AVIAN FOREST SUBDIVISION

Traffic Impact Study

E Raccoon Valley Drive (S.R. 170)

Knoxville, TN

A Traffic Impact Study for the Proposed Avian Forest Subdivision

Submitted to

Knoxville – Knox County Metropolitan Planning Commission

September 18, 2017
FMA Project No. 595.001

Submitted By:

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Executive Summary

Iron Forge, LLC is proposing a residential development with single family homes in Knox County. The project is located on E Raccoon Valley Drive (S.R. 170) west of Interstate I-75. The development will consist of 93 single family homes. Construction is proposed to take place this year and this study assumes full build out for the development will occur in 2020.

The proposed subdivision site access will tie into E Raccoon Valley Drive (S.R. 170) at the proposed Avian Forest Road. Avian Forest Road is approximately 464 feet west of the intersection of E Raccoon Valley Road (S.R. 170) and Raccoon Woods Road. The proposed lane configuration is a 13 foot lane exiting the development and a 13 foot lane entering the development.

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

E Raccoon Valley Drive (S.R. 170) @ Avian Forest Road
At the intersection of E Raccoon Valley Drive (S.R. 170) at Avian Forest Road the westbound approach operates at a LOS A and the northbound approach operates at a LOS B during both the AM and PM peak hours after the completion of the Avian Forest Subdivision.

The proposed intersection of E Raccoon Valley Drive (S.R. 170) at Avian Forest Road has a measured sight distance that exceeds 400 feet east and west of the intersection, which meets the requirement. The approximate sight distance is 1,150 feet east and 425 feet west of the intersection. FMA recommends any landscaping be installed so as to maintain the sight distance and continue to comply with Knox County Engineering & Public Works requirements.

Neither an eastbound right turn lane nor a westbound left turn lane is warranted at the intersection of E Raccoon Valley Drive (S.R. 170) at Avian Forest Road.

E Raccoon Valley Drive (S.R. 170) @ Raccoon Woods Road
At the intersection of E Raccoon Valley Drive (S.R. 170) at Raccoon Woods Road, the westbound approach operates at a LOS A and the northbound approach operates at a LOS B after the completion of the Avian Forest Subdivision.

1 Introduction

1.1 Project Description

This report provides a summary of a traffic impact study that was performed for the proposed Avian Forest Subdivision. The project site is located on E Raccoon Valley Drive (S.R. 170) west of Interstate I-75 in Knox County, Tennessee. The location of the site is shown in Figure 1.

The proposed Avian Forest Subdivision will consist of 93 single family lots. Full Buildout is expected to occur within three years, or by the year 2020. 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.

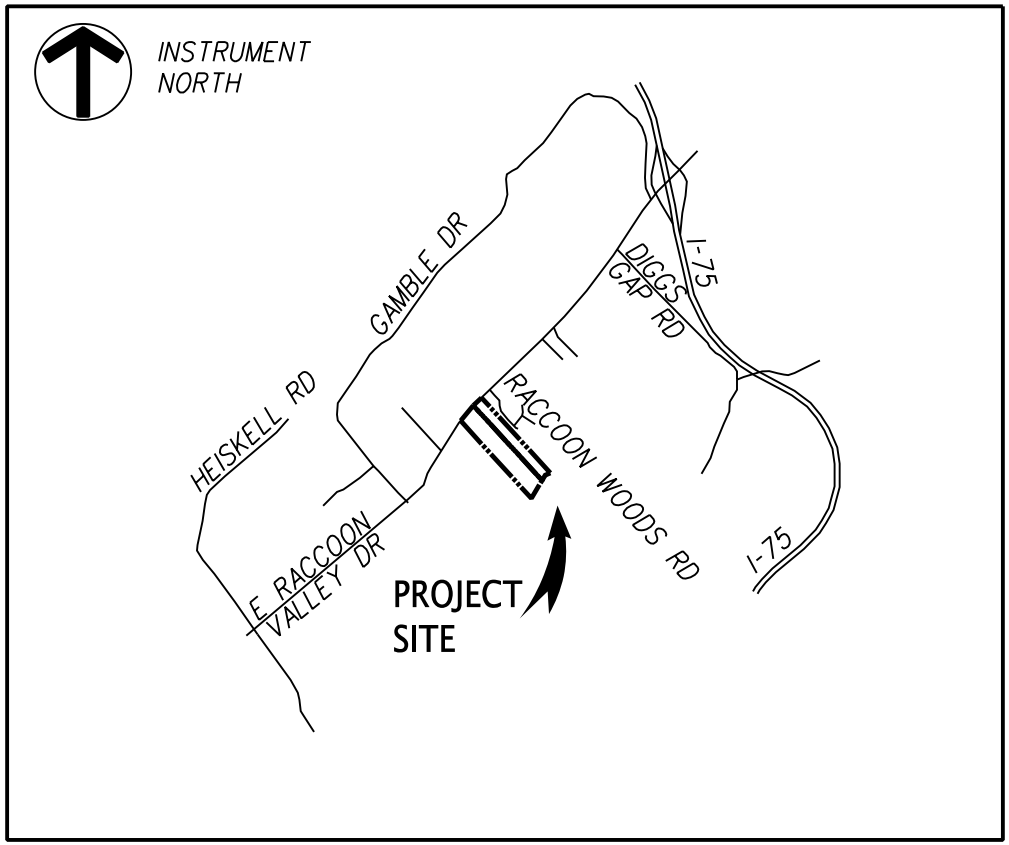
1.2 Existing Site Conditions

The proposed subdivision site access will tie into E Raccoon Valley Drive (S.R. 170) at the proposed Avian Forest Road. Avian Forest Road is approximately 464 feet west of the intersection of E Raccoon Valley Road (S.R. 170) and Raccoon Woods Road and approximately 1,195 feet east of the intersection of E Raccoon Valley Road (S.R. 170) and Denny Way.

During a site visit it was determined that E Raccoon Valley Drive (S.R. 170) is a two-lane road with a pavement width of 22 feet at the proposed project entrance. The Knoxville-Knox County Metropolitan Planning Commission classifies Raccoon Valley Drive (S.R. 170) between the Anderson County Line and I-75 as a major arterial per the Major Road Plan. The posted speed limit on E Raccoon Valley Drive (S.R. 170) is 40 mph. The intersection sight distance at the proposed Avian Forest Road was measured at approximately 1,150 feet east and 425 feet west of the intersection.

Raccoon Woods Road is a two-lane road and has no posted speed limit. The Knoxville-Knox County Metropolitan Planning Commission does not list a classification for Raccoon Woods Road per the Major Road Plan; therefore it is considered a local street.

FIGURE 1



LOCATION MAP
(NOT TO SCALE)

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LOCATION MAP

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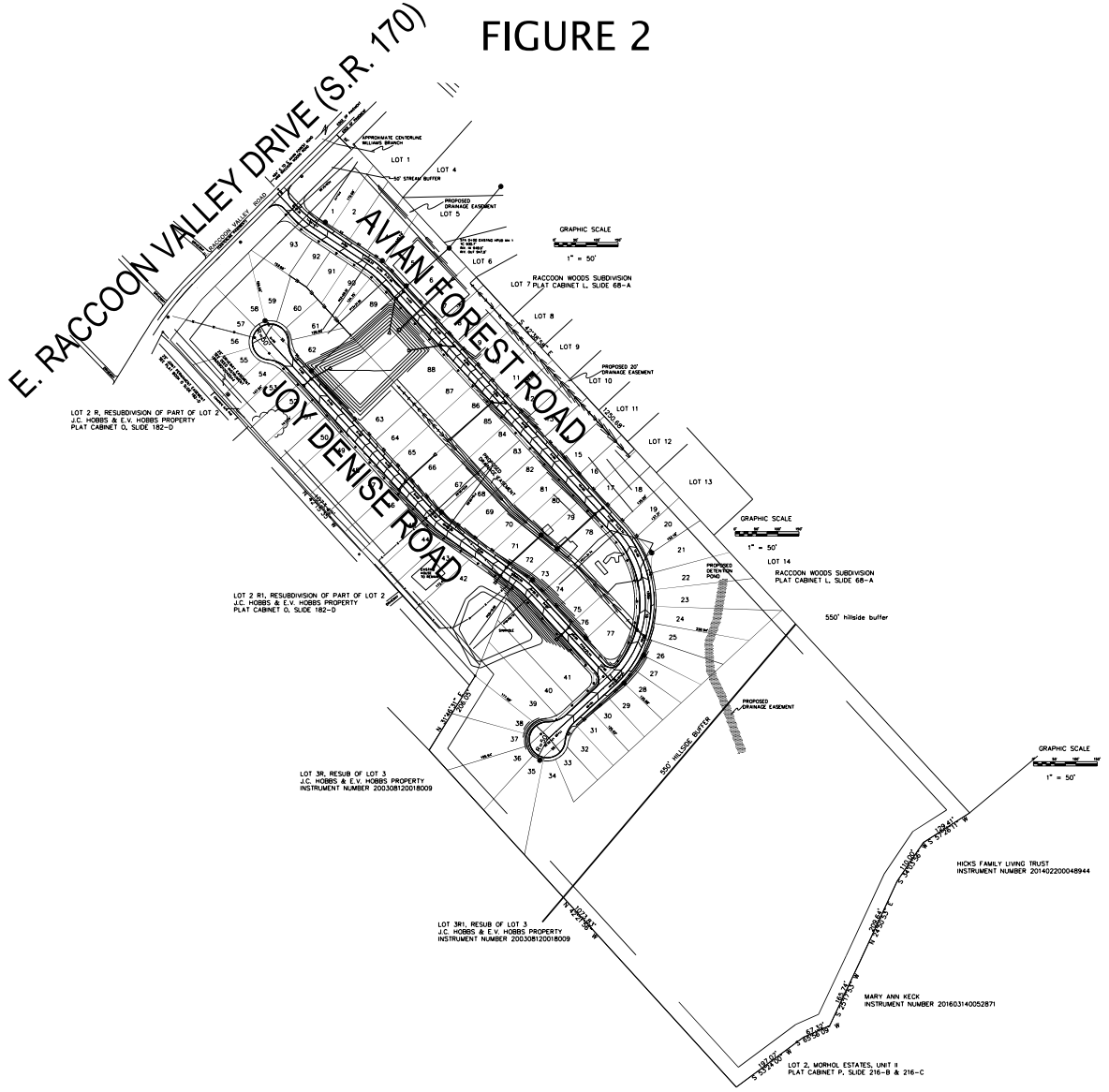
FIGURE 2



