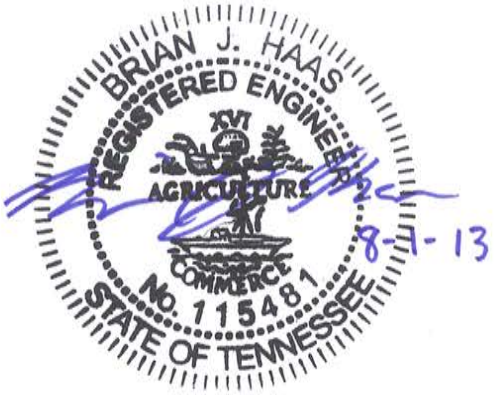
Traffic Impact Study
Karns Farm Residential Development
Gray Hendrix Road, Knox County, TN

PREPARED FOR:

Southland Engineering Consultants
4909 Ball Road
Knoxville, TN 37931



PREPARED BY:

Cannon & Cannon, Inc.
8550 Kingston Pike
Knoxville, TN 37919
Tel: 865.670.8555

CCI Project No. 00773-0003

July 3, 2013
(Revised July 25, 2013)
(Revised August 1, 2013)

Cannon&Cannon,Inc.
Consulting Engineers • Field Surveyors

TABLE OF CONTENTS

FIGURES & TABLES

EXECUTIVE SUMMARY

This report provides a summary of a traffic impact study that was performed for a proposed residential development to be located off Gray Hendrix Road in the Karns community of Knox County, Tennessee. The project site is located on the south and east sides of Gray Hendrix Road in the vicinity of the intersection of Gray Hendrix Road with Garrison Drive. The current plans for this proposed residential development provide for 185 single family dwelling units at full build-out. The site has two proposed entrances on Gray Hendrix Road: one approximately 500 feet east of Garrison Drive and one approximately 1,200 feet south of Garrison Drive. In addition, a connection to Sherwin Road in the Golden Meadows subdivision to the east is being proposed.

The purpose of this study was the evaluation of the traffic operational and safety impacts of the proposed development upon the adjacent portion of Gray Hendrix Road. Of particular interest were the intersections of the two site entrance roadways with Gray Hendrix Road, as well as the intersection of Gray Hendrix Road and Garrison Drive. Appropriate intersection evaluations were conducted at these locations for existing and future conditions, both with and without traffic volumes generated from the proposed 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 the proposed development will have limited impact on intersection and roadway capacity in the study area. However, a sight distance issue currently exists at the intersection of Gray Hendrix Road and Garrison Drive, which will be addressed with a planned improvement at the Gray Hendrix Road and Garrison Drive intersection. This improvement includes switching the stop controlled approach from northbound Gray Hendrix Road to eastbound Garrison Drive. However, according to the capacity analyses, this would result in a poor level-of-service (F) for the eastbound approach during the A.M. peak traffic hour. Since the capacity analyses of this report were based on factored summer traffic counts, it is suggested that additional traffic count data be collected during a month when school is in session in order to confirm preferred intersection operation before implementing proposed traffic control. Other possible alternatives to address this issue are the construction of a westbound right-turn lane on Gray Hendrix Road in conjunction with the planned improvements or construction of a roundabout intersection.

Speeding and crash potential has been mentioned previously by the public in relation to Gray Hendrix Road. While the exact magnitude of this problem is unknown, a couple of simple measures are available to improve roadway safety. One would be to add white edgelines to

the section of the roadway south of Garrison Drive and to refurbish all pavement markings on this section and the section east of Garrison Road. In addition, a centerline rumble stripe could be considered for both sections of Gray Hendrix Road.

The following listing is a summary of the improvements that are recommended in order to address the above issues and appropriately serve the traffic generated by the proposed development:

1. Install a STOP sign on both site entrance roadway approaches to Gray Hendrix Road.
2. Maximize intersection corner sight distance at all proposed site entrance roadways by removing any existing vegetation which may restrict sight distance.
3. Add white edgeline pavement markings to Gray Hendrix Road south of Garrison Drive, and refurbish all pavement markings on Gray Hendrix Road both east and south of Garrison Drive.
4. Implement currently proposed roadway and traffic control changes for the Gray Hendrix Road and Garrison Drive intersection, although the addition of a westbound right-turn lane or the possible inclusion of a roundabout intersection in these improvements should be considered.

INTRODUCTION & PURPOSE OF STUDY

This report provides a summary of a traffic impact study that was performed for a proposed residential development to be located off Gray Hendrix Road in the Karns community of Knox County, Tennessee. The project site is located on the south and east sides of Gray Hendrix Road in the vicinity of the intersection of Gray Hendrix Road with Garrison Drive. FIGURE 1 is a project location map identifying the project site in relation to the major roadways in the vicinity of the proposed development.

The current plans for this proposed residential development provides for 185 single family dwelling units at full build-out. FIGURE 2 is a site plan showing the proposed site layout with two proposed entrances on Gray Hendrix Road. These entrances include one approximately 500 feet east of Garrison Drive, and one approximately 1,200 feet south of Garrison Drive. In addition, a connection to Sherwin Road in the Golden Meadows subdivision to the east is being proposed.

The purpose of this study was the evaluation of the traffic operational and safety impacts of the proposed development upon the adjacent portion of Gray Hendrix Road. Of particular interest were the intersections of the two site entrance roadways with Gray Hendrix Road, as well as the intersection of Gray Hendrix Road and Garrison Drive. Appropriate intersection evaluations were conducted at these locations for existing and future conditions, both with and without traffic volumes generated from the proposed 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 1
LOCATION MAP

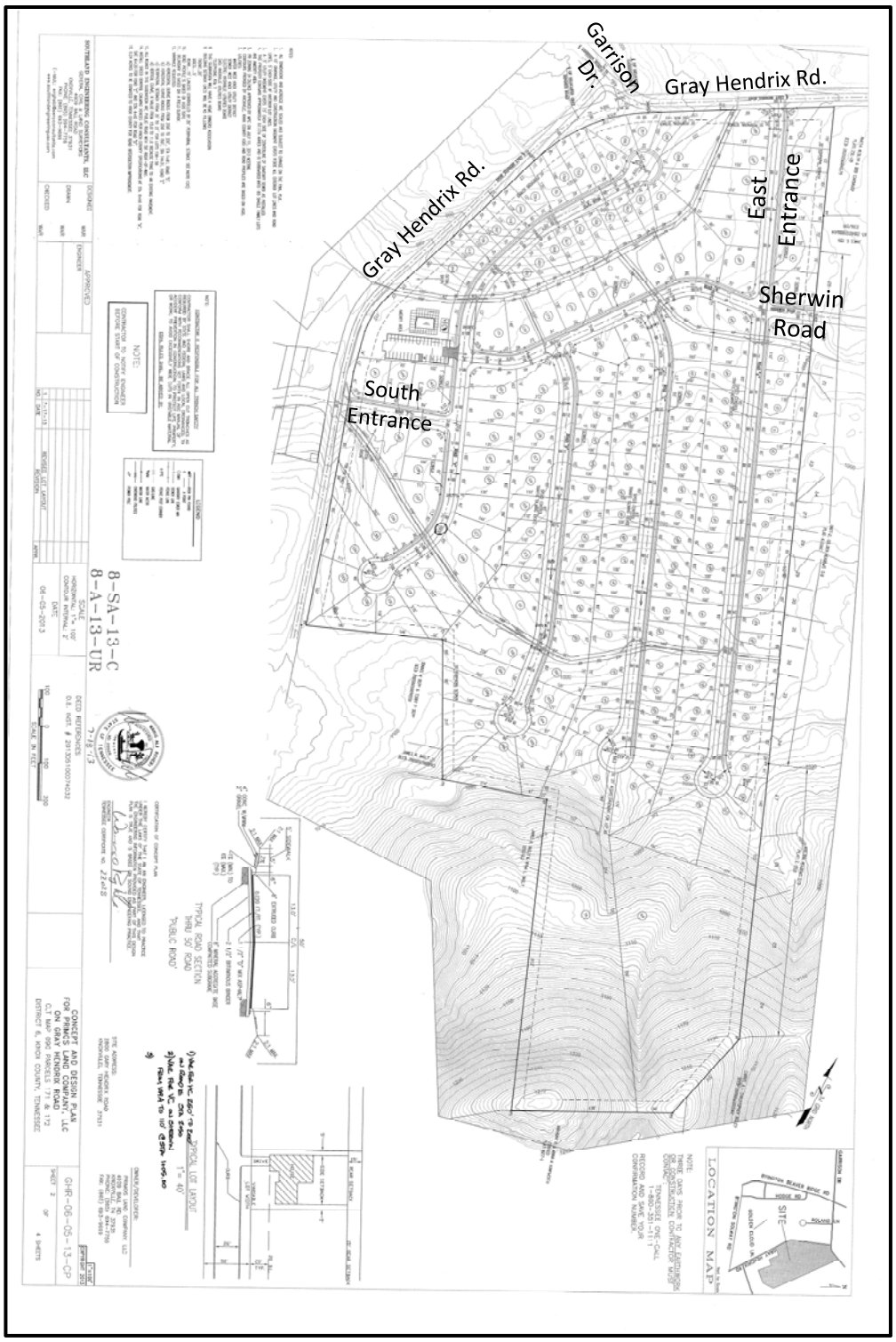


FIGURE 2
CONCEPTUAL SITE PLAN

EXISTING CONDITIONS

EXISTING ROADWAY CONDITIONS

Gray Hendrix Road is classified as a Local access roadway and is maintained by Knox County. The roadway pavement is approximately 17 feet in width south of the Garrison Drive intersection and approximately 18 feet in width east of the intersection. Both sections of roadway are striped with a center double solid yellow line delineating two traffic lanes of approximately 8.5 to 9 feet and no shoulder. The section east of Garrison Drive has white edgelines, while the section south of Garrison Drive does not. The posted speed limit on Gray Hendrix Road is 30 mph.

EXISTING TRAFFIC DATA

Existing traffic data was gathered for this study. The Tennessee Department of Transportation (TDOT) collects average daily traffic data (ADT) annually 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 is contained in TABLE 1.

TABLE 1
AVERAGE DAILY TRAFFIC COUNT SUMMARY

Count Year	Station T364 Oak Ridge Highway east of Pellissippi Parkway	Station T159 Oak Ridge Highway west of Ball Road
2012	11,997	15,509
2011	11.488	14,876
2010	11,033	15,208
2009	11,597	15,324
2008	10,781	14,611
2007	10,639	16,032

In addition to the available ADT data, intersection turning movement traffic counts were conducted specifically for this study at the intersection of Gray Hendrix Road and Garrison Drive, with the primary purpose of determining the current peak hour operating volumes. These counts were conducted during the A.M. and P.M. peak traffic hours.

Because the intersection of Gray Hendrix Road and Garrison Drive is in close proximity to several schools and the turning movement counts were performed in June 2013 when school was not in session, additional turning movement counts conducted previously at adjacent

intersections were obtained from Knox County. These counts were conducted at various intersections in the vicinity of the development over the past twelve years during months which were affected by school traffic. Although all additional turning movement counts were reviewed, one count was chosen as an official baseline for comparison for this study. That count was conducted at the intersection of Byington Beaver Ridge Road and Garrison Drive in September 2010. This count was chosen over others because it was the closest in proximity to the intersection of Gray Hendrix Road and Garrison Drive and was also the most recent turning movement count conducted.

In order to compare the 2010 count to the 2013 count performed for this study, the 2010 count needed to be projected to 2013 traffic volumes using an annual growth factor. Based on data available such as TDOT ADT values, as well as knowledge of the area, an annual growth rate of two percent was assumed. This annual growth rate was applied to the 2010 count at the intersection of Byington Beaver Ridge Road at Garrison Drive in order to obtain 2013 traffic volumes at this intersection. The 2013 projected volumes for the Byington Beaver Ridge Road intersection were then used to make a comparison between school and non-school traffic volumes. Volumes on the section of Garrison Drive between the two intersections were developed using both the 2013 projected volumes with school traffic and the actual traffic count conducted at the intersection of Gray Hendrix Road and Garrison Drive in June 2013 (non-school traffic). A "school" factor was developed by comparing the two traffic volumes (school –vs- non-school) on the roadway link between the two intersections. This factor was applied to the turning movement count conducted at Gray Hendrix Road and Garrison Drive in order to obtain school season traffic volumes to be used in the analysis. The volumes and processes used to determine the A.M. and P.M. factors are contained in the APPENDIX.

The existing traffic volumes, factored to represent traffic volumes during school season, are summarized on FIGURE 3, 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 were conducted for the intersection of Gray Hendrix Road and Garrison Drive. The analyses were performed with the 2013 existing traffic volumes and existing intersection side-street STOP traffic control and lane configurations for both A.M. and P.M. peak traffic periods. Existing analyses indicate that the intersection is operating at level-of-service (LOS) "C" for A.M. traffic and LOS "B" for P.M. traffic for the side street (northbound approach).

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 "Intersection Capacity and Level of Service Concepts", which provides a description of the utilized procedures.

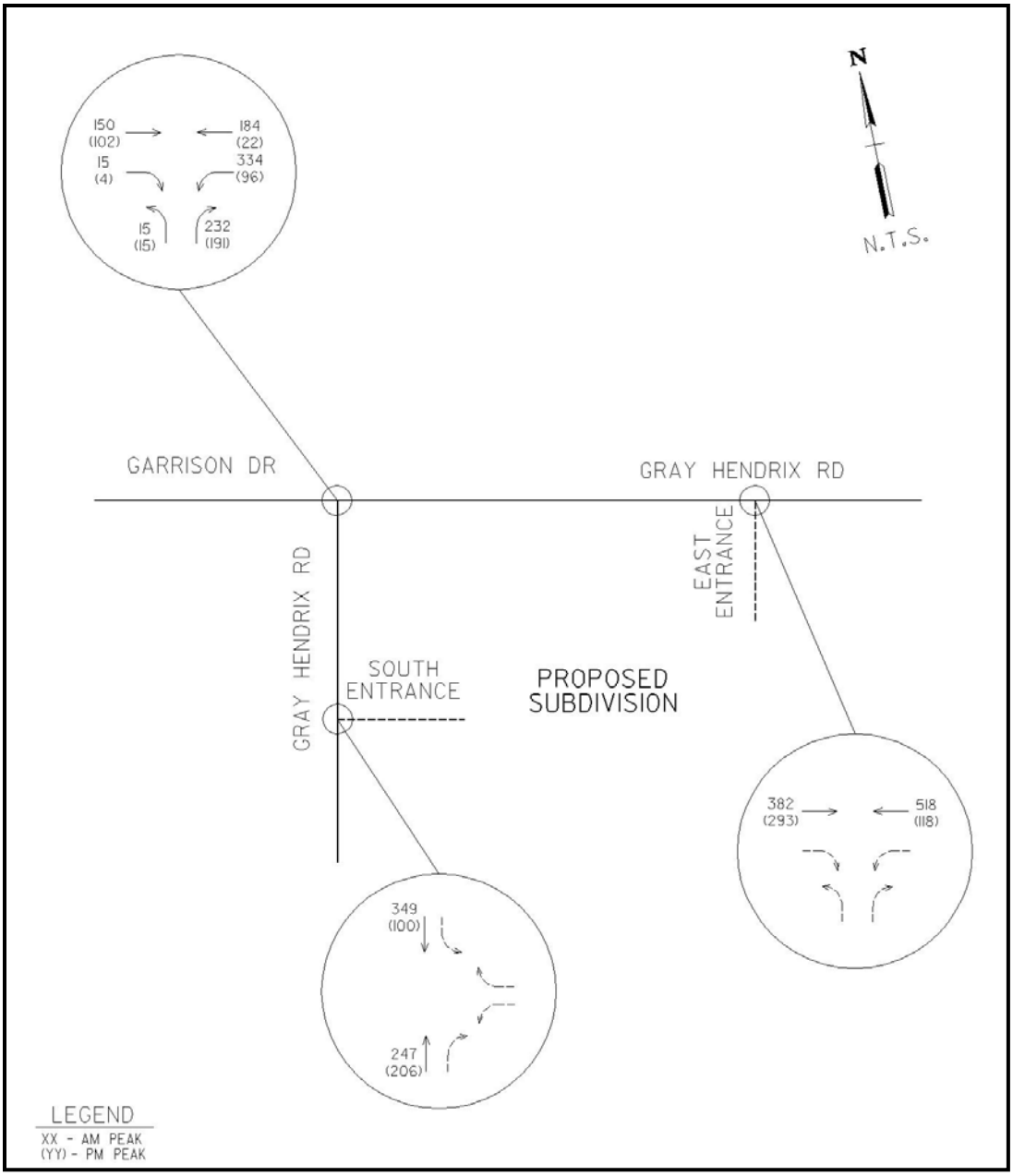


FIGURE 3
2013 EXISTING TRAFFIC VOLUMES

BACKGROUND CONDITIONS

BACKGROUND TRAFFIC GROWTH

Year 2018 was established as the appropriate design/analysis year for this study for full build-out conditions. In order to determine traffic volumes resulting solely from background traffic growth to year 2018, it was necessary to establish an annual growth rate for existing traffic. The TDOT 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 two percent was assumed. FIGURE 4 contains the background traffic volumes that would result from a two percent annual growth from year 2013, when the counts were conducted, to year 2018.

