicles	2	2			2	2				2		2
PHF	0.87	0.87			0.93	0.88				0.92		0.81
Pretimed/Actuated (P/A)	A	A			A	A				A		A
Startup Lost Time	2.0	2.0			2.0					2.0		2.0
Extension of Effective Green	2.0	2.0			2.0					2.0		2.0
Arrival Type	3	3			3					3		3
Unit Extension	3.0	3.0			3.0					3.0		3.0
Ped/Bike/RTOR Volume	0	0		0	0	76	0	0		0	0	31
Lane Width	12.0	12.0			12.0					12.0		12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	4	N
Parking/Hour												
Bus Stops/Hour	0	0			0					0		0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	
Phasing	EB Only	EW Perm	03	04	SB Only	06	07	08				
Timing	G = 18.2	G = 31.1	G = 0.0	G = 0.0	G = 22.7	G = 0.0	G = 0.0	G = 0.0				
	Y = 5.5	Y = 6	Y = 0	Y = 0	Y = 6.5	Y = 0	Y = 0	Y = 0				
Duration of Analysis (hrs) = 0.25						Cycle Length C = 90.0						
Lane Group Capacity, Control Delay, and LOS Determination												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Adjusted Flow Rate	374	1237			1017					391		114
Lane Group Capacity	441	2160			1152					437		391
v/c Ratio	0.85	0.57			0.88					0.89		0.29
Green Ratio	0.61	0.61			0.35					0.25		0.25
Uniform Delay d ₁	23.6	10.6			27.7					32.5		27.2
Delay Factor k	0.38	0.17			0.41					0.42		0.11
Incremental Delay d ₂	12.5	0.3			7.2					20.4		0.4
PF Factor	1.000	1.000			1.000					1.000		1.000
Control Delay	36.1	10.9			34.9					52.9		27.6
Lane Group LOS	D	B			C					D		C
Approach Delay	16.7			34.9						47.2		
Approach LOS	B			C						D		
Intersection Delay	27.6			Intersection LOS						C		

BACK-OF-QUEUE WORKSHEET												
General Information												
Project Description <i>Hardin Valley Subdivision</i>												
Average Back of Queue												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	<i>L</i>	<i>T</i>			<i>TR</i>					<i>L</i>		<i>R</i>
Initial Queue/Lane	0.0	0.0			0.0					0.0		0.0
Flow Rate/Lane Group	374	1237			1017					391		114
Satflow/Lane	717	1862			1751					1734		1552
Capacity/Lane Group	441	2160			1152					437		391
Flow Ratio	0.5	0.3			0.3					0.2		0.1
v/c Ratio	0.85	0.57			0.88					0.89		0.29
I Factor	0.850	0.850			0.850					1.000		1.000
Arrival Type	3	3			3					3		3
Platoon Ratio	1.00	1.00			1.00					1.00		1.00
PF Factor	1.00	1.00			1.00					1.00		1.00
Q ₁	4.4	9.7			12.6					9.4		2.3
k _B	0.4	0.6			0.4					0.4		0.4
Q ₂	1.7	0.8			2.5					2.5		0.2
Q Average	6.0	10.6			15.1					11.9		2.5
Percentile Back of Queue (95th percentile)												
f _B %	1.9	1.8			1.8					1.8		2.0
Back of Queue	11.6	19.4			26.6					21.6		5.0
Queue Storage Ratio												
Queue Spacing	25.0	25.0			25.0					25.0		25.0
Queue Storage	187	0			0					344		354
Average Queue Storage Ratio	0.8									0.9		0.2
95% Queue Storage Ratio	1.6									1.6		0.4

Attachment 6
Intersection Worksheet
Background AM/PM Peaks

SHORT REPORT												
General Information						Site Information						
Analyst <i>Addie Kirkham</i> Agency or Co. <i>FMA</i> Date Performed <i>5/22/2015</i> Time Period <i>Background AM Peak</i>						Intersection <i>Hardin @ Westcott</i> Area Type <i>All other areas</i> Jurisdiction <i>Knox County</i> Analysis Year <i>2018</i>						
Volume and Timing Input												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1	2			2	1				1		1
Lane Group	L	T			T	R				L		R
Volume (vph)	521	511			948	81				84		379
% Heavy Vehicles	2	2			2	2				2		2
PHF	0.73	0.83			0.95	0.72				0.71		0.83
Pretimed/Actuated (P/A)	A	A			A	A				A		A
Startup Lost Time	2.0	2.0			2.0	2.0				2.0		2.0
Extension of Effective Green	2.0	2.0			2.0	2.0				2.0		2.0
Arrival Type	3	3			3	3				3		3
Unit Extension	3.0	3.0			3.0	3.0				3.0		3.0
Ped/Bike/RTOR Volume	0	0		0	0	27	0	0		0	0	186
Lane Width	12.0	12.0			12.0	12.0				12.0		12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0	0			0	0				0		0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	
Phasing	EB Only	EW Perm	03	04	SB Only	06	07	08				
Timing	G = 22.3	G = 20.9	G = 0.0	G = 0.0	G = 9.8	G = 0.0	G = 0.0	G = 0.0				
	Y = 5.5	Y = 6	Y = 0	Y = 0	Y = 5.5	Y = 0	Y = 0	Y = 0				
Duration of Analysis (hrs) = 0.25						Cycle Length C = 70.0						
Lane Group Capacity, Control Delay, and LOS Determination												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Adjusted Flow Rate	714	616			998	75				118		233
Lane Group Capacity	670	2468			1059	473				248		222
v/c Ratio	1.07	0.25			0.94	0.16				0.48		1.05
Green Ratio	0.70	0.70			0.30	0.30				0.14		0.14
Uniform Delay d ₁	18.2	3.9			24.0	18.1				27.7		30.1
Delay Factor k	0.50	0.11			0.46	0.11				0.11		0.50
Incremental Delay d ₂	47.3	0.0			11.4	0.1				1.4		74.0
PF Factor	1.000	1.000			1.000	1.000				1.000		1.000
Control Delay	65.5	4.0			35.4	18.2				29.2		104.1
Lane Group LOS	E	A			D	B				C		F
Approach Delay	37.0			34.2						78.9		
Approach LOS	D			C						E		
Intersection Delay	41.2			Intersection LOS						D		