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SITE PLAN

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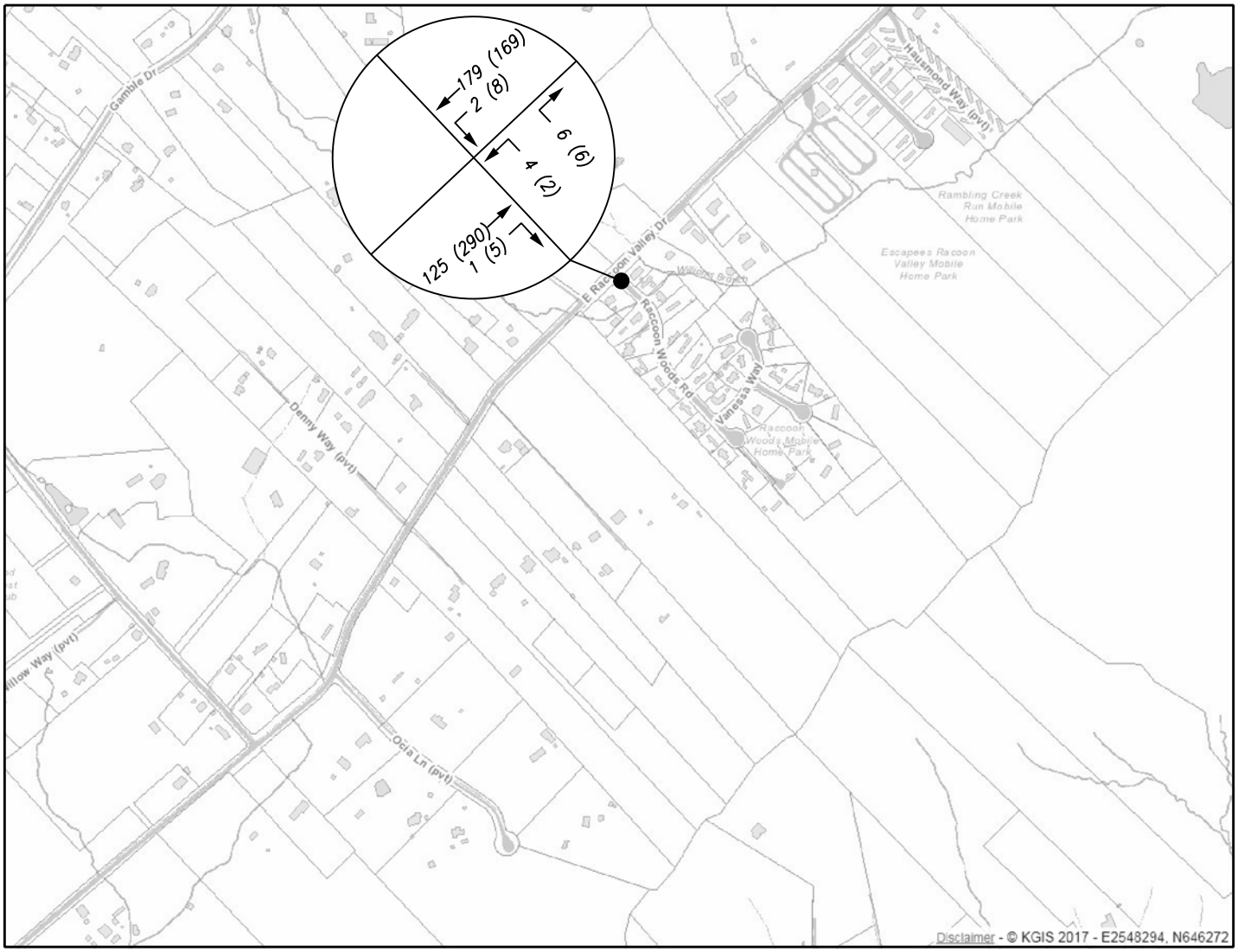
2 Existing Traffic Volumes

FMA conducted a turning movement count at the intersection of E Raccoon Valley Drive (S.R. 170) and Raccoon Woods Road on Thursday July 13, 2017 and on Wednesday August 23, 2017. The existing volumes from the August 23, 2017 count including the AM and PM peak hour traffic volumes at the count location is shown in Figure 3, and the count data collected from both turning movement counts is included in Attachment 1.

The current AM peak hour and PM peak hour were determined using the turning movement count that FMA conducted on August 23, 2017. The AM peak hour occurred between 7:00 am and 8:00 am, and the PM peak hour occurred between 5:00 pm and 6:00 pm.



LEGEND:

← 5 (16) *TURNING MOVEMENT VOLUME AM (PM)*

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2017 EXISTING PEAK HOUR TRAFFIC

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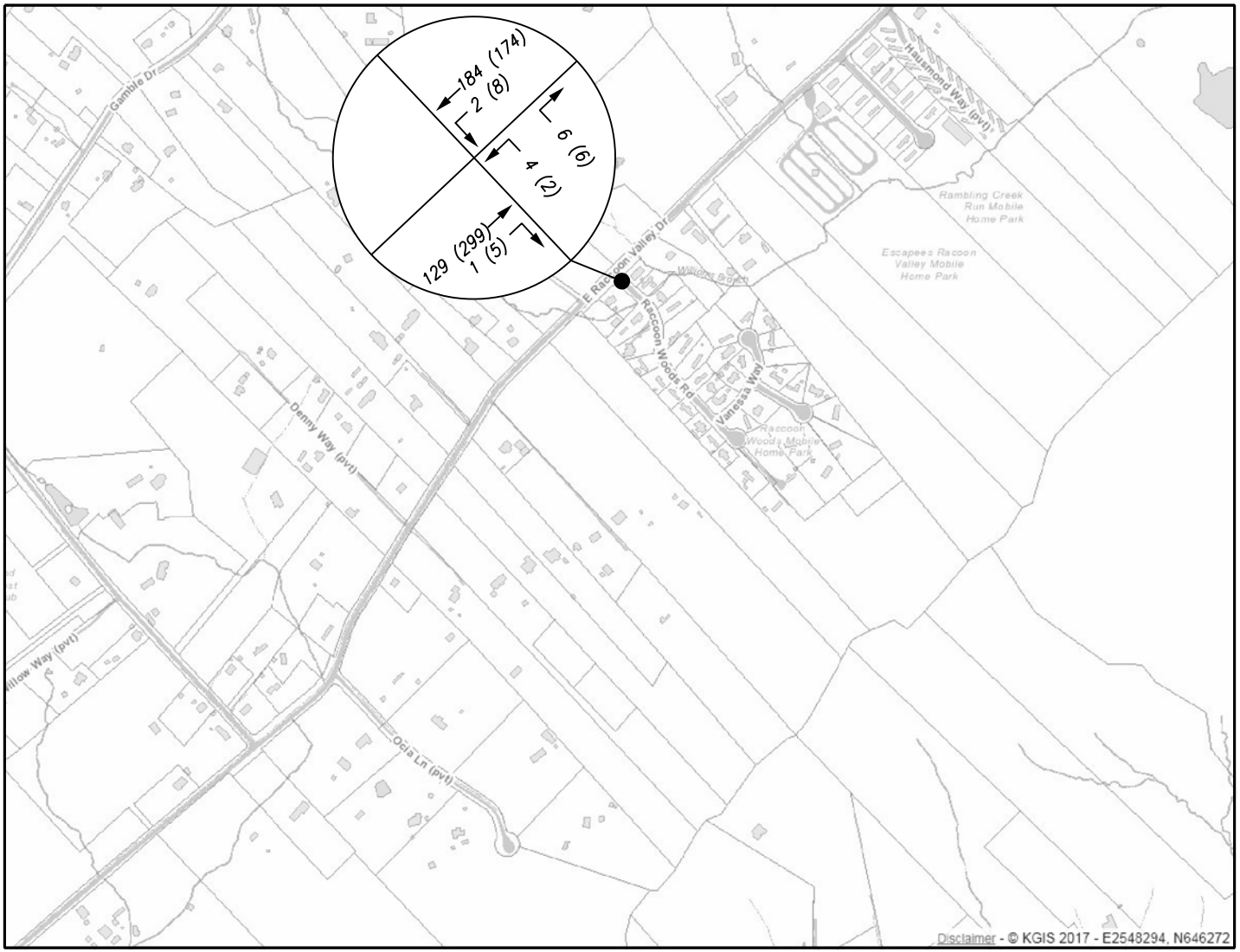
3 Background Growth

The Tennessee Department of Transportation (TDOT) maintains count station #000028 on W Raccoon Valley Drive (S.R. 170) near the Anderson County line and west of the proposed project. The annual traffic growth rate for this station between 2000 and 2016 is approximately 0.56%.

