

E-Z STOP FOOD MART

TRAFFIC IMPACT STUDY

SCHAAD ROAD
KNOX COUNTY, TN

CCI PROJECT NO. 01634-0000

REV 2



PREPARED FOR:
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REVISED
DECEMBER 1
2021

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REVISION 2 (12/01/21)

This report replaces the previous version of the traffic impact study dated 11/22/2021 prepared for this project in its entirety. The associated changes are related to an increase in building size to approximately 6,500 square feet (from 6,200 square feet).

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EXECUTIVE SUMMARY

This report provides a summary of a traffic impact study that was performed for a proposed E-Z Stop Food Mart development to be located in northwest Knox County, Tennessee. The proposed project site is on Schaad Road in the northeast quadrant of the intersection of Schaad Road at Johnson Road. The conceptual development plan for this project proposes a convenience market with approximately 6,500 square feet of floor area and 16 gas pumps. The development will be built in one phase with anticipated completion in the year 2022.

The purpose of this study was the evaluation of the traffic operational and safety impacts of the proposed development upon roadways in the vicinity of the site. Appropriate intersection evaluations were conducted at the study intersections 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 consisted of intersection capacity analyses, turn lane warrant evaluations, traffic signal warrant evaluations, and sight distance assessments.

The primary conclusion of this study is that the traffic generated from the proposed development will have significant impacts on the existing intersection of Schaad Road at Johnson Road, while the combination of the proposed development with the extension of Schaad Road will create extreme impacts to side street delays at this intersection. Both the development and the extension of Schaad Road will have only minimal impacts to the intersection of Ball Camp Pike at Johnson Road.

Based on the above conclusions, the following is a list of recommendations to mitigate traffic impacts resulting from increased traffic with the proposed development:

1. Install a traffic signal at the intersection of Schaad Road at Johnson Road. The traffic signal will likely be warranted and would provide benefit with the extension of Schaad Road, regardless of whether the proposed development is built or not.
2. Install an exclusive left turn lane on the southbound Johnson Road approach of the intersection of Schaad Road at Johnson Road. This mitigation strategy would widen this approach to include a total of three lanes: one shared through / right turn lane, one exclusive left turn lane, and one departure lane. The left turn lane should have a minimum storage of 100'. If widened symmetrically to both sides of the roadway, the left turn lane should include a 50' bay taper and a 65' approach taper.
3. Install a right turn lane on Schaad Road for the development's eastern right-in / right-out driveway. The right turn lane should have a storage length of 150' and a taper length of 145'.
4. Maintain intersection corner sight distances at the site access points and the intersection of Schaad Road at Johnson Road by ensuring that site grading, landscaping, signing, and other features do not restrict lines of sight.
5. Conduct follow-up traffic counts after the completion of the Schaad Road extension project and/or upon completion of the development to verify this traffic impact study's assumptions.

INTRODUCTION & PURPOSE OF STUDY

This report provides a summary of a traffic impact study that was performed for a proposed E-Z Stop Foot Mart development to be located in northwest Knox County, Tennessee. The proposed project site is on Schaad Road in the northeast quadrant of the intersection of Schaad Road at Johnson Road. FIGURE 1 is a location map identifying the major roadways in the project vicinity.