BACK-OF-QUEUE WORKSHEET												
General Information												
Project Description <i>Hardin Valley Subdivision</i>												
Average Back of Queue												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	<i>L</i>	<i>T</i>			<i>T</i>	<i>R</i>				<i>L</i>		<i>R</i>
Initial Queue/Lane	0.0	0.0			0.0	0.0				0.0		0.0
Flow Rate/Lane Group	714	616			998	75				118		233
Satflow/Lane	954	1862			1862	1583				1770		1583
Capacity/Lane Group	670	2468			1059	473				248		222
Flow Ratio	0.7	0.2			0.3	0.0				0.1		0.1
v/c Ratio	1.07	0.25			0.94	0.16				0.48		1.05
I Factor	0.650	0.650			0.650	0.650				1.000		1.000
Arrival Type	3	3			3	3				3		3
Platoon Ratio	1.00	1.00			1.00	1.00				1.00		1.00
PF Factor	1.00	1.00			1.00	1.00				1.00		1.00
Q1	6.1	2.3			9.9	1.1				2.1		4.5
k _B	0.3	0.5			0.3	0.2				0.3		0.2
Q2	8.6	0.1			2.7	0.0				0.2		3.4
Q Average	14.7	2.5			12.6	1.1				2.3		8.0
Percentile Back of Queue (95th percentile)												
f _B %	1.8	2.0			1.8	2.1				2.0		1.9
Back of Queue	25.9	5.0			22.7	2.3				4.8		15.0
Queue Storage Ratio												
Queue Spacing	25.0	25.0			25.0	25.0				25.0		25.0
Queue Storage	170	0			0	210				312		312
Average Queue Storage Ratio	2.2					0.1				0.2		0.6
95% Queue Storage Ratio	3.8					0.3				0.4		1.2

SHORT REPORT												
General Information						Site Information						
Analyst <i>Addie Kirkham</i> Agency or Co. <i>FMA</i> Date Performed <i>5/22/2015</i> Time Period <i>Background AM Peak</i>						Intersection <i>Hardin @ Ball Camp</i> <i>Byington</i> Area Type <i>All other areas</i> Jurisdiction <i>Knox County</i> Analysis Year <i>2018</i>						
Volume and Timing Input												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1	2			2	0				1		1
Lane Group	L	T			TR					L		R
Volume (vph)	174	471			805	181				484		167
% Heavy Vehicles	2	2			2	2				2		2
PHF	0.68	0.84			0.84	0.83				0.93		0.83
Pretimed/Actuated (P/A)	A	A			A	A				A		A
Startup Lost Time	2.0	2.0			2.0					2.0		2.0
Extension of Effective Green	2.0	2.0			2.0					2.0		2.0
Arrival Type	3	3			3					3		3
Unit Extension	3.0	3.0			3.0					3.0		3.0
Ped/Bike/RTOR Volume	0	0		0	0	32	0	0		0	0	42
Lane Width	12.0	12.0			12.0					12.0		12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	4	N
Parking/Hour												
Bus Stops/Hour	0	0			0					0		0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	
Phasing	EB Only	EW Perm	03	04	SB Only	06	07	08				
Timing	G = 15.8	G = 37.6	G = 0.0	G = 0.0	G = 38.6	G = 0.0	G = 0.0	G = 0.0				
	Y = 5.5	Y = 6	Y = 0	Y = 0	Y = 6.5	Y = 0	Y = 0	Y = 0				
Duration of Analysis (hrs) = 0.25						Cycle Length C = 110.0						
Lane Group Capacity, Control Delay, and LOS Determination												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Adjusted Flow Rate	256	561			1138					520		151
Lane Group Capacity	322	1899			1184					608		545
v/c Ratio	0.80	0.30			0.96					0.86		0.28
Green Ratio	0.54	0.54			0.34					0.35		0.35
Uniform Delay d ₁	29.2	14.1			35.5					33.1		25.7
Delay Factor k	0.34	0.11			0.47					0.39		0.11
Incremental Delay d ₂	11.2	0.1			15.8					11.5		0.3
PF Factor	1.000	1.000			1.000					1.000		1.000
Control Delay	40.4	14.2			51.3					44.6		25.9
Lane Group LOS	D	B			D					D		C
Approach Delay	22.4			51.3						40.4		
Approach LOS	C			D						D		
Intersection Delay	39.5			Intersection LOS						D		

BACK-OF-QUEUE WORKSHEET												
General Information												
Project Description <i>Hardin Valley Subdivision</i>												
Average Back of Queue												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	<i>L</i>	<i>T</i>			<i>TR</i>					<i>L</i>		<i>R</i>
Initial Queue/Lane	<i>0.0</i>	<i>0.0</i>			<i>0.0</i>					<i>0.0</i>		<i>0.0</i>
Flow Rate/Lane Group	<i>256</i>	<i>561</i>			<i>1138</i>					<i>520</i>		<i>151</i>
Satflow/Lane	<i>596</i>	<i>1862</i>			<i>1818</i>					<i>1734</i>		<i>1552</i>
Capacity/Lane Group	<i>322</i>	<i>1899</i>			<i>1184</i>					<i>608</i>		<i>545</i>
Flow Ratio	<i>0.4</i>	<i>0.2</i>			<i>0.3</i>					<i>0.3</i>		<i>0.1</i>
v/c Ratio	<i>0.80</i>	<i>0.30</i>			<i>0.96</i>					<i>0.86</i>		<i>0.28</i>
I Factor	<i>0.850</i>	<i>0.850</i>			<i>0.850</i>					<i>1.000</i>		<i>1.000</i>
Arrival Type	<i>3</i>	<i>3</i>			<i>3</i>					<i>3</i>		<i>3</i>
Platoon Ratio	<i>1.00</i>	<i>1.00</i>			<i>1.00</i>					<i>1.00</i>		<i>1.00</i>
PF Factor	<i>1.00</i>	<i>1.00</i>			<i>1.00</i>					<i>1.00</i>		<i>1.00</i>
Q ₁	<i>4.1</i>	<i>5.0</i>			<i>17.9</i>					<i>14.7</i>		<i>3.3</i>
k _B	<i>0.3</i>	<i>0.7</i>			<i>0.5</i>					<i>0.6</i>		<i>0.5</i>
Q ₂	<i>1.1</i>	<i>0.3</i>			<i>4.8</i>					<i>2.7</i>		<i>0.2</i>
Q Average	<i>5.2</i>	<i>5.2</i>			<i>22.7</i>					<i>17.5</i>		<i>3.5</i>
Percentile Back of Queue (95th percentile)												
f _B %	<i>1.9</i>	<i>1.9</i>			<i>1.7</i>					<i>1.7</i>		<i>2.0</i>
Back of Queue	<i>10.1</i>	<i>10.2</i>			<i>37.8</i>					<i>30.2</i>		<i>7.0</i>
Queue Storage Ratio												
Queue Spacing	<i>25.0</i>	<i>25.0</i>			<i>25.0</i>					<i>25.0</i>		<i>25.0</i>
Queue Storage	<i>187</i>	<i>0</i>			<i>0</i>					<i>344</i>		<i>354</i>
Average Queue Storage Ratio	<i>0.7</i>									<i>1.3</i>		<i>0.2</i>
95% Queue Storage Ratio	<i>1.4</i>									<i>2.2</i>		<i>0.5</i>