BACKGROUND CAPACITY ANALYSES / LEVELS-OF-SERVICE

Capacity analyses as described in the Existing Conditions section of this report were conducted utilizing the FIGURE 4 background traffic volumes and existing intersection traffic control and lane configurations. The analyses indicate that the intersection will continue to operate at level-of-service "C" during A.M. peak traffic and LOS "B" during P.M. traffic in the year 2018 without development traffic. 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.

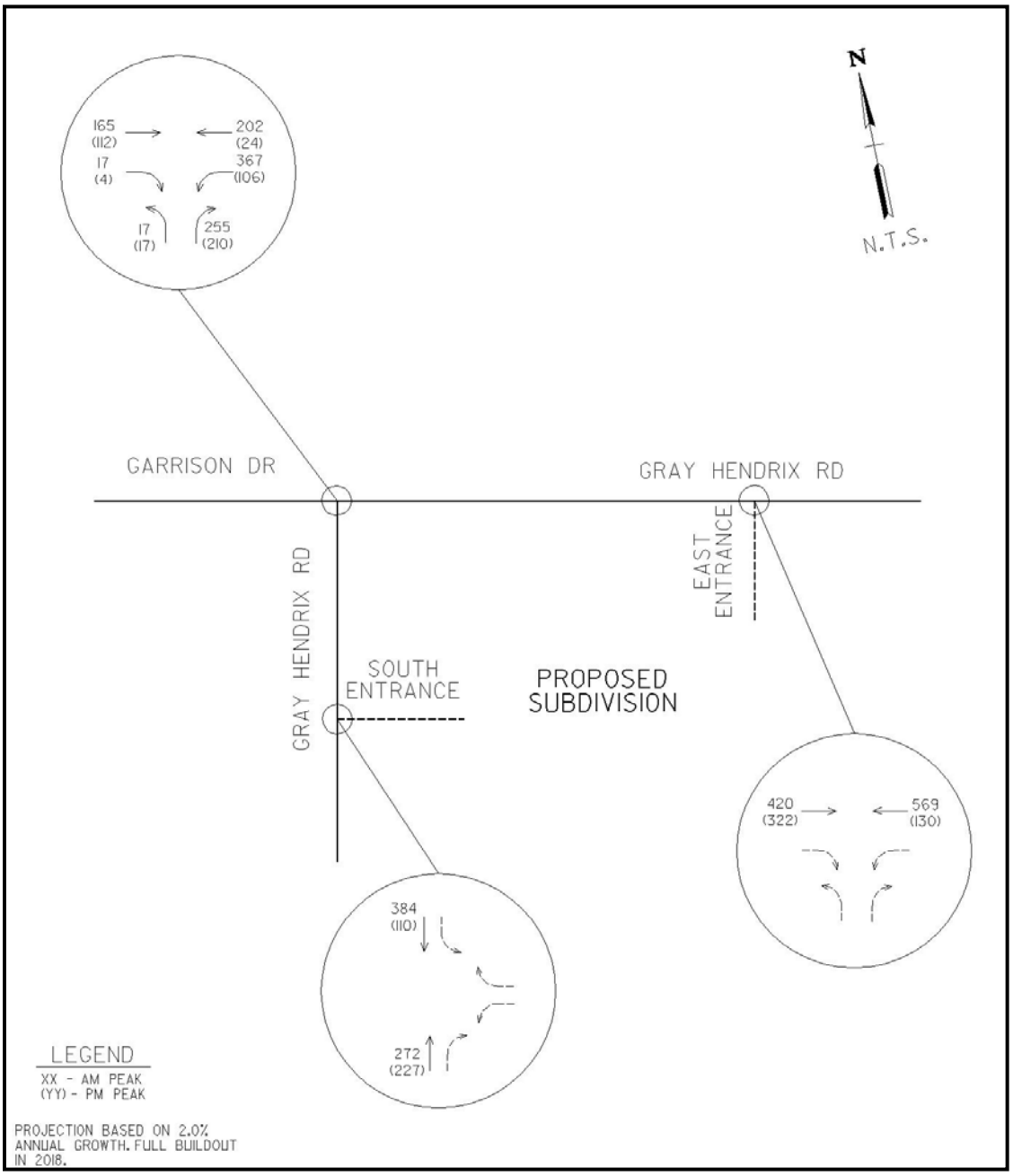


FIGURE 4
2018 BACKGROUND TRAFFIC VOLUMES

FUTURE CONDITIONS

TRIP GENERATION

In order to estimate the expected traffic volumes to be generated by the proposed development, the procedures of Trip Generation, Eighth Edition (Institute of Transportation Engineers, 2008) were utilized. The generated traffic volumes were determined based on the weekday morning and evening peak hour of adjacent street traffic trip generation rates for single-family detached housing (Land Use Code 210, Volume 2, pages 290 to 292). As noted earlier in the report, the anticipated number of units upon full build-out is 185, which was used to determine the number of new trips generated. 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 (trips/hour)	PM Peak (trips/hour)
Single-Family Detached Housing	210	185	1,832	139	183
Entering Trips		units	916	35	115
Exiting Trips			916	104	68

In addition, traffic was generated for the potential redistribution of trips from the Golden Meadows subdivision due to the proposed connection with Sherwin Road. It was assumed that traffic from the 86 units west of Wilnoty Drive would potentially redistribute to the proposed site entrance roadways of the Karns Farm Subdivision. Information on the trip generation for the redistribution of the Golden Meadows subdivision is contained in the APPENDIX.

TRIP DISTRIBUTION AND ASSIGNMENT

FIGURES 5A – 5D provide a summary of the entering and exiting trip distribution patterns assumed for the study intersections for both the Karns Farm subdivision and the Golden Meadows subdivision, respectively. These patterns were based on the existing traffic patterns derived from the traffic counts, as well as knowledge of the area. FIGURES 6A and 6B show the generated trips as assigned to the study intersections in accordance with these distribution patterns. FIGURE 7 shows the combined year 2018 volumes reflecting the existing traffic, the background traffic growth, the newly generated traffic from the proposed development, and

the redistributed Golden Meadows traffic due to the proposed connection to Sherwin Road. These 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 2018 full build-out conditions utilizing the FIGURE 7 combined traffic volumes with both existing and proposed intersection traffic control. For the intersection of Gray Hendrix Road and Garrison Drive, the County has proposed intersection improvements that would change the stopping approach from the existing northbound Gray Hendrix Road approach to the eastbound Garrison Drive approach. The analyses indicate that under existing intersection traffic control, the intersection of Gray Hendrix Road and Garrison Drive will operate at level-of-service "D" during A.M. peak traffic and LOS "B" during the P.M. peak after full build-out of the proposed development. Under the proposed intersection traffic control, the intersection will operate at LOS "F" during the A.M. peak and LOS "B" during the P.M. peak. The analyses for proposed intersection conditions were performed assuming single lane approaches for all legs of the intersection. Capacity analyses utilizing additional improvements were also conducted. Additional analyses at this intersection included adding a westbound right-turn lane on Gray Hendrix Road with the proposed intersection traffic control, all-way stop control with and without a westbound right-turn lane, and a roundabout intersection. Note that for the proposed intersection geometry scenario at Gray Hendrix Road and Garrison Drive in the capacity analyses printouts, Gray Hendrix Road is referred to as the east-west approaches and Garrison Drive is referred to as the southbound approach.

In addition, the proposed East site entrance roadway will operate at LOS "D" for A.M. peak traffic and LOS "B" for P.M. traffic under side-street STOP conditions, and the proposed South entrance roadway will operate at LOS "C" during A.M. traffic and LOS "B" during P.M. traffic. These analyses assumed single lane approaches for all site entrance roadways. 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. Due to the proximity of Karns Middle School to the east of the proposed development on Gray Hendrix Road, there is potential for traffic queues from the school to spill back past the proposed East site entrance roadway and potentially to the intersection with Garrison Drive, particularly when school dismisses in the afternoon. Traffic queues should be verified once school is back in session.

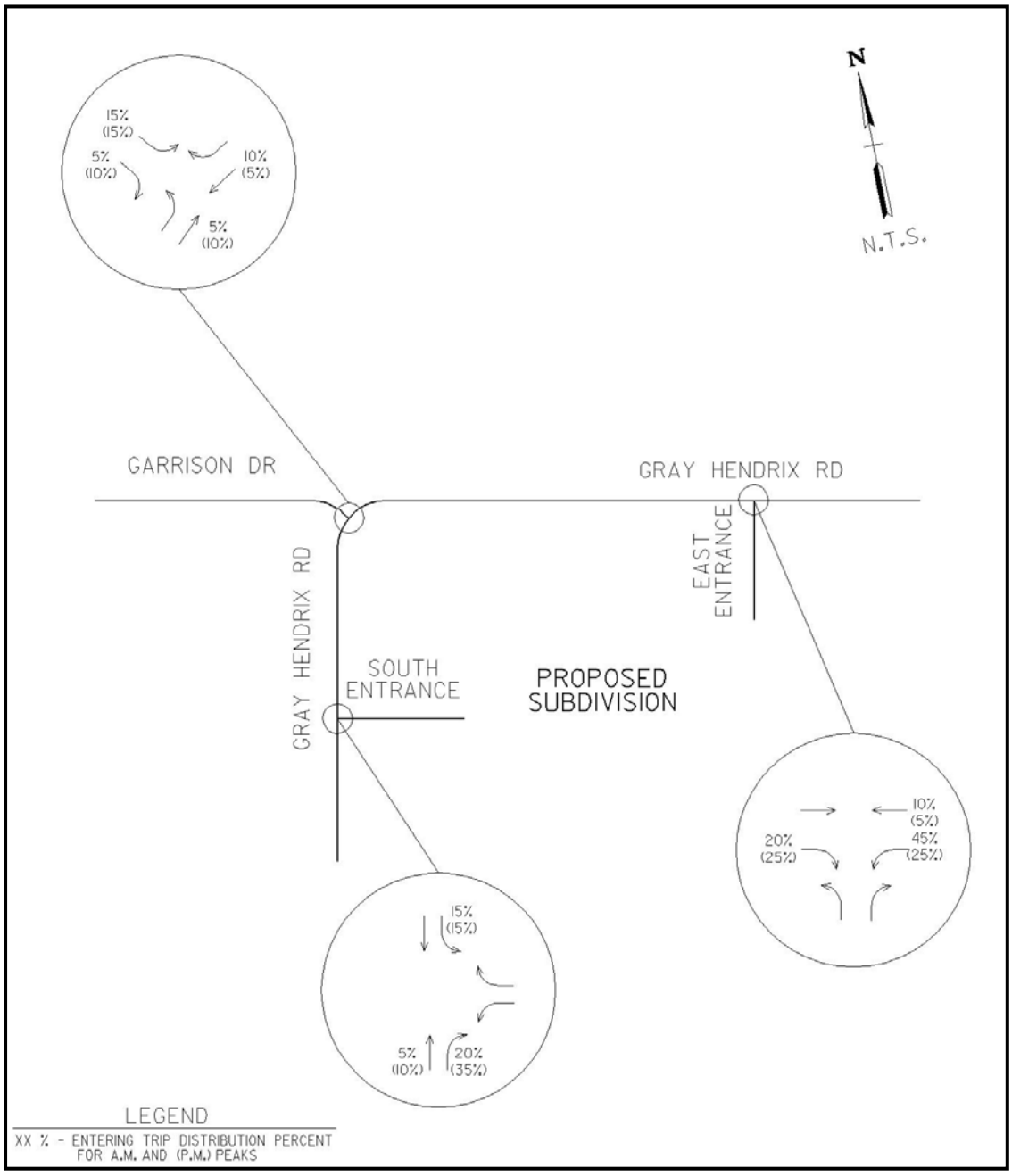


FIGURE 5A
TRIP DISTRIBUTION – ENTERING
(KARNS FARM SUBDIVISION)

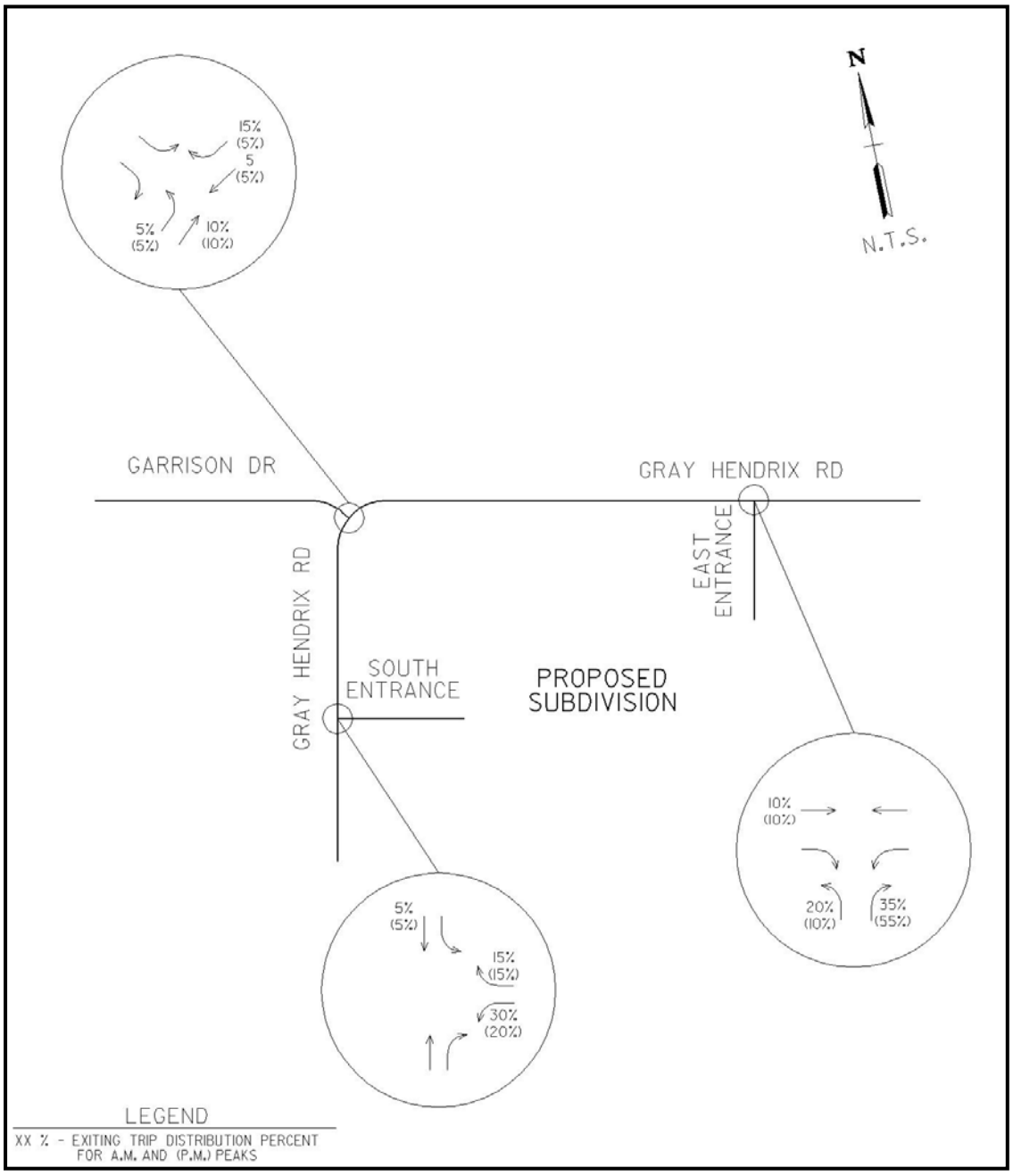


FIGURE 5B
TRIP DISTRIBUTION – EXITING
(KARNS FARM SUBDIVISION)