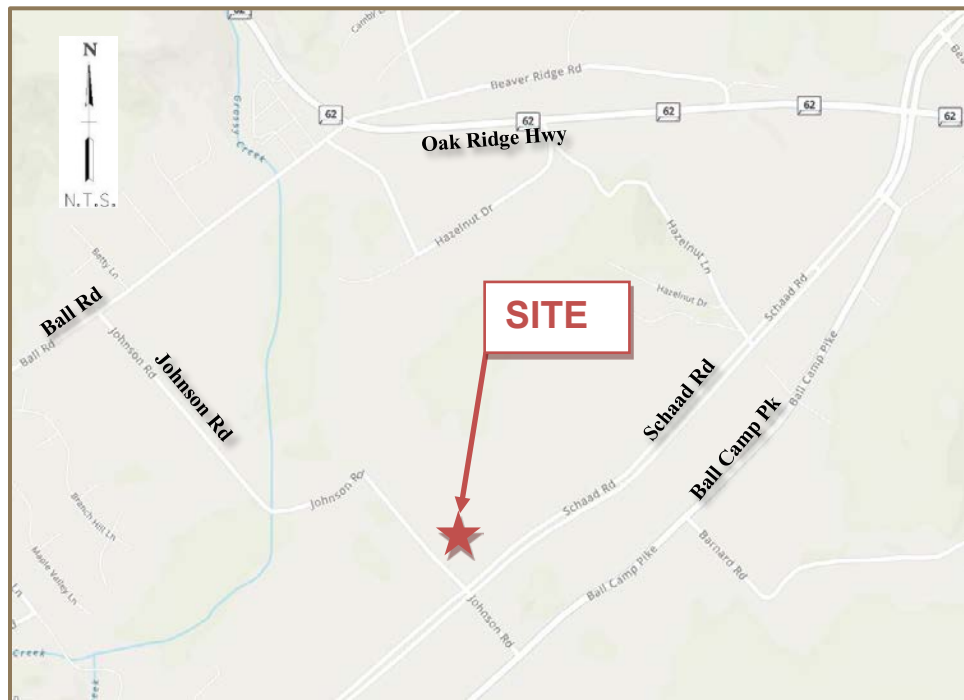


FIGURE 1
LOCATION MAP

PROJECT DESCRIPTION

The conceptual development plan for this project proposes a convenience market with approximately 6,500 square feet of floor area and 16 gas pumps. The development will be built in one phase with anticipated completion in the year 2022.

Access to the development will be provided via two right-in / right-out driveways on Schaad Road and one full access driveway on Johnson Road. The Schaad Road driveways will be located approximately 160 feet and 330 feet from the intersection with Johnson Road, while the full access on Johnson Road will be located approximately 100 feet from Schaad Road. FIGURE 2 is a Conceptual Site Plan which illustrates the proposed site configuration and adjacent roadways.

STUDY AREA

The project study area consists of the existing intersections of Schaad Road at Johnson Road and Ball Camp Pike at Johnson Road. These study intersections were selected in consultation with Knox County Engineering & Public Works and Knoxville-Knox County Planning and were identified as intersections that have potential to be significantly impacted by traffic generated by the proposed development. In addition to these existing intersections, the proposed site access driveways with Schaad Road and Johnson Road were also evaluated.

The purpose of this study was the evaluation of the traffic operational and safety impacts of the proposed development upon roadways in the vicinity of the site. Appropriate intersection evaluations were conducted at the study intersections 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 consisted of intersection capacity analyses, turn lane warrant evaluations, traffic signal warrant evaluations, and sight distance assessments.

EXISTING CONDITIONS

EXISTING ROADWAY CONDITIONS

Schaad Road is located to the immediate south of the project site and is classified as a Minor Arterial per the Knoxville-Knox County Major Road Plan. Schaad Road connects Amherst Elementary School and several residential subdivisions on the west end to Oak Ridge Highway to the east. Schaad Road continues east to Clinton Highway, where it changes names to Callahan Drive and continues past Interstate 75. Schaad Road currently dead ends just west of Amherst Elementary School; however, construction is underway to extend Schaad Road further west to Middlebrook Pike. Within the study limits, Schaad Road is a four-lane divided roadway that contains two travel lanes in each direction with a raised grass median. Curb, gutter, and sidewalk are provided on both sides of the roadway. The posted speed limit on Schaad Road is 45 mph.

Johnson Road is located to the immediate west of the project site and is considered a Local Street. Johnson Road connects Ball Road on its north end to Ball Camp Pike on its south end. North of Schaad Road and adjacent to the project site, Johnson Road is an undivided roadway with one travel lane in each direction and no curb, gutter, or sidewalks. The posted speed on this section of Johnson Road is 25 mph. South of Schaad Road to Ball Camp Pike, Johnson Road is an undivided three-lane roadway with one travel lane in each direction and a center two-way left-turn lane. This section of Johnson Road has curb and gutter but no sidewalk, and it has a posted speed limit of 30 mph.

Ball Camp Pike in the vicinity of the development is an undivided two-lane roadway, with one travel lane in each direction, and is classified as a Major Collector. It has a posted speed limit of 40 mph and contains no curb, gutter, or sidewalk. Ball Camp Pike connects Middlebrook Pike to the west with Schaad Road on its east end.

The existing intersection of Schaad Road at Johnson Road is a four-legged intersection with side street stop control on both Johnson Road approaches. The eastbound and westbound approaches on Schaad Road both include one exclusive left turn lane, one exclusive through lane, and one shared through / right turn lane. The northbound Johnson Road approach consists of an exclusive left turn lane and a shared through / right turn lane, while the southbound approach contains a single lane for all movements.

The existing intersection of Ball Camp Pike at Johnson Road is a three-legged intersection with side street stop control on the Johnson Road southbound approach. The eastbound and westbound approaches on Ball Camp Pike both include single lanes for all movements. The southbound Johnson Road approach consists of two approach lanes with one being an exclusive left turn lane and the other being an exclusive right turn lane.