For the purpose of this study, an annual growth rate of 1.0% for traffic at the intersection of E Raccoon Valley Drive (S.R. 170) and Raccoon Woods Road was assumed until full occupancy is reached in 2020. Attachment 2 shows the trend line growth charts for the TDOT count station.

Figure 4 demonstrates the projected background peak hour volumes at the intersection after applying the background growth rate to the existing conditions.



LEGEND:

← 5 (16) TURNING MOVEMENT VOLUME AM (PM)

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2020 BACKGROUND PEAK HOUR TRAFFIC

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4 Trip Generation and Trip Distribution

Single-Family Detached Housing or Land Use 210 was used to calculate site trips for the proposed single family housing using the fitted curve equations from *Trip Generation, 9th Edition,* published by the Institute of Transportation Engineers. The land use worksheets are included in Attachment 3.

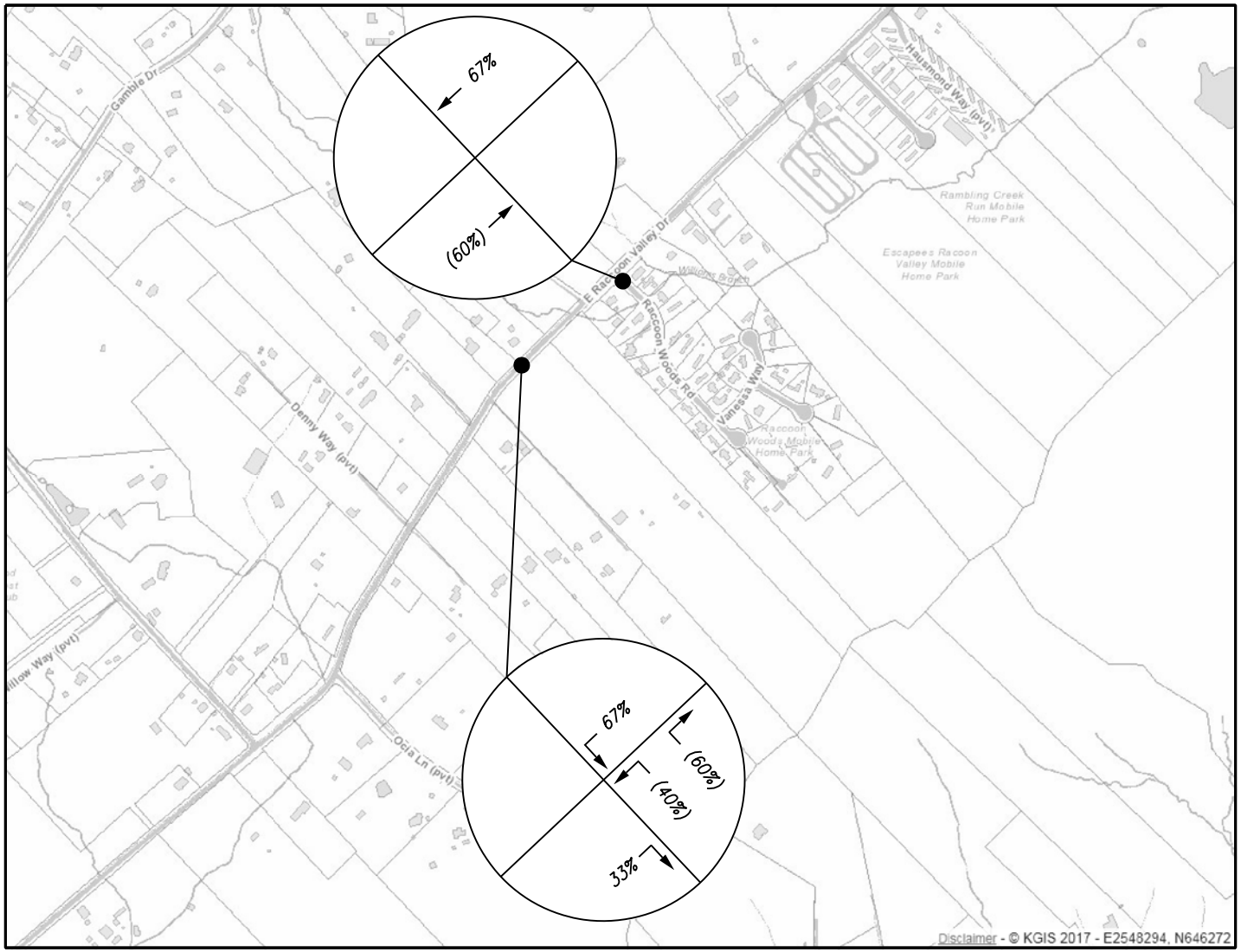
The Avian Forest Subdivision has 93 single family detached housing units. The total number of trips generated by the Avian Forest Subdivision was estimated to be 982 daily trips. A trip generation summary is shown in Table 4-1.

Table 4-1
Avian Forest Subdivision
Trip Generation Summary

	Single-Family Detached Housing (Land Use 210)				
	Total New Trips	% Entering	%Exiting	Number Entering	Number Exiting
Weekday	982	50	50	491	491
A.M. Peak	75	25	75	19	56
P.M. Peak	98	63	37	62	36

The directional distribution of the traffic generated by the Avian Forest Subdivision was determined using the traffic data collected for the existing conditions. Figure 5 shows the AM peak hour trip distribution and Figure 6 shows the PM peak hour trip distribution for the Avian Forest Subdivision.

Using the trip distribution the trips generated from the Avian Forest Subdivision are shown in Figure 7. Figure 8 shows the combined peak hour traffic volumes from the background growth and the full build out of the Avian Forest Subdivision.



LEGEND:

← 50% (50%) TRIP DISTRIBUTION ENTERING (EXITING)

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AM PEAK HOUR TRIP DISTRIBUTION

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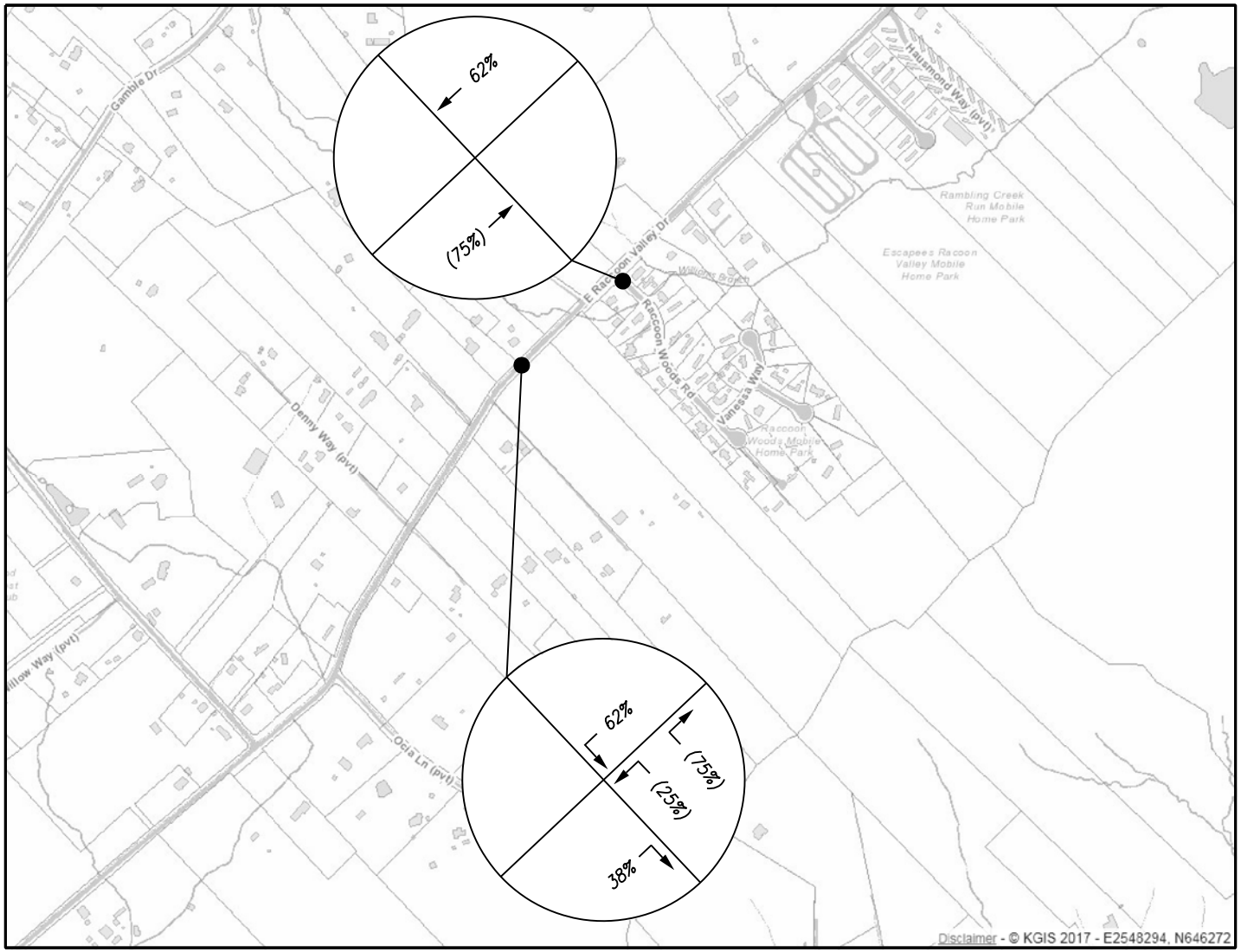

LEGEND:

← 50% (50%) TRIP DISTRIBUTION ENTERING (EXITING)

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PM PEAK HOUR TRIP DISTRIBUTION

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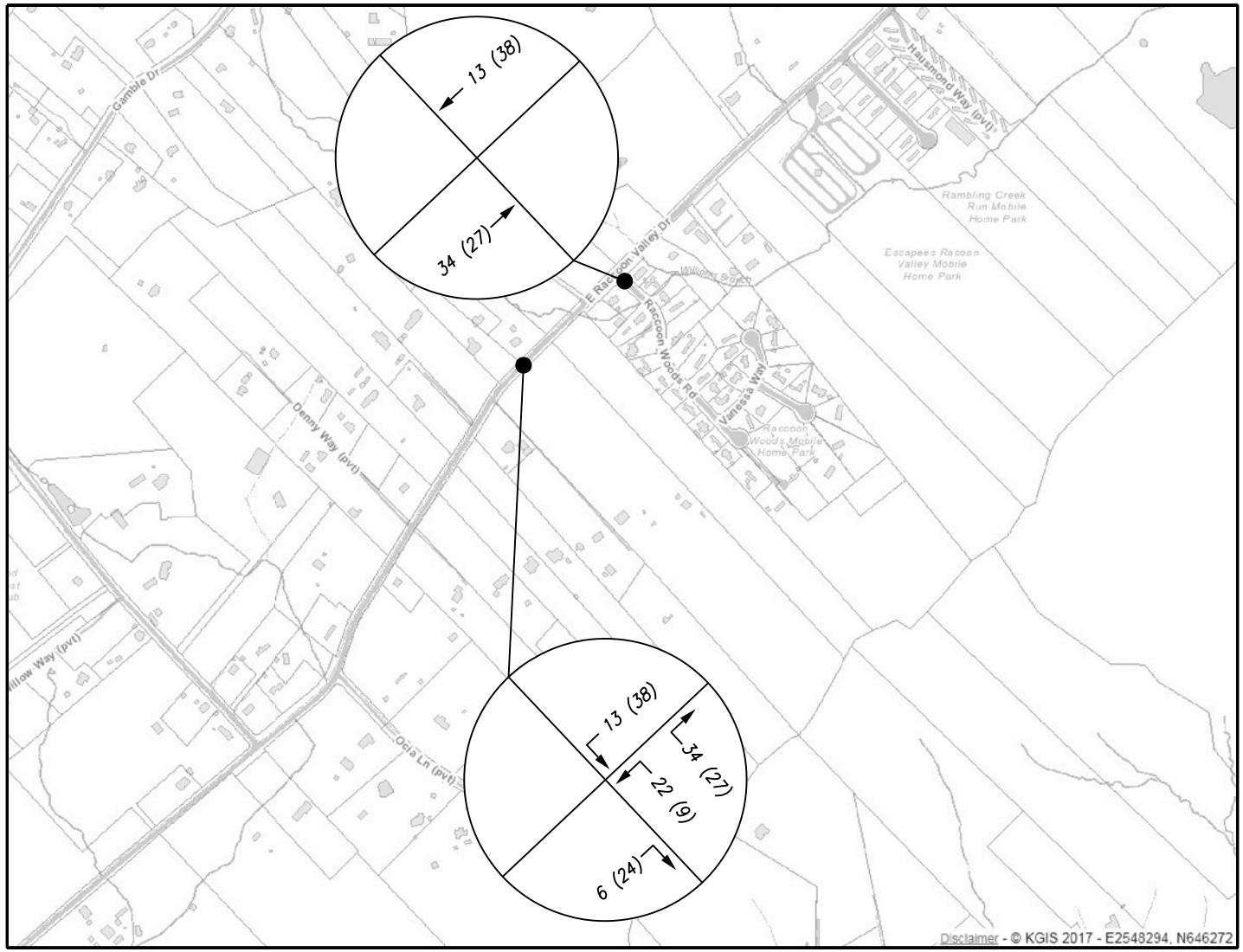

LEGEND:

← 5 (16) *TURNING MOVEMENT VOLUME AM (PM)*

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PEAK HOUR SUBDIVISION TRAFFIC

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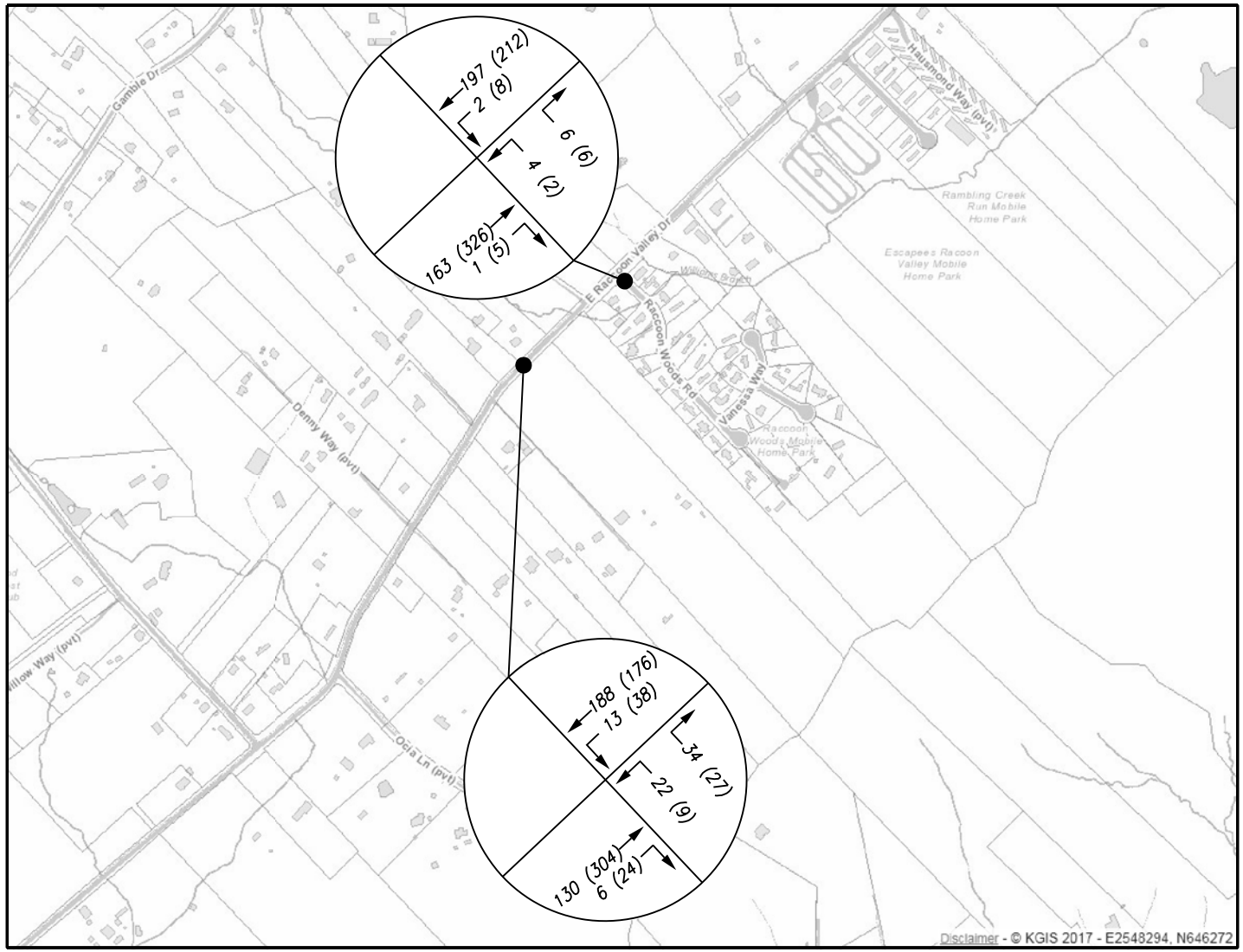

LEGEND:

← 5 (16) TURNING MOVEMENT VOLUME AM (PM)

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2020 PEAK HOUR TRAFFIC FULL BUILDOUT

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5 Projected Capacity and Level of Service

Unsignalized intersection capacity analyses were performed for the AM and PM peak hours to evaluate the traffic conditions at the intersections of E Raccoon Valley Drive (S.R. 170) at Raccoon Woods Road and the intersection of E Raccoon Valley Drive (S.R. 170) at Avian Forest Road. HCS7 intersection worksheets are included in Attachments 4, 5 and 6.

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

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

		Delay (sec)/LOS
E Raccoon Valley Drive @ Raccoon Woods Road (Existing 2017)		
AM Peak	WB	7.5 / A
	NB	9.8 / A
PM Peak	WB	7.9 / A
	NB	10.5 / B
E Raccoon Valley Drive @ Raccoon Woods Road (Background 2020)		
AM Peak	WB	7.5 / A
	NB	9.8 / A
PM Peak	WB	8.0 / A
	NB	10.6 / B
E Raccoon Valley Drive @ Raccoon Woods Road (Full Buildout 2020)		
AM Peak	WB	7.6 / A
	NB	10.1 / B
PM Peak	WB	8.0 / A
	NB	10.9 / B

E Raccoon Valley Drive @ Avian Forest Road (Full Buildout 2020)		
AM Peak	WB NB	7.5 / A 10.1 / B
PM Peak	WB NB	8.1 / A 11.4 / B

6 Turn Lane Warrant Analysis

The intersection of E Raccoon Valley Road (S.R. 170) at Avian Forest Road was evaluated to determine if an eastbound right turn lane or a westbound left turn lane on E Raccoon Valley Road (S.R. 170) was warranted. The Knox County Department of Engineering and Public Works handbook, "Access Control and Driveway Design Policy," was used to analyze the information.