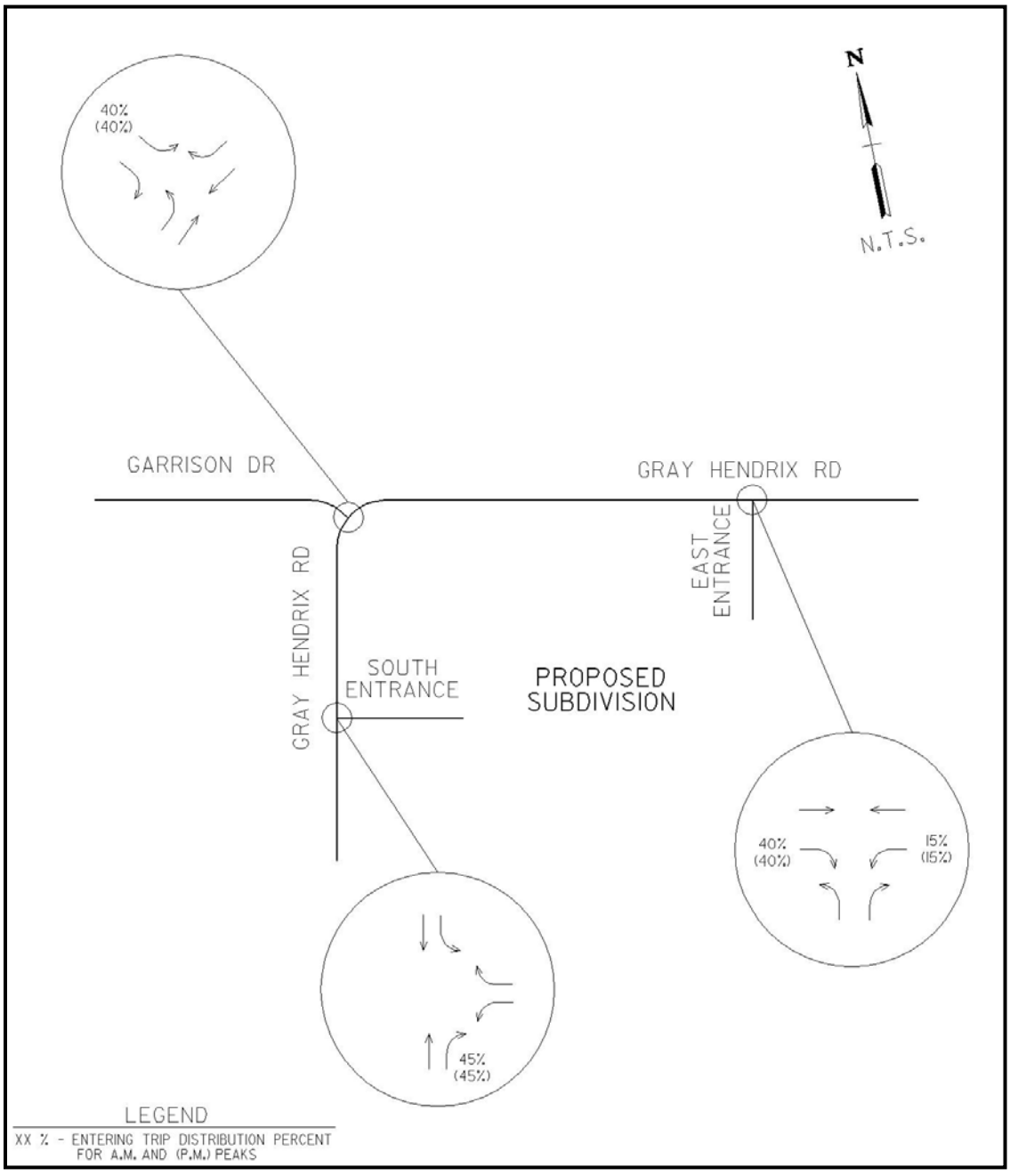


FIGURE 5C
TRIP DISTRIBUTION – ENTERING
(GOLDEN MEADOWS SUBDIVISION)

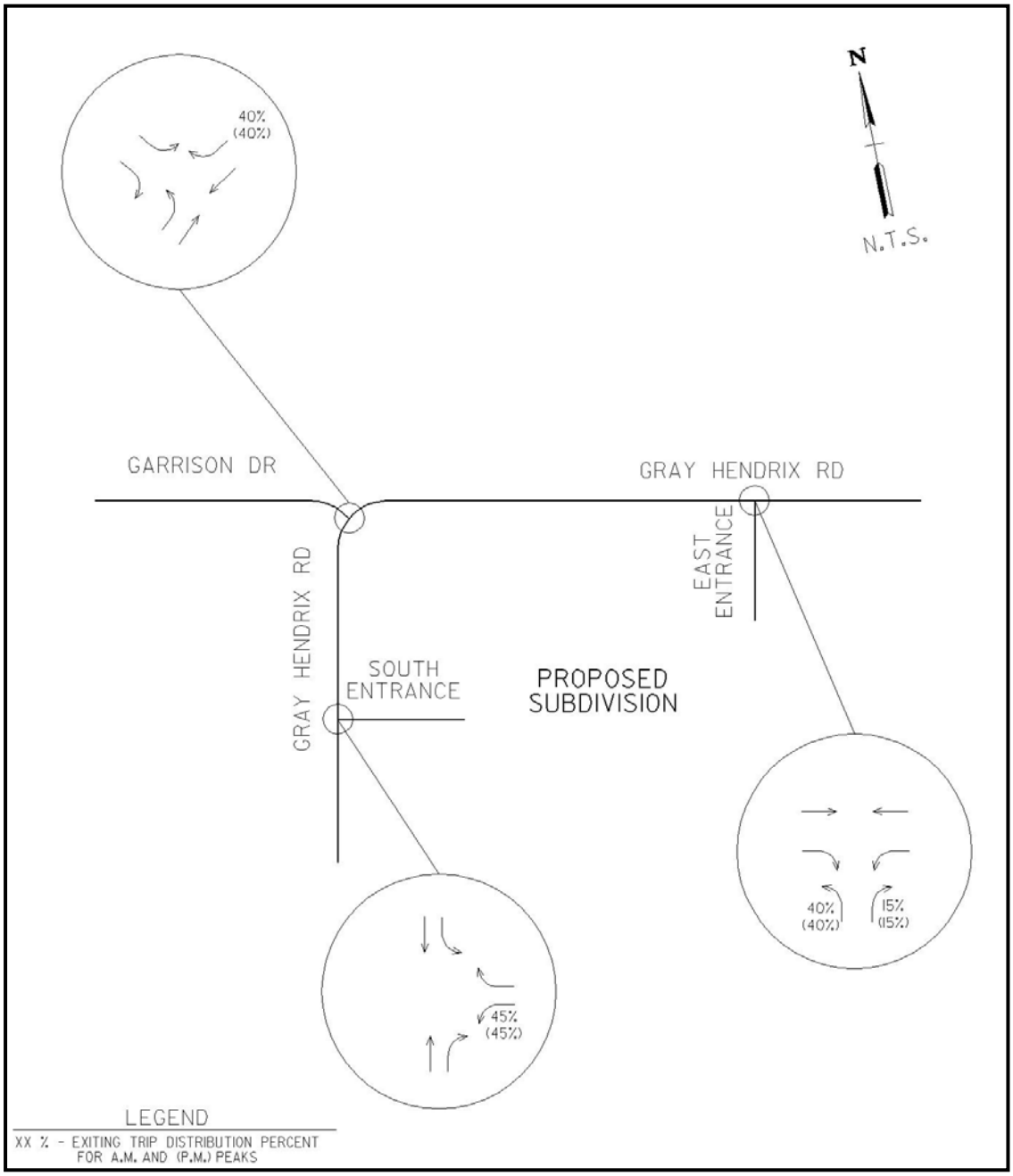


FIGURE 5D
TRIP DISTRIBUTION – EXITING
(GOLDEN MEADOWS SUBDIVISION)

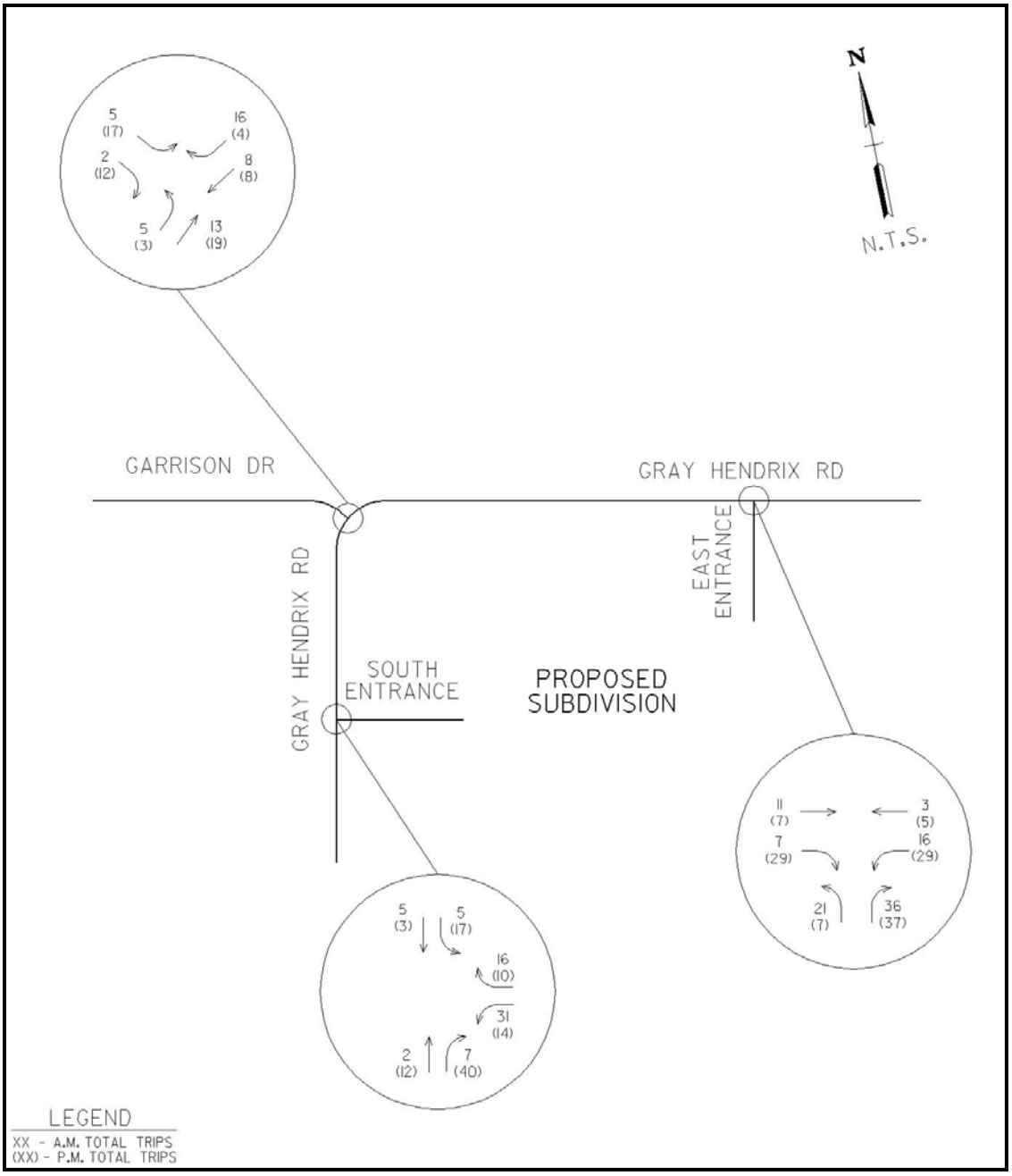


FIGURE 6A
TRIP ASSIGNMENTS
(KARNS FARM SUBDIVISION)

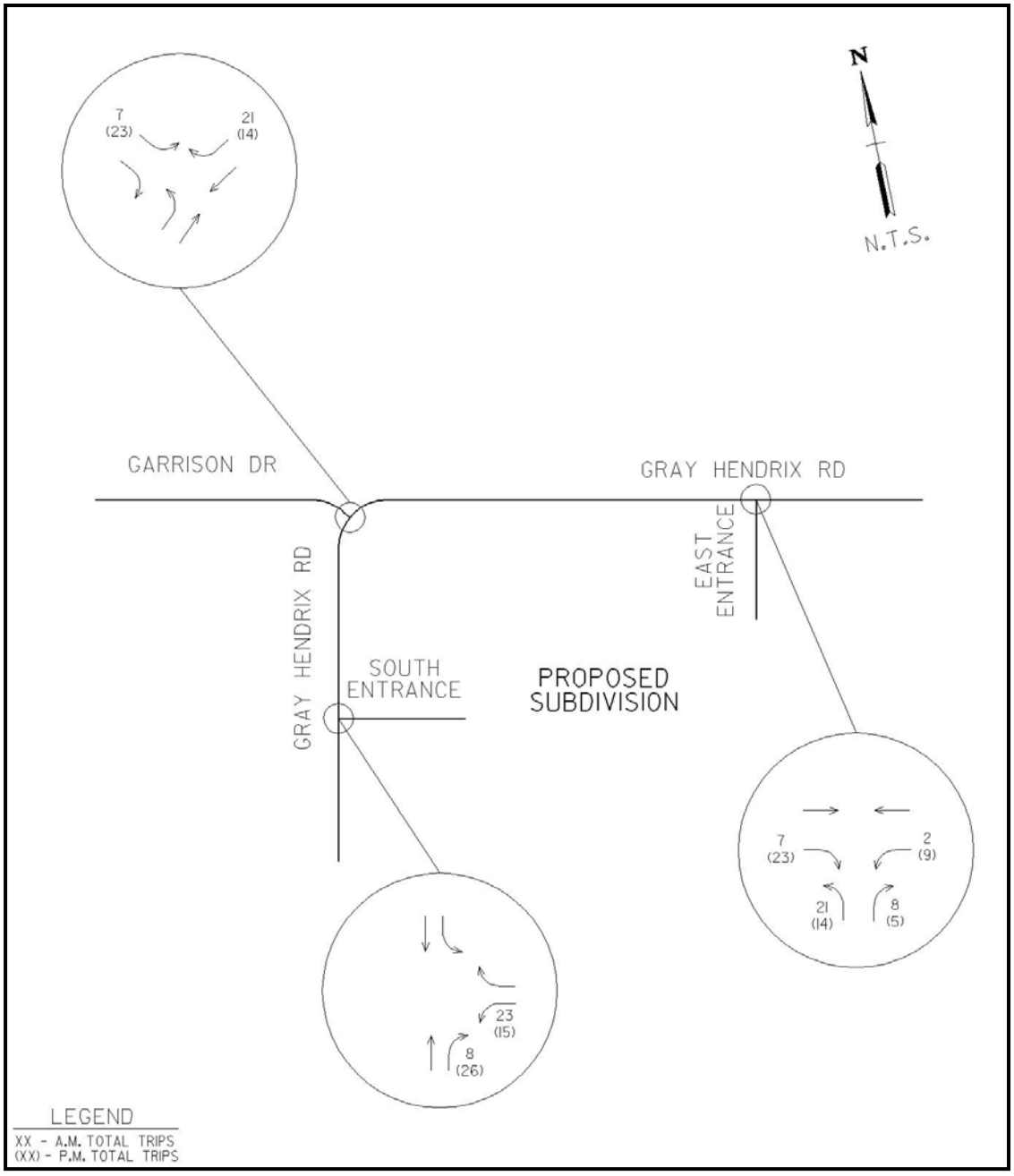


FIGURE 6B
TRIP ASSIGNMENTS
(GOLDEN MEADOWS SUBDIVISION)