EXISTING SITE CONDITIONS

The project site consists of approximately 2 acres located in the northeast quadrant of the intersection of Schaad Road at Johnson Road. A single-family residence currently occupies the site. The project site is relatively flat and grassy and contains a few trees. FIGURE 3 provides an aerial photograph of the existing site conditions.



FIGURE 3
EXISTING SITE CONDITIONS

EXISTING TRAFFIC DATA

The Tennessee Department of Transportation (TDOT) collects annual average daily traffic (AADT) data on roadways in the study area. Two count stations were identified on study roadways in the vicinity of the project site which are likely to have particular relevance for this study. The last five years of traffic data from these two counts are summarized in TABLE 1.

TABLE 1: ANNUAL AVERAGE DAILY TRAFFIC COUNT SUMMARY

COUNT YEAR	STATION 47000574 SCHAAD ROAD WEST OF SR-62	STATION 47000578 BALL CAMP PIKE WEST OF BAKERTOWN ROAD
2020	2,360	6,524
2019	2,298	6,421
2018	1,370	5,326
2017	1,433	6,262
2016	2,316	6,200

In addition to the available TDOT AADT data, traffic data was collected specifically for this study. Intersection turning movement counts (TMC) were conducted at the existing study intersections to determine the current peak hour operating volumes. The traffic counts were conducted during the hours of 7am – 9am and 4pm – 6pm on a typical weekday during August 2021 when Knox County Schools were in session.

During the time of traffic data collection, regional traffic volumes and patterns were recovering from COVID-19 pandemic restrictions including telecommuting or working from home practices. Due to this, the collected intersection turning movement count data was increased by 20% to address reductions in typical travel volumes due to the ongoing pandemic. The collected 2021 peak hour volumes for the morning (AM) and evening (PM) peak hours are summarized in FIGURE 4, while the peak hour volumes with the 20% Covid factor applied are contained in FIGURE 4A. Complete AADT and TMC data are located in APPENDIX A.