SHORT REPORT												
General Information						Site Information						
Analyst <i>Addie Kirkham</i> Agency or Co. <i>FMA</i> Date Performed <i>5/22/2015</i> Time Period <i>Background PM Peak</i>						Intersection <i>Hardin @ Westcott</i> Area Type <i>All other areas</i> Jurisdiction <i>Knox County</i> Analysis Year <i>2018</i>						
Volume and Timing Input												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1	2			2	1				1		1
Lane Group	L	T			T	R				L		R
Volume (vph)	416	1384			792	32				141		313
% Heavy Vehicles	2	2			2	2				2		2
PHF	0.93	0.86			0.94	0.66				0.74		0.84
Pretimed/Actuated (P/A)	A	A			A	A				A		A
Startup Lost Time	2.0	2.0			2.0	2.0				2.0		2.0
Extension of Effective Green	2.0	2.0			2.0	2.0				2.0		2.0
Arrival Type	3	3			3	3				3		3
Unit Extension	3.0	3.0			3.0	3.0				3.0		3.0
Ped/Bike/RTOR Volume	0	0		0	0	11	0	0		0	0	156
Lane Width	12.0	12.0			12.0	12.0				12.0		12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0	0			0	0				0		0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	
Phasing	EB Only	EW Perm	03	04	SB Only	06	07	08				
Timing	G = 11.5	G = 22.8	G = 0.0	G = 0.0	G = 8.7	G = 0.0	G = 0.0	G = 0.0				
	Y = 5.5	Y = 6	Y = 0	Y = 0	Y = 5.5	Y = 0	Y = 0	Y = 0				
Duration of Analysis (hrs) = 0.25						Cycle Length C = 60.0						
Lane Group Capacity, Control Delay, and LOS Determination												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Adjusted Flow Rate	447	1609			843	32				191		187
Lane Group Capacity	513	2353			1348	602				257		230
v/c Ratio	0.87	0.68			0.63	0.05				0.74		0.81
Green Ratio	0.67	0.66			0.38	0.38				0.15		0.15
Uniform Delay d ₁	10.5	6.2			15.1	11.8				24.6		24.9
Delay Factor k	0.40	0.25			0.21	0.11				0.30		0.35
Incremental Delay d ₂	10.5	0.5			0.6	0.0				11.1		19.6
PF Factor	1.000	1.000			1.000	1.000				1.000		1.000
Control Delay	20.9	6.8			15.7	11.8				35.7		44.4
Lane Group LOS	C	A			B	B				D		D
Approach Delay	9.8			15.6						40.0		
Approach LOS	A			B						D		
Intersection Delay	14.8			Intersection LOS						B		

BACK-OF-QUEUE WORKSHEET												
General Information												
Project Description <i>Hardin Valley Subdivision</i>												
Average Back of Queue												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	<i>L</i>	<i>T</i>			<i>T</i>	<i>R</i>				<i>L</i>		<i>R</i>
Initial Queue/Lane	0.0	0.0			0.0	0.0				0.0		0.0
Flow Rate/Lane Group	447	1609			843	32				191		187
Satflow/Lane	764	1862			1862	1583				1770		1583
Capacity/Lane Group	513	2353			1348	602				257		230
Flow Ratio	0.6	0.5			0.2	0.0				0.1		0.1
v/c Ratio	0.87	0.68			0.63	0.05				0.74		0.81
I Factor	0.650	0.650			0.650	0.650				1.000		1.000
Arrival Type	3	3			3	3				3		3
Platoon Ratio	1.00	1.00			1.00	1.00				1.00		1.00
PF Factor	1.00	1.00			1.00	1.00				1.00		1.00
Q1	2.9	8.7			6.0	0.3				3.1		3.0
k _B	0.2	0.4			0.3	0.3				0.2		0.2
Q2	1.4	0.8			0.5	0.0				0.6		0.8
Q Average	4.3	9.5			6.5	0.4				3.7		3.9
Percentile Back of Queue (95th percentile)												
f _B %	2.0	1.9			1.9	2.1				2.0		2.0
Back of Queue	8.5	17.7			12.4	0.7				7.3		7.7
Queue Storage Ratio												
Queue Spacing	25.0	25.0			25.0	25.0				25.0		25.0
Queue Storage	170	0			0	210				312		312
Average Queue Storage Ratio	0.6					0.0				0.3		0.3
95% Queue Storage Ratio	1.2					0.1				0.6		0.6

