TRAFFIC IMPACT STUDY

HATTIES PLACE SUBDIVISION – UNITS 2 & 3

BALL ROAD
KNOX COUNTY, TN

CCI PROJECT NO. 00773-0007

REV 2

PREPARED FOR
Southland Engineering
Consultants, LLC
4909 Ball Road,
Knoxville, TN 37931

SUBMITTED BY
CANNON & CANNON INC
CONSULTING ENGINEERS
FIELD SURVEYORS

JULY 13
2016

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BALL ROAD
KNOX COUNTY, TN

CCI PROJECT NO. 00773-0007

REVISION 2 (7/13/16)

This report replaces REV 1 of the traffic impact study report dated 6/1/16 prepared for this project in its entirety. The associated changes involved additional turn-lane warrant analysis, as well as various editorial corrections to the text and figures.

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EXECUTIVE SUMMARY

This report provides a summary of a traffic impact study that was performed for a proposed single-family residential development to be located along Ball Road just east of the intersection with Ball Camp Pike in West Knox County. The project site is located on the north side of Ball Road and the east side of Fitzgerald Road. The conceptual development plan for this project, Hatties Place Subdivision - Units 2 & 3, proposes a maximum of 125 single-family lots. Unit 1 of the subdivision is currently under construction and contains 64 lots. Once completed, the subdivision will have two access points on to Ball Road – one existing access at Hatties Place Road and a second located approximately 700 feet east of Hatties Place Road.

The purpose of this study was the evaluation of the traffic operational and safety impacts of the proposed residential development upon roadways in the vicinity of the site. Of particular interest were the intersections of Ball Road at the existing and proposed site entrances. Appropriate intersection evaluations were conducted at these locations for existing and future conditions, both with and without traffic volumes generated from the proposed residential development, in order to determine the anticipated impacts and to establish recommended measures to mitigate these impacts. These evaluations included intersection capacity analyses, corner sight distance reviews and others as appropriate.

The primary conclusion of this study is that the traffic generated from Units 1, 2, and 3 of the proposed single-family residential development will not have a significant impact on intersection capacity and operational conditions at the study intersections. Specifically, under existing and full site development conditions, the intersections of Ball Road and Hatties Place Road and Ball Road with proposed entrance Road "A" are anticipated to operate at very good levels-of-service of "B" or better during both the A.M. and P.M. peak hours. The following is a summary of other conclusions and recommendations that resulted from this study:

1. Intersection sight distances, once vegetation is removed at the existing and proposed subdivision entrances on Ball Road, will be more than adequate for the posted speed limit. These sight distances should be further maintained by ensuring any site landscaping or site signage is properly placed. The required vegetation removal is located along the north side of Ball Road, adjacent to the southern side of Unit 2. This vegetation must be removed and the grading along those lots performed such that sight distances of at least 400 feet are provided along Ball Road.
2. The proposed Road "A" should be provided with a minimum 30 inch standard STOP sign on its approach to the intersection with Ball Road.

INTRODUCTION & PURPOSE OF STUDY

This report provides a summary of a traffic impact study that was performed for a proposed single-family residential development to be located along Ball Road just east of the intersection with Ball Camp Pike in West Knox County. The project site is located on the north side of Ball Road and the east side of Fitzgerald Road. FIGURE 1 is a location map identifying the major roadways in the vicinity of the site.

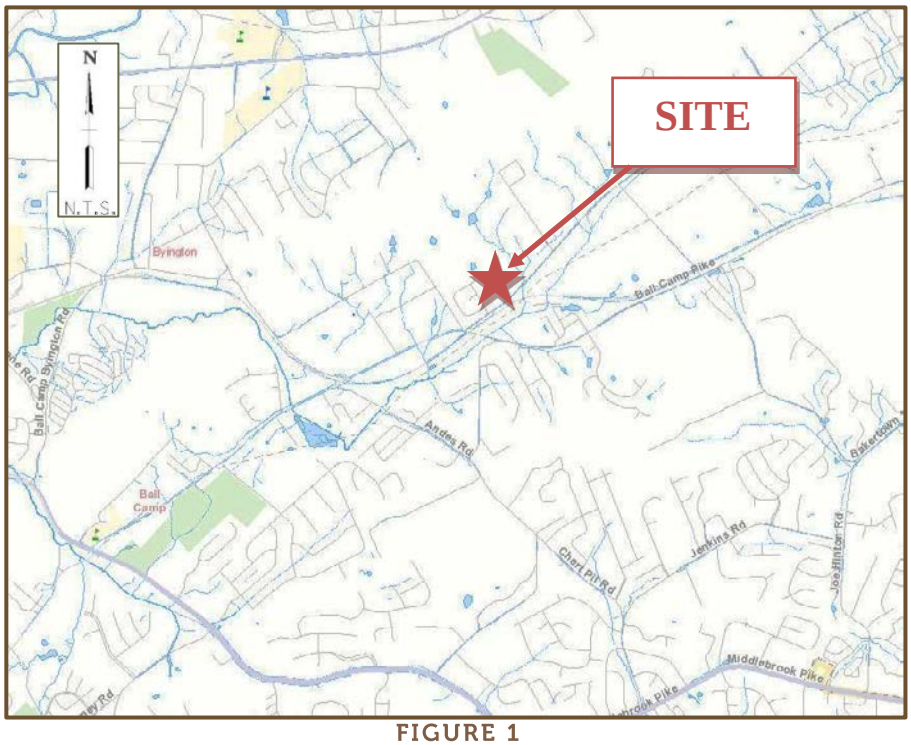


FIGURE 1
LOCATION MAP

The conceptual development plan for this project, Hatties Place Subdivision proposes a maximum of 189 single-family lots, 64 in Unit 1 which is currently under construction and 125 in Units 2 and 3. Once completed, the subdivision will have two access points on to Ball Road – one at the existing access at Hatties Place Road and a second located approximately 700 feet east of Hatties Place Road. FIGURE 2 is a Conceptual Site Plan which illustrates the proposed site configuration.

The purpose of this study was the evaluation of the traffic operational and safety impacts of the proposed residential development upon roadways in the vicinity of the site. Of particular interest were the intersections of Ball Road at the existing and proposed site entrances. Appropriate intersection evaluations were conducted at these locations for existing and future conditions, both with and without traffic volumes generated from the proposed residential development, in order to determine the anticipated impacts and to establish recommended measures to mitigate these impacts. These evaluations included intersection capacity analyses, corner sight distance reviews and others as appropriate.

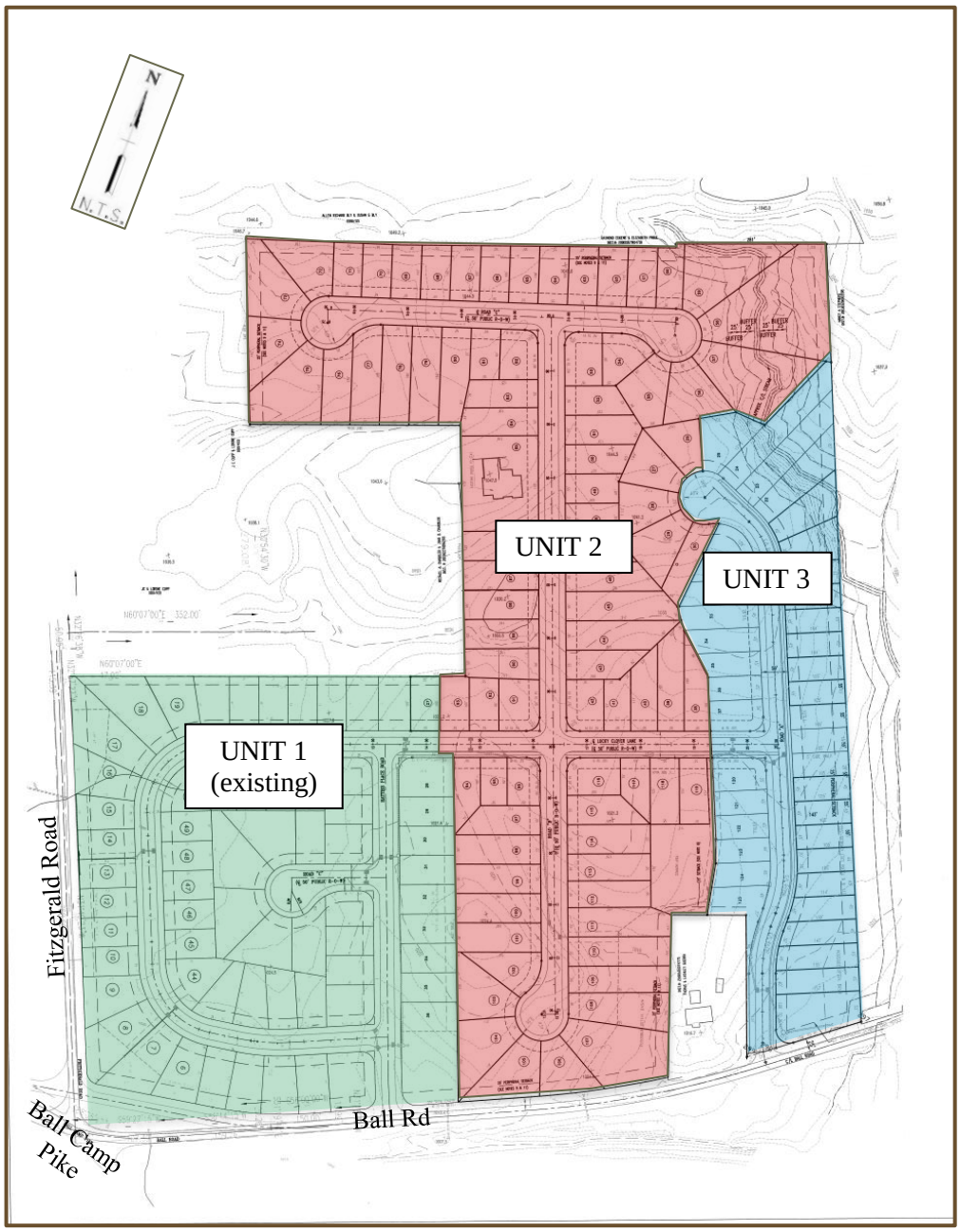


FIGURE 2
CONCEPTUAL SITE PLAN

EXISTING CONDITIONS

EXISTING ROADWAY CONDITIONS

Ball Road is a Major Collector roadway that provides east-west access between Ball Camp Pike to the west and Oak Ridge Highway to the east. In the vicinity of the proposed development, the roadway consists of one through travel lane in each direction, with total pavement widths of approximately 20 feet, and little or no shoulder. The speed limit on Ball Road is posted as 40 mph. The 2015 ADT on Ball Road was 5,753.

EXISTING SITE CONDITIONS

The existing site consists of approximately 28 acres for Units 2 & 3 of the development along with 13 acres in Unit 1. The site is bordered on all sides by undeveloped land and residential uses. Approximately 25% of the lots in Unit 1 appear to be currently occupied by residents. Numerous houses are currently under construction in Unit 1.

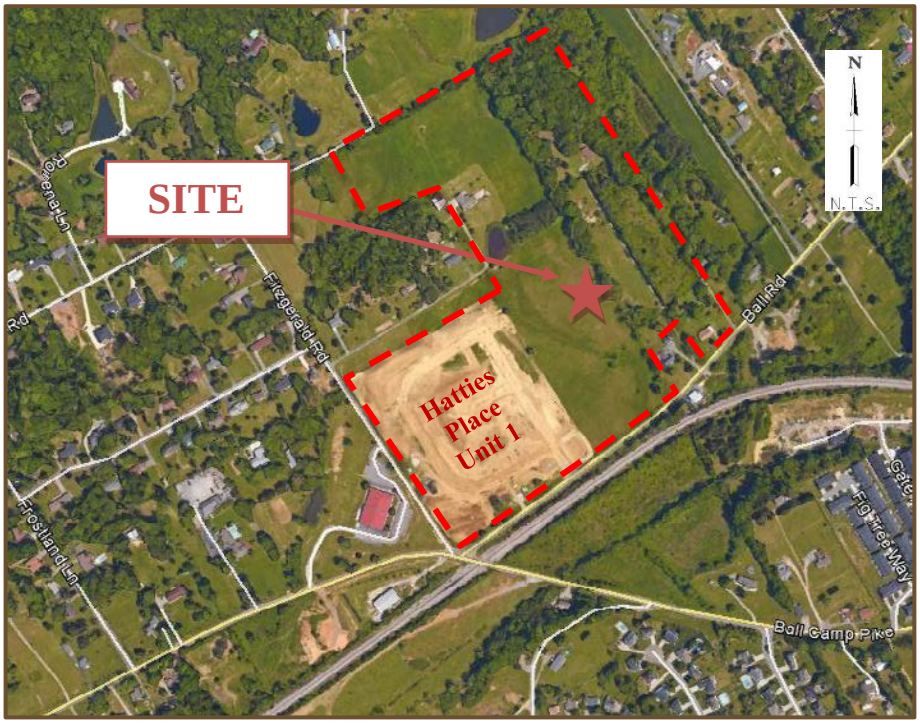


FIGURE 3
EXISTING SITE CONDITIONS

EXISTING TRAFFIC DATA

Existing traffic data was gathered for this study. The Metropolitan Planning Commission (MPC) and the Tennessee Department of Transportation (TDOT) collect annual average daily traffic data (AADT) on roadways in the study area. Two count stations were found near the project site that were felt to have particular relevance for this study. The most currently available data from these count stations are contained in TABLE 1.