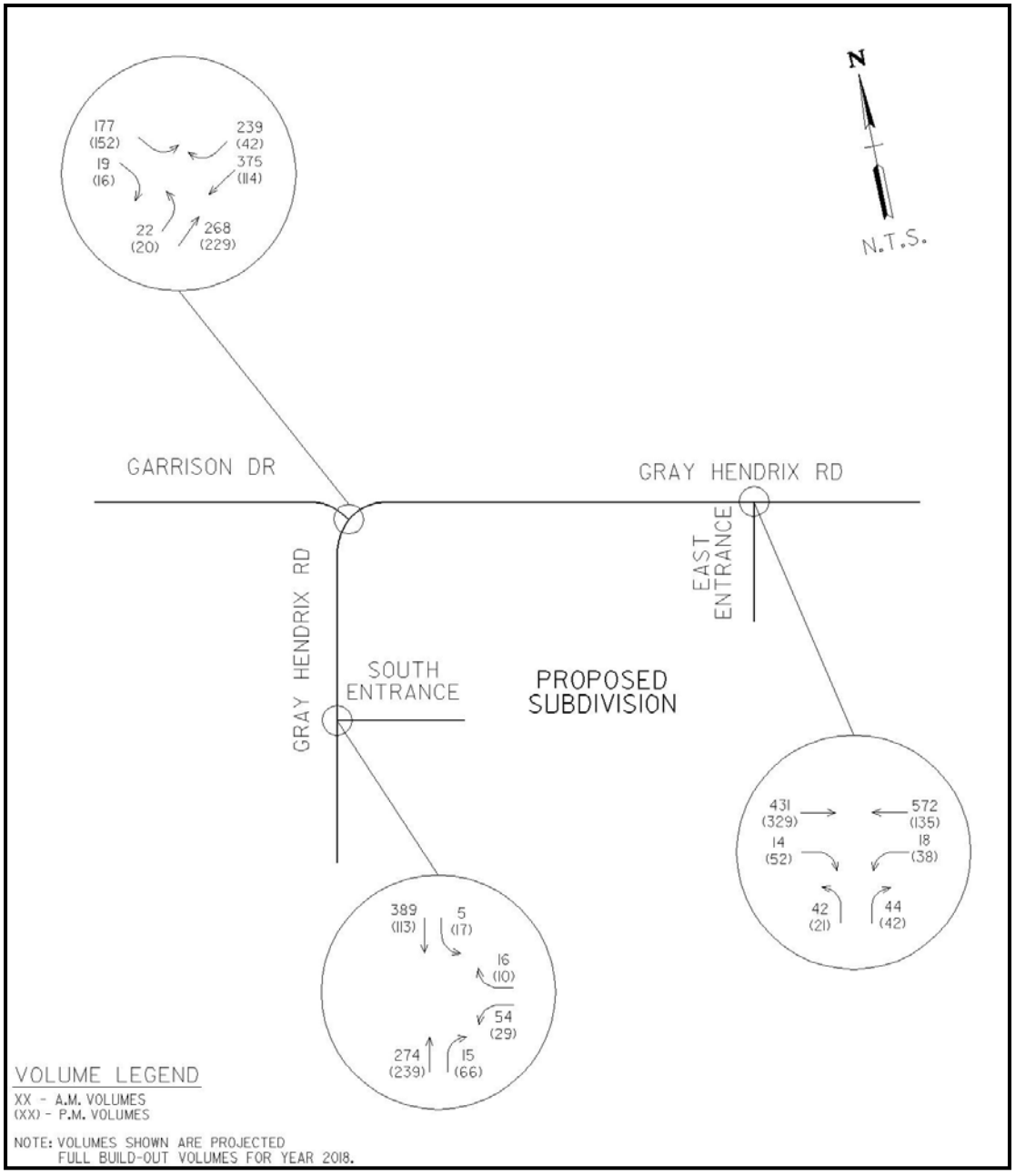


FIGURE 7
2018 COMBINED TRAFFIC DATA

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, background, and anticipated 2018 combined traffic conditions. Existing geometry and traffic control were used in the analyses of the intersection of Gray Hendrix Road and Garrison Drive for existing, background, and combined conditions. Additionally, the intersection was analyzed for a proposed traffic control scheme under combined conditions. This proposed intersection improvement will change the location of the stop sign from the northbound approach to the eastbound approach in addition to modifications with the alignment of the intersection. Analyses were also performed for the addition of a westbound right-turn lane under the proposed intersection scheme, for all-way stop control with and without a westbound right-turn lane, and for a roundabout alternative at this intersection. The analyses of the intersections of Gray Hendrix Road with the two proposed site entrances utilized side street stop control with a single lane approach on the site entrances.

Intersection capacity analyses for the projected year of 2018 indicate that the intersection of Gray Hendrix Road and Garrison Drive will continue to operate at acceptable levels-of-service during both peak periods for existing traffic control as well as during the P.M. peak period under proposed geometry and traffic control. The intersections of Gray Hendrix Road at the two proposed site entrances will also operate at acceptable levels-of-service during both peak periods. However, the Gray Hendrix and Garrison Drive intersection is expected to operate at LOS “F” during the A.M. peak traffic period with an average vehicle side street delay of 73.4 seconds under proposed geometry and traffic control.

Additional analyses of the Gray Hendrix and Garrison Drive intersection indicate that the A.M. peak level-of-service at the intersection will improve to LOS “E” with the addition of a westbound right-turn lane on Gray Hendrix Road with the proposed intersection geometry and traffic control. Analyses performed for the A.M. peak for all-way stop conditions with and without a westbound right-turn lane indicate that the intersection will operate at LOS “B” and “F”, respectively. Finally, the intersection is expected to operate at LOS “B” during A.M. peak traffic with the roundabout alternative. Level-of-service is expected to be acceptable for P.M. peak traffic for all scenarios analyzed.

TABLE 3
CAPACITY ANALYSIS SUMMARY

Intersection	Time Period	2013 Existing (LOS/Delay)	Year 2018 Background (LOS/Delay)	Year 2018 Combined (LOS/Delay)
Gray Hendrix Road at Garrison Drive Existing Geometry and Control (SIDE STREET STOP)[1]	A.M. P.M.	C 15.5 B 10.4	C 19.4 B 10.7	D 27.1 B 11.7
Gray Hendrix Road at Garrison Drive Proposed Geometry and Control (SIDE-STREET STOP)[1]	A.M. P.M.	- -	- -	F 70.9 B 14.2
Gray Hendrix Road at Garrison Drive Proposed Geometry and Control (SIDE-STREET STOP with Westbound Right-turn Lane)[1]	A.M. P.M.	- -	- -	E 39.5 B 13.8
Gray Hendrix Road at Garrison Drive Proposed Geometry and Control (ALL-WAY STOP)[2]	A.M. P.M.	- -	- -	F 75.3 A 9.4
Gray Hendrix Road at Garrison Drive Proposed Geometry and Control (ALL-WAY STOP with Westbound Right-turn Lane)[2]	A.M. P.M.	- -	- -	B 11.8 A 8.7
Gray Hendrix Road at Garrison Drive Alternative Geometry and Control (ROUNDABOUT)[3]	A.M. P.M.	- -	- -	B 11.8 A 5.9
Gray Hendrix Road at East Entrance Proposed Geometry and Control (SIDE STREET STOP)[1]	A.M. P.M.	- -	- -	D 27.1 B 12.4
Gray Hendrix Road at South Entrance Proposed Geometry and Control (SIDE STREET STOP)[1]	A.M. P.M.	- -	- -	C 17.4 B 11.7

[1]SIDE STREET STOP CONTROL – Level-of-Service and Average Vehicular Delay (seconds) for side street approach utilizing HCM methodology.

[2]ALL WAY STOP CONTROL – Level-of-Service and Average Vehicular Delay (seconds) for full intersection utilizing HCM methodology.

[3]ROUNDABOUT CONTROL – Level-of-Service and Average Vehicular Delay (seconds) for full intersection utilizing HCM methodology.

See APPENDIX for detailed computer print-out summaries and discussion of Capacity and Level-of-Service concepts.

TURN LANE ASSESSMENT

Left-turn and right-turn lane warrants were conducted on Gray Hendrix Road at the two site entrance roadways as well as at the intersection of Garrison Drive under proposed development conditions. These analyses employed Tables 4A and 4B from the *Knox County Access Control and Driveway Design Policy*, which are based on turn lane warrants developed by Harmelink. The results were that neither left-turn lanes or right-turn lanes will be warranted at either of the two proposed site entrance roadways nor at the intersection of Gray Hendrix Road and Garrison Drive under proposed traffic control. Copies of Tables 4A and 4B are located in the APPENDIX.

CORNER SIGHT DISTANCE

Intersection corner sight distance was field measured at the two proposed site entrance roadways as well as at the existing intersection of Gray Hendrix Road and Garrison Drive. Based on the posted 30 mph speed limit, the required minimum sight distance in accordance with Knox County regulations would be 300 feet. The following is a summary of the sight distance evaluations at each of the intersections:

- Gray Hendrix Road at Garrison Drive:
  Sight distance at the intersection of Gray Hendrix Road and Garrison Drive was measured at approximately 220 feet looking west and approximately 400 feet looking east. Sight distance looking west is restricted by a vertical crest curve, and sight distance looking east is restricted by vegetation. Sight distance looking east was measured looking across the front property line of the property located at 2801 Gray Hendrix Road.

Gray Hendrix Road at Garrison Drive
(Looking west along Garrison Drive)

Gray Hendrix Road at Garrison Drive
(Looking east along Gray Hendrix Road)

- Gray Hendrix Road at East Entrance:

  Sight distance at Gray Hendrix Road and the proposed East Entrance Roadway was measured at approximately 450 feet looking west and in excess of 450 feet looking east.

Gray Hendrix Road at East Entrance
(Looking west along Gray Hendrix Road)

Gray Hendrix Road at East Entrance
(Looking east along Gray Hendrix Road)

- Gray Hendrix Road at South Entrance:

  Sight distance at Gray Hendrix Road and the proposed South Entrance Roadway was measured at approximately 330 feet looking south and approximately 375 feet looking north. Sight distance to the south is restricted by a vertical crest curve, and sight distance looking north is restricted by a horizontal curve and vegetation.

Gray Hendrix Road at South Entrance
(Looking south along Gray Hendrix Road)

Gray Hendrix Road at South Entrance
(Looking north along Gray Hendrix Road)

CONCLUSIONS & RECOMMENDATIONS

The primary conclusion of this study is that the traffic generated from the proposed development will have limited impact on intersection and roadway capacity in the study area. A sight distance issue currently exists at the intersection of Gray Hendrix Road and Garrison Drive, which will be addressed with the proposed intersection modifications at Gray Hendrix Road and Garrison Drive. According to the capacity analyses, this would result in a poor level-of-service (F) for the eastbound approach during the A.M. peak traffic hour. Since the capacity analyses of this report were based on factored summer traffic counts, it is suggested that additional traffic count data be collected during a month when school is in session in order to confirm preferred intersection operation before implementing proposed traffic control.

Speeding and crash potential has been mentioned previously by the public in relation to Gray Hendrix Road. While the exact magnitude of this problem is unknown, a couple of simple measures are available to improve roadway safety. One would be to add white edgelines to the section of the roadway south of Garrison Drive and to refurbish all pavement markings on this section and the section east of Garrison Road. In addition, a centerline rumble stripe could be considered for both sections of Gray Hendrix Road.

The following listing is a summary of the improvements that are recommended in order to address the above issues and appropriately serve the traffic generated by the proposed development:

1. Install a STOP sign on both site entrance roadway approaches to Gray Hendrix Road.
2. Maximize intersection corner sight distance at the proposed site entrance roadways by removing any existing vegetation which may restrict sight distance.
3. Add white edgeline pavement markings to Gray Hendrix Road south of Garrison Drive, and refurbish all pavement markings on Gray Hendrix Road both east and south of Garrison Drive.
4. Implement currently proposed roadway and traffic control changes for the Gray Hendrix Road and Garrison Drive intersection, although the addition of a westbound right-turn lane or the possible inclusion of a roundabout intersection in these improvements should be considered.

APPENDIX

TRAFFIC DATA

TRIP GENERATION

CAPACITY ANALYSES

TRAFFIC DATA

Knox County Engineering & Public Works
205 W. Baxter Avenue
Knoxville, TN 37917
865-215-5860

File Name : TMC 9-22-10
Site Code : 00000000
Start Date : 09/22/2010
Page No : 1

Groups Printed- Unshifted

	Beaver Ridge-Byington Rd Southbound				Garrison Rd Westbound				Beaver Ridge-Byington Rd Northbound				Garrison Rd Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	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		
06:45 AM	0	103	1	104	3	1	2	6	0	50	4	54	0	1	0	1	165
Total	0	103	1	104	3	1	2	6	0	50	4	54	0	1	0	1	165
07:00 AM	0	129	5	134	8	1	5	14	0	81	13	94	4	1	1	6	248
07:15 AM	7	174	3	184	17	5	16	38	0	97	28	125	3	2	0	5	352
07:30 AM	7	152	6	165	25	8	11	44	0	99	20	119	3	1	0	4	332
07:45 AM	6	171	4	181	34	7	7	48	5	72	38	115	2	2	0	4	348
Total	20	626	18	664	84	21	39	144	5	349	99	453	12	6	1	19	1280
08:00 AM	3	144	29	176	28	12	13	53	6	75	43	124	3	3	3	9	362
08:15 AM	5	123	8	136	21	2	14	37	5	74	27	106	1	1	1	3	282
08:30 AM	3	120	2	125	13	3	1	17	1	63	4	68	3	1	2	6	216
*** BREAK ***																	
Total	11	387	39	437	62	17	28	107	12	212	74	298	7	5	6	18	860
*** BREAK ***																	
04:00 PM	7	106	1	114	6	0	3	9	1	131	7	139	2	2	0	4	266
04:15 PM	5	94	1	100	4	3	5	12	1	104	4	109	2	3	1	6	227
04:30 PM	1	87	5	93	3	0	6	9	3	116	10	129	3	1	1	5	236
04:45 PM	7	84	2	93	2	0	2	4	0	130	11	141	2	1	3	6	244
Total	20	371	9	400	15	3	16	34	5	481	32	518	9	7	5	21	973
05:00 PM	3	99	1	103	14	0	1	15	4	149	13	166	4	3	1	8	292
05:15 PM	3	114	2	119	4	0	5	9	0	139	17	156	0	5	1	6	290
05:30 PM	2	131	4	137	2	2	2	6	4	128	31	163	0	4	1	5	311
Grand Total	59	1831	74	1964	184	44	93	321	30	1508	270	1808	32	31	15	78	4171
Apprch %	3.0	93.2	3.8		57.3	13.7	29.0		1.7	83.4	14.9		41.0	39.7	19.2		
Total %	1.4	43.9	1.8	47.1	4.4	1.1	2.2	7.7	0.7	36.2	6.5	43.3	0.8	0.7	0.4	1.9	

	Beaver Ridge-Byington Rd Southbound				Garrison Rd Westbound				Beaver Ridge-Byington Rd Northbound				Garrison Rd Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour From 06:45 AM to 11:45 AM - Peak 1 of 1																	
Intersection	07:15 AM																
Volume	23	641	42	706	104	32	47	183	11	343	129	483	11	8	3	22	1394
Percent	3.3	90.8	5.9		56.8	17.5	25.7		2.3	71.0	26.7		50.0	36.4	13.6		
08:00 Volume	3	144	29	176	28	12	13	53	6	75	43	124	3	3	3	9	362
Peak Factor																	0.963
High Int.	07:15 AM				08:00 AM				07:15 AM				08:00 AM				
Volume	7	174	3	184	28	12	13	53	0	97	28	125	3	3	3	9	
Peak Factor				0.959				0.863				0.966				0.611	
Peak Hour From 12:00 PM to 05:30 PM - Peak 1 of 1																	
Intersection	04:45 PM																
Volume	15	428	9	452	22	2	10	34	8	546	72	626	6	13	6	25	1137
Percent	3.3	94.7	2.0		64.7	5.9	29.4		1.3	87.2	11.5		24.0	52.0	24.0		
05:30 Volume	2	131	4	137	2	2	2	6	4	128	31	163	0	4	1	5	311
Peak Factor																	0.914
High Int.	05:30 PM				05:00 PM				05:00 PM				05:00 PM				
Volume	2	131	4	137	14	0	1	15	4	149	13	166	4	3	1	8	
Peak Factor				0.825				0.567				0.943				0.781	

Study Name	Gray Hendrix Road at Garrison Drive TMC
Start Date	Tuesday, June 18, 2013 7:00 AM
End Date	Tuesday, June 18, 2013 6:00 PM
Site Code	1

Road Volumes

TMV	Movement												
	Westbound			Westbound Total	Northbound			Northbound Total	Eastbound			Eastbound Total	Grand Total
Interval	L	T	U		L	U	R		T	U	R		
6/18/2013 7:00	6	4	0	10	0	0	8	8	4	0	0	4	22
6/18/2013 7:15	14	3	0	17	0	0	9	9	4	0	2	6	32
6/18/2013 7:30	14	7	0	21	1	0	10	11	6	0	1	7	39
6/18/2013 7:45	14	10	0	24	0	0	9	9	2	0	1	3	36
6/18/2013 8:00	20	9	0	29	2	0	18	20	10	0	1	11	60
6/18/2013 8:15	21	12	0	33	0	0	11	11	13	0	0	13	57
6/18/2013 8:30	17	4	0	21	0	0	7	7	1	0	0	1	29
6/18/2013 8:45	10	4	0	14	0	0	5	5	2	0	2	4	23
6/18/2013 16:00	10	2	0	12	0	0	16	16	5	0	0	5	33
6/18/2013 16:15	13	2	0	15	2	0	18	20	6	0	4	10	45
6/18/2013 16:30	7	2	0	9	4	0	16	20	6	0	0	6	35
6/18/2013 16:45	11	5	0	16	1	0	24	25	7	0	0	7	48
6/18/2013 17:00	14	3	0	17	4	0	27	31	14	0	1	15	63
6/18/2013 17:15	12	3	0	15	1	0	32	33	18	0	1	19	67
6/18/2013 17:30	15	1	0	16	3	0	21	24	13	0	0	13	53
6/18/2013 17:45	12	5	0	17	0	0	25	25	11	0	0	11	53
Grand Total	210	76	0	286	18	0	256	274	122	0	13	135	695