SHORT REPORT												
General Information						Site Information						
Analyst <i>Addie Kirkham</i> Agency or Co. <i>FMA</i> Date Performed <i>5/22/2015</i> Time Period <i>Background PM Peak</i>						Intersection <i>Hardin @ Ball Camp</i> <i>Byington</i> Area Type <i>All other areas</i> Jurisdiction <i>Knox County</i> Analysis Year <i>2018</i>						
Volume and Timing Input												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1	2			2	0				1		1
Lane Group	L	T			TR					L		R
Volume (vph)	366	1210			640	482				405		138
% Heavy Vehicles	2	2			2	2				2		2
PHF	0.87	0.87			0.93	0.88				0.92		0.81
Pretimed/Actuated (P/A)	A	A			A	A				A		A
Startup Lost Time	2.0	2.0			2.0					2.0		2.0
Extension of Effective Green	2.0	2.0			2.0					2.0		2.0
Arrival Type	3	3			3					3		3
Unit Extension	3.0	3.0			3.0					3.0		3.0
Ped/Bike/RTOR Volume	0	0		0	0	89	0	0		0	0	35
Lane Width	12.0	12.0			12.0					12.0		12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	4	N
Parking/Hour												
Bus Stops/Hour	0	0			0					0		0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	
Phasing	EB Only	EW Perm	03	04	SB Only	06	07	08				
Timing	G = 17.1	G = 33.3	G = 0.0	G = 0.0	G = 21.6	G = 0.0	G = 0.0	G = 0.0				
	Y = 5.5	Y = 6	Y = 0	Y = 0	Y = 6.5	Y = 0	Y = 0	Y = 0				
Duration of Analysis (hrs) = 0.25						Cycle Length C = 90.0						
Lane Group Capacity, Control Delay, and LOS Determination												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Adjusted Flow Rate	421	1391			1135					440		127
Lane Group Capacity	419	2203			1235					416		372
v/c Ratio	1.00	0.63			0.92					1.06		0.34
Green Ratio	0.63	0.62			0.37					0.24		0.24
Uniform Delay d ₁	27.0	10.6			27.1					34.2		28.3
Delay Factor k	0.50	0.21			0.44					0.50		0.11
Incremental Delay d ₂	41.7	0.5			9.7					60.2		0.6
PF Factor	1.000	1.000			1.000					1.000		1.000
Control Delay	68.7	11.1			36.8					94.4		28.9
Lane Group LOS	E	B			D					F		C
Approach Delay	24.5			36.8						79.7		
Approach LOS	C			D						E		
Intersection Delay	37.4			Intersection LOS						D		

BACK-OF-QUEUE WORKSHEET												
General Information												
Project Description <i>Hardin Valley Subdivision</i>												
Average Back of Queue												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	<i>L</i>	<i>T</i>			<i>TR</i>					<i>L</i>		<i>R</i>
Initial Queue/Lane	0.0	0.0			0.0					0.0		0.0
Flow Rate/Lane Group	421	1391			1135					440		127
Satflow/Lane	669	1862			1752					1734		1552
Capacity/Lane Group	419	2203			1235					416		372
Flow Ratio	0.6	0.4			0.3					0.3		0.1
v/c Ratio	1.00	0.63			0.92					1.06		0.34
I Factor	0.850	0.850			0.850					1.000		1.000
Arrival Type	3	3			3					3		3
Platoon Ratio	1.00	1.00			1.00					1.00		1.00
PF Factor	1.00	1.00			1.00					1.00		1.00
Q ₁	4.9	11.4			14.2					11.0		2.6
k _B	0.3	0.6			0.5					0.4		0.4
Q ₂	4.4	1.1			3.4					6.5		0.2
Q Average	9.2	12.4			17.6					17.5		2.8
Percentile Back of Queue (95th percentile)												
f _B %	1.9	1.8			1.7					1.7		2.0
Back of Queue	17.2	22.4			30.4					30.2		5.7
Queue Storage Ratio												
Queue Spacing	25.0	25.0			25.0					25.0		25.0
Queue Storage	187	0			0					344		354
Average Queue Storage Ratio	1.2									1.3		0.2
95% Queue Storage Ratio	2.3									2.2		0.4

Attachment 7
Intersection Worksheet
Background AM/PM Peaks + Development

SHORT REPORT												
General Information						Site Information						
Analyst <i>Addie Kirkham</i> Agency or Co. <i>FMA</i> Date Performed <i>5/22/2015</i> Time Period <i>Developed AM Peak</i>						Intersection <i>Hardin @ Westcott</i> Area Type <i>All other areas</i> Jurisdiction <i>Knox County</i> Analysis Year <i>2018</i>						
Volume and Timing Input												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1	2			2	1				1		1
Lane Group	L	T			T	R				L		R
Volume (vph)	521	537			1100	90				88		379
% Heavy Vehicles	2	2			2	2				2		2
PHF	0.73	0.83			0.95	0.72				0.71		0.83
Pretimed/Actuated (P/A)	A	A			A	A				A		A
Startup Lost Time	2.0	2.0			2.0	2.0				2.0		2.0
Extension of Effective Green	2.0	2.0			2.0	2.0				2.0		2.0
Arrival Type	3	3			3	3				3		3
Unit Extension	3.0	3.0			3.0	3.0				3.0		3.0
Ped/Bike/RTOR Volume	0	0		0	0	30	0	0		0	0	186
Lane Width	12.0	12.0			12.0	12.0				12.0		12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0	0			0	0				0		0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	
Phasing	EB Only	EW Perm	03	04	SB Only	06	07	08				
Timing	G = 40.2	G = 37.4	G = 0.0	G = 0.0	G = 15.4	G = 0.0	G = 0.0	G = 0.0				
	Y = 5.5	Y = 6	Y = 0	Y = 0	Y = 5.5	Y = 0	Y = 0	Y = 0				
Duration of Analysis (hrs) = 0.25						Cycle Length C = 110.0						
Lane Group Capacity, Control Delay, and LOS Determination												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Adjusted Flow Rate	714	647			1158	83				124		233
Lane Group Capacity	715	2680			1206	538				248		222
v/c Ratio	1.00	0.24			0.96	0.15				0.50		1.05
Green Ratio	0.76	0.76			0.34	0.34				0.14		0.14
Uniform Delay d ₁	30.2	4.0			35.6	25.3				43.7		47.3
Delay Factor k	0.50	0.11			0.47	0.11				0.11		0.50
Incremental Delay d ₂	26.8	0.0			12.8	0.1				1.6		74.0
PF Factor	1.000	1.000			1.000	1.000				1.000		1.000
Control Delay	56.9	4.1			48.4	25.4				45.3		121.3
Lane Group LOS	E	A			D	C				D		F
Approach Delay	31.8			46.8						94.9		
Approach LOS	C			D						F		
Intersection Delay	45.7			Intersection LOS						D		