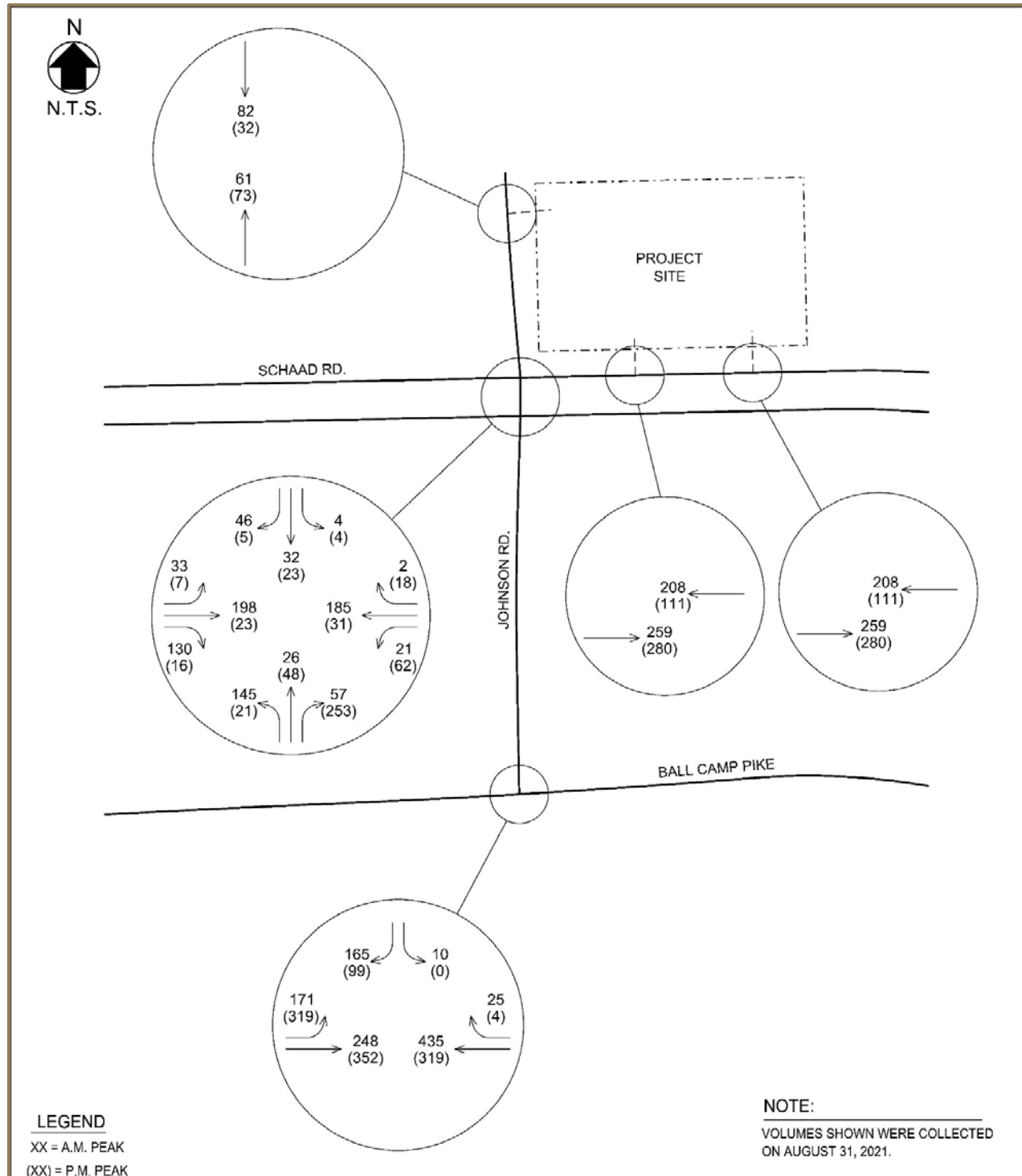


FIGURE 4
2021 EXISTING RAW TRAFFIC VOLUMES

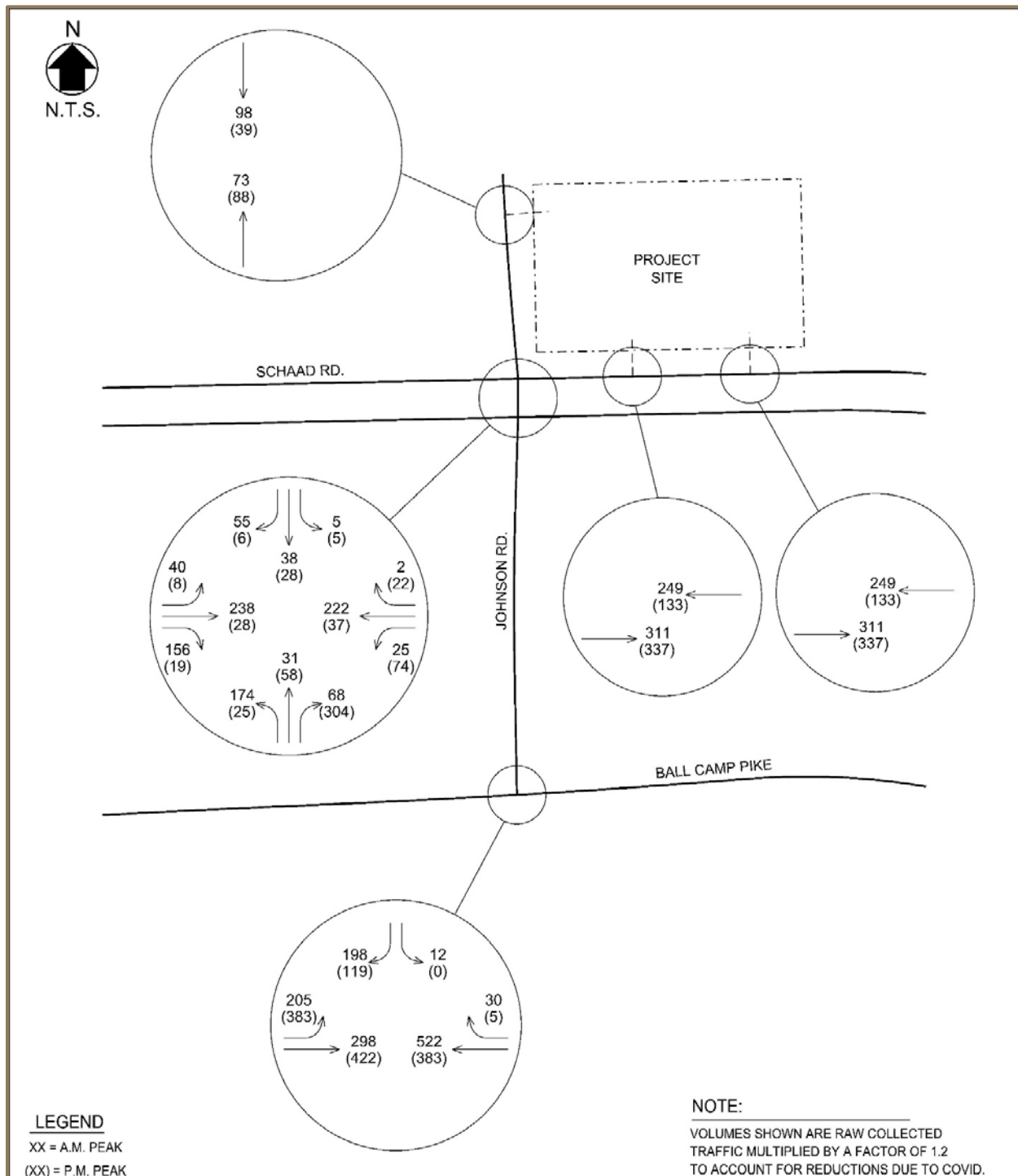


FIGURE 4A
2021 EXISTING FACTORED TRAFFIC VOLUMES

EXISTING CAPACITY ANALYSES / LEVELS-OF-SERVICE

Capacity analyses for this project were conducted for the study intersections utilizing the Version 7 of the *Highway Capacity Software* (HCS), which uses methodology from the *Highway Capacity Manual*. These evaluations were conducted for the AM and PM peak hours under existing intersection geometry and traffic control and utilizing the factored peak hour volumes contained in FIGURE 4A. A description of the fundamentals of these procedures is contained in APPENDIX D in the section titled "Capacity and Level-of-Service Concepts".

The results of these analyses for the existing traffic conditions were that all major street left turn movements and side street approaches are operating at level-of-service (LOS) "C" or better during all peak traffic periods with the exception of the northbound approach at the intersection of Schaad Road at Johnson Road, which operates at LOS "F" with an average vehicle delay of approximately 50 seconds during the AM peak. Further, the southbound left turn movement at the intersection of Ball Camp Pike at Johnson Road experiences LOS "F" during both peak traffic periods, although this movement has very little traffic volume. TABLE 2 provides a summary of the capacity analyses results for existing conditions, and more detailed information is contained on the capacity software output summaries in APPENDIX D.

TABLE 2: EXISTING CONDITIONS CAPACITY ANALYSES SUMMARY

ID	INTERSECTION	TRAFFIC CONTROL	MOVEMENT / APPROACH	AM PEAK	PM PEAK
1	Schaad at Johnson	Side Street Stop	EBL	A 8.2	A 7.4
			WBL	A 9.0	A 7.5
			NB	F 50.2	B 12.4
			SB	C 16.6	B 11.8
2	Ball Camp at Johnson	Side Street Stop	EBL	B 10.3	B 10.1
			SB	C 22.2	B 12.2

BACKGROUND CONDITIONS

BACKGROUND TRAFFIC GROWTH