Study Name	Gray Hendrix Road at Garrison Drive TMC
Start Date	Tuesday, June 18, 2013 7:00 AM
End Date	Tuesday, June 18, 2013 6:00 PM
Site Code	1

Report Summary

		Westbound - Gray Hendrix Road					Northbound - Gray Hendrix Road					Eastbound - Garrison Drive					
Time Period	**Class.**	**L**	**T**	**U**	**I**	**O**	**L**	**R**	**U**	**I**	**O**	**T**	**R**	**U**	**I**	**O**	**Total**
Peak 1	Car	69	38	0	107	79	3	48	0	51	72	31	3	0	34	41	192
Specified Period	%	100%	100%	0%	100%	100%	100%	100%	0%	100%	100%	100%	100%	0%	100%	100%	100%
7:00 AM - 9:00 AM	**Total**	**69**	**38**	**0**	**107**	**79**	**3**	**48**	**0**	**51**	**72**	**31**	**3**	**0**	**34**	**41**	**192**
One Hour Peak	PHF	0.82	0.79	0	0.81	0.71	0.38	0.67	0	0.64	0.86	0.6	0.75	0	0.65	0.85	0.8
7:30 AM - 8:30 AM	Approach %				56%	41%				27%	38%				18%	21%	
Peak 2	Car	53	12	0	65	161	8	105	0	113	55	56	2	0	58	20	236
Specified Period	%	100%	100%	0%	100%	100%	100%	100%	0%	100%	100%	100%	100%	0%	100%	100%	100%
4:00 PM - 6:00 PM	**Total**	**53**	**12**	**0**	**65**	**161**	**8**	**105**	**0**	**113**	**55**	**56**	**2**	**0**	**58**	**20**	**236**
One Hour Peak	PHF	0.88	0.6	0	0.96	0.8	0.5	0.82	0	0.86	0.92	0.78	0.5	0	0.76	0.71	0.88
5:00 PM - 6:00 PM	Approach %				28%	68%				48%	23%				25%	8%	

Station #	County	Location	Route #
000364	Knox	NEAR ANDERSON CO LINE	SR062

Record	Year	AADT
1	2012	11997
2	2011	11488
3	2010	11033
4	2009	11597
5	2008	10781
6	2007	10639
7	2006	12201
8	2005	12497
9	2004	11668
10	2003	10920
11	2002	10338
12	2001	10312
13	2000	10544
14	1999	10095
15	1998	9836
16	1997	10560
17	1996	14849
18	1995	11363
19	1994	9905
20	1993	8667
21	1992	9909
22	1991	9513
23	1990	9213
24	1989	9165
25	1988	8091
26	1987	7231
27	1986	7578

Oak Ridge Hwy east of Pellissippi

2010 to 2012 growth: $11997 = 11033(1+x)^2$ $x = 4.28\%$

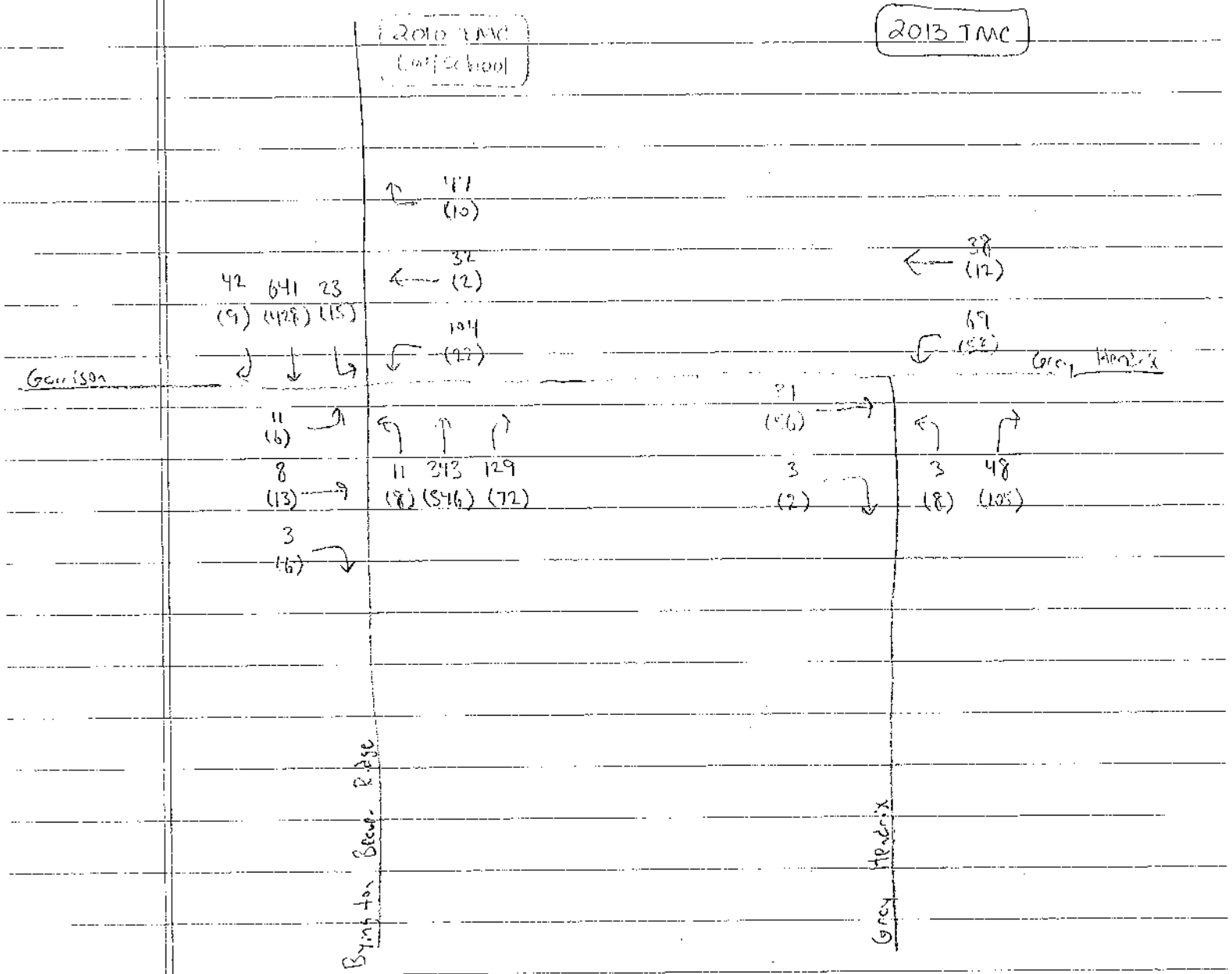
Station #	County	Location	Route #
000262	Knox	WEST KNOXVILLE	SR062

Record	Year	AADT
1	2012	15509
2	2011	14876
3	2010	15208
4	2009	15324
5	2008	14611
6	2007	16032
7	2006	17831
8	2005	17506
9	2004	17414
10	2003	16593
11	2002	16762
12	2001	14864
13	2000	14734
14	1999	15486
15	1998	14494
16	1997	14898
17	1996	13536
18	1995	15717
19	1994	12565
20	1993	15492
21	1992	11701
22	1991	11400
23	1990	11387
24	1989	10525
25	1988	9882
26	1987	8957
27	1986	8929
28	1985	9208

Oak Ridge Hwy west of Bell Road

2010 to 2012 5-yr Avg: $\frac{15509 + 15208}{2} (1+x)^2$ x: 0.1% annual

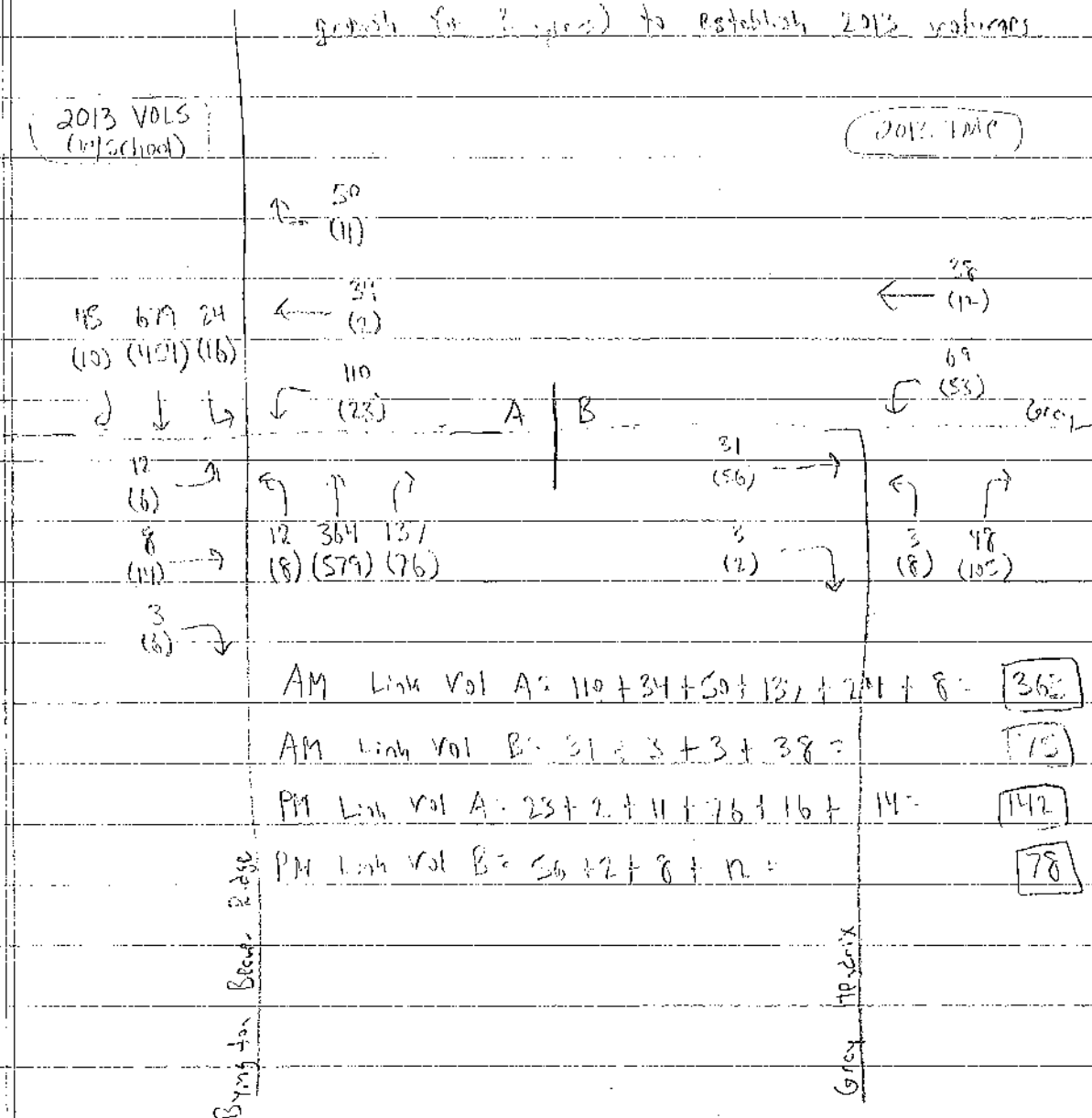
Raw Traffic Data (2pg, 2pb)



- Byington Solway Ridge & Garrison TMC is from 7pb car was supplied by Knox County
- Grey Hendrix & Garrison TMC was received in June 2013 by UCS

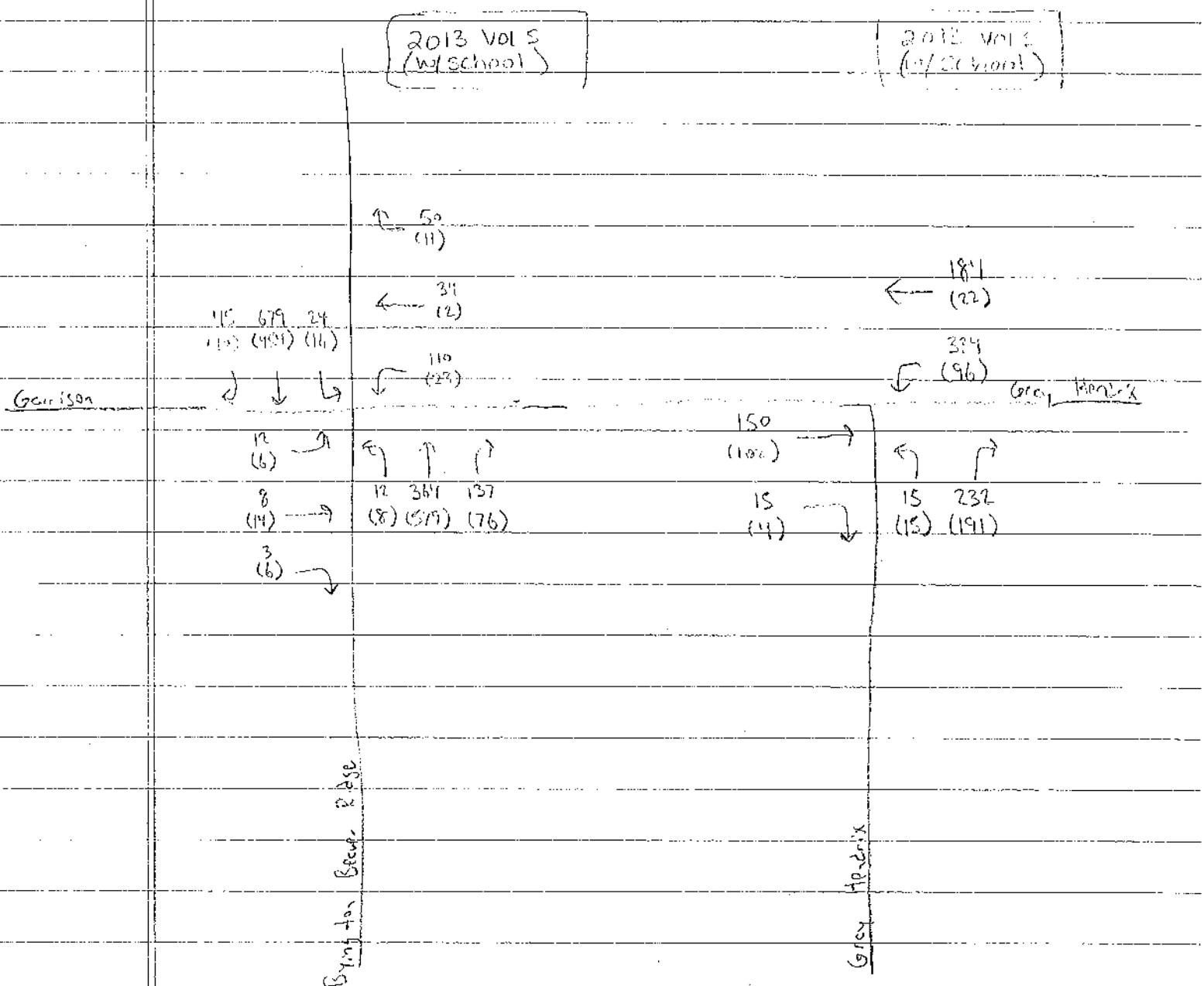
Traffic Data - Factored to 2013 Volumes

- Bayington Bros. Ridge & Garrison TMC factored by 1.06 (2.0% annual growth for 3 years) to establish 2013 volumes



- School factors to apply to Grey Hendrix & Garrison TMC:
  - AM: AM Link Vol A / AM Link Vol B: 243 / 75 = 4.84
  - PM: PM Link Vol B / PM Link Vol B: 142/78 = 1.82

Existing 2 hr Volumes - Factored for School



- Gray-Hendrix & Garrison TMC factored 4.84 for AM and 1.82 for PM

TRIP GENERATION

Single-Family Detached Housing
(210)