BACK-OF-QUEUE WORKSHEET												
General Information												
Project Description <i>Hardin Valley Subdivision</i>												
Average Back of Queue												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	<i>L</i>	<i>T</i>			<i>T</i>	<i>R</i>				<i>L</i>		<i>R</i>
Initial Queue/Lane	0.0	0.0			0.0	0.0				0.0		0.0
Flow Rate/Lane Group	714	647			1158	83				124		233
Satflow/Lane	940	1862			1862	1583				1770		1583
Capacity/Lane Group	715	2680			1206	538				248		222
Flow Ratio	0.8	0.2			0.3	0.1				0.1		0.1
v/c Ratio	1.00	0.24			0.96	0.15				0.50		1.05
I Factor	0.650	0.650			0.650	0.650				1.000		1.000
Arrival Type	3	3			3	3				3		3
Platoon Ratio	1.00	1.00			1.00	1.00				1.00		1.00
PF Factor	1.00	1.00			1.00	1.00				1.00		1.00
Q ₁	8.2	3.1			18.2	1.8				3.5		7.1
k _B	0.4	0.6			0.4	0.3				0.3		0.3
Q ₂	6.0	0.2			4.1	0.1				0.3		3.8
Q Average	14.2	3.3			22.3	1.8				3.8		10.9
Percentile Back of Queue (95th percentile)												
f _B %	1.8	2.0			1.7	2.0				2.0		1.8
Back of Queue	25.2	6.6			37.3	3.7				7.6		19.9
Queue Storage Ratio												
Queue Spacing	25.0	25.0			25.0	25.0				25.0		25.0
Queue Storage	170	0			0	210				312		312
Average Queue Storage Ratio	2.1					0.2				0.3		0.9
95% Queue Storage Ratio	3.7					0.4				0.6		1.6

TWO-WAY STOP CONTROL SUMMARY								
General Information				Site Information				
Analyst	Addie Kirkham			Intersection	Hardin Valley@ Project Entranc			
Agency/Co.	FMA			Jurisdiction	Knox County			
Date Performed	7/17/2015			Analysis Year	2018			
Analysis Time Period	Full Buildout AM Peak							
Project Description <i>Hardin Valley Subdivision</i>								
East/West Street: <i>Hardin Valley Road</i>				North/South Street: <i>Project Entrance</i>				
Intersection Orientation: <i>East-West</i>				Study Period (hrs): <i>0.25</i>				
Vehicle Volumes and Adjustments								
Major Street	Eastbound			Westbound				
Movement	1	2	3	4	5	6		
	L	T	R	L	T	R		
Volume (veh/h)		595	30	30	1014			
Peak-Hour Factor, PHF	1.00	0.90	0.90	0.90	0.90	1.00		
Hourly Flow Rate, HFR (veh/h)	0	661	33	33	1126	0		
Percent Heavy Vehicles	0	--	--	0	--	--		
Median Type	Raised curb							
RT Channelized			0				0	
Lanes	0	2	1	1	2		0	
Configuration		T	R	L	T			
Upstream Signal		0			0			
Minor Street	Northbound			Southbound				
Movement	7	8	9	10	11	12		
	L	T	R	L	T	R		
Volume (veh/h)	164		29					
Peak-Hour Factor, PHF	0.90	1.00	0.90	1.00	1.00	1.00		
Hourly Flow Rate, HFR (veh/h)	182	0	32	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	1	0	1	0	0	0		
Configuration	L		R					
Delay, Queue Length, and Level of Service								
Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			
v (veh/h)		33	182		32			
C (m) (veh/h)		911	289		716			
v/c		0.04	0.63		0.04			
95% queue length		0.11	3.94		0.14			
Control Delay (s/veh)		9.1	36.5		10.3			
LOS		A	E		B			
Approach Delay (s/veh)	--	--	32.6					
Approach LOS	--	--	D					

SHORT REPORT												
General Information						Site Information						
Analyst <i>Addie Kirkham</i> Agency or Co. <i>FMA</i> Date Performed <i>5/22/2015</i> Time Period <i>Full Buildout AM Peak</i>						Intersection <i>Hardin @ Ball Camp</i> <i>Byington</i> Area Type <i>All other areas</i> Jurisdiction <i>Knox County</i> Analysis Year <i>2018</i>						
Volume and Timing Input												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1	2			2	0				1		1
Lane Group	L	T			TR					L		R
Volume (vph)	180	494			831	181				484		170
% Heavy Vehicles	2	2			2	2				2		2
PHF	0.68	0.84			0.84	0.83				0.93		0.83
Pretimed/Actuated (P/A)	A	A			A	A				A		A
Startup Lost Time	2.0	2.0			2.0					2.0		2.0
Extension of Effective Green	2.0	2.0			2.0					2.0		2.0
Arrival Type	3	3			3					3		3
Unit Extension	3.0	3.0			3.0					3.0		3.0
Ped/Bike/RTOR Volume	0	0		0	0	32	0	0		0	0	43
Lane Width	12.0	12.0			12.0					12.0		12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	4	N
Parking/Hour												
Bus Stops/Hour	0	0			0					0		0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	
Phasing	EB Only	EW Perm	03	04	SB Only	06	07	08				
Timing	G = 11.4	G = 32.6	G = 0.0	G = 0.0	G = 28.0	G = 0.0	G = 0.0	G = 0.0				
	Y = 5.5	Y = 6	Y = 0	Y = 0	Y = 6.5	Y = 0	Y = 0	Y = 0				
Duration of Analysis (hrs) = 0.25						Cycle Length C = 90.0						
Lane Group Capacity, Control Delay, and LOS Determination												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Adjusted Flow Rate	265	588			1169					520		153
Lane Group Capacity	307	1951			1255					539		483
v/c Ratio	0.86	0.30			0.93					0.96		0.32
Green Ratio	0.56	0.55			0.36					0.31		0.31
Uniform Delay d ₁	22.9	10.9			27.6					30.5		23.7
Delay Factor k	0.39	0.11			0.45					0.47		0.11
Incremental Delay d ₂	18.9	0.1			10.9					29.9		0.4
PF Factor	1.000	1.000			1.000					1.000		1.000
Control Delay	41.9	11.0			38.6					60.4		24.1
Lane Group LOS	D	B			D					E		C
Approach Delay	20.6			38.6						52.2		
Approach LOS	C			D						D		
Intersection Delay	36.3			Intersection LOS						D		