TABLE 1
ANNUAL AVERAGE DAILY TRAFFIC COUNT SUMMARY

COUNT YEAR	TDOT COUNT STATION 079 BALL ROAD WEST OF RIDGEDALE	TDOT COUNT STATION 465 ANDES ROAD BTW BALL CAMP & CURETON
2015	5,753	4,238
2014	5,676	4,287
2013	6,022	4,031
2012	6,181	4,282
2011	5,352	3,875

In addition to the available ADT data, an intersection turning movement traffic count was conducted at the intersection of Ball Road and Hatties Place Road and was utilized to determine the current AM and PM peak hour operating volumes. The existing traffic count is summarized on FIGURE 4, and the raw data traffic count summary sheets are contained in the APPENDIX.

EXISTING CAPACITY ANALYSES / LEVELS-OF-SERVICE

Capacity analyses employing the methods of the Highway Capacity Manual (HCM2010) were conducted for the intersection of Ball Road and Hatties Place Road. The unsignalized capacity analyses were performed utilizing the 2016 existing traffic volumes, existing intersection traffic control, and lane configurations. Existing analyses indicate that the intersection is operating at an acceptable level-of-service (LOS) "B" during both the A.M. and P.M. peak traffic periods. The EVALUATIONS section of this report may be referenced for tabular summaries of these analyses, while more detailed summaries are presented on the computer printouts contained in the APPENDIX. Also contained in the APPENDIX is a section entitled "Capacity and Level of Service Concepts", which provides a description of the utilized procedures.

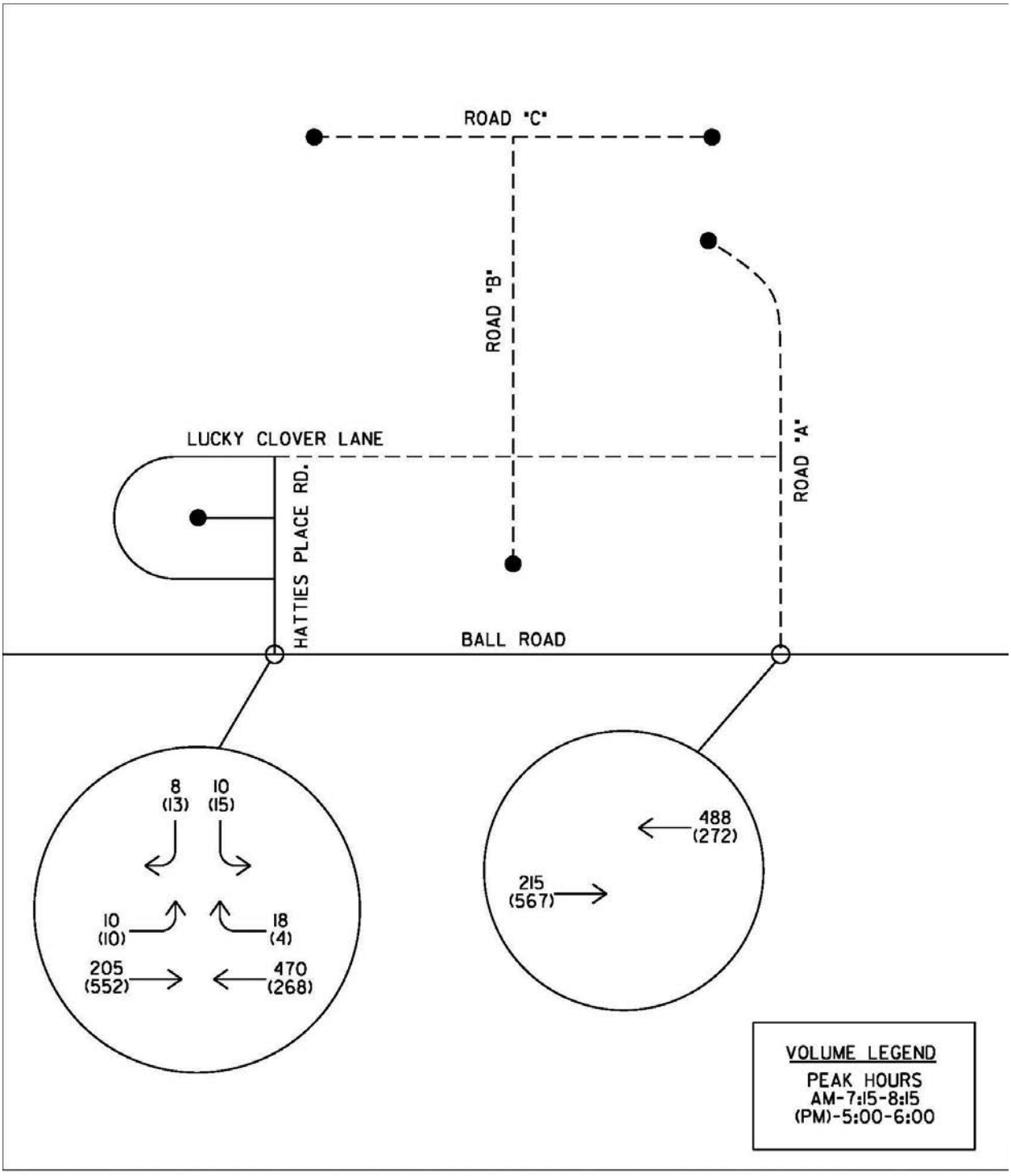


FIGURE 4
2016 EXISTING TRAFFIC VOLUMES

4.0 BACKGROUND CONDITIONS

BACKGROUND TRAFFIC GROWTH

Units 2 and 3 of the proposed single-family residential development are anticipated to be constructed in one general phase with anticipated completion in approximately six years. Therefore, year 2022 was established as the appropriate analysis year for this study. In order to determine traffic volumes resulting solely from background traffic growth to year 2022, it was necessary to establish an annual growth rate for existing traffic. The ADT values previously discussed, as well as knowledge of the area, were used to determine an approximate annual growth rate. Based on the available data, a background annual growth rate of 1.5% was assumed.

A new roadway is currently under design in the vicinity of this development that is anticipated to significantly reduce the through traffic volumes along Ball Road in the future. The Schaad Road Connector will be a multi-lane roadway extending from the intersection of Lovell Road and Ball Camp Pike to the existing western terminus of Schaad Road. Once completed, the Schaad Road Connector will complete a multi-lane corridor extending from Lovell Road to Oak Ridge Highway. The section of the new roadway from Lovell Road / Ball Camp Pike to its planned temporary terminus with Ball Camp Pike, just east of the proposed development, is anticipated to be completed within this study's background growth horizon. Traffic projections provided by the Knoxville MPC anticipate as much as an 80% reduction in through traffic volumes along Ball Road east of Ball Camp Pike once the new roadway is constructed. For the purposes of this study, only a 60% reduction in through traffic volumes along Ball Road was assumed. The background traffic volumes shown on FIGURE 5 represent Year 2022 background growth conditions without traffic related to Units 2 and 3 of the proposed single-family residential development and a 60% reduction in through traffic volumes on Ball Road due to the pending completion of the Schaad Road Connector.

Due to the amount of current construction related traffic associated with Unit 1 of this development, it was felt the existing turning movement volumes entering and exiting Hatties Place Road could be skewed. Therefore, for purposes of background traffic, all movements into and out of Hatties Place Road were eliminated. These will be addressed in the FUTURE CONDITIONS section by a complete trip generation of all project phases.

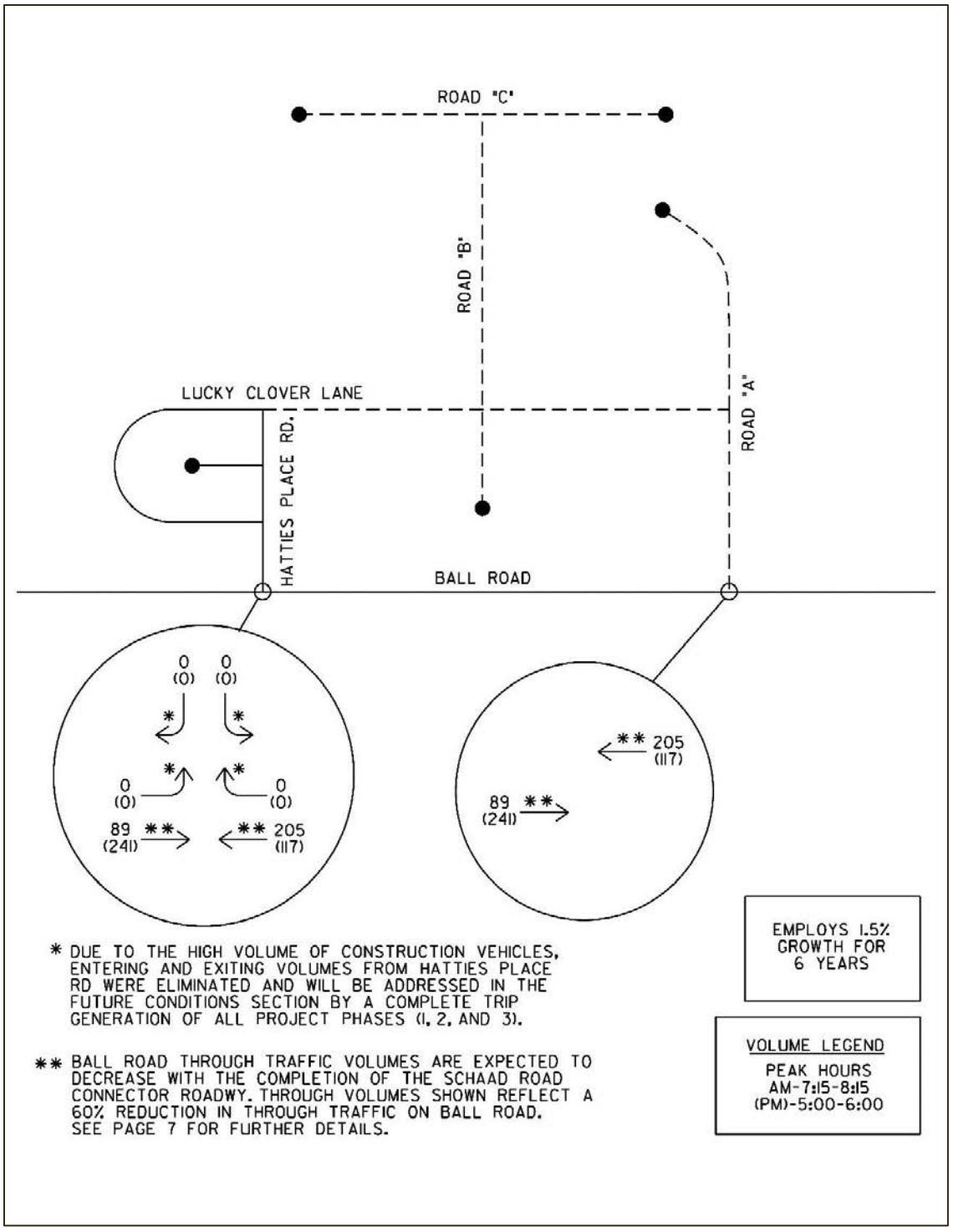


FIGURE 5
2022 BACKGROUND TRAFFIC VOLUMES

5.0 FUTURE CONDITIONS

TRIP GENERATION

In order to estimate the expected traffic volumes to be generated by the proposed development, the procedures recommended by the Institute of Transportation Engineers and Knox County were utilized. Trip generation rates developed by the Institute of Transportation Engineers for single family residential type developments were utilized to generate the estimated trips for the proposed development. The generated traffic volumes were determined based on the data for the peak hours of adjacent street traffic. See TABLE 2 for a summary of the traffic generated for this project. More detailed information is contained in the APPENDIX.

TABLE 2
TRIP GENERATION SUMMARY

LAND USE	ITE CODE	SIZE	WEEKDAY (TRIPS/DAY)	AM PEAK HOUR (TRIPS/HR)	PM PEAK HOUR (TRIPS/HR)
Hatties Place Subdivision (Units 1, 2, 3)					
Single Family Residential	210	189 Units	1886	143	187
Entering Trips			943	36	118
Exiting Trips			943	107	69

TRIP DISTRIBUTION AND ASSIGNMENT

FIGURE 6 provides a summary of the trip distribution patterns assumed for this study. These patterns were based on the existing traffic patterns derived from the traffic counts, as well as knowledge of the area. A distribution pattern of approximately 70/30 was assumed for this study with 70% destined to / from the west and 30% to / from the east.