No turn lane warrants are met at the intersection of E Raccoon Valley Road (S.R. 170) at Avian Forest Road during the AM or PM peak hours. The turn lane warrant worksheets and analysis are included in Attachment 7.

7 Conclusions and Recommendations

7.1 E Raccoon Valley Drive (S.R. 170)

E Raccoon Valley Drive (S.R. 170) is classified as a major arterial. The minimum intersection spacing required for an arterial is 400 feet per the "Minimum Subdivision Regulations" for Knoxville and Knox County. The proposed distance between the intersection of E Raccoon Valley Drive (S.R. 170) at Avian Forest Road and E Raccoon Valley Drive (S.R. 170) at Raccoon Woods Road is 464 feet. This intersection exceeds the typical minimum separation of 400 feet between roads on an arterial; therefore, no change is necessary.

7.2 E Raccoon Valley Drive (S.R. 170) @ Avian Forest Road

At the intersection of E Raccoon Valley Drive (S.R. 170) at Avian Forest Road the westbound approach operates at a LOS A and the northbound approach operates at a LOS B during both the AM and PM peak hours after the completion of the Avian Forest Subdivision. The unsignalized intersection capacity analyses shows a 95%

queue length for the northbound approach of less than one car length during both the AM and PM peak hours; therefore, the proposed geometry of one 13 foot lane exiting the subdivision will be adequate.

The minimum required sight distance for a road with a posted speed limit of 40 mph is 400 feet in each direction in accordance with the "Minimum Subdivision Regulations" for Knoxville and Knox County. The proposed intersection of E Raccoon Valley Drive (S.R. 170) at Avian Forest Road has a measured sight distance that exceeds 400 feet east and west of the intersection, which meets the requirement. The approximate sight distance is 1,150 feet east and 425 feet west of the intersection. FMA recommends any landscaping be installed so as to maintain the sight distance and continue to comply with Knox County Engineering & Public Works requirements.

Neither an eastbound right turn lane nor a westbound left turn lane is warranted at the intersection of E Raccoon Valley Drive (S.R. 170) at Avian Forest Road.

7.3 E Raccoon Valley Drive (S.R. 170) @ Raccoon Woods Road

At the intersection of E Raccoon Valley Drive (S.R. 170) at Raccoon Woods Road, the westbound approach operates at a LOS A and the northbound approach operates at a LOS B after the completion of the Avian Forest Subdivision.

Attachment 1
Traffic Counts

Attachment 1
Traffic Counts

Project: Avian Forest Subdivision
Date Conducted: 07/13/2017

	E Raccoon Valley Dr Eastbound			E Raccoon Valley Dr Westbound			Raccoon Woods Rd Northbound			
Start	Thru	Right	Total	Left	Thru	Total	Left	Right	Total	Int. Total
7:00 AM	17	1	18	1	38	39	1	2	3	60
7:15 AM	27	0	27	0	54	54	1	1	2	83
7:30 AM	26	0	26	1	44	45	3	1	4	75
7:45 AM	19	1	20	0	36	36	0	0	0	56
Total	89	2	91	2	172	174	5	4	9	274
8:00 AM	13	1	14	0	25	25	1	1	2	41
8:15 AM	24	0	24	0	39	39	1	1	2	65
8:30 AM	14	0	14	0	25	25	1	0	1	40
8:45 AM	21	0	21	0	24	24	0	0	0	45
Total	72	1	73	0	113	113	3	2	5	191
3:00 PM	30	0	30	1	23	24	0	1	1	55
3:15 PM	35	0	35	2	25	27	0	1	1	63
3:30 PM	53	2	55	1	33	34	0	1	1	90
3:45 PM	37	1	38	0	29	29	1	0	1	68
Total	155	3	158	4	110	114	1	3	4	276
4:00 PM	50	1	51	1	30	31	0	1	1	83
4:15 PM	52	0	52	2	26	28	1	0	1	81
4:30 PM	47	1	48	0	26	26	0	1	1	75
4:45 PM	74	2	76	4	37	41	0	1	1	118
Total	223	4	227	7	119	126	1	3	4	357
5:00 PM	61	2	63	1	34	35	1	0	1	99
5:15 PM	67	0	67	0	38	38	0	1	1	106
5:30 PM	77	1	78	2	36	38	1	0	1	117
5:45 PM	66	2	68	1	40	41	3	1	4	113
Total	271	5	276	4	148	152	5	2	7	435
Grand Total	810	15	825	17	662	679	15	14	29	1533
Approach %	98.2	1.8		2.5	97.5		51.7	48.3		
Total %	52.8	1.0	53.8	1.1	43.2	44.3	1.0	0.9	1.9	

Project: Avian Forest Subdivision
Date Conducted: 08/23/2017

	E Raccoon Valley Dr Eastbound			E Raccoon Valley Dr Westbound			Raccoon Woods Rd Northbound			
Start	Thru	Right	Total	Left	Thru	Total	Left	Right	Total	Int. Total
7:00 AM	31	0	31	1	47	48	2	1	3	82
7:15 AM	36	0	36	0	43	43	2	1	3	82
7:30 AM	36	1	37	0	53	53	0	3	3	93
7:45 AM	22	0	22	1	36	37	0	1	1	60
Total	125	1	126	2	179	181	4	6	10	317
8:00 AM	23	0	23	0	30	30	0	1	1	54
8:15 AM	27	0	27	2	32	34	1	4	5	66
8:30 AM	18	0	18	0	25	25	0	0	0	43
8:45 AM	11	0	11	0	17	17	0	0	0	28
Total	79	0	79	2	104	106	1	5	6	191
3:00 PM	30	2	32	4	23	27	1	1	2	61
3:15 PM	21	1	22	0	17	17	1	2	3	42
3:30 PM	37	0	37	2	26	28	2	0	2	67
3:45 PM	44	1	45	1	22	23	0	3	3	71
Total	132	4	136	7	88	95	4	6	10	241
4:00 PM	60	1	61	1	26	27	1	0	1	89
4:15 PM	53	3	56	3	27	30	1	1	2	88
4:30 PM	58	3	61	0	37	37	1	3	4	102
4:45 PM	72	2	74	2	30	32	0	0	0	106
Total	243	9	252	6	120	126	3	4	7	385
5:00 PM	70	1	71	1	31	32	0	1	1	104
5:15 PM	67	2	69	3	44	47	1	2	3	119
5:30 PM	84	2	86	3	38	41	0	3	3	130
5:45 PM	69	0	69	1	56	57	1	0	1	127
Total	290	5	295	8	169	177	2	6	8	480
Grand Total	869	19	888	25	660	685	14	27	41	1614
Approach %	97.9	2.1		3.6	96.4		34.1	65.9		
Total %	53.8	1.2	55.0	1.5	40.9	42.4	0.9	1.7	2.5	

Project: Avian Forest Subdivision
Date Conducted: 8/23/2017

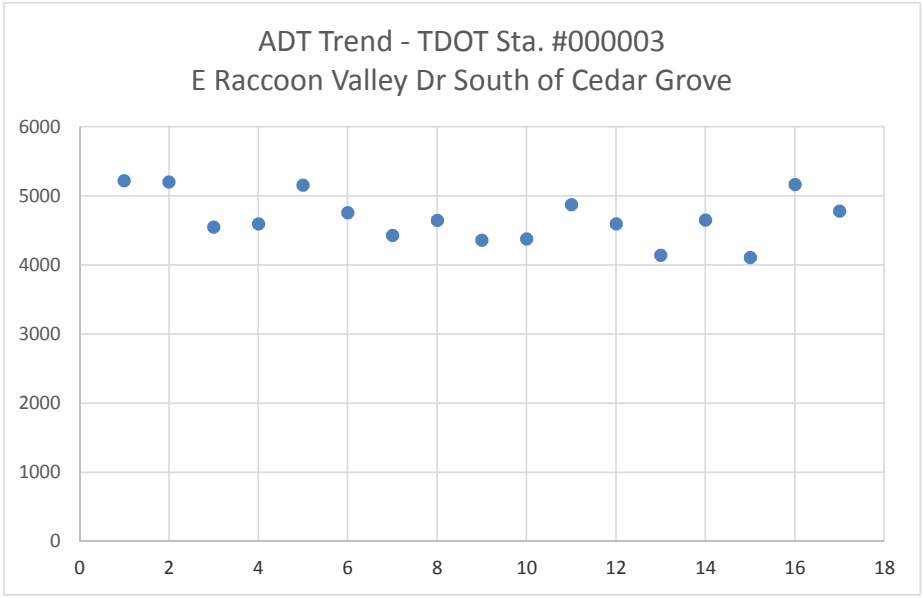
AM Peak Hour	7:00 AM - 8:00 AM	317
PM Peak Hour	5:00 PM - 6:00 PM	480