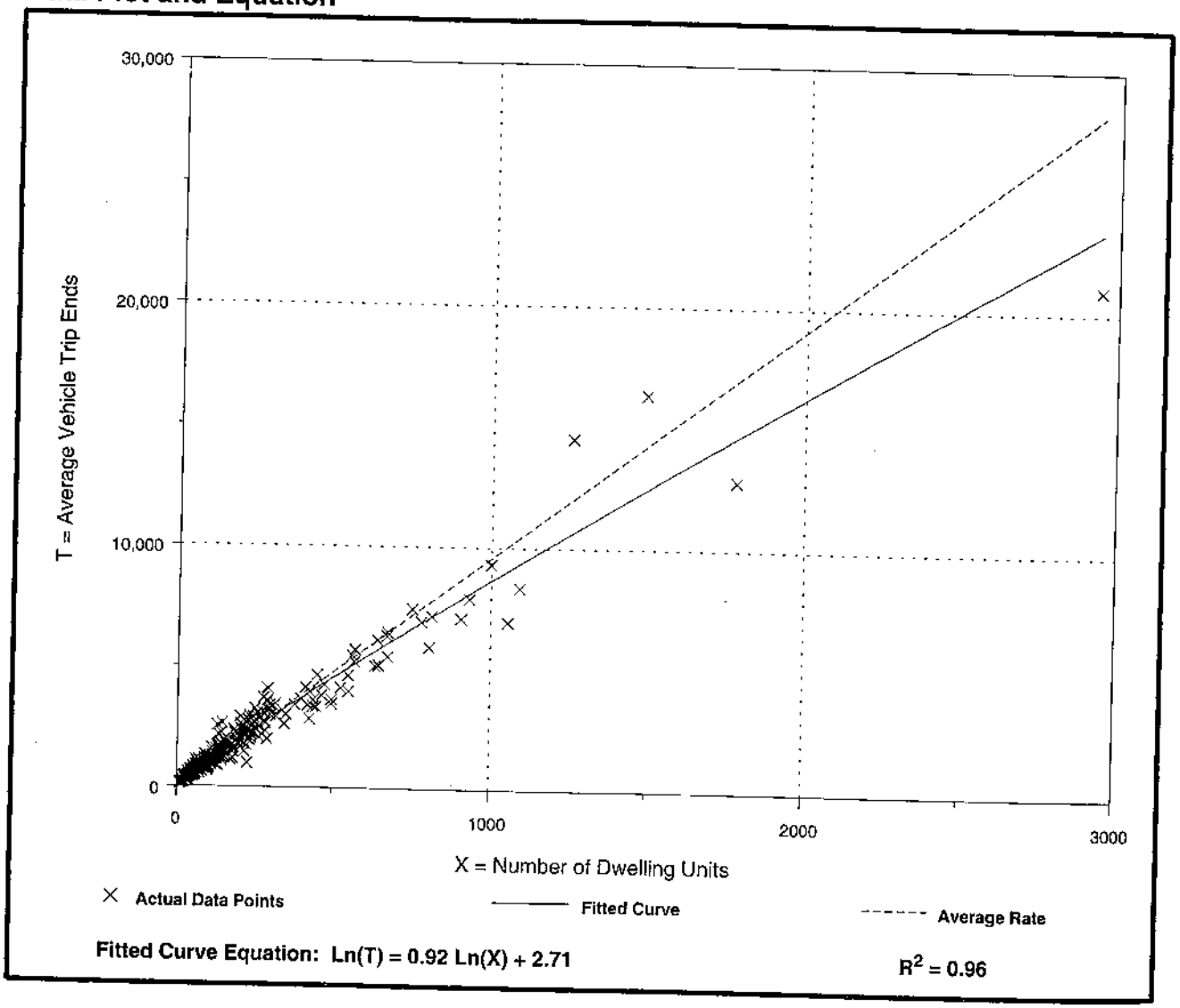
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

Number of Studies: 351
Avg. Number of Dwelling Units: 197
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Dwelling Unit

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

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.92 Ln(X) + 2.71

R^2 = 0.96

Single-Family Detached Housing
(210)

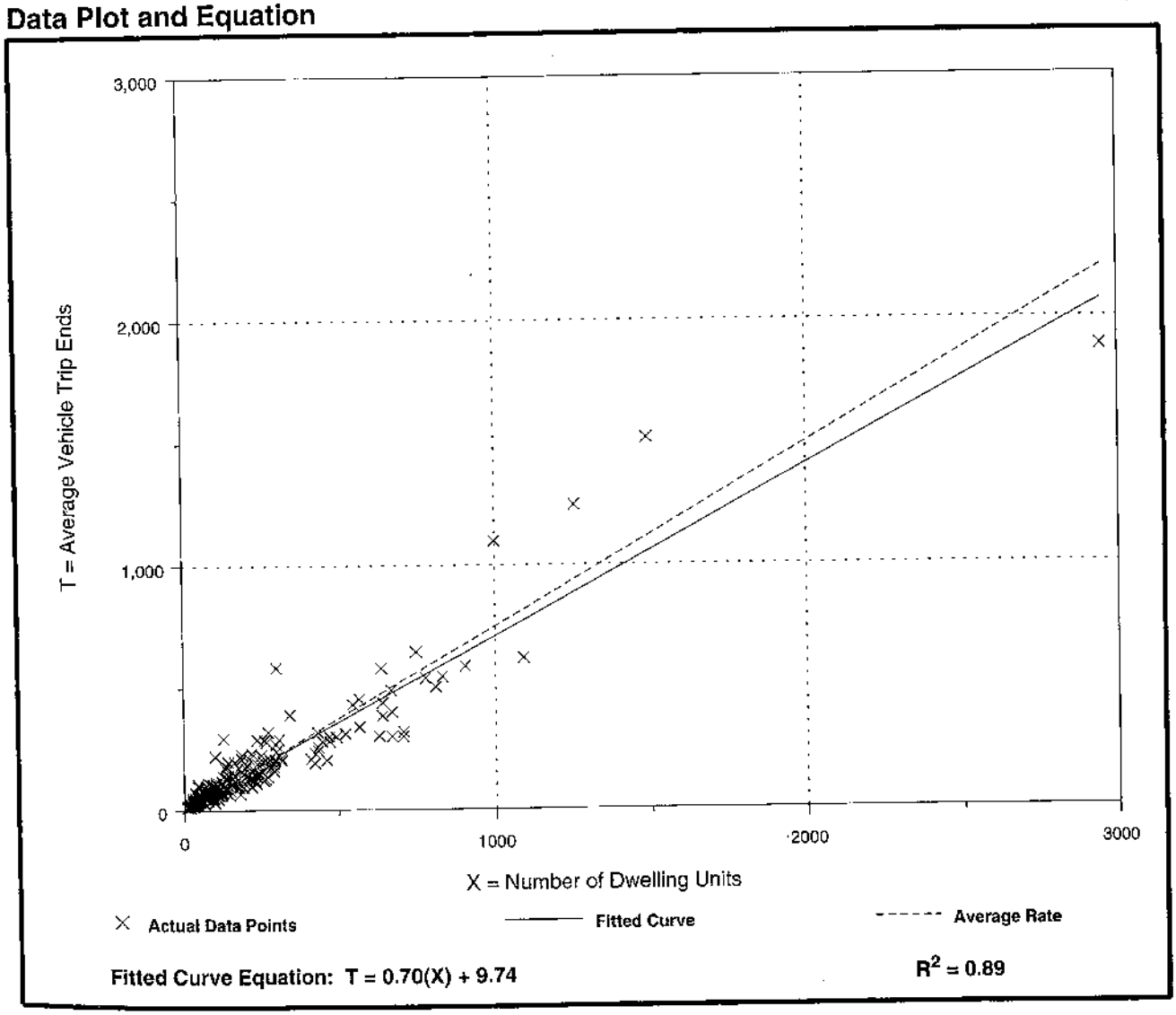
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Number of Studies: 286
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)

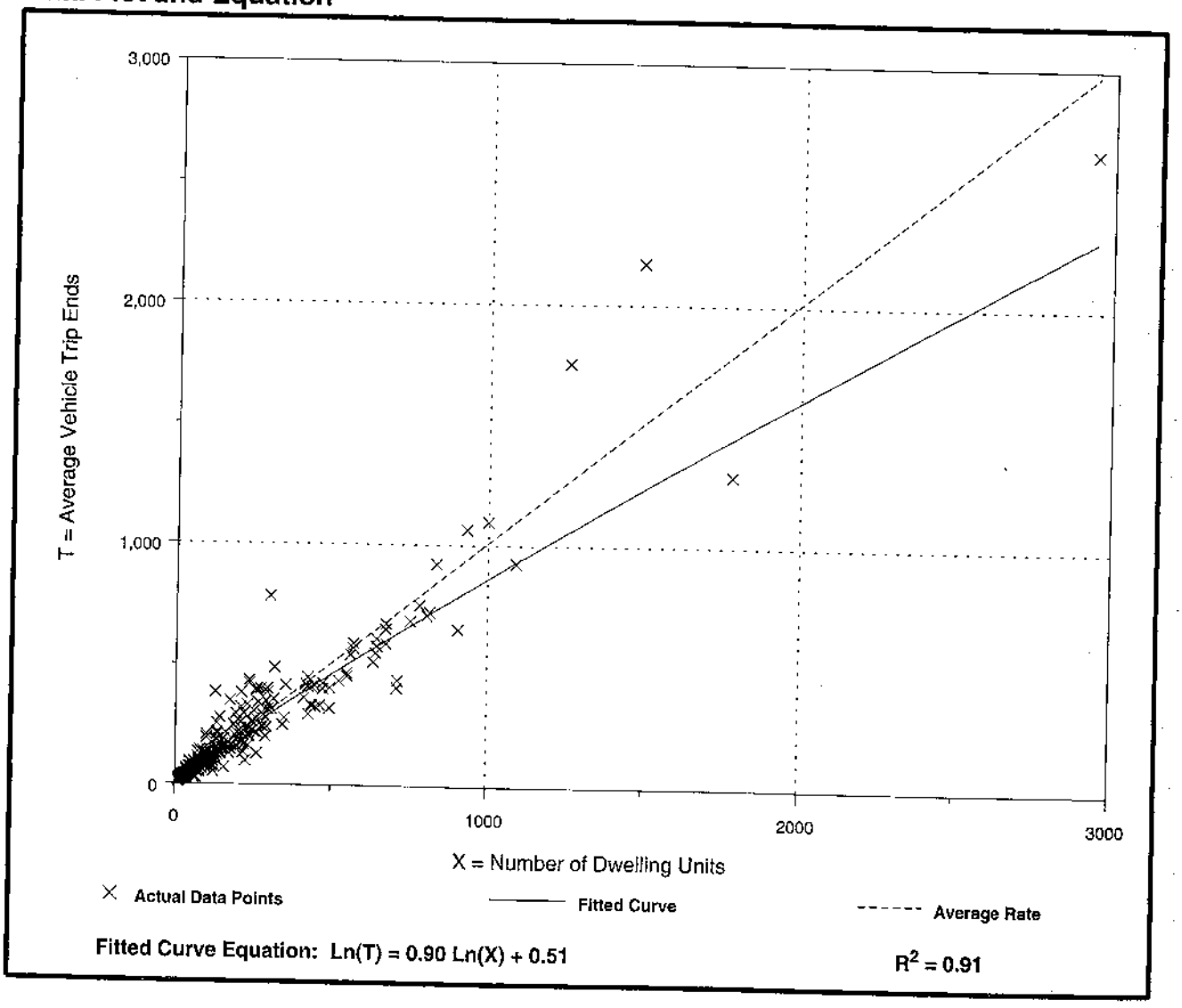
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

Number of Studies: 314
Avg. Number of Dwelling Units: 208
Directional Distribution: 63% entering, 37% exiting

Trip Generation per Dwelling Unit

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

Data Plot and Equation



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

$R^2 = 0.91$

TRIP GENERATION

KARNS FARM SUBDIVISION

ITE TRIP GENERATION (210)

185 DWELLING UNITS

WEEKDAY

T = e^(.92*Ln(X)+2.71)
T = 1831.20

50%	ENTERING =	916
50%	EXITING =	916

AM PEAK

T = .7*(X)+9.74
T = 139.24

25%	ENTERING =	35
75%	EXITING =	104

PM PEAK

T = .9*Ln(X)+.51
T = 182.79

63%	ENTERING =	115
37%	EXITING =	68

TRIP GENERATION

GOLDEN MEADOWS REDISTRIBUTION

ITE TRIP GENERATION (210)

86 DWELLING UNITS

WEEKDAY

T = e^(.92*Ln(X)+2.71)
T = 905.06

50%	ENTERING =	453
50%	EXITING =	453

AM PEAK

T = .7*(X)+9.74
T = 69.94

25%	ENTERING =	17
75%	EXITING =	52

PM PEAK

T = .9*Ln(X)+.51
T = 91.74

63%	ENTERING =	58
37%	EXITING =	34

CAPACITY 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 Federal Highway Administration has published the Year 2000 Highway Capacity Manual (HCM2000), 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.

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*BJH*
Agency/Co.	*Cannon & Cannon, Inc.*
Date Performed	*6/27/2013*
Analysis Time Period	*AM Peak*

Site Information

Intersection	*Gray Hendrix @ Garrison*
Jurisdiction	*Knox County*
Analysis Year	*Existing 2013*

Project Description *Existing Geometry*

East/West Street: *Garrison Drive / Gray Hendrix* | North/South Street: *Gray Hendrix Road*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*150*	*15*	*334*	*184*	
Peak-Hour Factor, PHF	*1.00*	*0.80*	*0.80*	*0.80*	*0.80*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*0*	*187*	*18*	*417*	*229*	*0*
Percent Heavy Vehicles	*0*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration			*TR*	*LT*		
Upstream Signal		*0*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*15*		*232*			
Peak-Hour Factor, PHF	*0.80*	*1.00*	*0.80*	*1.00*	*1.00*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*18*	*0*	*289*	*0*	*0*	*0*
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration		*LR*				

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*417*		*307*				
C (m) (veh/h)		*1378*		*646*				
v/c		*0.30*		*0.48*				
95% queue length		*1.29*		*2.56*				
Control Delay (s/veh)		*8.7*		*15.5*				
LOS		*A*		*C*				
Approach Delay (s/veh)	--	--	*15.5*					
Approach LOS	--	--	*C*					

HCS+™ Version 5.6 Generated: 7/2/2013 3:07 PM

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*BJH*
Agency/Co.	*Cannon & Cannon, Inc.*
Date Performed	*6/27/2013*
Analysis Time Period	*PM Peak*

Site Information

Intersection	*Gray Hendrix @ Garrison*
Jurisdiction	*Knox County*
Analysis Year	*Existing 2013*

Project Description *Existing Geometry*

East/West Street: *Garrison Drive / Gray Hendrix* | North/South Street: *Gray Hendrix Road*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*102*	*4*	*96*	*22*	
Peak-Hour Factor, PHF	*1.00*	*0.88*	*0.88*	*0.88*	*0.88*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*0*	*115*	*4*	*109*	*25*	*0*
Percent Heavy Vehicles	*0*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration			*TR*	*LT*		
Upstream Signal		*0*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*15*		*191*			
Peak-Hour Factor, PHF	*0.88*	*1.00*	*0.88*	*1.00*	*1.00*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*17*	*0*	*217*	*0*	*0*	*0*
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration		*LR*				

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*109*		*234*				
C (m) (veh/h)		*1482*		*903*				
v/c		*0.07*		*0.26*				
95% queue length		*0.24*		*1.04*				
Control Delay (s/veh)		*7.6*		*10.4*				
LOS		*A*		*B*				
Approach Delay (s/veh)	--	--	*10.4*					
Approach LOS	--	--	*B*					

HCS+™ Version 5.6 Generated: 7/2/2013 3:08 PM

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*BJH*
Agency/Co.	*Cannon & Cannon, Inc.*
Date Performed	*6/27/2013*
Analysis Time Period	*AM Peak*

Site Information

Intersection	*Gray Hendrix @ Garrison*
Jurisdiction	*Knox County*
Analysis Year	*Background 2018*

Project Description *Existing Geometry*

East/West Street: *Garrison Drive / Gray Hendrix* | North/South Street: *Gray Hendrix Road*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*165*	*17*	*367*	*202*	
Peak-Hour Factor, PHF	*1.00*	*0.80*	*0.80*	*0.80*	*0.80*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*0*	*206*	*21*	*458*	*252*	*0*
Percent Heavy Vehicles	*0*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration			*TR*	*LT*		
Upstream Signal		*0*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*17*		*255*			
Peak-Hour Factor, PHF	*0.80*	*1.00*	*0.80*	*1.00*	*1.00*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*21*	*0*	*318*	*0*	*0*	*0*
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration		*LR*				