FIGURE 7 provides a summary of the anticipated trips as assigned to the study intersections utilizing the trip generation data from TABLE 2 and the distribution patterns shown on FIGURE 6. Trip assignments for Unit 2 were handled differently than Units 1 and 3, since Unit 2 of the development does not have direct access to Ball Road. For Units 1 and 3, 100% of the lots were assumed to utilize the entrance located in their part of the development. For Unit 2, depending on individual lot location and desired destination, a resident of Unit 2 may choose to utilize either Hatties Place Road through Unit 1 of the development or proposed Road "A" through Unit 3. For this reason an assumption was made that 85% of Unit 2 would utilize the entrance that is "toward" their destination direction, i.e., those destined to the west of the development will utilize the western entrance, Hatties Place Road, and those destined to the east will utilize the eastern entrance, proposed Road "A". Recognizing that there will be some cases, either due to lot location or preference, where irregardless of the ultimate destination the preferred access will be via Road "A" through Unit 3. It was assumed that 15% of Unit 2 would utilize proposed Road "A" as their primary access irregardless of their destination.

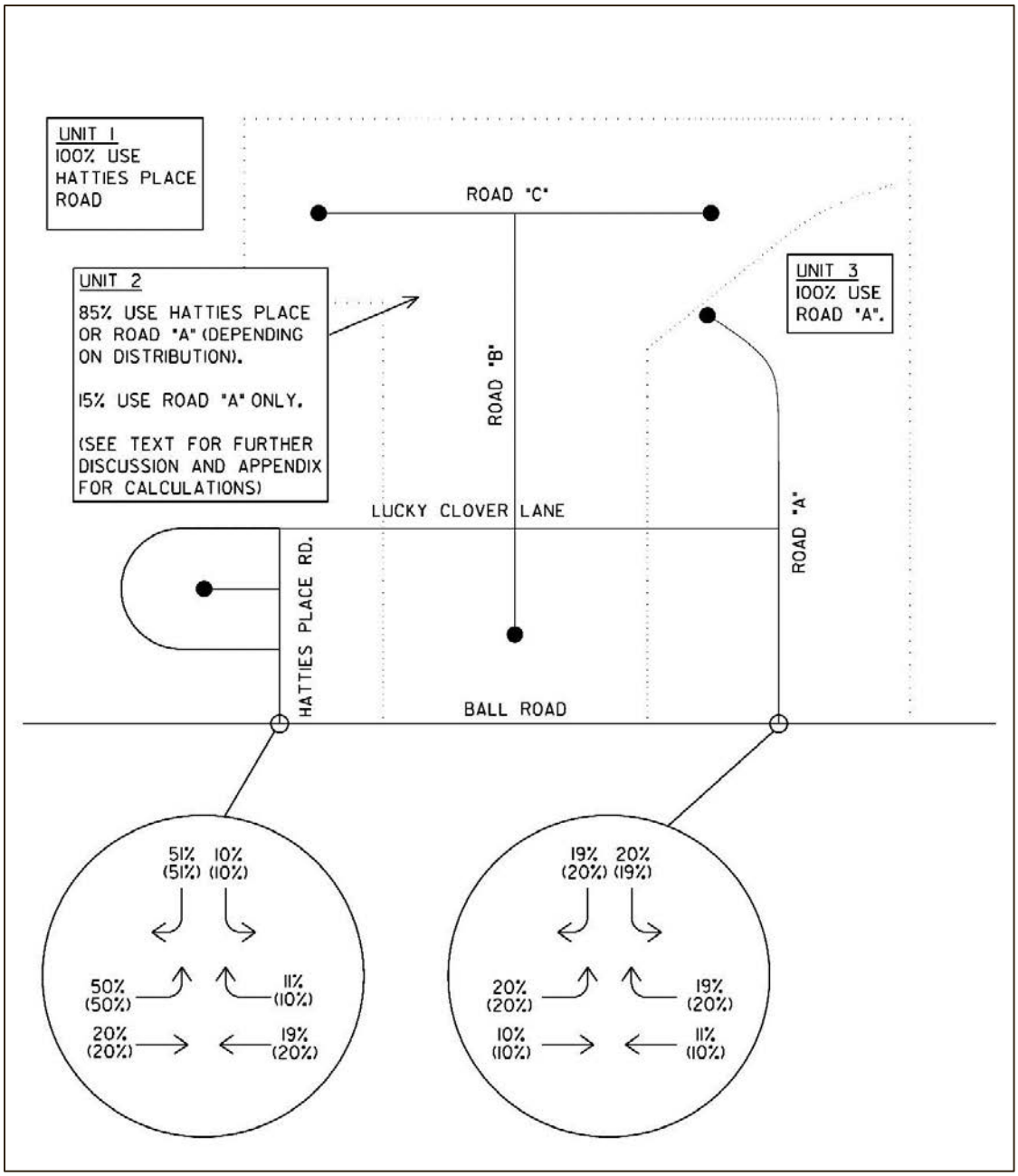


FIGURE 6
TRIP DISTRIBUTION PATTERNS

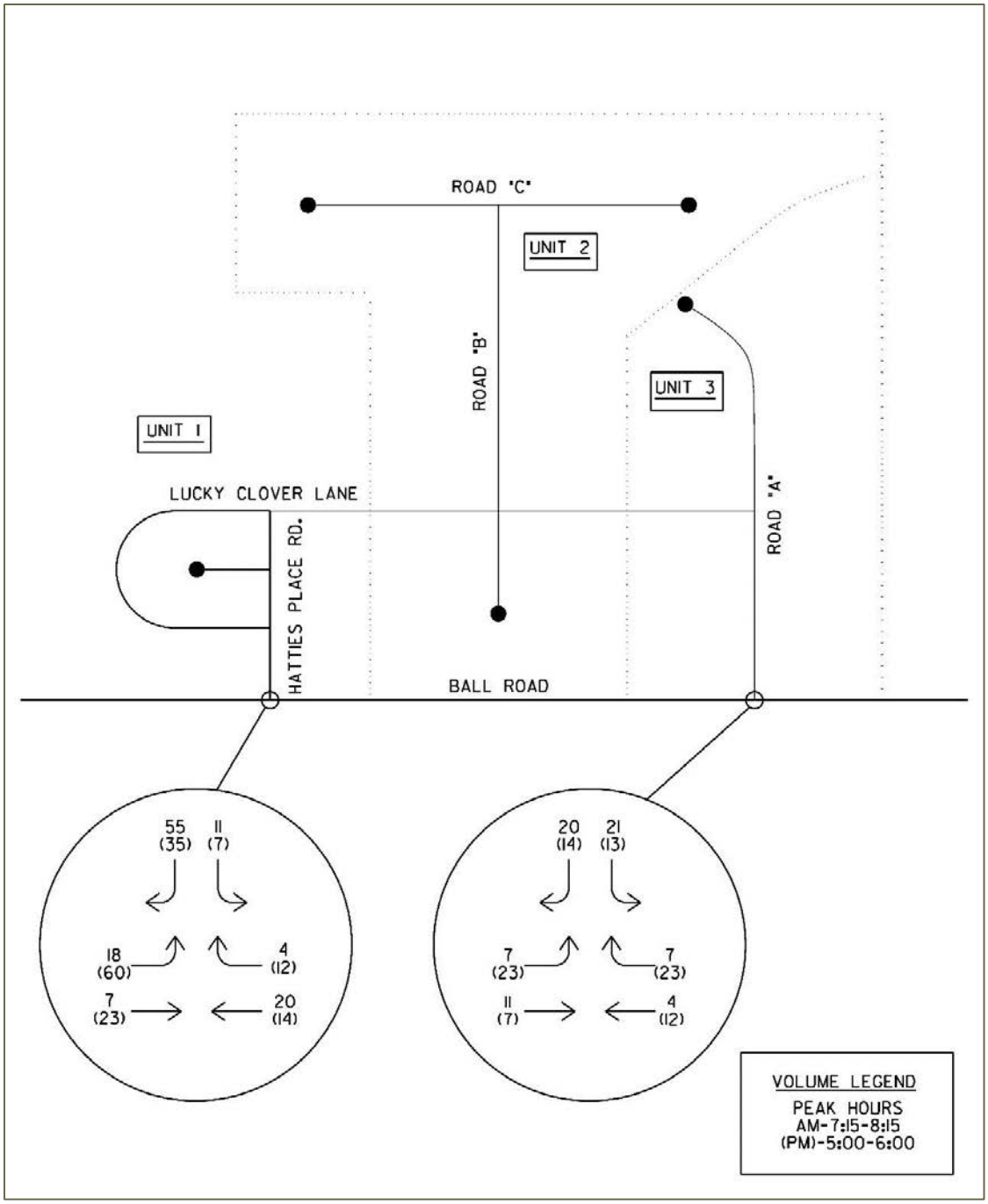


FIGURE 7
GENERATED TRIPS

Future projected traffic volumes were developed by adding the generated trips shown in FIGURE 7 to the 2022 background traffic volumes developed in the previous section (Figure 5). These combined year 2022 volumes reflect the existing traffic, the background traffic growth, and the newly generated traffic from the proposed development. FIGURE 8 represents the 2022 combined traffic data with trips generated from the proposed development. The volumes shown in FIGURE 8 are the combined volumes used in the analysis of the future conditions.

FUTURE CAPACITY ANALYSES / LEVELS-OF-SERVICE

Capacity analyses as described in the Existing Conditions section of this report were conducted for 2022 full build-out conditions utilizing the Year 2022 combined volumes shown in FIGURE 8, and side street STOP control at the proposed two site entrance intersections onto Ball Road. Unsignalized capacity analysis indicate that the intersection of Ball Road and Hatties Place Road is anticipated to continue to operate at an acceptable LOS "B" during both the A.M. and P.M. peak hours.

The unsignalized capacity analyses for the intersection of Ball Road and proposed Road "A" indicate a side street LOS "B" during both the A.M. and P.M. peak hours. The EVALUATIONS section of this report may be referenced for tabular summaries of these analyses, while more detailed summaries are presented on the computer printouts contained in the APPENDIX.

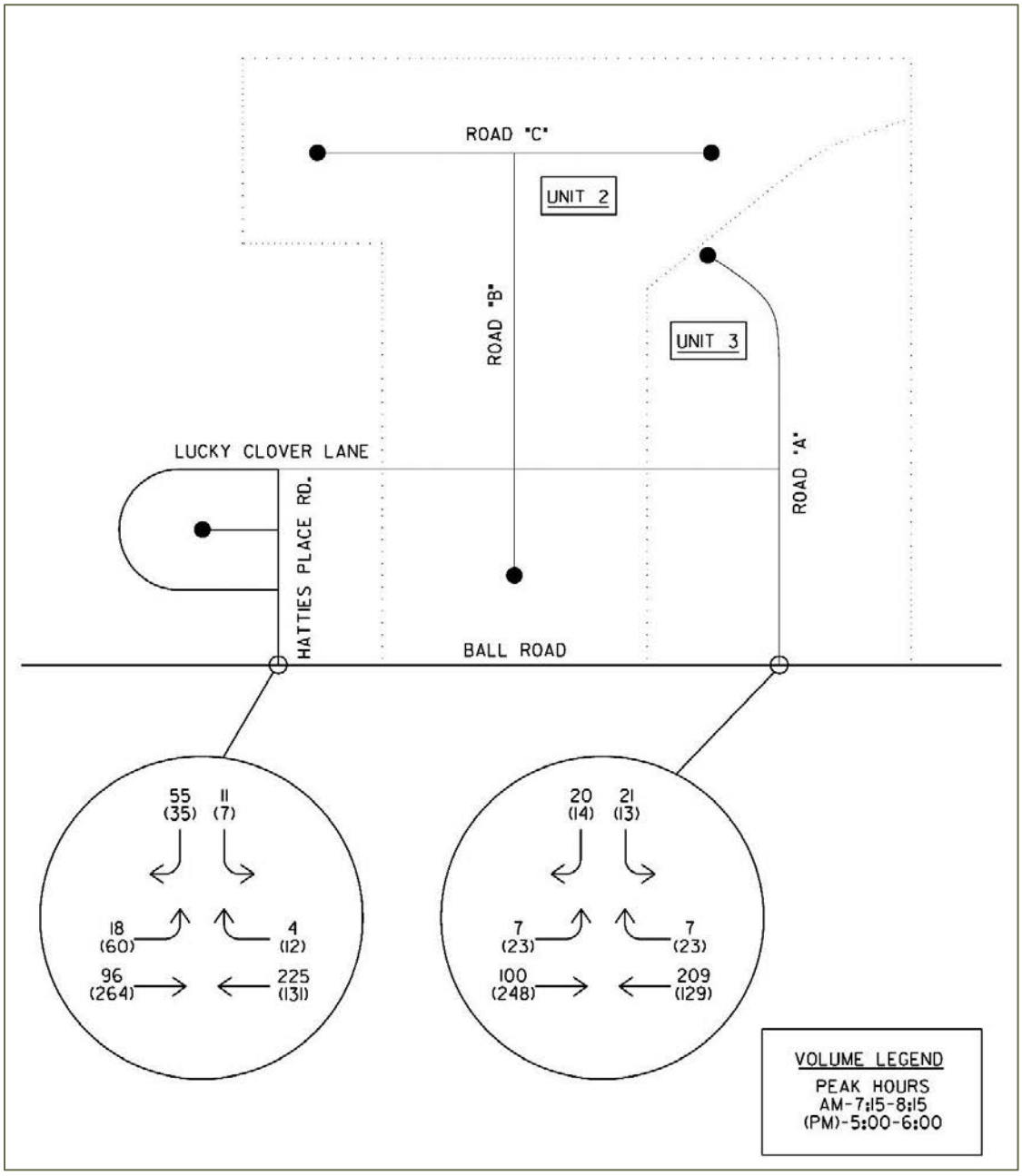


FIGURE 8
2022 COMBINED TRAFFIC DATA

6.0 EVALUATIONS

INTERSECTION CAPACITY ANALYSES:

As discussed in the preceding sections of this report, capacity analyses employing the methods of the Highway Capacity Manual (HCM) were conducted for the study intersections. These analyses were performed for existing and anticipated 2022 combined traffic conditions. Existing and proprosed geometry and traffic control were used in the analyses of the intersections of Ball Road and the development entrances. A summary of the capacity analysis results for the Year 2016 Existing Conditions, and Year 2022 Combined Conditions is shown in TABLE 3. Background analyses were not conducted since the side street existing volumes were not included in the background traffic volumes (Figure 5).