	E Raccoon Valley Dr Eastbound			E Raccoon Valley Dr Westbound			Raccoon Woods Rd Northbound			
Start	Thru	Right	App. Total	Left	Thru	App. Total	Left	Right	App. Total	Int. Total
Peak Hour Analysis from 7:00 AM to 9:00 AM										
AM Peak Hour begins at 7:00 AM										
7:00 AM	31	0	31	**1**	47	48	**2**	1	3	82
7:15 AM	**36**	0	36	0	43	43	2	1	3	82
7:30 AM	36	**1**	37	0	**53**	53	0	**3**	3	**93**
7:45 AM	22	0	22	1	36	37	0	1	1	60
Total Volume	125	1	126	2	179	181	4	6	10	317
Future (1% over 3 yrs)	129	1		2	184		4	6		327
PHF	0.87	0.25		0.50	0.84		0.50	0.50		0.85
Peak Hour Analysis from 3:00 PM to 6:00 PM										
PM Peak Hour begins at 4:45 PM										
5:00 PM	70	1	71	1	31	32	0	1	1	104
5:15 PM	67	**2**	69	**3**	44	47	**1**	2	3	119
5:30 PM	**84**	2	86	3	38	41	0	**3**	3	**130**
5:45 PM	69	0	69	1	**56**	57	1	0	1	127
Total Volume	290	5	295	8	169	177	2	6	8	480
Future (1% over 3 yrs)	299	5		8	174		2	6		495
PHF	0.86	0.63		0.67	0.75		0.50	0.50		0.92

Attachment 2
ADT Trends

Attachment 2
ADT Trends

	Year	Adjusted Average Daily Traffic
1	2000	5221
2	2001	5202
3	2002	4551
4	2003	4598
5	2004	5156
6	2005	4760
7	2006	4431
8	2007	4649
9	2008	4360
10	2009	4376
11	2010	4874
12	2011	4596
13	2012	4142
14	2013	4653
15	2014	4108
16	2015	5167
17	2016	4782



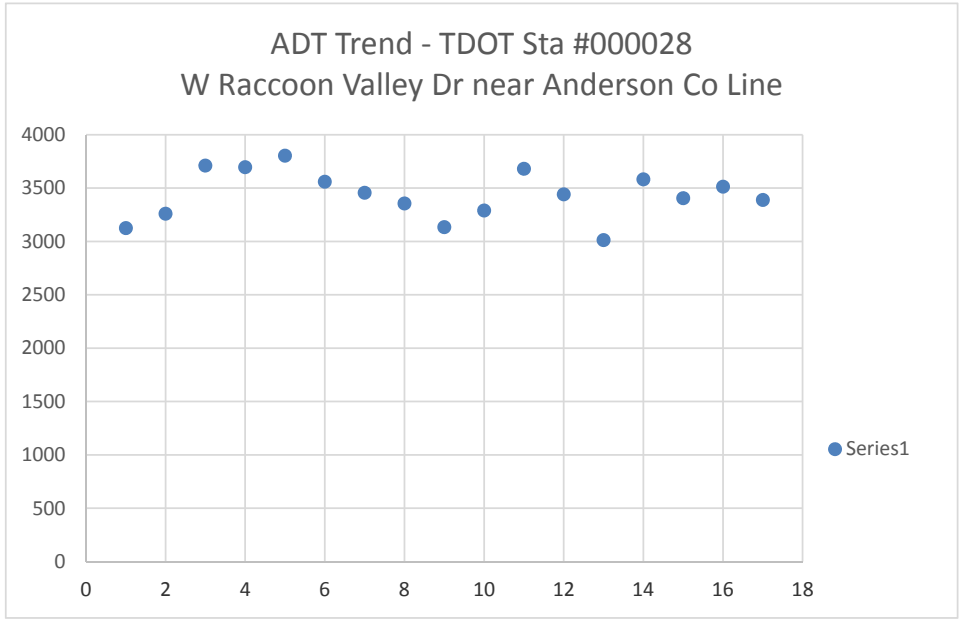
Most Recent Trend Line Growth

Year	ADT
2011	4596
2016	4782

Annual Percent Growth	0.27%

Attachment 2
ADT Trends

	Year	Adjusted Average Daily Traffic
1	2000	3126
2	2001	3260
3	2002	3712
4	2003	3696
5	2004	3804
6	2005	3560
7	2006	3457
8	2007	3356
9	2008	3135
10	2009	3290
11	2010	3681
12	2011	3442
13	2012	3013
14	2013	3583
15	2014	3406
16	2015	3514
17	2016	3390



Most Recent Trend Line Growth

Year	ADT
2000	3126
2016	3390

Annual Percent Growth	0.56%

Attachment 3
Trip Generation

Project: Avian Forest Subdivision **Attachment 3**
Date Conducted: 7/11/2017 **Trip Generation**

Single-Family Detached Housing - 93 Units
(Land Use 210)

Average Daily Traffic
Ln(T) = 0.92 Ln(X) + 2.72
Ln(T) = 0.92 Ln(93 units) + 2.72
T = 982

Peak Hour of Adjacent Street Traffic
One Hour Between 7 and 9 a.m.
T = 0.70(X) + 9.74
T = 0.70(93 units) + 9.74
T = 75

Peak Hour of Adjacent Street Traffic
One Hour Between 4 and 6 p.m.
Ln(T) = 0.90 Ln(X) +0.51
Ln(T) = 0.90 Ln(93 units) +0.51
T = 98

		Percent		Number	
Time Period	Total Trips	Enter	Exit	Enter	Exit
Weekday (24 hours)	982	50%	50%	491	491
AM Peak Hour	75	25%	75%	19	56
PM Peak Hour	98	63%	37%	62	36

Single-Family Detached Housing
(210)

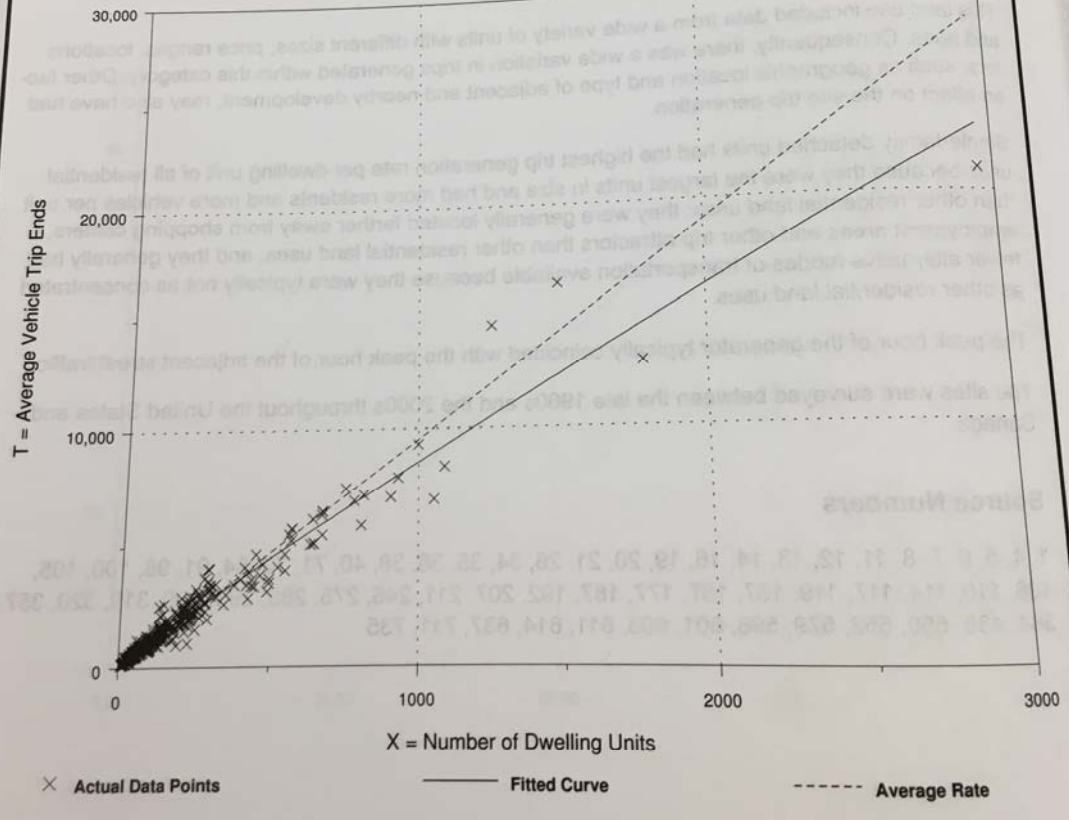
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

Number of Studies: 355
Avg. Number of Dwelling Units: 198
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
9.52	4.31 - 21.85	3.70

Data Plot and Equation



Fitted Curve Equation: $Ln(T) = 0.92\ Ln(X) + 2.72$

$R^2 = 0.95$

Single-Family Detached Housing
(210)