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*458*		*339*				
C (m) (veh/h)		*1353*		*583*				
v/c		*0.34*		*0.58*				
95% queue length		*1.51*		*3.72*				
Control Delay (s/veh)		*9.0*		*19.4*				
LOS		*A*		*C*				
Approach Delay (s/veh)	--	--	*19.4*					
Approach LOS	--	--	*C*					

HCS+™ Version 5.6 Generated: 7/2/2013 3:07 PM

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*BJH*
Agency/Co.	*Cannon & Cannon, Inc.*
Date Performed	*6/27/2013*
Analysis Time Period	*PM Peak*

Site Information

Intersection	*Gray Hendrix @ Garrison*
Jurisdiction	*Knox County*
Analysis Year	*Background 2018*

Project Description *Existing Geometry*

East/West Street: *Garrison Drive / Gray Hendrix* | North/South Street: *Gray Hendrix Road*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*112*	*4*	*106*	*24*	
Peak-Hour Factor, PHF	*1.00*	*0.88*	*0.88*	*0.88*	*0.88*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*0*	*127*	*4*	*120*	*27*	*0*
Percent Heavy Vehicles	*0*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration			*TR*	*LT*		
Upstream Signal		*0*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*17*		*210*			
Peak-Hour Factor, PHF	*0.88*	*1.00*	*0.88*	*1.00*	*1.00*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*19*	*0*	*238*	*0*	*0*	*0*
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration		*LR*				

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*120*		*257*				
C (m) (veh/h)		*1467*		*884*				
v/c		*0.08*		*0.29*				
95% queue length		*0.27*		*1.21*				
Control Delay (s/veh)		*7.7*		*10.7*				
LOS		*A*		*B*				
Approach Delay (s/veh)	--	--	*10.7*					
Approach LOS	--	--	*B*					

HCS+™ Version 5.6 Generated: 7/2/2013 3:07 PM

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*BJH*
Agency/Co.	*Cannon & Cannon, Inc.*
Date Performed	*7/31/2013*
Analysis Time Period	*AM Peak*

Site Information

Intersection	*Gray Hendrix @ Garrison*
Jurisdiction	*Knox County*
Analysis Year	*Combined 2018*

Project Description *Existing Geometry*

East/West Street: *Garrison Drive / Gray Hendrix* | North/South Street: *Gray Hendrix Road*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*177*	*19*	*375*	*239*	
Peak-Hour Factor, PHF	*1.00*	*0.80*	*0.80*	*0.80*	*0.80*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*0*	*221*	*23*	*468*	*298*	*0*
Percent Heavy Vehicles	*0*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration			*TR*	*LT*		
Upstream Signal		*0*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*22*		*268*			
Peak-Hour Factor, PHF	*0.80*	*1.00*	*0.80*	*1.00*	*1.00*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*27*	*0*	*334*	*0*	*0*	*0*
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration		*LR*				

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*468*		*361*				
C (m) (veh/h)		*1334*		*512*				
v/c		*0.35*		*0.71*				
95% queue length		*1.60*		*5.54*				
Control Delay (s/veh)		*9.1*		*27.1*				
LOS		*A*		*D*				
Approach Delay (s/veh)	--	--		*27.1*				
Approach LOS	--	--		*D*				

HCS+™ Version 5.6

Generated: 7/31/2013 3:02 PM

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*BJH*
Agency/Co.	*Cannon & Cannon, Inc.*
Date Performed	*7/31/2013*
Analysis Time Period	*PM Peak*

Site Information

Intersection	*Gray Hendrix @ Garrison*
Jurisdiction	*Knox County*
Analysis Year	*Combined 2018*

Project Description *Existing Geometry*

East/West Street: *Garrison Drive / Gray Hendrix* | North/South Street: *Gray Hendrix Road*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*152*	*16*	*114*	*42*	
Peak-Hour Factor, PHF	*1.00*	*0.88*	*0.88*	*0.88*	*0.88*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*0*	*172*	*18*	*129*	*47*	*0*
Percent Heavy Vehicles	*0*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration			*TR*	*LT*		
Upstream Signal		*0*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*20*		*229*			
Peak-Hour Factor, PHF	*0.88*	*1.00*	*0.88*	*1.00*	*1.00*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*22*	*0*	*260*	*0*	*0*	*0*
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration		*LR*				

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*129*		*282*				
C (m) (veh/h)		*1396*		*819*				
v/c		*0.09*		*0.34*				
95% queue length		*0.30*		*1.54*				
Control Delay (s/veh)		*7.8*		*11.7*				
LOS		*A*		*B*				
Approach Delay (s/veh)	--	--		*11.7*				
Approach LOS	--	--		*B*				

HCS+™ Version 5.6

Generated: 7/31/2013 3:03 PM

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*BJH*
Agency/Co.	*Cannon & Cannon, Inc.*
Date Performed	*7/31/2013*
Analysis Time Period	*AM Peak*

Site Information

Intersection	*Gray Hendrix @ Garrison*
Jurisdiction	*Knox County*
Analysis Year	*Combined 2018*

Project Description *Proposed Geometry*

East/West Street: *Gray Hendrix Road* | North/South Street: *Garrison Drive*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*22*	*268*			*375*	*239*
Peak-Hour Factor, PHF	*0.80*	*0.80*	*0.80*	*0.80*	*0.80*	*0.80*
Hourly Flow Rate, HFR (veh/h)	*27*	*334*	*0*	*0*	*468*	*298*
Percent Heavy Vehicles	*0*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration	*LT*					*TR*
Upstream Signal		*0*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*177*		*19*
Peak-Hour Factor, PHF	*0.80*	*1.00*	*0.80*	*0.80*	*1.00*	*0.80*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*221*	*0*	*23*
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration					*LR*	

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LT*						*LR*	
v (veh/h)	*27*						*244*	
C (m) (veh/h)	*856*						*273*	
v/c	*0.03*						*0.89*	
95% queue length	*0.10*						*7.92*	
Control Delay (s/veh)	*9.3*						*70.9*	
LOS	*A*						*F*	
Approach Delay (s/veh)	--	--				*70.9*		
Approach LOS	--	--				*F*		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*BJH*
Agency/Co.	*Cannon & Cannon, Inc.*
Date Performed	*7/31/2013*
Analysis Time Period	*PM Peak*

Site Information

Intersection	*Gray Hendrix @ Garrison*
Jurisdiction	*Knox County*
Analysis Year	*Combined 2018*

Project Description *Proposed Geometry*

East/West Street: *Gray Hendrix Road* | North/South Street: *Garrison Drive*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*20*	*229*			*114*	*42*
Peak-Hour Factor, PHF	*0.88*	*0.88*	*0.80*	*0.80*	*0.88*	*0.88*
Hourly Flow Rate, HFR (veh/h)	*22*	*260*	*0*	*0*	*129*	*47*
Percent Heavy Vehicles	*0*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration	*LT*					*TR*
Upstream Signal		*0*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*152*		*16*
Peak-Hour Factor, PHF	*0.80*	*1.00*	*0.80*	*0.88*	*1.00*	*0.88*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*172*	*0*	*18*
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration					*LR*	

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LT*						*LR*	
v (veh/h)	*22*						*190*	
C (m) (veh/h)	*1412*						*578*	
v/c	*0.02*						*0.33*	
95% queue length	*0.05*						*1.43*	
Control Delay (s/veh)	*7.6*						*14.2*	
LOS	*A*						*B*	
Approach Delay (s/veh)	--	--				*14.2*		
Approach LOS	--	--				*B*		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*BJH*
Agency/Co.	*Cannon & Cannon, Inc.*
Date Performed	*7/31/2013*
Analysis Time Period	*AM Peak*

Site Information

Intersection	*Gray Hendrix @ Garrison*
Jurisdiction	*Knox County*
Analysis Year	*Combined 2018*

Project Description *Proposed Geometry w/ WBR Lane*

East/West Street: *Gray Hendrix Road* | North/South Street: *Garrison Drive*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*22*	*268*			*375*	*239*
Peak-Hour Factor, PHF	*0.80*	*0.80*	*0.80*	*0.80*	*0.80*	*0.80*
Hourly Flow Rate, HFR (veh/h)	*27*	*334*	*0*	*0*	*468*	*298*
Percent Heavy Vehicles	*0*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*1*
Configuration	*LT*				*T*	*R*
Upstream Signal		*0*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*177*		*19*
Peak-Hour Factor, PHF	*0.80*	*1.00*	*0.80*	*0.80*	*1.00*	*0.80*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*221*	*0*	*23*
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration					*LR*	

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LT*						*LR*	
v (veh/h)	*27*						*244*	
C (m) (veh/h)	*856*						*336*	
v/c	*0.03*						*0.73*	
95% queue length	*0.10*						*5.41*	
Control Delay (s/veh)	*9.3*						*39.5*	
LOS	*A*						*E*	
Approach Delay (s/veh)	--	--				*39.5*		
Approach LOS	--	--				*E*		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*BJH*
Agency/Co.	*Cannon & Cannon, Inc.*
Date Performed	*7/31/2013*
Analysis Time Period	*PM Peak*

Site Information

Intersection	*Gray Hendrix @ Garrison*
Jurisdiction	*Knox County*
Analysis Year	*Combined 2018*

Project Description *Proposed Geometry w/ WBR Lane*

East/West Street: *Gray Hendrix Road* | North/South Street: *Garrison Drive*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*20*	*229*			*114*	*42*
Peak-Hour Factor, PHF	*0.88*	*0.88*	*0.80*	*0.80*	*0.88*	*0.88*
Hourly Flow Rate, HFR (veh/h)	*22*	*260*	*0*	*0*	*129*	*47*
Percent Heavy Vehicles	*0*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*1*
Configuration	*LT*				*T*	*R*
Upstream Signal		*0*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*152*		*16*
Peak-Hour Factor, PHF	*0.80*	*1.00*	*0.80*	*0.88*	*1.00*	*0.88*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*172*	*0*	*18*
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration					*LR*	

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LT*						*LR*	
v (veh/h)	*22*						*190*	
C (m) (veh/h)	*1412*						*596*	
v/c	*0.02*						*0.32*	
95% queue length	*0.05*						*1.37*	
Control Delay (s/veh)	*7.6*						*13.8*	
LOS	*A*						*B*	
Approach Delay (s/veh)	--	--				*13.8*		
Approach LOS	--	--				*B*		

HCS+™ Version 5.6

Generated: 7/31/2013 3:34 PM

ALL-WAY STOP CONTROL ANALYSIS

General Information

Analyst	*BJH*
Agency/Co.	*Cannon & Cannon, Inc.*
Date Performed	*7/31/2013*
Analysis Time Period	*AM Peak*

Site Information

Intersection	*Gray Hendrix @ Garrison*
Jurisdiction	*Knox County*
Analysis Year	*Combined 2018*

Project ID *All-Way Stop*

East/West Street: *Garrison Drive / Gray Hendrix* North/South Street: *Gray Hendrix Road*

Volume Adjustments and Site Characteristics

Approach	Eastbound			Westbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	*0*	*177*	*19*	*375*	*239*	*0*
%Thrus Left Lane						

Approach	Northbound			Southbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	*22*	*0*	*268*	*0*	*0*	*0*
%Thrus Left Lane						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	*TR*		*LT*		*LR*			
PHF	*0.80*		*0.80*		*0.80*			
Flow Rate (veh/h)	*244*		*766*		*361*			
% Heavy Vehicles	*0*		*0*		*0*			
No. Lanes	*1*		*1*		*1*		*0*	
Geometry Group	*1*		*1*		*1*			
Duration, T	*0.25*							

Saturation Headway Adjustment Worksheet

Prop. Left-Turns	*0.0*		*0.6*		*0.1*			
Prop. Right-Turns	*0.1*		*0.0*		*0.9*			
Prop. Heavy Vehicle	*0.0*		*0.0*		*0.0*			
hLT-adj	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*		
hRT-adj	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*		
hHV-adj	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*		
hadj, computed	*-0.1*		*0.1*		*-0.5*			

Departure Headway and Service Time

hd, initial value (s)	*3.20*		*3.20*		*3.20*			
x, initial	*0.22*		*0.68*		*0.32*			
hd, final value (s)	*6.07*		*5.62*		*5.80*			
x, final value	*0.41*		*1.19*		*0.58*			
Move-up time, m (s)	*2.0*		*2.0*		*2.0*			
Service Time, t_s (s)	*4.1*		*3.6*		*3.8*			

Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Capacity (veh/h)	*494*		*766*		*611*			
Delay (s/veh)	*13.26*		*122.71*		*16.57*			
LOS	*B*		*F*		*C*			
Approach: Delay (s/veh)	*13.26*		*122.71*		*16.57*			
LOS	*B*		*F*		*C*			
Intersection Delay (s/veh)	*75.28*							
Intersection LOS	*F*							

 HCS+™ Version 5.6 Generated: 7/31/2013 3:24 PM

ALL-WAY STOP CONTROL ANALYSIS

General Information

Analyst	*BJH*
Agency/Co.	*Cannon & Cannon, Inc.*
Date Performed	*7/31/2013*
Analysis Time Period	*PM Peak*

Site Information

Intersection	*Gray Hendrix @ Garrison*
Jurisdiction	*Knox County*
Analysis Year	*Combined 2018*

Project ID *All-Way Stop*

East/West Street: *Garrison Drive / Gray Hendrix* North/South Street: *Gray Hendrix Road*

Volume Adjustments and Site Characteristics

Approach	Eastbound			Westbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	*0*	*152*	*16*	*114*	*42*	*0*
%Thrus Left Lane						

Approach	Northbound			Southbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	*20*	*0*	*229*	*0*	*0*	*0*
%Thrus Left Lane						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	*TR*		*LT*		*LR*			
PHF	*0.88*		*0.88*		*0.88*			
Flow Rate (veh/h)	*190*		*176*		*282*			
% Heavy Vehicles	*0*		*0*		*0*			
No. Lanes	*1*		*1*		*1*		*0*	
Geometry Group	*1*		*1*		*1*			
Duration, T	*0.25*							

Saturation Headway Adjustment Worksheet

Prop. Left-Turns	*0.0*		*0.7*		*0.1*			
Prop. Right-Turns	*0.1*		*0.0*		*0.9*			
Prop. Heavy Vehicle	*0.0*		*0.0*		*0.0*			
hLT-adj	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*		
hRT-adj	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*		
hHV-adj	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*		
hadj, computed	*-0.1*		*0.1*		*-0.5*			

Departure Headway and Service Time

hd, initial value (s)	*3.20*		*3.20*		*3.20*			
x, initial	*0.17*		*0.16*		*0.25*			
hd, final value (s)	*4.73*		*4.95*		*4.26*			
x, final value	*0.25*		*0.24*		*0.33*			
Move-up time, m (s)	*2.0*		*2.0*		*2.0*			
Service Time, t_s (s)	*2.7*		*2.9*		*2.3*			

Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Capacity (veh/h)	*440*		*426*		*532*			
Delay (s/veh)	*9.30*		*9.52*		*9.39*			
LOS	*A*		*A*		*A*			
Approach: Delay (s/veh)	*9.30*		*9.52*		*9.39*			
LOS	*A*		*A*		*A*			
Intersection Delay (s/veh)	*9.40*							
Intersection LOS	*A*							

 HCS+™ Version 5.6 Generated: 7/31/2013 3:25 PM

ALL-WAY STOP CONTROL ANALYSIS

General Information

Analyst	*BJH*
Agency/Co.	*Cannon & Cannon, Inc.*
Date Performed	*7/31/2013*
Analysis Time Period	*AM Peak*

Site Information

Intersection	*Gray Hendrix @ Garrison*
Jurisdiction	*Knox County*
Analysis Year	*Combined 2018*

Project ID *All-Way Stop w/ WBR Lane*

East/West Street: *Garrison Drive / Gray Hendrix* North/South Street: *Gray Hendrix Road*

Volume Adjustments and Site Characteristics

Approach	Eastbound			Westbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	*0*	*177*	*19*	*375*	*239*	*0*
%Thrus Left Lane						

Approach	Northbound			Southbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	*22*	*0*	*268*	*0*	*0*	*0*
%Thrus Left Lane						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	*TR*		*T*		*LR*			
PHF	*0.80*		*0.80*		*0.80*			
Flow Rate (veh/h)	*244*		*298*		*361*			
% Heavy Vehicles	*0*		*0*		*0*			
No. Lanes	*1*		*1*		*1*		*0*	
Geometry Group	*1*		*1*		*1*			
Duration, T	*0.25*							