TABLE 3
CAPACITY ANALYSIS SUMMARY

INTERSECTION	TIME PERIOD	YEAR 2016 EXISTING (LOS/DELAY)	YEAR 2022 BACKGROUND (LOS/DELAY)	YEAR 2022 PROJECTED (LOS/DELAY)
Ball Road at Hatties Place Road	A.M.	B 13.6	-	B 10.2
(SIDE-STREET STOP)[1]	P.M.	B 14.4	-	B 10.0
Ball Road at Proposed Road "A"	A.M.	-	-	B 10.3
(SIDE-STREET STOP)[1]	P.M.	-	-	B 10.6

[1]SIDE STREET STOP CONTROL – Level-of-Service and Average Vehicular Delay (seconds) for side street approach utilizing HCM methodology.
See APPENDIX for detailed computer print-out summaries and discussion of Capacity and Level-of-Service concepts.

As shown in TABLE 3, the subdivision entrances onto Ball Road are anticipated to operate at a good levels-of-service of "B" or better. This existing and proposed entrances have one entering and one exiting travel lane.

TURN LANE ASSESSMENT

Left and right turn-lane warrants were evaluated for the two subdivision entrance intersections with Ball Road under Year 2022 Combined conditions. These analyses employed Tables 5A and 5B from the Knox County Access Control and Driveway Design Policy, which is based on turn lane warrants developed by Harmelink. The Year 2022 Combined conditions assumes a 60% reduction in Ball Road traffic will occur once the Schaad Road Connector roadway is completed. Under these conditions the results were that turn lanes are not warranted at either intersection.

Given the uncertainty of the amount of traffic that will divert from Ball Road to the new Schaad Road facility in the future, various diversion scenarios were evaluated to determine at what level turn lanes might be warranted. It was found that at a level of 40% reduction in Ball Road background traffic an eastbound left-turn lane would be warranted at the existing intersection of Hatties Place Road. The turn lane warrant worksheets are located in the APPENDIX and a summary is shown in TABLE 4.

TABLE 4
TURN LANE WARRANT SUMMARY

INTERSECTION	AM PEAK			PM PEAK		
	BALL ROAD DIVERTED TRAFFIC			BALL ROAD DIVERTED TRAFFIC		
	60%	40%	0%	60%	40%	0%
Hatties Place Road						
Left-turn lane warranted?	NO	NO	NO	NO	YES	YES
Right-turn lane warranted?	NO	NO	NO	NO	NO	NO
Road A						
Left-turn lane warranted?	NO	NO	NO	NO	NO	NO
Right-turn lane warranted?	NO	NO	NO	NO	NO	NO

SIGHT DISTANCE ASSESSMENT

Intersection sight distance was assessed looking both directions along Ball Road from the proposed eastern subdivision entrance intersection (Road A), as well as at the existing western entrance (Hatties Place Road). The speed limit along Ball Road is 40 mph, so the minimum required sight distance to oncoming traffic is 400 feet. At the proposed eastern subdivision entrance (Road A) the sight distance field assessment found a sight distance in excess of 500 feet looking to the left (east) and approximately 300 feet looking to the right (west). Due to existing vegetation located west of the proposed subdivision entrance (Road "A"), the actual sight distance could not be determined. By utilizing available topographic data from KGIS, it is estimated that when the vegetation is removed a sight distance of 400^{+} feet will be available.

Sight distance estimates at the existing western entrance (Hatties Place Road) were found to be approximately 350 feet looking to the left (east) and 500 feet to the right (west). The sight distance looking to the left (east) from Hatties Place Road was restricted due to the presence of a few small trees / brush along the side of Ball Road. If this vegetation were to be removed it is estimated the available sight distance would be improved to approximately 450 feet. Photographs of existing sight distances are shown in FIGURE 11. Care should be taken during the site development to ensure that site landscaping and signage does not restrict intersection sight distance views.

Sight distance looking east along Ball Road from proposed eastern entrance (Road A) is greater than 500'.

Sight distance looking west along Ball Road from proposed eastern entrance (Road A) is is approximately 300'.

Sight distance looking east along Ball Road from existing western entrance (Hatties Place Road) is approximately 350'.

Sight distance looking west along Ball Road from existing western entrance (Hatties Place Road) is approximately 500'.

FIGURE 9
SIGHT DISTANCE ASSESSMENT

7.0 CONCLUSIONS & RECOMMENDATIONS

The primary conclusion of this study is that the traffic generated from Units 2 and 3 of the proposed single-family residential development will not have a significant impact on intersection capacity and operational conditions at the study intersections. Specifically, under existing and full site development conditions, the intersections of Ball Road and Hatties Place Road and Ball Road with proposed entrance Road "A" are anticipated to operate at very good levels-of-service of "B" or better during both the A.M. and P.M. peak hours.

The following is a summary of other conclusions and recommendations that resulted from this study:

1. Intersection sight distances, once vegetation is removed at the existing and proposed subdivision entrances on Ball Road, will be more than adequate for the posted speed limit. These sight distances should be further maintained by ensuring any site landscaping or site signage is properly placed. The required vegetation removal is located along the north side of Ball Road, adjacent to the southern side of Unit 2. This vegetation must be removed and the grading along those lots performed such that sight distances of at least 400 feet are provided along Ball Road.
2. The proposed Road "A" should be provided with a minimum 30 inch standard STOP sign on its approach to the intersection with Ball Road.

8.0 APPENDIX

APPENDIX A | TRAFFIC DATA

APPENDIX B | TRIP GENERATION

APPENDIX C | ANALYSES

APPENDIX A | TRAFFIC DATA

Traffic History

Station #	County	Location	Route #
000079	Knox	WEST OF RIDGEDALE	01252

Record	Year	AADT
1	2014	5676
2	2013	6022
3	2012	6181
4	2011	5352
5	2010	6247
6	2009	6480
7	2008	7071
8	2007	6865
9	2006	7982
10	2005	7275
11	2004	8069
12	2003	7902
13	2002	5210
14	2001	4833
15	2000	5814
16	1999	4371
17	1998	4110
18	1997	4096
19	1996	4031
20	1995	4587
21	1994	3528
22	1993	4024
23	1992	3613
24	1991	3832
25	1990	3364
26	1989	2865
27	1988	2965

COVERAGE COUNT DATA WITH 24 HOUR TOTALS

Station Number:	000079	**County:**	47 Knox
Start Date:	02 / 09 / 2015	**End Date:**	02 / 10 / 2015
Start Time:	12 : 00	**End Time:**	12 : 00
Direction:	0 (Coverage)		

Time	
12:00 - 13:00	284
13:00 - 14:00	317
14:00 - 15:00	358
15:00 - 16:00	390
16:00 - 17:00	498
17:00 - 18:00	635
18:00 - 19:00	424
19:00 - 20:00	233
20:00 - 21:00	189
21:00 - 22:00	128
22:00 - 23:00	67
23:00 - 24:00	37
24:00 - 01:00	24
01:00 - 02:00	12
02:00 - 03:00	6
03:00 - 04:00	14
04:00 - 05:00	38
05:00 - 06:00	80
06:00 - 07:00	204
07:00 - 08:00	476
08:00 - 09:00	462
09:00 - 10:00	285
10:00 - 11:00	279
11:00 - 12:00	259

Total: 5,699x Variation Factor: 1.03 = 5,870 x Truck Factor: 0.98 = AADT: 5,752.57

Peak AM	Peak Total	Peak Hour Factor	Peak PM	Peak Total	Peak Hour Factor
07:15 - 08:15	518	0.93	17:00 - 18:00	635	0.90

Peak AM %	Dir Dist AM %	Peak PM %	Dir Dist PM %	Daily Peak %	Daily Dir Dist %
9	65	11	65	11	65

Traffic History

Station #	County	Location	Route #
000465	Knox	ANDES RD.-BETWEEN BALL CAMP & CURETON RD.	05619

Record	Year	AADT
1	2014	4287
2	2013	4031
3	2012	4282
4	2011	3875
5	2010	3999

COVERAGE COUNT DATA WITH 24 HOUR TOTALS

Station Number:	000465	**County:**	47 Knox
Start Date:	02 / 09 / 2015	**End Date:**	02 / 10 / 2015
Start Time:	12 : 00	**End Time:**	12 : 00
Direction:	0 (Coverage)		

Time	
12:00 - 13:00	215
13:00 - 14:00	233
14:00 - 15:00	282
15:00 - 16:00	336
16:00 - 17:00	362
17:00 - 18:00	450
18:00 - 19:00	322
19:00 - 20:00	169
20:00 - 21:00	140
21:00 - 22:00	103
22:00 - 23:00	61
23:00 - 24:00	34
24:00 - 01:00	18
01:00 - 02:00	4
02:00 - 03:00	16
03:00 - 04:00	10
04:00 - 05:00	16
05:00 - 06:00	56
06:00 - 07:00	124
07:00 - 08:00	451
08:00 - 09:00	308
09:00 - 10:00	195
10:00 - 11:00	192
11:00 - 12:00	186

Total: 4,283x Variation Factor: 1.02 = 4,369 x Truck Factor: 0.97 = AADT: 4,237.60

Peak AM	Peak Total	Peak Hour Factor	Peak PM	Peak Total	Peak Hour Factor
07:15 - 08:15	480	0.88	16:45 - 17:45	452	0.84

Peak AM %	Dir Dist AM %	Peak PM %	Dir Dist PM %	Daily Peak %	Daily Dir Dist %
11	65	11	65	11	65

Cannon & Cannon, Inc.
Consulting Engineers - Field Surveyors
8550 Kingston Pike
Knoxville, TN 37919

CCI Project Name: Halties Place TIS
CCI Project Number: 773-0007
Intersection: Ball @ Halties Place
Counted By: CCI

File Name : Ball_Halties Place_am_5-5-16
Site Code : 00000002
Start Date : 5/5/2016
Page No : 1