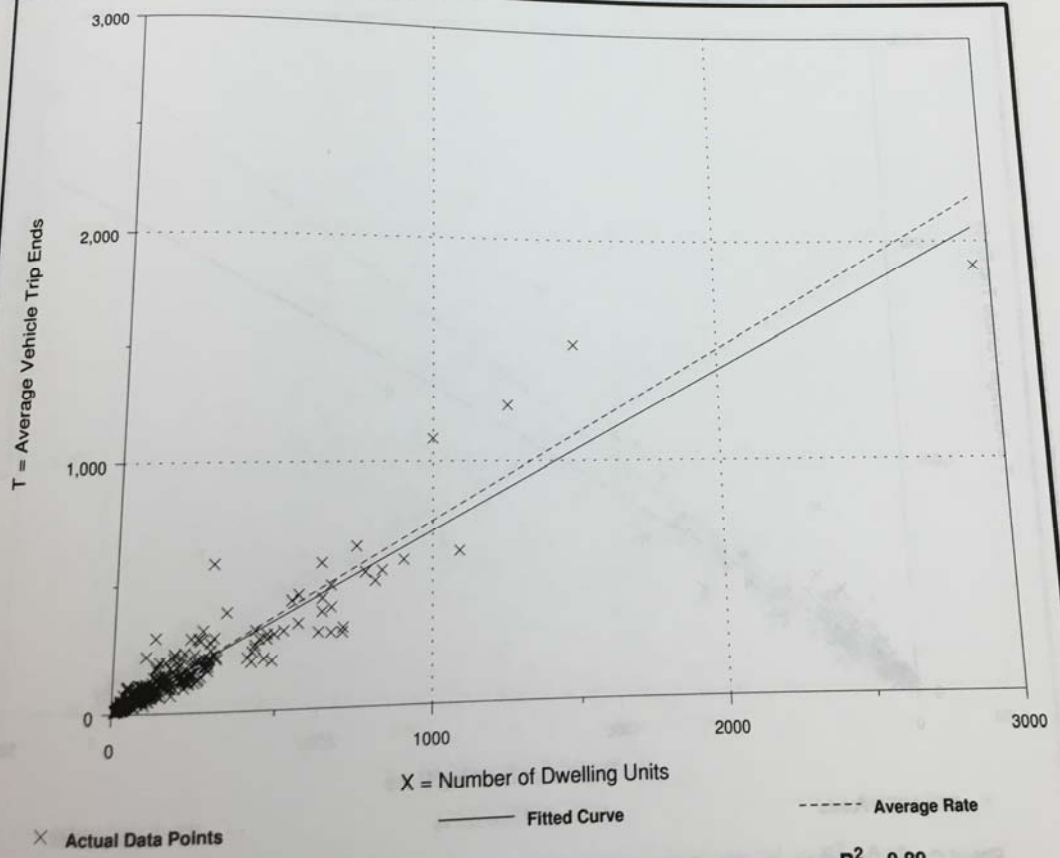
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Number of Studies: 292
Avg. Number of Dwelling Units: 194
Directional Distribution: 25% entering, 75% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.75	0.33 - 2.27	0.90

Data Plot and Equation



$R^2 = 0.89$

Fitted Curve Equation: T = 0.70(X) + 9.74

Single-Family Detached Housing
(210)

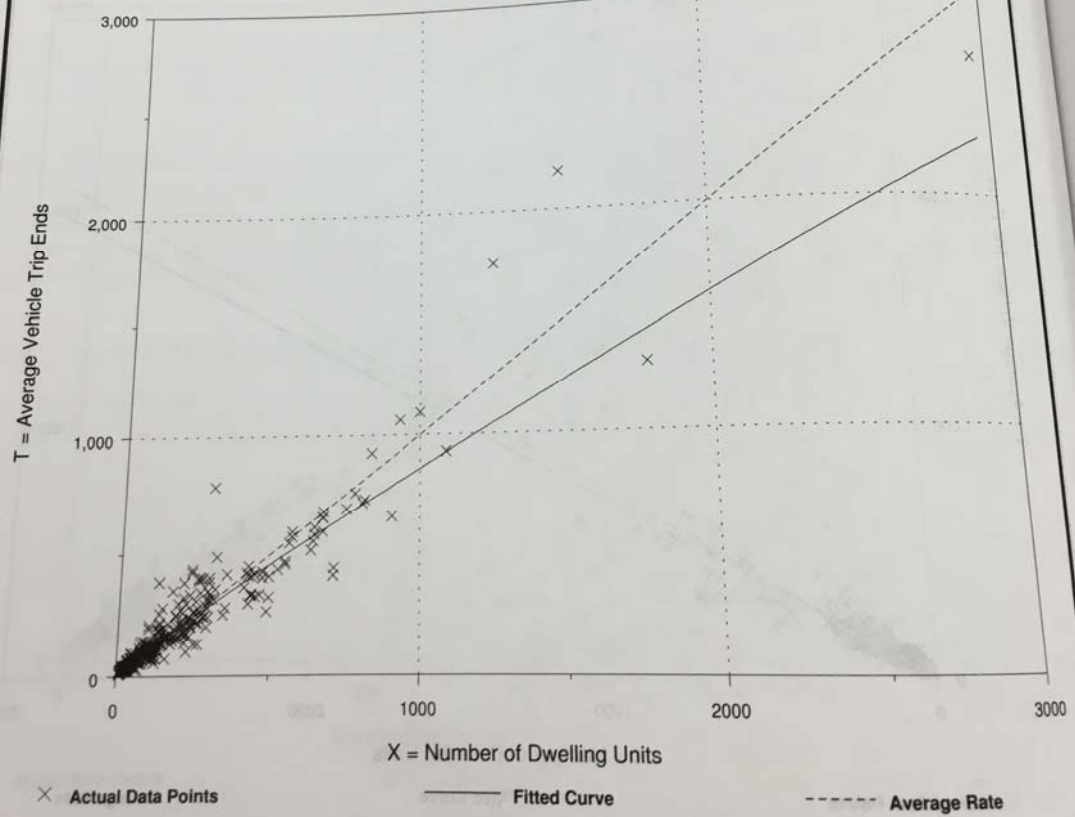
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

Number of Studies: 321
Avg. Number of Dwelling Units: 207
Directional Distribution: 63% entering, 37% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
1.00	0.42 - 2.98	1.05

Data Plot and Equation



Fitted Curve Equation: $Ln(T) = 0.90\ Ln(X) + 0.51$

$R^2 = 0.91$

Attachment 4
Intersection Worksheets
Existing AM/PM Peaks

HCS7 Two-Way Stop-Control Report

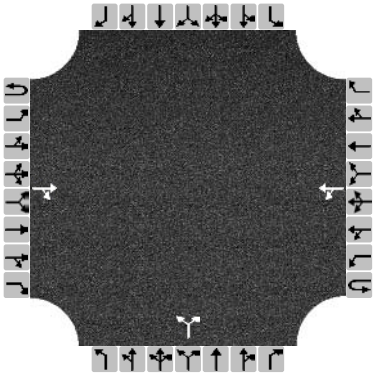
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	9/11/2017
Analysis Year	2017
Time Analyzed	Existing AM Peak
Intersection Orientation	East-West
Project Description	595.001 Avian Forest SD

Site Information

Intersection	E Rac Valley @ Rac Woods
Jurisdiction	Knox County
East/West Street	E Raccoon Valley Road
North/South Street	Raccoon Woods Road
Peak Hour Factor	0.85
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	0	0
Configuration				TR		LT					LR					
Volume, V (veh/h)			125	1		2	179			4		6				
Percent Heavy Vehicles (%)						2				2		2				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized		No				No				No				No		
Median Type/Storage			Undivided													

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.1		6.2				
Critical Headway (sec)						4.12				6.42		6.22				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.22				3.52		3.32				

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						2					12					
Capacity, c (veh/h)						1433					767					
v/c Ratio						0.00					0.02					
95% Queue Length, Q_{95} (veh)						0.0					0.0					
Control Delay (s/veh)						7.5					9.8					
Level of Service, LOS						A					A					
Approach Delay (s/veh)						0.1				9.8						
Approach LOS										A						

HCS7 Two-Way Stop-Control Report

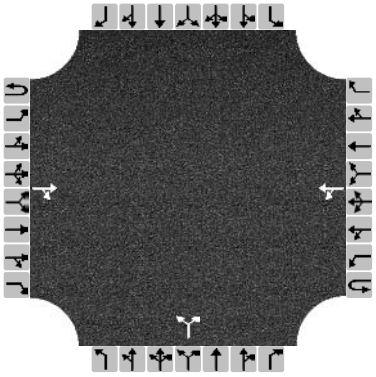
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	9/11/2017
Analysis Year	2017
Time Analyzed	Existing PM Peak
Intersection Orientation	East-West
Project Description	595.001 Avian Forest SD

Site Information

Intersection	E Rac Valley @ Rac Woods
Jurisdiction	Knox County
East/West Street	E Raccoon Valley Road
North/South Street	Raccoon Woods Road
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	0	0
Configuration				TR		LT					LR					
Volume, V (veh/h)			290	5		8	169			2		6				
Percent Heavy Vehicles (%)						2				2		2				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.1		6.2				
Critical Headway (sec)						4.12				6.42		6.22				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.22				3.52		3.32				

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						9					9					
Capacity, c (veh/h)						1239					662					
v/c Ratio						0.01					0.01					
95% Queue Length, Q_{95} (veh)						0.0					0.0					
Control Delay (s/veh)						7.9					10.5					
Level of Service, LOS						A					B					
Approach Delay (s/veh)						0.4				10.5						
Approach LOS										B						

Attachment 5
Intersection Worksheets
Background AM/PM Peaks

HCS7 Two-Way Stop-Control Report

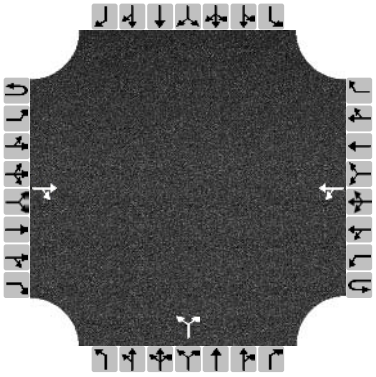
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	9/11/2017
Analysis Year	2020
Time Analyzed	Background AM Peak
Intersection Orientation	East-West
Project Description	595.001 Avian Forest SD

Site Information

Intersection	E Rac Valley @ Rac Woods
Jurisdiction	Knox County
East/West Street	E Raccoon Valley Road
North/South Street	Raccoon Woods Road
Peak Hour Factor	0.85
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	0	0
Configuration				TR		LT					LR					
Volume, V (veh/h)			129	1		2	184			4		6				
Percent Heavy Vehicles (%)						2				2		2				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized		No				No				No				No		
Median Type/Storage			Undivided													

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.1		6.2				
Critical Headway (sec)						4.12				6.42		6.22				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.22				3.52		3.32				