Saturation Headway Adjustment Worksheet

Prop. Left-Turns	*0.0*		*0.0*		*0.1*			
Prop. Right-Turns	*0.1*		*0.0*		*0.9*			
Prop. Heavy Vehicle	*0.0*		*0.0*		*0.0*			
hLT-adj	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*		
hRT-adj	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*		
hHV-adj	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*		
hadj, computed	*-0.1*		*0.0*		*-0.5*			

Departure Headway and Service Time

hd, initial value (s)	*3.20*		*3.20*		*3.20*			
x, initial	*0.22*		*0.26*		*0.32*			
hd, final value (s)	*5.23*		*5.21*		*4.77*			
x, final value	*0.35*		*0.43*		*0.48*			
Move-up time, m (s)	*2.0*		*2.0*		*2.0*			
Service Time, t_s (s)	*3.2*		*3.2*		*2.8*			

Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Capacity (veh/h)	*494*		*548*		*611*			
Delay (s/veh)	*11.07*		*12.09*		*12.05*			
LOS	*B*		*B*		*B*			
Approach: Delay (s/veh)	*11.07*		*12.09*		*12.05*			
LOS	*B*		*B*		*B*			
Intersection Delay (s/veh)	*11.80*							
Intersection LOS	*B*							

 HCS+™ Version 5.6 Generated: 7/31/2013 3:30 PM

ALL-WAY STOP CONTROL ANALYSIS

General Information

Analyst	*BJH*
Agency/Co.	*Cannon & Cannon, Inc.*
Date Performed	*7/31/2013*
Analysis Time Period	*PM Peak*

Site Information

Intersection	*Gray Hendrix @ Garrison*
Jurisdiction	*Knox County*
Analysis Year	*Combined 2018*

Project ID *All-Way Stop w/ WBR Lane*

East/West Street: *Garrison Drive / Gray Hendrix* North/South Street: *Gray Hendrix Road*

Volume Adjustments and Site Characteristics

Approach	Eastbound			Westbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	*0*	*152*	*16*	*114*	*42*	*0*
%Thrus Left Lane						

Approach	Northbound			Southbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	*20*	*0*	*229*	*0*	*0*	*0*
%Thrus Left Lane						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	*TR*		*T*		*LR*			
PHF	*0.88*		*0.88*		*0.88*			
Flow Rate (veh/h)	*190*		*47*		*282*			
% Heavy Vehicles	*0*		*0*		*0*			
No. Lanes	*1*		*1*		*1*		*0*	
Geometry Group	*1*		*1*		*1*			
Duration, T	*0.25*							

Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
Prop. Left-Turns	*0.0*		*0.0*		*0.1*			
Prop. Right-Turns	*0.1*		*0.0*		*0.9*			
Prop. Heavy Vehicle	*0.0*		*0.0*		*0.0*			
hLT-adj	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*		
hRT-adj	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*		
hHV-adj	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*		
hadj, computed	*-0.1*		*0.0*		*-0.5*			

Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
hd, initial value (s)	*3.20*		*3.20*		*3.20*			
x, initial	*0.17*		*0.04*		*0.25*			
hd, final value (s)	*4.51*		*4.73*		*3.93*			
x, final value	*0.24*		*0.06*		*0.31*			
Move-up time, m (s)	*2.0*		*2.0*		*2.0*			
Service Time, t_s (s)	*2.5*		*2.7*		*1.9*			

Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Capacity (veh/h)	*440*		*297*		*532*			
Delay (s/veh)	*8.91*		*8.04*		*8.66*			
LOS	*A*		*A*		*A*			
Approach: Delay (s/veh)	*8.91*		*8.04*		*8.66*			
LOS	*A*		*A*		*A*			
Intersection Delay (s/veh)	*8.69*							
Intersection LOS	*A*							

 HCS+™ Version 5.6 Generated: 7/31/2013 3:31 PM

ROUNDABOUT REPORT

General Information		Site Information	
Analyst	BJH	Intersection	Gray Hendrix @ Garrison
Agency or Co.	Cannon & Cannon, Inc.	E/W Street Name	Garrison Drive / Gray Hendrix
Date Performed	7/31/2013	N/S Street Name	
Time Period	AM Peak	Analysis Year	Combined 2018
Peak Hour Factor	0.80	Project ID	Roundabout Analysis

Project Description:

Volume Adjustment and Site Characteristics

	EB				WB				NB				SB			
	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	U
Number of Lanes (N)	0	1	0		0	1	0		0	0	0		0	0	0	
Lane Assignment			TR				LT				LR					
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	1				1				1				1			
Volume (V), veh/h		177	19	0	375	239		0	22		268	0				0
Heavy Veh. Adj. (f_{HV}), %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians Crossing	0				0				0				0			

Critical and Follow-Up Headway Adjustment

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (sec)	5.1929	5.1929	5.1929	5.1929	5.1929	5.1929	5.1929	5.1929	5.1929	5.1929	5.1929	5.1929
Follow-Up Headway (sec)	3.1858	3.1858	3.1858	3.1858	3.1858	3.1858	3.1858	3.1858	3.1858	3.1858	3.1858	3.1858

Flow Computations

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Circulating Flow (V_c), pc/h	469			28			221			796		
Exiting Flow (V_{ex}), pc/h	556			326			0			493		
Entry Flow (V_e), pc/h		245			768			363				
Entry Volume veh/h		245			768			363				

Capacity and v/c Ratios

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Capacity (c_{PCE}), pc/h		707			1099			906			0	
Capacity (c), veh/h		707			1099			906			0	
v/c Ratio (X)		0.35			0.70			0.40				

Delay and Level of Service

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		9.5			14.0			8.6				
Lane LOS		A			B			A			F	
Lane 95% Queue		1.5			6.1			1.9				
Approach Delay, s/veh	9.50			13.99			8.61					
Approach LOS, s/veh	A			B			A					
Intersection Delay, s/veh	11.77											
Intersection LOS	B											

ROUNDABOUT REPORT

General Information		Site Information	
Analyst	*BJH*	Intersection	*Gray Hendrix @ Garrison*
Agency or Co.	*Cannon & Cannon, Inc.*	E/W Street Name	*Garrison Drive / Gray Hendrix*
Date Performed	*7/31/2013*	N/S Street Name	*Gray Hendrix Road*
Time Period	*PM Peak*	Analysis Year	*Combined 2018*
Peak Hour Factor	*0.88*	Project ID	*Roundabout Analysis*

Project Description:

Volume Adjustment and Site Characteristics

	EB				WB				NB				SB			
	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	U
Number of Lanes (N)	*0*	*1*	*0*		*0*	*1*	*0*		*0*	*0*	*0*		*0*	*0*	*0*	
Lane Assignment			*TR*				*LT*				*LR*					
Right-Turn Bypass	*None*				None				None				None			
Conflicting Lanes	*1*				1				1				1			
Volume (V), veh/h		*152*	*16*	*0*	*114*	*42*		*0*	*20*		*229*	*0*				*0*
Heavy Veh. Adj. (f_{HV}), %	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Pedestrians Crossing	*0*				0				0				0			

Critical and Follow-Up Headway Adjustment

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (sec)	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*
Follow-Up Headway (sec)	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*

Flow Computations

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Circulating Flow (V_c), pc/h	*130*			*23*			*173*			*201*		
Exiting Flow (V_{ex}), pc/h	*433*			*70*			*0*			*148*		
Entry Flow (V_e), pc/h		*191*			*177*			*283*				
Entry Volume veh/h		*191*			*177*			*283*				

Capacity and v/c Ratios

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Capacity (c_{PCE}), pc/h		*993*			*1105*			*951*			*0*	
Capacity (*c*), veh/h		*993*			*1105*			*951*			*0*	
v/c Ratio (X)		*0.19*			*0.16*			*0.30*				

Delay and Level of Service

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		*5.4*			*4.7*			*6.9*				
Lane LOS		*A*			*A*			*A*			*F*	
Lane 95% Queue		*0.7*			*0.6*			*1.3*				
Approach Delay, s/veh	*5.45*			*4.68*			*6.87*					
Approach LOS, s/veh	*A*			*A*			*A*					
Intersection Delay, s/veh	*5.86*											
Intersection LOS	*A*											

 HCS 2010™ 6.50 Roundabouts Generated: 7/31/2013 3:20 PM

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*BJH*
Agency/Co.	*Cannon & Cannon, Inc.*
Date Performed	*7/31/2013*
Analysis Time Period	*AM Peak*

Site Information

Intersection	*Gray Hendrix @ East Entrance*
Jurisdiction	*Knox County*
Analysis Year	*Combined 2018*

Project Description *East Site Entrance*

East/West Street: *Gray Hendrix Road* | North/South Street: *East Site Entrance*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*431*	*14*	*18*	*572*	
Peak-Hour Factor, PHF	*1.00*	*0.80*	*0.80*	*0.80*	*0.80*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*0*	*538*	*17*	*22*	*714*	*0*
Percent Heavy Vehicles	*0*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration			*TR*	*LT*		
Upstream Signal		*0*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*42*		*44*			
Peak-Hour Factor, PHF	*0.80*	*1.00*	*0.80*	*1.00*	*1.00*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*52*	*0*	*54*	*0*	*0*	*0*
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration		*LR*				

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*22*		*106*				
C (m) (veh/h)		*1026*		*267*				
v/c		*0.02*		*0.40*				
95% queue length		*0.07*		*1.81*				
Control Delay (s/veh)		*8.6*		*27.1*				
LOS		*A*		*D*				
Approach Delay (s/veh)	--	--	*27.1*					
Approach LOS	--	--	*D*					

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*BJH*
Agency/Co.	*Cannon & Cannon, Inc.*
Date Performed	*7/31/2013*
Analysis Time Period	*PM Peak*

Site Information

Intersection	*Gray Hendrix @ East Entrance*
Jurisdiction	*Knox County*
Analysis Year	*Combined 2018*

Project Description *East Site Entrance*

East/West Street: *Gray Hendrix Road* | North/South Street: *East Site Entrance*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*329*	*52*	*38*	*135*	
Peak-Hour Factor, PHF	*1.00*	*0.88*	*0.88*	*0.88*	*0.88*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*0*	*373*	*59*	*43*	*153*	*0*
Percent Heavy Vehicles	*0*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration			*TR*	*LT*		
Upstream Signal		*0*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*21*		*42*			
Peak-Hour Factor, PHF	*0.88*	*1.00*	*0.88*	*1.00*	*1.00*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*23*	*0*	*47*	*0*	*0*	*0*
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration		*LR*				

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*43*		*70*				
C (m) (veh/h)		*1138*		*555*				
v/c		*0.04*		*0.13*				
95% queue length		*0.12*		*0.43*				
Control Delay (s/veh)		*8.3*		*12.4*				
LOS		*A*		*B*				
Approach Delay (s/veh)	--	--	*12.4*					
Approach LOS	--	--	*B*					

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*BJH*
Agency/Co.	*Cannon & Cannon, Inc.*
Date Performed	*7/31/2013*
Analysis Time Period	*AM Peak*

Site Information

Intersection	*Gray Hendrix @ South Entrance*
Jurisdiction	*Knox County*
Analysis Year	*Combined 2018*

Project Description *South Site Entrance*

East/West Street: *South Site Entrance* | North/South Street: *Gray Hendrix Road*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*274*	*15*	*5*	*389*	
Peak-Hour Factor, PHF	*1.00*	*0.80*	*0.80*	*0.80*	*0.80*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*0*	*342*	*18*	*6*	*486*	*0*
Percent Heavy Vehicles	*0*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration			*TR*	*LT*		
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*54*		*16*
Peak-Hour Factor, PHF	*1.00*	*1.00*	*1.00*	*0.80*	*1.00*	*0.80*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*67*	*0*	*19*
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration					*LR*	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*6*		*86*				
C (m) (veh/h)		*1210*		*375*				
v/c		*0.00*		*0.23*				
95% queue length		*0.01*		*0.87*				
Control Delay (s/veh)		*8.0*		*17.4*				
LOS		*A*		*C*				
Approach Delay (s/veh)	--	--	*17.4*					
Approach LOS	--	--	*C*					

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*BJH*
Agency/Co.	*Cannon & Cannon, Inc.*
Date Performed	*7/31/2013*
Analysis Time Period	*PM Peak*

Site Information

Intersection	*Gray Hendrix @ South Entrance*
Jurisdiction	*Knox County*
Analysis Year	*Combined 2018*

Project Description *South Site Entrance*

East/West Street: *South Site Entrance* | North/South Street: *Gray Hendrix Road*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*239*	*66*	*17*	*113*	
Peak-Hour Factor, PHF	*1.00*	*0.88*	*0.88*	*0.88*	*0.88*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*0*	*271*	*75*	*19*	*128*	*0*
Percent Heavy Vehicles	*0*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration			*TR*	*LT*		
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*29*		*10*
Peak-Hour Factor, PHF	*1.00*	*1.00*	*1.00*	*0.88*	*1.00*	*0.88*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*32*	*0*	*11*
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration					*LR*	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*19*		*43*				
C (m) (veh/h)		*1224*		*583*				
v/c		*0.02*		*0.07*				
95% queue length		*0.05*		*0.24*				
Control Delay (s/veh)		*8.0*		*11.7*				
LOS		*A*		*B*				
Approach Delay (s/veh)	--	--	*11.7*					
Approach LOS	--	--	*B*					

Gray Hendrix & Garrison (Proposed Alignment)

TABLE 4A

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

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

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

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	= / > 600
100 - 149 150 - 199	100 90	80 75	70 65	60 55	55 50	50 45
200 - 249 250 - 299	80 70	72 65	460 55	55 50	50 45	45 40
300 - 349 350 - 399	65 60	60 55	50 50	50 45	45 40	40 40
400 - 449 450 - 499	55 50	50 45	45 45	45 40	40 35	35 35
500 - 549 550 - 599	50 45	45 40	40 40	40 35	35 35	35 35
600 - 649 650 - 699	40 35	35 35	35 35	35 30	35 30	30 30
700 - 749 750 or More	30 30	30 30	30 30	30 30	30 30	30 30

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

AM 64 → 22 → 268

Left-turn lane NOT warranted

PM 156 → 20 → 229

Gray Hendricks & Garrison (Proposed Alignment)

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

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

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

AM — 239 / 325

Right-turn lane NOT warranted

PM — 92 / 114

Gray Hendrix & East Entrance

TABLE 4A

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

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

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

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	= / > 600
100 - 149 150 - 199	100 90	80 75	70 65	60 55	55 50	50 45
200 - 249 250 - 299	80 70	72 65	460 55	55 50	50 45	45 40
300 - 349 350 - 399	65 60	60 55	50 50	50 45	45 40	40 40
400 - 449 450 - 499	55 50	50 45	45 45	45 40	(40) AM 35	35 35
500 - 549 550 - 599	50 45	45 40	40 40	40 35	35 35	35 35
600 - 649 650 - 699	40 35	35 35	35 35	35 30	35 30	30 30
700 - 749 750 or More	30 30	30 30	30 30	30 30	30 30	30 30

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

AM

445 →

← 572

↳ 18

Left-turn lane MAY warranted

381 →

PM

← 135

↳ 38

Gray Hendrix E East Entrance

TABLE 4B

RIGHT-TURN LANE VOLUME THRESHOLDS

FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 35 MPH OR LESS

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

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

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

AM

431 →

14 ↴

Right-turn lane NOT warranted

PM

329 →

52 ↴

Gray Hendrix South Entrance

TABLE 4A

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

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

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

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	= / > 600
100 - 149 150 - 199	100 90	80 75	70 65	60 55	55 50	50 45
200 - 249 250 - 299	80 (70) AM	72 65	460 55	55 50	50 45	45 40
300 - 349 350 - 399	65 60	60 55	50 50	50 45	45 40	40 40
400 - 449 450 - 499	55 50	50 45	45 45	45 40	40 35	35 35
500 - 549 550 - 599	50 45	45 40	40 40	40 35	35 35	35 35
600 - 649 650 - 699	40 35	35 35	35 35	35 30	35 30	30 30
700 - 749 750 or More	30 30	30 30	30 30	30 30	30 30	30 30

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

AM
389 ↓ 5 ↳
↑ 289

Left-turn lane NOT warranted

113 ↓ PM 17 ↳
↑ 365

Grey Hendrix @ South Entrance

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

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

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

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

AM

Right-turn lane NOT warranted

PM

↑ ↱ 274 15

↑ ↱ 234 66