BACK-OF-QUEUE WORKSHEET												
General Information												
Project Description <i>Hardin Valley Subdivision</i>												
Average Back of Queue												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	<i>L</i>	<i>T</i>			<i>TR</i>					<i>L</i>		<i>R</i>
Initial Queue/Lane	0.0	0.0			0.0					0.0		0.0
Flow Rate/Lane Group	265	588			1169					520		153
Satflow/Lane	553	1862			1819					1734		1552
Capacity/Lane Group	307	1951			1255					539		483
Flow Ratio	0.5	0.2			0.3					0.3		0.1
v/c Ratio	0.86	0.30			0.93					0.96		0.32
I Factor	0.850	0.850			0.850					1.000		1.000
Arrival Type	3	3			3					3		3
Platoon Ratio	1.00	1.00			1.00					1.00		1.00
PF Factor	1.00	1.00			1.00					1.00		1.00
Q1	3.3	4.2			14.7					12.8		2.9
k _B	0.3	0.6			0.5					0.5		0.4
Q2	1.4	0.3			3.7					4.5		0.2
Q Average	4.7	4.4			18.4					17.3		3.1
Percentile Back of Queue (95th percentile)												
f _B %	2.0	2.0			1.7					1.7		2.0
Back of Queue	9.3	8.7			31.6					29.9		6.3
Queue Storage Ratio												
Queue Spacing	25.0	25.0			25.0					25.0		25.0
Queue Storage	187	0			0					344		354
Average Queue Storage Ratio	0.6									1.3		0.2
95% Queue Storage Ratio	1.2									2.2		0.4

SHORT REPORT												
General Information						Site Information						
Analyst <i>Addie Kirkham</i> Agency or Co. <i>FMA</i> Date Performed <i>5/22/2015</i> Time Period <i>Developed PM Peak</i>						Intersection <i>Hardin @ Westcott</i> Area Type <i>All other areas</i> Jurisdiction <i>Knox County</i> Analysis Year <i>2018</i>						
Volume and Timing Input												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1	2			2	1				1		1
Lane Group	L	T			T	R				L		R
Volume (vph)	416	1518			893	37				151		314
% Heavy Vehicles	2	2			2	2				2		2
PHF	0.93	0.86			0.94	0.66				0.74		0.84
Pretimed/Actuated (P/A)	A	A			A	A				A		A
Startup Lost Time	2.0	2.0			2.0	2.0				2.0		2.0
Extension of Effective Green	2.0	2.0			2.0	2.0				2.0		2.0
Arrival Type	3	3			3	3				3		3
Unit Extension	3.0	3.0			3.0	3.0				3.0		3.0
Ped/Bike/RTOR Volume	0	0		0	0	12	0	0		0	0	155
Lane Width	12.0	12.0			12.0	12.0				12.0		12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0	0			0	0				0		0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	
Phasing	EB Only	EW Perm	03	04	SB Only	06	07	08				
Timing	G = 12.7	G = 21.1	G = 0.0	G = 0.0	G = 9.2	G = 0.0	G = 0.0	G = 0.0				
	Y = 5.5	Y = 6	Y = 0	Y = 0	Y = 5.5	Y = 0	Y = 0	Y = 0				
Duration of Analysis (hrs) = 0.25						Cycle Length C = 60.0						
Lane Group Capacity, Control Delay, and LOS Determination												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Adjusted Flow Rate	447	1765			950	38				204		189
Lane Group Capacity	499	2323			1247	557				271		243
v/c Ratio	0.90	0.76			0.76	0.07				0.75		0.78
Green Ratio	0.66	0.66			0.35	0.35				0.15		0.15
Uniform Delay d ₁	14.0	7.1			17.2	12.9				24.3		24.4
Delay Factor k	0.42	0.31			0.31	0.11				0.31		0.33
Incremental Delay d ₂	13.2	1.0			1.9	0.0				11.3		14.8
PF Factor	1.000	1.000			1.000	1.000				1.000		1.000
Control Delay	27.2	8.1			19.1	13.0				35.6		39.2
Lane Group LOS	C	A			B	B				D		D
Approach Delay	11.9			18.8						37.3		
Approach LOS	B			B						D		
Intersection Delay	16.6			Intersection LOS						B		

BACK-OF-QUEUE WORKSHEET												
General Information												
Project Description <i>Hardin Valley Subdivision</i>												
Average Back of Queue												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	<i>L</i>	<i>T</i>			<i>T</i>	<i>R</i>				<i>L</i>		<i>R</i>
Initial Queue/Lane	0.0	0.0			0.0	0.0				0.0		0.0
Flow Rate/Lane Group	447	1765			950	38				204		189
Satflow/Lane	752	1862			1862	1583				1770		1583
Capacity/Lane Group	499	2323			1247	557				271		243
Flow Ratio	0.6	0.5			0.3	0.0				0.1		0.1
v/c Ratio	0.90	0.76			0.76	0.07				0.75		0.78
I Factor	0.650	0.650			0.650	0.650				1.000		1.000
Arrival Type	3	3			3	3				3		3
Platoon Ratio	1.00	1.00			1.00	1.00				1.00		1.00
PF Factor	1.00	1.00			1.00	1.00				1.00		1.00
Q1	3.1	10.6			7.3	0.4				3.3		3.0
k _B	0.2	0.4			0.3	0.2				0.2		0.2
Q2	1.6	1.2			0.8	0.0				0.7		0.7
Q Average	4.7	11.8			8.2	0.4				3.9		3.8
Percentile Back of Queue (95th percentile)												
f _B %	2.0	1.8			1.9	2.1				2.0		2.0
Back of Queue	9.2	21.4			15.4	0.9				7.8		7.5
Queue Storage Ratio												
Queue Spacing	25.0	25.0			25.0	25.0				25.0		25.0
Queue Storage	170	0			0	210				312		312
Average Queue Storage Ratio	0.7					0.1				0.3		0.3
95% Queue Storage Ratio	1.4					0.1				0.6		0.6