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						2					12					
Capacity, c (veh/h)						1427					760					
v/c Ratio						0.00					0.02					
95% Queue Length, Q_{95} (veh)						0.0					0.0					
Control Delay (s/veh)						7.5					9.8					
Level of Service, LOS						A					A					
Approach Delay (s/veh)						0.1				9.8						
Approach LOS										A						

HCS7 Two-Way Stop-Control Report

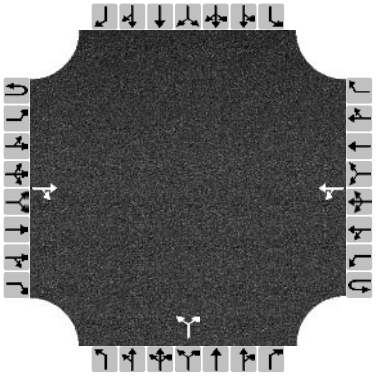
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	9/11/2017
Analysis Year	2020
Time Analyzed	Background PM Peak
Intersection Orientation	East-West
Project Description	595.001 Avian Forest SD

Site Information

Intersection	E Rac Valley @ Rac Woods
Jurisdiction	Knox County
East/West Street	E Raccoon Valley Road
North/South Street	Raccoon Woods Road
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	0	0
Configuration				TR		LT					LR					
Volume, V (veh/h)			299	5		8	174			2		6				
Percent Heavy Vehicles (%)						2				2		2				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.1		6.2				
Critical Headway (sec)						4.12				6.42		6.22				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.22				3.52		3.32				

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						9					9					
Capacity, c (veh/h)						1229					652					
v/c Ratio						0.01					0.01					
95% Queue Length, Q_{95} (veh)						0.0					0.0					
Control Delay (s/veh)						8.0					10.6					
Level of Service, LOS						A					B					
Approach Delay (s/veh)						0.4				10.6						
Approach LOS										B						

Attachment 6
Intersection Worksheets
Full Buildout AM/PM Peaks

HCS7 Two-Way Stop-Control Report

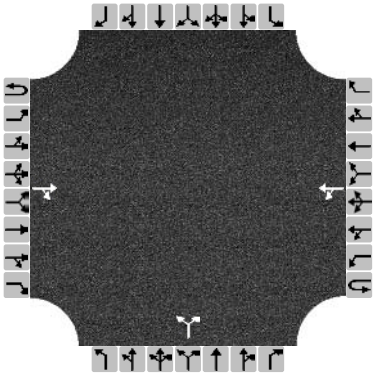
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	9/11/2017
Analysis Year	2020
Time Analyzed	Full Buildout AM Peak
Intersection Orientation	East-West
Project Description	595.001 Avian Forest SD

Site Information

Intersection	E Rac Valley @ Rac Woods
Jurisdiction	Knox County
East/West Street	E Raccoon Valley Road
North/South Street	Raccoon Woods Road
Peak Hour Factor	0.85
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	0	0
Configuration				TR		LT					LR					
Volume, V (veh/h)			163	1		2	197			4		6				
Percent Heavy Vehicles (%)						2				2		2				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized		No				No				No				No		
Median Type/Storage			Undivided													

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.1		6.2				
Critical Headway (sec)						4.12				6.42		6.22				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.22				3.52		3.32				

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						2					12					
Capacity, c (veh/h)						1379					713					
v/c Ratio						0.00					0.02					
95% Queue Length, Q_{95} (veh)						0.0					0.1					
Control Delay (s/veh)						7.6					10.1					
Level of Service, LOS						A					B					
Approach Delay (s/veh)						0.1					10.1					
Approach LOS											B					

HCS7 Two-Way Stop-Control Report

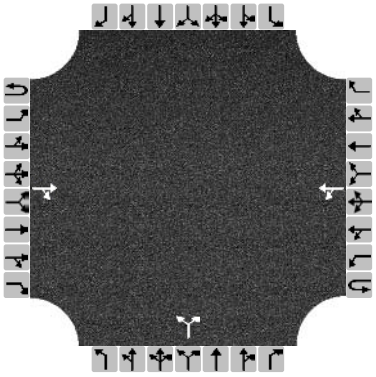
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	9/11/2017
Analysis Year	2020
Time Analyzed	Full Buildout PM Peak
Intersection Orientation	East-West
Project Description	595.001 Avian Forest SD

Site Information

Intersection	E Rac Valley @ Rac Woods
Jurisdiction	Knox County
East/West Street	E Raccoon Valley Road
North/South Street	Raccoon Woods Road
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	0	0
Configuration				TR		LT					LR					
Volume, V (veh/h)			326	5		8	212			2		6				
Percent Heavy Vehicles (%)						2				2		2				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.1		6.2				
Critical Headway (sec)						4.12				6.42		6.22				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.22				3.52		3.32				

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						9					9					
Capacity, c (veh/h)						1199					619					
v/c Ratio						0.01					0.01					
95% Queue Length, Q_{95} (veh)						0.0					0.0					
Control Delay (s/veh)						8.0					10.9					
Level of Service, LOS						A					B					
Approach Delay (s/veh)						0.4				10.9						
Approach LOS										B						

HCS7 Two-Way Stop-Control Report

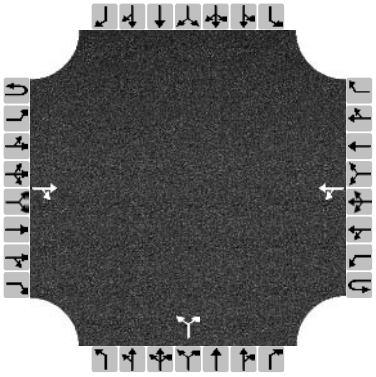
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	9/11/2017
Analysis Year	2020
Time Analyzed	Full Buildout AM Peak
Intersection Orientation	East-West
Project Description	595.001 Avian Forest SD

Site Information

Intersection	E Rac Valley @ Avian Fore
Jurisdiction	Knox County
East/West Street	E Raccoon Valley Road
North/South Street	Avian Forest Road
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	0	0
Configuration				TR		LT					LR					
Volume, V (veh/h)			130	6		13	188			22		34				
Percent Heavy Vehicles (%)						3				3		3				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized		No				No				No				No		
Median Type/Storage			Undivided													

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.1		6.2				
Critical Headway (sec)						4.13				6.43		6.23				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.23				3.53		3.33				

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						14					61					
Capacity, c (veh/h)						1426					762					
v/c Ratio						0.01					0.08					
95% Queue Length, Q_{95} (veh)						0.0					0.3					
Control Delay (s/veh)						7.5					10.1					
Level of Service, LOS						A					B					
Approach Delay (s/veh)						0.6				10.1						
Approach LOS										B						

HCS7 Two-Way Stop-Control Report

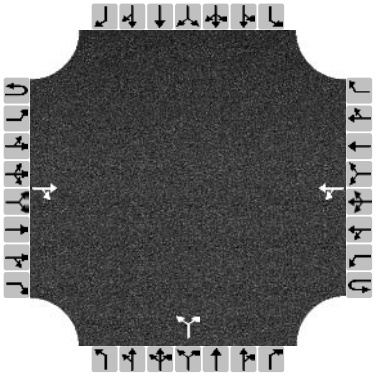
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	9/11/2017
Analysis Year	2020
Time Analyzed	Full Buildout PM Peak
Intersection Orientation	East-West
Project Description	595.001 Avian Forest SD

Site Information

Intersection	E Rac Valley @ Avian Fore
Jurisdiction	Knox County
East/West Street	E Raccoon Valley Road
North/South Street	Avian Forest Road
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	0	0
Configuration				TR		LT					LR					
Volume, V (veh/h)			304	24		38	176			9		27				
Percent Heavy Vehicles (%)						3				3		3				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized		No				No				No				No		
Median Type/Storage			Undivided													

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.1		6.2				
Critical Headway (sec)						4.13				6.43		6.23				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.23				3.53		3.33				

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						41					39					
Capacity, c (veh/h)						1196					605					
v/c Ratio						0.03					0.06					
95% Queue Length, Q_{95} (veh)						0.1					0.2					
Control Delay (s/veh)						8.1					11.4					
Level of Service, LOS						A					B					
Approach Delay (s/veh)						1.7				11.4						
Approach LOS										B						

Attachment 7
Turn Lane Warrant Analysis

Attachment 7
Turn Lane Warrant Analysis

Project: Avian Forest Subdivision

E Raccoon Valley Dr VOLUMES
at Avian Forest Road

LEFT TURN	Opposing	Thru	LT	LT MAX	Warrant Met
AM	136	188	13	180	NO
PM	328	176	38	90	NO

E Raccoon Valley Dr VOLUMES
at Avian Forest Road

RIGHT TURN	Thru	RT	RT MAX	Warrant Met
AM	130	6	449	NO
PM	304	24	249	NO

Raccoon Valley @ Avian Forest

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 - 149 150 - 199	13 LT AM Peak 200	180 140	140 105	110 90	80 70	70 60
200 - 249 250 - 299	160 130	115 100	85 75	75 65	65 60	55 50
300 - 349 350 - 399	38 LT PM Peak	90 80	70 65	60 55	55 50	45 40
400 - 449 450 - 499	90 80	70 65	60 55	50 45	45 40	35 30
500 - 549 550 - 599	70 65	60 55	45 40	35 35	35 30	25 25
600 - 649 650 - 699	60 55	45 35	35 35	30 30	25 25	25 20
700 - 749 750 or More	50 45	35 35	30 25	25 25	20 20	20 20

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

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

Raccoon Valley @ Avian Forest

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	6 RT AM Peak			24 RT PM Peak		
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	Yes 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.