Groups Printed- Unshifted

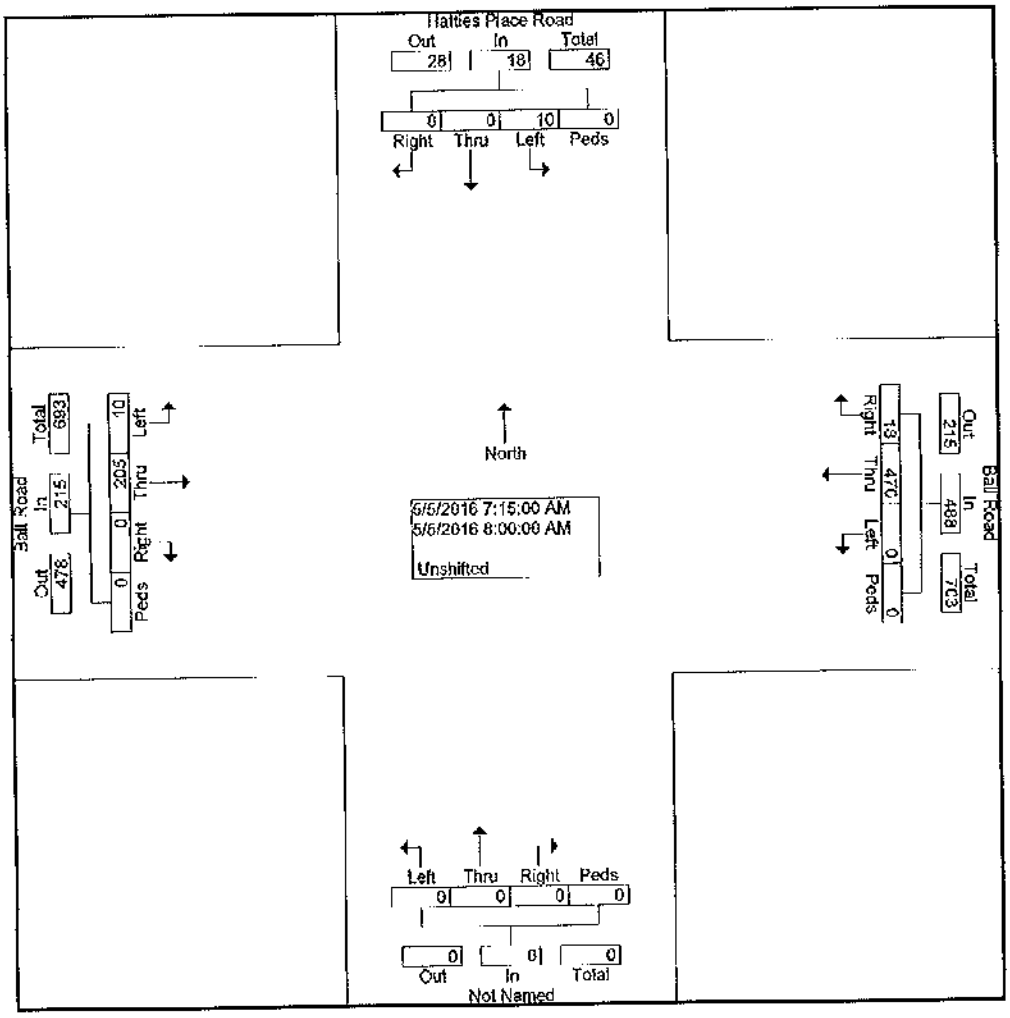
	Halties Place Road Southbound					Ball Road Westbound					Northbound					Ball Road Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:15 AM	1	0	4	0	5	0	118	5	0	123	0	0	0	0	0	1	49	0	0	50	178
07:30 AM	2	0	1	0	3	0	131	6	0	137	0	0	0	0	0	2	45	0	0	47	187
07:45 AM	3	0	1	0	4	0	105	3	0	108	0	0	0	0	0	2	59	0	0	61	173
Total	6	0	6	0	12	0	354	14	0	368	0	0	0	0	0	5	153	0	0	158	538
08:00 AM	4	0	2	0	6	0	116	4	0	120	0	0	0	0	0	5	52	0	0	57	183
Grand Total	10	0	8	0	18	0	470	18	0	488	0	0	0	0	0	10	205	0	0	215	721
Apprch %	55.6	0.0	44.4	0.0		0.0	96.3	3.7	0.0		0.0	0.0	0.0	0.0		4.7	95.3	0.0	0.0		
Total %	1.4	0.0	1.1	0.0	2.5	0.0	65.2	2.5	0.0	67.7	0.0	0.0	0.0	0.0	0.0	1.4	28.4	0.0	0.0	29.8	

Cannon & Cannon, Inc.
Consulting Engineers - Field Surveyors
8550 Kingston Pike
Knoxville, TN 37919

CCI Project Name: Hatties Place TIS
CCI Project Number: 773-0007
Intersection: Ball @ Hatties Place
Counted By: CCI

File Name : Ball_Hatties Place_am_5-5-16
Site Code : 00000002
Start Date : 5/5/2016
Page No : 2

	Hatties Place Road Southbound					Ball Road Westbound					Northbound					Ball Road Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 07:15 AM to 08:00 AM - Peak 1 of 1																					
Intersection	07:15 AM																				
Volume	10	0	8	0	18	0	470	18	0	488	0	0	0	0	0	10	205	0	0	215	721
Percent	55.6	0.0	44.4	0.0		0.0	96.3	3.7	0.0		0.0	0.0	0.0	0.0		4.7	95.3	0.0	0.0		
07:30 Volume	2	0	1	0	3	0	131	6	0	137	0	0	0	0	0	2	45	0	0	47	187
Peak Factor																					0.964
High Int.	08:00 AM					07:30 AM					7:00:00 AM					07:45 AM					
Volume	4	0	2	0	6	0	131	6	0	137	0	0	0	0	0	2	59	0	0	61	
Peak Factor					0.750					0.891										0.881	



Cannon & Cannon, Inc.
Consulting Engineers - Field Surveyors
8550 Kingston Pike
Knoxville, TN 37919

CCI Project Name: Hatties Place TIS
CCI Project Number: 773-0007
Intersection: Ball @ Hatties Place
Counted By: CCI

File Name : Ball_Hatties Place_pm_5-4-16
Site Code : 00000002
Start Date : 5/4/2016
Page No : 1

Groups Printed- Unshifted

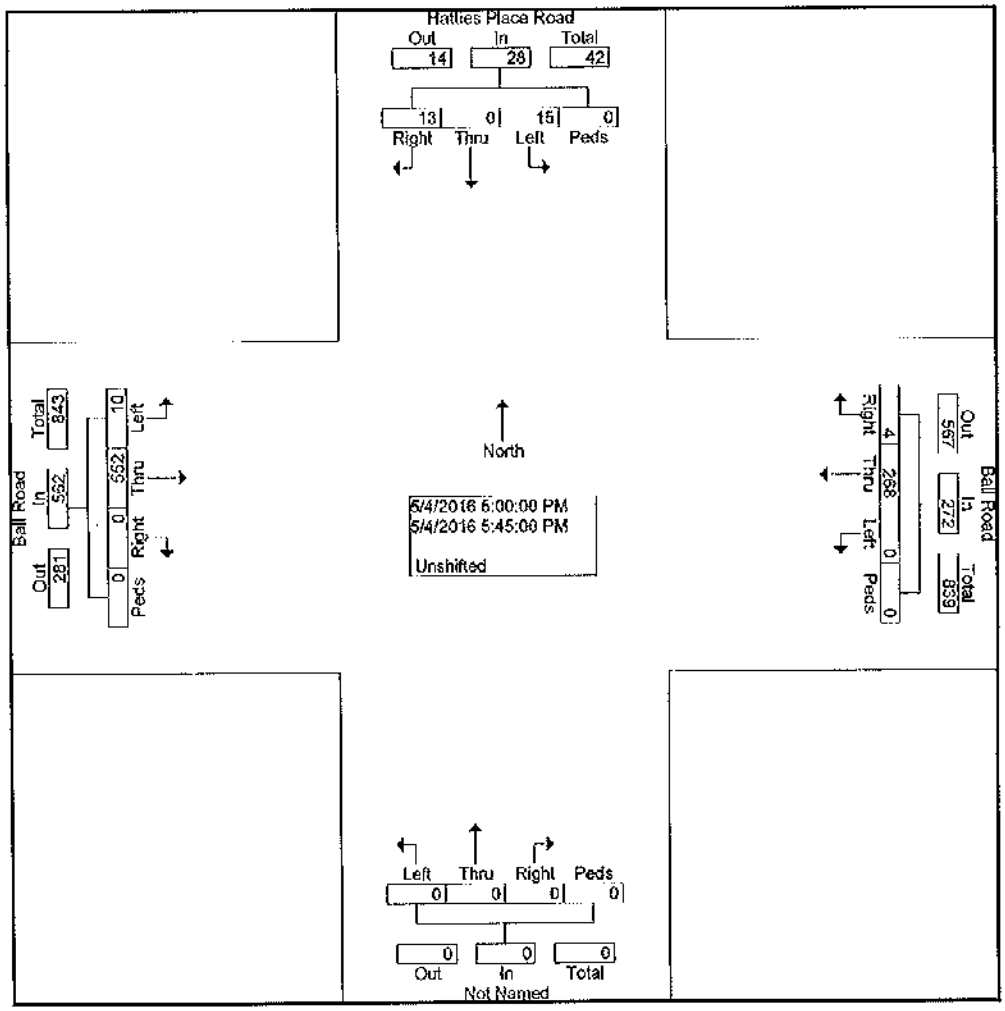
	Hatties Place Road Southbound					Ball Road Westbound					Northbound					Ball Road Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
05:00 PM	6	0	4	0	10	0	66	0	0	66	0	0	0	0	0	2	138	0	0	140	216
05:15 PM	3	0	3	0	6	0	70	2	0	72	0	0	0	0	0	4	152	0	0	156	234
05:30 PM	5	0	3	0	8	0	61	0	0	61	0	0	0	0	0	1	150	0	0	151	220
05:45 PM	1	0	3	0	4	0	71	2	0	73	0	0	0	0	0	3	112	0	0	115	192
Total	15	0	13	0	28	0	268	4	0	272	0	0	0	0	0	10	552	0	0	562	862
Grand Total	15	0	13	0	28	0	268	4	0	272	0	0	0	0	0	10	552	0	0	562	862
Apprch %	53.6	0.0	46.4	0.0		0.0	98.5	1.5	0.0		0.0	0.0	0.0	0.0		1.8	98.2	0.0	0.0		
Total %	1.7	0.0	1.5	0.0	3.2	0.0	31.1	0.5	0.0	31.6	0.0	0.0	0.0	0.0	0.0	1.2	64.0	0.0	0.0	65.2	

Cannon & Cannon, Inc.
Consulting Engineers - Field Surveyors
8550 Kingston Pike
Knoxville, TN 37919

CCI Project Name: Hatties Place TIS
CCI Project Number: 773-0007
Intersection: Ball @ Hatties Place
Counted By: CCI

File Name : Ball_Hatties Place_pm_5-4-16
Site Code : 00000002
Start Date : 5/4/2016
Page No : 2

	Hatties Place Road Southbound					Ball Road Westbound					Northbound					Ball Road Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 05:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection	05:00 PM																				
Volume	15	0	13	0	28	0	268	4	0	272	0	0	0	0	0	10	552	0	0	562	862
Percent	53.6	0.0	46.4	0.0		0.0	98.5	1.5	0.0		0.0	0.0	0.0	0.0		1.8	98.2	0.0	0.0		
05:15 Volume	3	0	3	0	6	0	70	2	0	72	0	0	0	0	0	4	152	0	0	156	234
Peak Factor																					0.921
High Int.	05:00 PM					05:45 PM					4:45:00 PM					05:15 PM					
Volume	6	0	4	0	10	0	71	2	0	73	0	0	0	0	0	4	152	0	0	156	
Peak Factor					0.700					0.932										0.901	



APPENDIX B | TRIP GENERATION

Land Use: 210
Single-Family Detached Housing

Description

Single-family detached housing includes all single-family detached homes on individual lots. A typical site surveyed is a suburban subdivision.

Additional Data

The number of vehicles and residents had a high correlation with average weekday vehicle trip ends. The use of these variables was limited, however, because the number of vehicles and residents was often difficult to obtain or predict. The number of dwelling units was generally used as the independent variable of choice because it was usually readily available, easy to project and had a high correlation with average weekday vehicle trip ends.

This land use included data from a wide variety of units with different sizes, price ranges, locations and ages. Consequently, there was a wide variation in trips generated within this category. Other factors, such as geographic location and type of adjacent and nearby development, may also have had an effect on the site trip generation.

Single-family detached units had the highest trip generation rate per dwelling unit of all residential uses because they were the largest units in size and had more residents and more vehicles per unit than other residential land uses; they were generally located farther away from shopping centers, employment areas and other trip attractors than other residential land uses; and they generally had fewer alternative modes of transportation available because they were typically not as concentrated as other residential land uses.

The peak hour of the generator typically coincided with the peak hour of the adjacent street traffic.

The sites were surveyed between the late 1960s and the 2000s throughout the United States and Canada.