TWO-WAY STOP CONTROL SUMMARY								
General Information				Site Information				
Analyst	Addie Kirkham			Intersection	Hardin Valley@ Project Entranc			
Agency/Co.	FMA			Jurisdiction	Knox County			
Date Performed	7/17/2015			Analysis Year	2018			
Analysis Time Period	Full Buildout PM Peak							
Project Description <i>Hardin Valley Subdivision</i>								
East/West Street: <i>Hardin Valley Road</i>				North/South Street: <i>Project Entrance</i>				
Intersection Orientation: <i>East-West</i>				Study Period (hrs): <i>0.25</i>				
Vehicle Volumes and Adjustments								
Major Street	Eastbound			Westbound				
Movement	1	2	3	4	5	6		
	L	T	R	L	T	R		
Volume (veh/h)		1525	144	62	813			
Peak-Hour Factor, PHF	1.00	0.90	0.90	0.90	0.90	1.00		
Hourly Flow Rate, HFR (veh/h)	0	1694	160	68	903	0		
Percent Heavy Vehicles	0	--	--	0	--	--		
Median Type	Raised curb							
RT Channelized			0				0	
Lanes	0	2	1	1	2		0	
Configuration		T	R	L	T			
Upstream Signal		0			0			
Minor Street	Northbound			Southbound				
Movement	7	8	9	10	11	12		
	L	T	R	L	T	R		
Volume (veh/h)	107		36					
Peak-Hour Factor, PHF	0.90	1.00	0.90	1.00	1.00	1.00		
Hourly Flow Rate, HFR (veh/h)	118	0	40	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	1	0	1	0	0	0		
Configuration	L		R					
Delay, Queue Length, and Level of Service								
Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			
v (veh/h)		68	118		40			
C (m) (veh/h)		331	103		365			
v/c		0.21	1.15		0.11			
95% queue length		0.76	7.66		0.37			
Control Delay (s/veh)		18.7	210.9		16.1			
LOS		C	F		C			
Approach Delay (s/veh)	--	--	161.6					
Approach LOS	--	--	F					

SHORT REPORT												
General Information						Site Information						
Analyst <i>Addie Kirkham</i> Agency or Co. <i>FMA</i> Date Performed <i>5/22/2015</i> Time Period <i>Developed PM Peak</i>						Intersection <i>Hardin @ Ball Camp</i> <i>Byington</i> Area Type <i>All other areas</i> Jurisdiction <i>Knox County</i> Analysis Year <i>2018</i>						
Volume and Timing Input												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1	2			2	0				1		1
Lane Group	L	T			TR					L		R
Volume (vph)	373	1240			689	485				405		149
% Heavy Vehicles	2	2			2	2				2		2
PHF	0.87	0.87			0.93	0.88				0.92		0.81
Pretimed/Actuated (P/A)	A	A			A	A				A		A
Startup Lost Time	2.0	2.0			2.0					2.0		2.0
Extension of Effective Green	2.0	2.0			2.0					2.0		2.0
Arrival Type	3	3			3					3		3
Unit Extension	3.0	3.0			3.0					3.0		3.0
Ped/Bike/RTOR Volume	0	0		0	0	86	0	0		0	0	37
Lane Width	12.0	12.0			12.0					12.0		12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	4	N
Parking/Hour												
Bus Stops/Hour	0	0			0					0		0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	
Phasing	EB Only	EW Perm	03	04	SB Only	06	07	08				
Timing	G = 17.1	G = 33.3	G = 0.0	G = 0.0	G = 21.6	G = 0.0	G = 0.0	G = 0.0				
	Y = 5.5	Y = 6	Y = 0	Y = 0	Y = 6.5	Y = 0	Y = 0	Y = 0				
Duration of Analysis (hrs) = 0.25						Cycle Length C = 90.0						
Lane Group Capacity, Control Delay, and LOS Determination												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Adjusted Flow Rate	429	1425			1194					440		138
Lane Group Capacity	419	2203			1238					416		372
v/c Ratio	1.02	0.65			0.96					1.06		0.37
Green Ratio	0.63	0.62			0.37					0.24		0.24
Uniform Delay d ₁	27.2	10.8			27.8					34.2		28.5
Delay Factor k	0.50	0.22			0.47					0.50		0.11
Incremental Delay d ₂	46.7	0.6			15.9					60.2		0.6
PF Factor	1.000	1.000			1.000					1.000		1.000
Control Delay	73.9	11.4			43.7					94.4		29.2
Lane Group LOS	E	B			D					F		C
Approach Delay	25.8			43.7						78.8		
Approach LOS	C			D						E		
Intersection Delay	40.2			Intersection LOS						D		

BACK-OF-QUEUE WORKSHEET												
General Information												
Project Description <i>Hardin Valley Subdivision</i>												
Average Back of Queue												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	<i>L</i>	<i>T</i>			<i>TR</i>					<i>L</i>		<i>R</i>
Initial Queue/Lane	0.0	0.0			0.0					0.0		0.0
Flow Rate/Lane Group	429	1425			1194					440		138
Satflow/Lane	669	1862			1756					1734		1552
Capacity/Lane Group	419	2203			1238					416		372
Flow Ratio	0.6	0.4			0.4					0.3		0.1
v/c Ratio	1.02	0.65			0.96					1.06		0.37
I Factor	0.850	0.850			0.850					1.000		1.000
Arrival Type	3	3			3					3		3
Platoon Ratio	1.00	1.00			1.00					1.00		1.00
PF Factor	1.00	1.00			1.00					1.00		1.00
Q1	4.9	11.8			15.4					11.0		2.9
k _B	0.3	0.6			0.5					0.4		0.4
Q2	5.0	1.1			4.7					6.5		0.2
Q Average	9.9	13.0			20.0					17.5		3.1
Percentile Back of Queue (95th percentile)												
f _B %	1.8	1.8			1.7					1.7		2.0
Back of Queue	18.3	23.3			34.0					30.2		6.2
Queue Storage Ratio												
Queue Spacing	25.0	25.0			25.0					25.0		25.0
Queue Storage	187	0			0					344		354
Average Queue Storage Ratio	1.3									1.3		0.2
95% Queue Storage Ratio	2.4									2.2		0.4