Source Numbers

1, 4, 5, 6, 7, 8, 11, 12, 13, 14, 16, 19, 20, 21, 26, 34, 35, 36, 38, 40, 71, 72, 84, 91, 98, 100, 105, 108, 110, 114, 117, 119, 157, 167, 177, 187, 192, 207, 211, 246, 275, 283, 293, 300, 319, 320, 357, 384, 435, 550, 552, 579, 598, 601, 603, 611, 614, 637, 711, 735

Single-Family Detached Housing
(210)

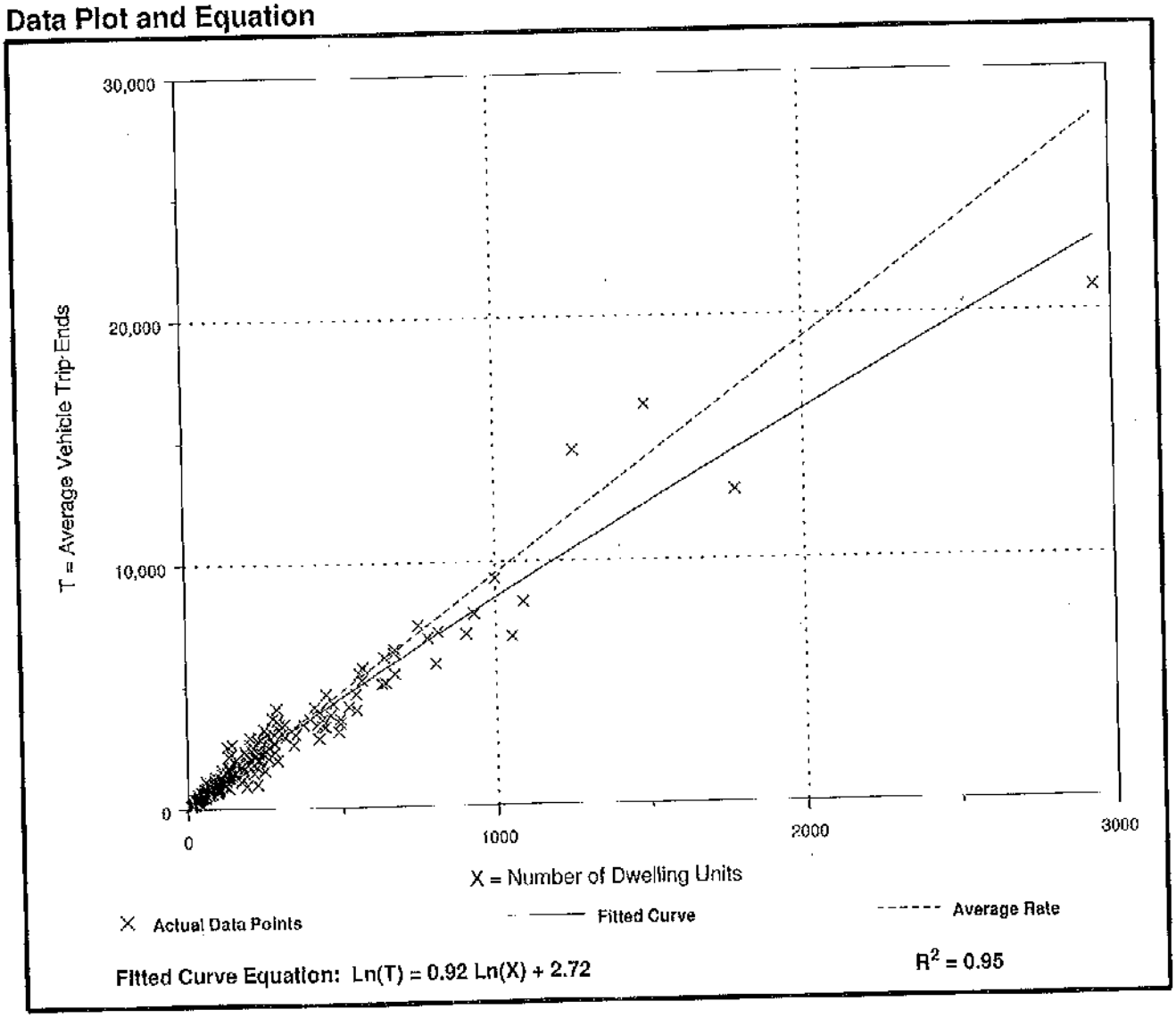
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

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)

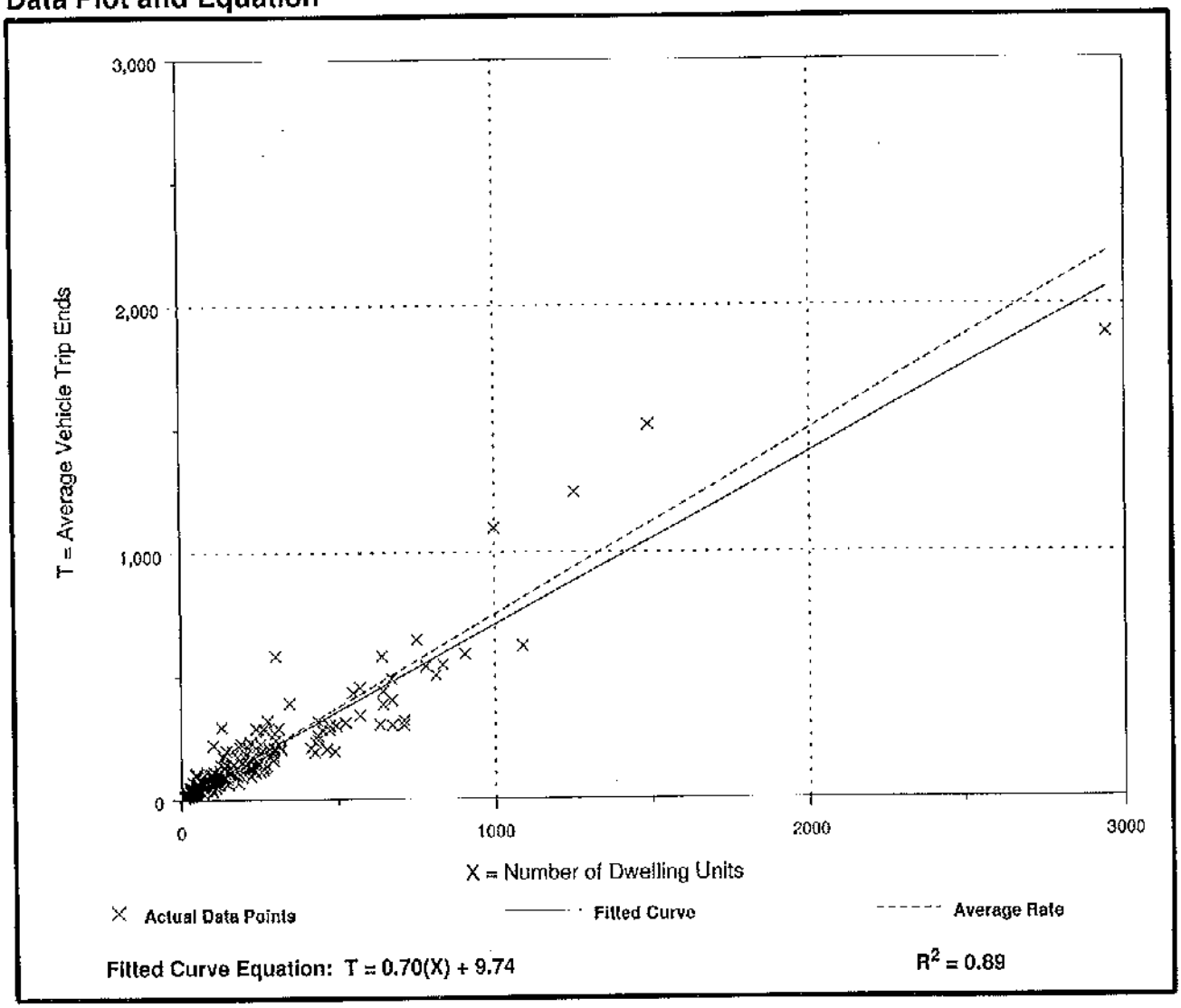
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

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



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

R^2 = 0.89

Single-Family Detached Housing
(210)

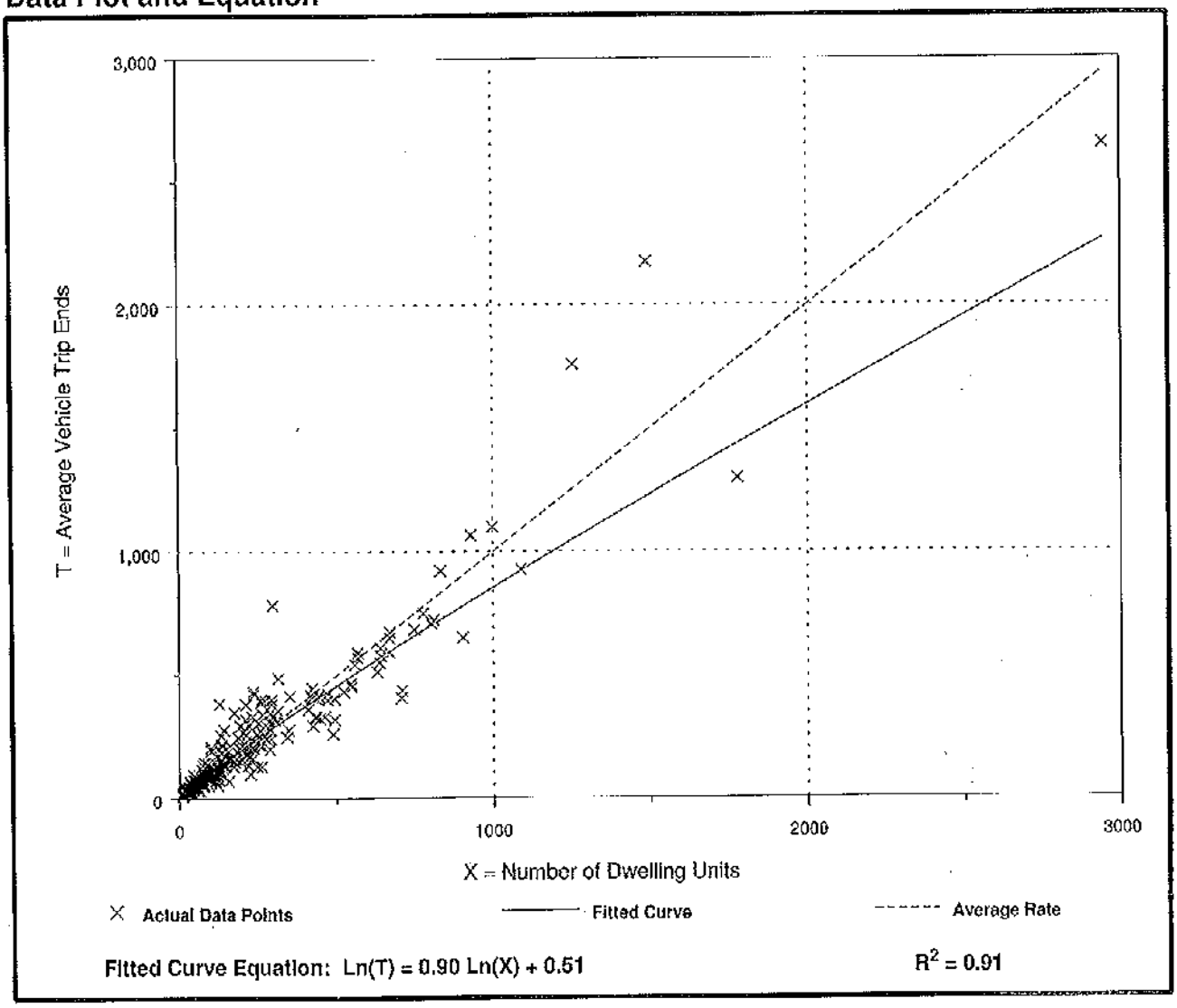
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

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

$R^2 = 0.91$

CANNON & CANNON INC
CONSULTING ENGINEERS · FIELD SURVEYORS

TRIP GENERATION

Hattie's Place Subdivision
Proj. No. 00773-0007

Land Use: Land Use: Single Family Residential
Land Use Code: Land Use Code: 210

Units 1,2 and 3

189 DWELLING UNITS

WEEKDAY

T = e^(.92*Ln(X)+2.71)
T = 1886

50%	ENTERING =	943 trips
50%	EXITING =	943 trips
	TOTAL =	1886 trips

AM PEAK HOUR

T = .7*(X)+9.74
T = 143

25%	ENTERING =	36 trips
75%	EXITING =	107 trips
	TOTAL =	143 trips

PM PEAK HOUR

T = .9*Ln(X)+.51
T = 187.00

63%	ENTERING =	118 trips
37%	EXITING =	69 trips
	TOTAL =	187 trips

Hatties Place TIS Trip Distribution and Assignments
00773-0007

	WHOLE PROJECT		PHASE 1		PHASE 2		PHASE 3		CHECK FOR TOTAL	
	189 Units		64 Units		87 Units		38 Units		189 Units	
	100%		34%		46%		20%		100%	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
ENTER	36	118	12	40	17	54	7	24	36	118
EXIT	107	69	37	23	49	32	21	14	107	69
TOTAL	143	187	49	63	66	86	28	38	143	187

	PHASE 2		PHASE 2		PHASE 2		CHECK FOR TOTAL	
	87 Units		74 Units		13 Units		87 Units	
	100%		85%		15%		100%	
	AM	PM	AM	PM	AM	PM	AM	PM
ENTER	16.56	54.28	14.076	46.138	2.484	8.142	16.56	54.28
EXIT	49.22	31.74	41.837	26.979	7.383	4.761	49.22	31.74
TOTAL	65.78	86.02	55.913	73.117	9.867	12.903	65.78	86.02

	AM		PM	
	70%	30%	70%	30%
ENTER	10	4	32	14
EXIT	29	13	19	8
TOTAL	39	17	51	22

56 73

"70%" use Hatties Place Rd / "30%" use Road A

AM	66
PM	86

	AM		PM	
	70%	30%	70%	30%
	2	1	6	2
	5	2	4	1
	7	3	10	3

10 13

Road A Only

	PHASE 1			
	AM		PM	
	70%	30%	70%	30%
ENTER	8	4	28	12
EXIT	26	11	16	7
TOTAL	34	15	44	19

49 63

Hatties Place Road Only

	PHASE 2			
	AM		PM	
	70%	30%	70%	30%
ENTER	5	2	17	7
EXIT	15	6	10	4
TOTAL	20	8	27	11

28 38

Road A Only

APPENDIX C | ANALYSES

CAPACITY AND LEVEL-OF-SERVICE CONCEPTS

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

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

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

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

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

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

HCS 2010 Two-Way Stop Control Summary Report

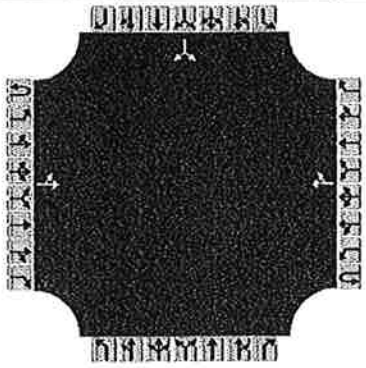
General Information

Analyst	RCB
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	5/9/2016
Analysis Year	2016
Time Analyzed	A.M. Existing
Intersection Orientation	East-West
Project Description	Hatties Place Subdivision

Site Information

Intersection	Ball Rd at Hatties Place
Jurisdiction	Knox County
East/West Street	Ball Road
North/South Street	Hatties Place Road
Peak Hour Factor	0.95
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	0	0		0	0	0
Configuration		LT						TR							LR	
Volume (veh/h)		10	205				470	18						10		8
Percent Heavy Vehicles		3												3		3
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		227													19	
Capacity		1045													439	
v/c Ratio		0.22													0.04	
95% Queue Length		0.0													0.1	
Control Delay (s/veh)		8.5													13.6	
Level of Service (LOS)		A													B	
Approach Delay (s/veh)	0.5												13.6			
Approach LOS	A												B			

HCS 2010 Two-Way Stop Control Summary Report

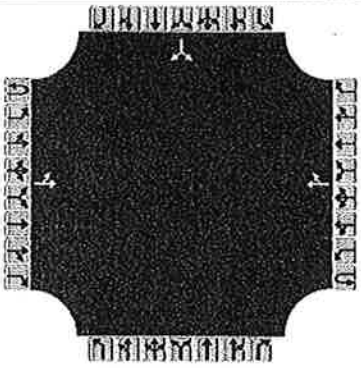
General Information

Analyst	RCB
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	5/9/2016
Analysis Year	2016
Time Analyzed	P.M. Existing
Intersection Orientation	East-West
Project Description	Hatties Place Subdivision

Site Information

Intersection	Ball Rd at Hatties Place
Jurisdiction	Knox County
East/West Street	Ball Road
North/South Street	Hatties Place 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	0	0		0	0	0
Configuration		LT						TR							LR	
Volume (veh/h)		10	552				268	4						15		13
Percent Heavy Vehicles		3												3		3
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		611													30	
Capacity		1259													415	
v/c Ratio		0.49													0.07	
95% Queue Length		0.0													0.2	
Control Delay (s/veh)		7.9													14.4	
Level of Service (LOS)		A													B	
Approach Delay (s/veh)	0.2												14.4			
Approach LOS	A												B			

HCS 2010 Two-Way Stop Control Summary Report

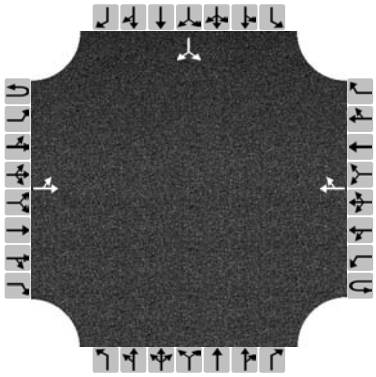
General Information

Analyst	RCB
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	7/8/16
Analysis Year	2022
Time Analyzed	A.M. Combined
Intersection Orientation	East-West
Project Description	Hatties Place Subdivision

Site Information

Intersection	Ball Rd at Hatties Place
Jurisdiction	Knox County
East/West Street	Ball Road
North/South Street	Hatties Place Road
Peak Hour Factor	0.95
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	0	0		0	0	0
Configuration		LT						TR							LR	
Volume (veh/h)		18	96				225	4						11		55
Percent Heavy Vehicles		3												3		3
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		120													70	
Capacity		1318													758	
v/c Ratio		0.09													0.09	
95% Queue Length		0.0													0.3	
Control Delay (s/veh)		7.8													10.2	
Level of Service (LOS)		A													B	
Approach Delay (s/veh)	1.3												10.2			
Approach LOS													B			

HCS 2010 Two-Way Stop Control Summary Report

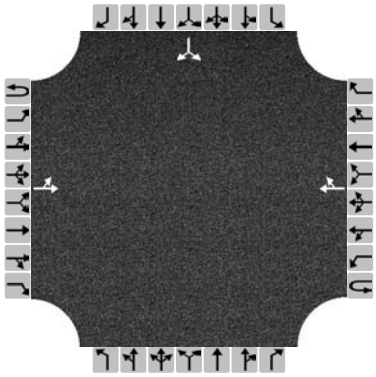
General Information

Analyst	RCB
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	7/8/16
Analysis Year	2022
Time Analyzed	P.M. Combined
Intersection Orientation	East-West
Project Description	Hatties Place Subdivision

Site Information

Intersection	Ball Rd at Hatties Place
Jurisdiction	Knox County
East/West Street	Ball Road
North/South Street	Hatties Place 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	0	0		0	0	0
Configuration		LT						TR							LR	
Volume (veh/h)		60	264				131	12						7		35
Percent Heavy Vehicles		3												3		3
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		352													46	
Capacity		1417													770	
v/c Ratio		0.25													0.06	
95% Queue Length		0.1													0.2	
Control Delay (s/veh)		7.7													10.0	
Level of Service (LOS)		A													A	
Approach Delay (s/veh)	1.8												10.0			
Approach LOS													A			

HCS 2010 Two-Way Stop Control Summary Report

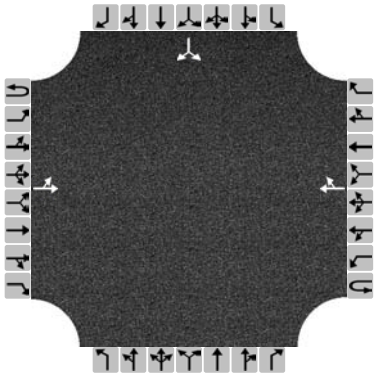
General Information

Analyst	RCB
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	7/8/16
Analysis Year	2022
Time Analyzed	A.M. Combined
Intersection Orientation	East-West
Project Description	Hatties Place Subdivision

Site Information

Intersection	Ball Rd at Road A
Jurisdiction	Knox County
East/West Street	Ball Road
North/South Street	Road A
Peak Hour Factor	0.95
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	0	0		0	0	0
Configuration		LT						TR							LR	
Volume (veh/h)		7	100				209	7						21		20
Percent Heavy Vehicles		3												3		3
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		112													43	
Capacity		1334													719	
v/c Ratio		0.08													0.06	
95% Queue Length		0.0													0.2	
Control Delay (s/veh)		7.7													10.3	
Level of Service (LOS)		A													B	
Approach Delay (s/veh)	0.5												10.3			
Approach LOS													B			

HCS 2010 Two-Way Stop Control Summary Report

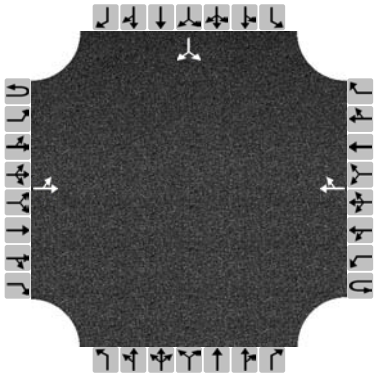
General Information

Analyst	RCB
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	7/8/16
Analysis Year	2022
Time Analyzed	P.M. Combined
Intersection Orientation	East-West
Project Description	Hatties Place Subdivision

Site Information

Intersection	Ball Rd at Road A
Jurisdiction	Knox County
East/West Street	Ball Road
North/South Street	Road A
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	0	0		0	0	0
Configuration		LT						TR							LR	
Volume (veh/h)		23	248				129	23						13		14
Percent Heavy Vehicles		3												3		3
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		295													29	
Capacity		1406													677	
v/c Ratio		0.21													0.04	
95% Queue Length		0.1													0.1	
Control Delay (s/veh)		7.6													10.6	
Level of Service (LOS)		A													B	
Approach Delay (s/veh)	0.8												10.6			
Approach LOS													B			

TABLE 5A KNOX COUNTY LEFT-TURN LANE VOLUME THRESHOLDS FOR 2-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH	Project No: 773-0007 Project Name: Hatties Place Traffic Impact Study Notes: 60% Diversion of Ball Rd volumes

(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	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	20	20	15	15	15

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

Intersection	Time Period	Opposing Volume	Through Volume	Left-Turn Volume	Warrant Threshold	Left-Turn Lane Warranted (Yes / No)
Ball @ Hatties Pl	AM	229	96	18	**160**	No
Ball @ Hatties Pl	PM	143	264	60	**110**	No
Ball @ Road A	AM	216	100	7	**160**	No
Ball @ Road A	PM	152	248	23	**105**	No

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

TABLE 5B KNOX COUNTY RIGHT-TURN LANE VOLUME THRESHOLDS FOR 2-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH	Project No: 773-0007 Project Name: Hatties Place Traffic Impact Study Notes: 60% Diversion of Ball Rd volumes

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

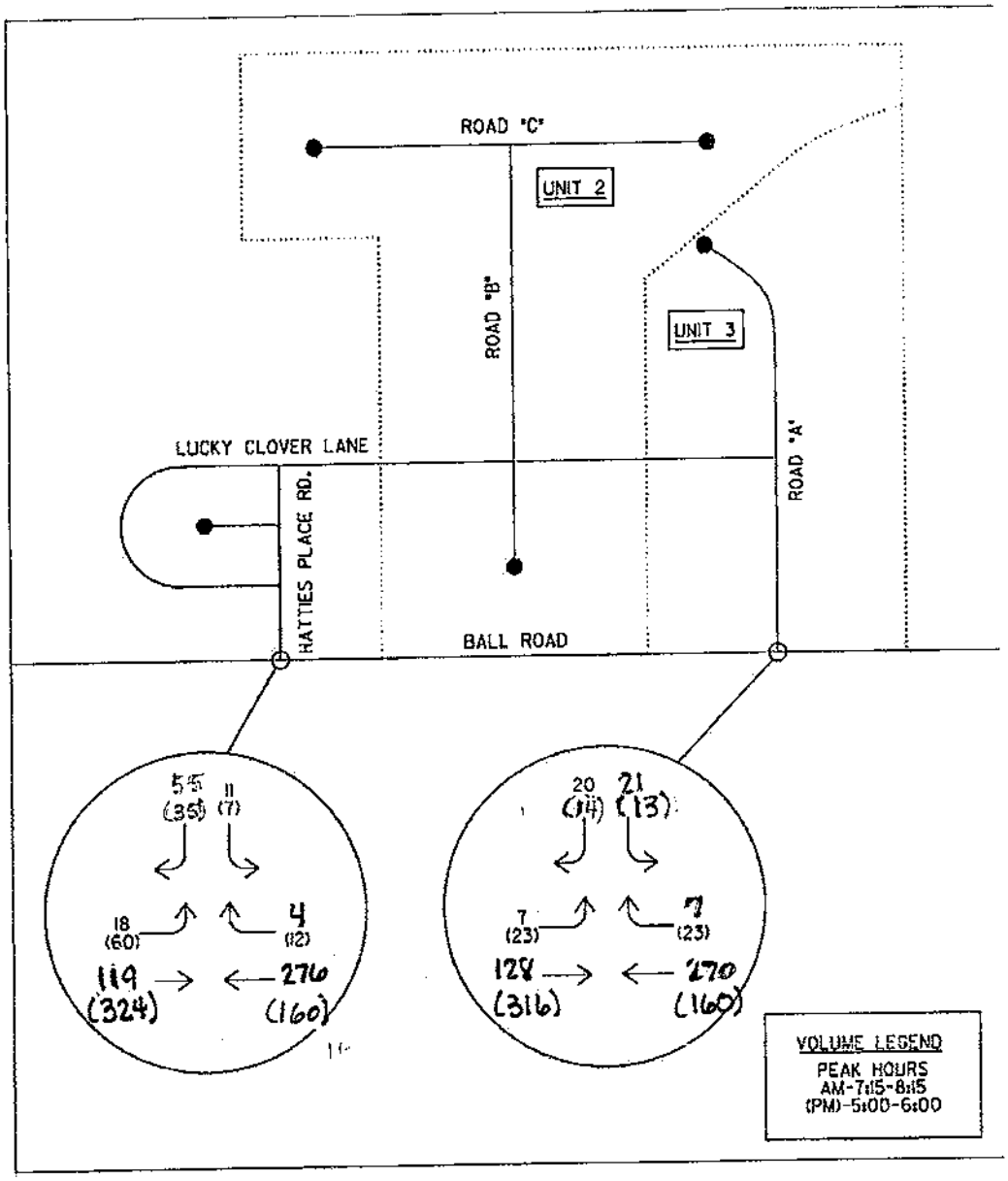
RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	= / > 600
Fewer Than 25						
25 - 49					Yes	Yes
50 - 99				Yes	Yes	Yes
100 - 149			Yes	Yes	Yes	Yes
150 - 199		Yes	Yes	Yes	Yes	Yes
200 - 249	Yes	Yes	Yes	Yes	Yes	Yes
250 - 299	Yes	Yes	Yes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