Attachment 8
Turn Lane Warrant Analysis

**Attachment 8
Turn Lane Warrant Analysis**

Project: Hardin Valley Subdivision

**Hardin Valley Road
at Project Entrance**

	VOLUMES				
LEFT TURN	Opposing	Thru	LT	LT MAX	Warrant Met
AM	342	532	30	30	YES
PM	845	427	62	20	YES

**Hardin Valley Road
at Project Entrance**

	VOLUMES				
RIGHT TURN	Thru	RT	RT MAX	Warrant Met	
AM	312	30	249	NO	
PM	801	144	24	YES	

7/28/15

TABLE 5A

LEFT-TURN LANE VOLUME THRESHOLDS
FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH

(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	250	180	140	110	80	70
150 - 199	200	140	105	90	70	60
200 - 249	160	115	85	75	65	55
250 - 299	130	100	75	65	60	50
300 - 349	110	90	70	60	55	45
350 - 399	100	80	65	55	50	40
400 - 449	90	70	60	50	45	35
450 - 499	80	65	55	45	40	30
500 - 549	70	60	45	35	35	25
550 - 599	65	55	40	35	30	25
600 - 649	60	45	35	30	25	25
650 - 699	55	35	35	30	25	20
700 - 749	50	35	30	25	20	20
750 or More	45	35	25	25	20	20

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	=/ > 600
100 - 149	70	60	50	45	40	35
150 - 199	60	55	45	40	35	30
200 - 249	55	50	40	35	30	30
250 - 299	50	45	35	30	30	30
300 - 349	45	40	35	30 (30) AM	25	25
350 - 399	40	35	30	25	25	20
400 - 449	35	30	30	25	20	20
450 - 499	30	25	25	20	20	20
500 - 549	25	25	20	20	20	15
550 - 599	25	20	20	20	20	15
600 - 649	25	20	20	20	20	15
650 - 699	20	20	20	20	20	15
700 - 749	20	20	20	15	15	15
750 or More	20	(62) (20) PM	20	15	15	15

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

7/28/15

TABLE 5B

**RIGHT-TURN LANE VOLUME THRESHOLDS
FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH**

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					30 AM	
100 - 149 150 - 199						
200 - 249 250 - 299					Yes	Yes Yes
300 - 349 350 - 399			Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499		Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes	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	Yes Yes
100 - 149 150 - 199		Yes	Yes Yes	Yes Yes	Yes Yes	PM Yes (M) Yes
200 - 249 250 - 299	Yes 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.

Attachment 9
Signal Warrant Analysis

**Attachment 9
Signal Warrant Analysis**

Project: Hardin Valley Subdivision

Hardin Valley Road @ Project Entrance
2018 Peak Hour Traffic Full Buildout

	Hardin Valley Road (Both Directions)	Project Entrance (Left Turns Only)	Warrant 1, Eight-Hr Vehicular Volume			Warrant 2, Four-Hr 70% Factor	Warrant 3, Peak Hour 70% Factor
			Condition A 70% Factor	Condition B 70% Factor	Condition A & B 70% Factor		
7:00 AM	1277	164	YES	YES	YES	YES	YES
8:00 AM	1245	164	YES	YES	YES	YES	YES
9:00 AM	-	-	-	-	-	-	-
10:00 AM	-	-	-	-	-	-	-
11:00 AM	820	57*	NO	YES	NO	NO	NO
12:00 PM	937	57*	NO	YES	NO	NO	NO
1:00 PM	-	-	-	-	-	-	-
2:00 PM	920	57*	NO	YES	NO	NO	NO
3:00 PM	1251	57*	NO	YES	NO	YES	NO
4:00 PM	1322	107	NO	YES	YES	YES	YES
5:00 PM	1787	107	NO	YES	YES	YES	YES

* Estimated Based on Generated ADT Number Exiting
 ((1927 ADT Exiting Full Buildout) - (193 AM Peak)*2 - (143 PM Peak)*2)/ 20 hours = 63 Trips/Hr
 63 Trips/Hr * Estimated 90% Left Turns = 57 Trips/HR

Hardin Valley Road @ Project Entrance
2018 Peak Hour Traffic 60% Buildout

	Hardin Valley Road (Both Directions)	Project Entrance (Left Turns Only)	Warrant 1, Eight-Hr Vehicular Volume			Warrant 2, Four-Hr 70% Factor	Warrant 3, Peak Hour 70% Factor
			Condition A 70% Factor	Condition B 70% Factor	Condition A & B 70% Factor		
7:00 AM	1277	98	NO	YES	YES	YES	YES
8:00 AM	1245	98	NO	YES	YES	YES	YES
9:00 AM	-	-	-	-	-	-	-
10:00 AM	-	-	-	-	-	-	-
11:00 AM	820	-	-	-	-	-	-
12:00 PM	937	-	-	-	-	-	-
1:00 PM	-	-	-	-	-	-	-
2:00 PM	920	-	-	-	-	-	-
3:00 PM	1251	-	-	-	-	-	-
4:00 PM	1322	64	NO	YES	NO	YES	NO
5:00 PM	1787	64	NO	YES	NO	YES	NO

Hardin Valley Road @ Project Entrance
2018 Peak Hour Traffic 75% Buildout

	Hardin Valley Road (Both Directions)	Project Entrance (Left Turns Only)	Warrant 1, Eight-Hr Vehicular Volume			Warrant 2, Four-Hr 70% Factor	Warrant 3, Peak Hour 70% Factor
			Condition A 70% Factor	Condition B 70% Factor	Condition A & B 70% Factor		
7:00 AM	1277	123	YES	YES	YES	YES	YES
8:00 AM	1245	123	YES	YES	YES	YES	YES
9:00 AM	-	-	-	-	-	-	-
10:00 AM	-	-	-	-	-	-	-
11:00 AM	820	-	-	-	-	-	-
12:00 PM	937	-	-	-	-	-	-
1:00 PM	-	-	-	-	-	-	-
2:00 PM	920	-	-	-	-	-	-
3:00 PM	1251	-	-	-	-	-	-
4:00 PM	1322	80	NO	YES	NO	YES	YES
5:00 PM	1787	80	NO	YES	NO	YES	YES