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

Intersection	Time Period	Through Volume	Right-Turn Volume	Right-Turn Lane Warranted (Yes / No)
Ball @ Hatties Pl	AM	225	4	No
Ball @ Hatties Pl	PM	131	12	No
Ball @ Road A	AM	209	7	No
Ball @ Road A	PM	129	23	No

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

with 50% reduction in Ball Road volumes



2022 COMBINED TRAFFIC DATA
(with 50% diversion of Ball Road traffic)

TABLE 5A KNOX COUNTY LEFT-TURN LANE VOLUME THRESHOLDS FOR 2-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH	Project No: 773-0007 Project Name: Hatties Place Traffic Impact Study Notes: 50% Diversion of Ball Rd volumes

(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	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	20	20	15	15	15

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

Intersection	Time Period	Opposing Volume	Through Volume	Left-Turn Volume	Warrant Threshold	Left-Turn Lane Warranted (Yes / No)
Ball @ Hatties Pl	AM	280	118	18	**130**	No
Ball @ Hatties Pl	PM	172	324	60	**70**	No
Ball @ Road A	AM	277	128	7	**130**	No
Ball @ Road A	PM	183	316	23	**70**	No

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

TABLE 5B KNOX COUNTY RIGHT-TURN LANE VOLUME THRESHOLDS FOR 2-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH	Project No: 773-0007 Project Name: Hatties Place Traffic Impact Study Notes: 50% Diversion of Ball Rd volumes

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

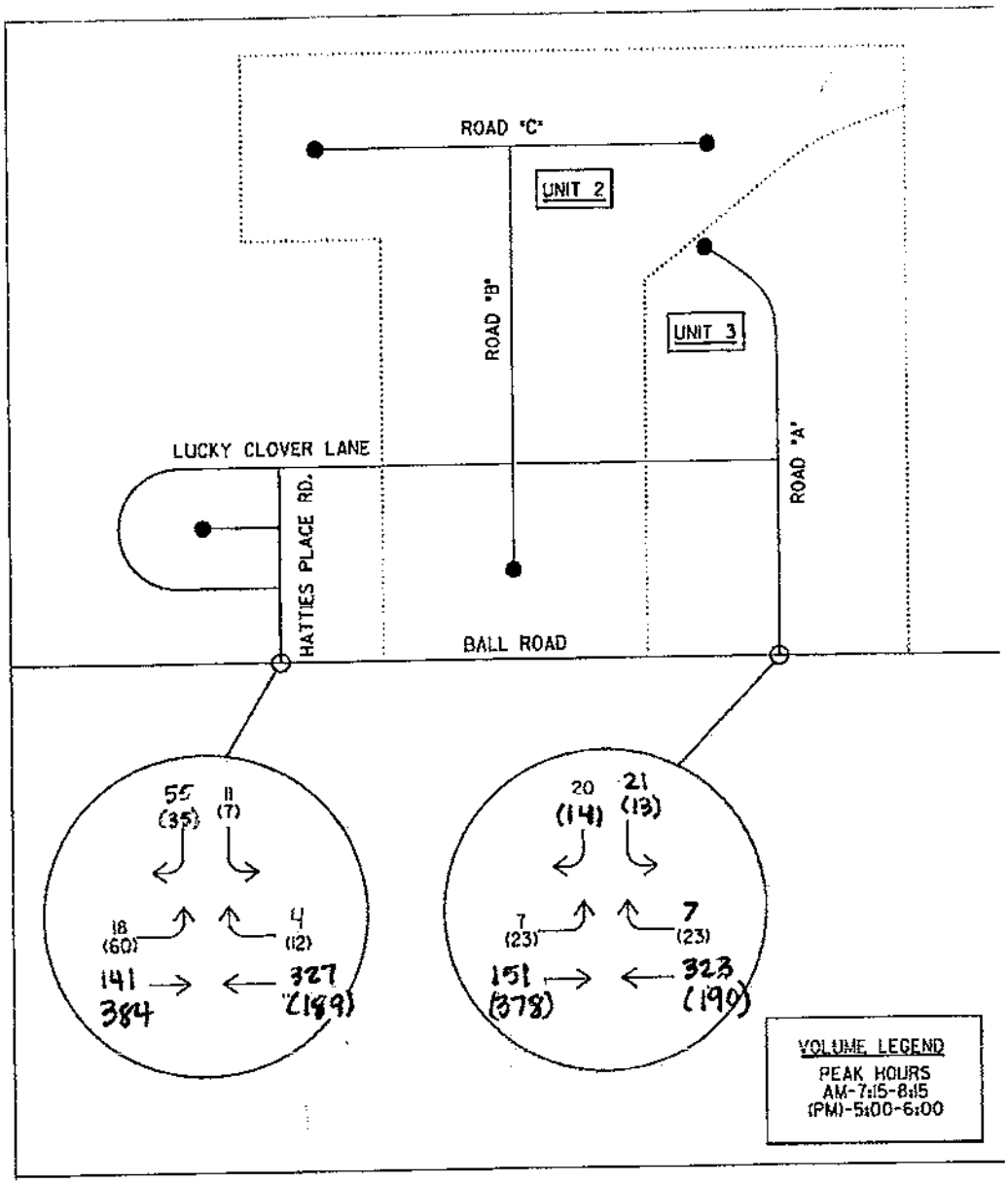
RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	= / > 600
Fewer Than 25						
25 - 49					Yes	Yes
50 - 99				Yes	Yes	Yes
100 - 149			Yes	Yes	Yes	Yes
150 - 199		Yes	Yes	Yes	Yes	Yes
200 - 249	Yes	Yes	Yes	Yes	Yes	Yes
250 - 299	Yes	Yes	Yes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

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

Intersection	Time Period	Through Volume	Right-Turn Volume	Right-Turn Lane Warranted (Yes / No)
Ball @ Hatties Pl	AM	276	4	No
Ball @ Hatties Pl	PM	160	12	No
Ball @ Road A	AM	270	7	No
Ball @ Road A	PM	160	23	No

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

With 40% reduction in Ball Road volumes



2022 COMBINED TRAFFIC DATA

(With 40% diversion of Ball Road traffic)

TABLE 5A KNOX COUNTY LEFT-TURN LANE VOLUME THRESHOLDS FOR 2-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH	Project No: 773-0007 Project Name: Hatties Place Traffic Impact Study Notes: 40% Diversion of Ball Rd volumes

(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	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	20	20	15	15	15

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

Intersection	Time Period	Opposing Volume	Through Volume	Left-Turn Volume	Warrant Threshold	Left-Turn Lane Warranted (Yes / No)
Ball @ Hatties Pl	AM	331	141	18	**110**	No
Ball @ Hatties Pl	PM	201	384	60	**55**	**YES**
Ball @ Road A	AM	330	151	7	**90**	No
Ball @ Road A	PM	213	378	23	**55**	No

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

TABLE 5B KNOX COUNTY RIGHT-TURN LANE VOLUME THRESHOLDS FOR 2-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH	Project No: 773-0007 Project Name: Hatties Place Traffic Impact Study Notes: 40% Diversion of Ball Rd volumes

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

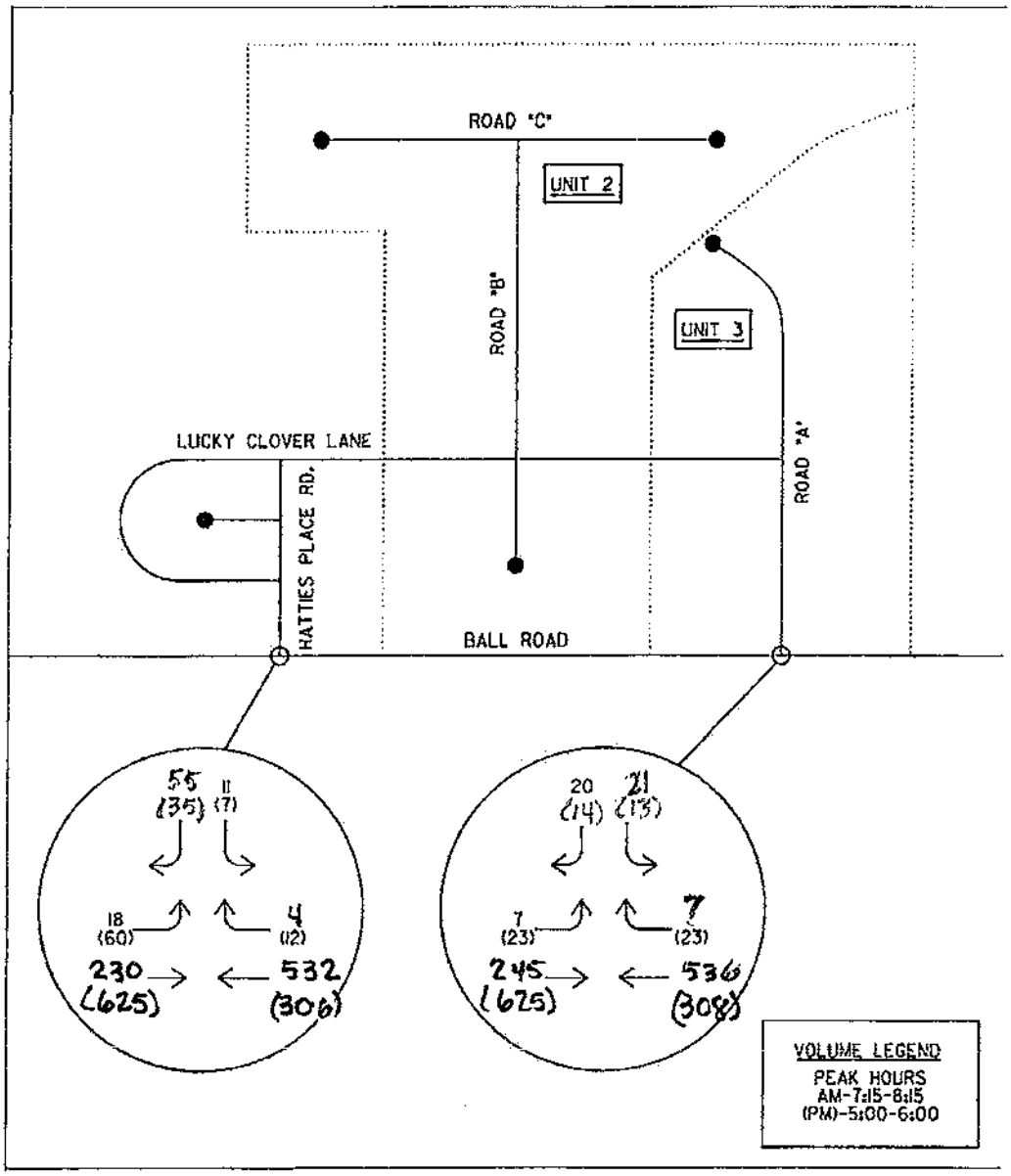
RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	= / > 600
Fewer Than 25						
25 - 49					Yes	Yes
50 - 99				Yes	Yes	Yes
100 - 149			Yes	Yes	Yes	Yes
150 - 199		Yes	Yes	Yes	Yes	Yes
200 - 249	Yes	Yes	Yes	Yes	Yes	Yes
250 - 299	Yes	Yes	Yes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

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

Intersection	Time Period	Through Volume	Right-Turn Volume	Right-Turn Lane Warranted (Yes / No)
Ball @ Hatties Pl	AM	327	4	No
Ball @ Hatties Pl	PM	189	12	No
Ball @ Road A	AM	323	7	No
Ball @ Road A	PM	190	23	No

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

With 0% reduction in Ball Road volumes



2022 COMBINED TRAFFIC DATA
(With 0% diversion of Ball Rd traffic)

TABLE 5A KNOX COUNTY LEFT-TURN LANE VOLUME THRESHOLDS FOR 2-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH	Project No: 773-0007 Project Name: Hatties Place Traffic Impact Study Notes: 0% Diversion of Ball Rd volumes

(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	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	20	20	15	15	15

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

Intersection	Time Period	Opposing Volume	Through Volume	Left-Turn Volume	Warrant Threshold	Left-Turn Lane Warranted (Yes / No)
Ball @ Hatties Pl	AM	536	230	18	**45**	No
Ball @ Hatties Pl	PM	318	625	60	**25**	YES
Ball @ Road A	AM	543	245	7	**45**	No
Ball @ Road A	PM	331	625	23	**25**	No

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

TABLE 5B KNOX COUNTY RIGHT-TURN LANE VOLUME THRESHOLDS FOR 2-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH	Project No: 773-0007 Project Name: Hatties Place Traffic Impact Study Notes: 0% Diversion of Ball Rd volumes

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

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

Intersection	Time Period	Through Volume	Right-Turn Volume	Right-Turn Lane Warranted (Yes / No)
Ball @ Hatties Pl	AM	532	4	No
Ball @ Hatties Pl	PM	306	12	No
Ball @ Road A	AM	536	7	No
Ball @ Road A	PM	308	23	No

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