As stated previously, the proposed development is anticipated to be constructed in one general phase with completion in year 2022. Additionally, an extension of Schaad Road is being constructed to connect the roadway with Middlebrook Pike, and construction for the extension is anticipated to be completed in 2024. The extension of Schaad Road is expected to significantly affect the traffic volumes at the study intersections. Therefore, year 2024 was established as the appropriate design / analysis year for the study.

In order to determine traffic volumes resulting solely from background traffic growth to year 2024, 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 appropriate annual growth rate. Based on the available data, a background annual growth rate of two and a half percent (2.5%) was established. FIGURE 5 summarizes the background traffic volumes that would result from a 2.5% annual growth rate from year 2021, when the counts were conducted, to the analysis year of 2024. The background traffic volumes shown on this figure represent background traffic conditions, which is without traffic related to the proposed development.

In addition to establishing traffic volumes resulting from background growth, this study also considered traffic that would be redistributed to Schaad Road once construction of the extension project is complete. Consistent with a traffic impact study that was previously prepared by Ajax Engineering for a proposed residential development in the area, and per travel demand data provided by Knoxville-Knox County Planning, it was assumed that through movements on Schaad Road would have an average daily traffic (ADT) volume of 14,000, a K-value of 12%, and a 65% directional distribution. The K-value was applied to both AM and PM peak hour traffic, and the 65% directional distribution was applied to westbound traffic in the AM peak and eastbound traffic in the PM peak. Intersection peak hour turning movement volumes destined to and from Ball Camp Pike were reduced by a factor of 0.8 with the anticipation that some traffic currently utilizing Ball Camp Pike would redistribute to Schaad Road. Finally, traffic on the west leg of Schaad Road going to and from the north leg of Johnson Road were increased by a factor of 1.2. FIGURE 5A summarizes anticipated background traffic volumes after the opening of the Schaad Road extension.

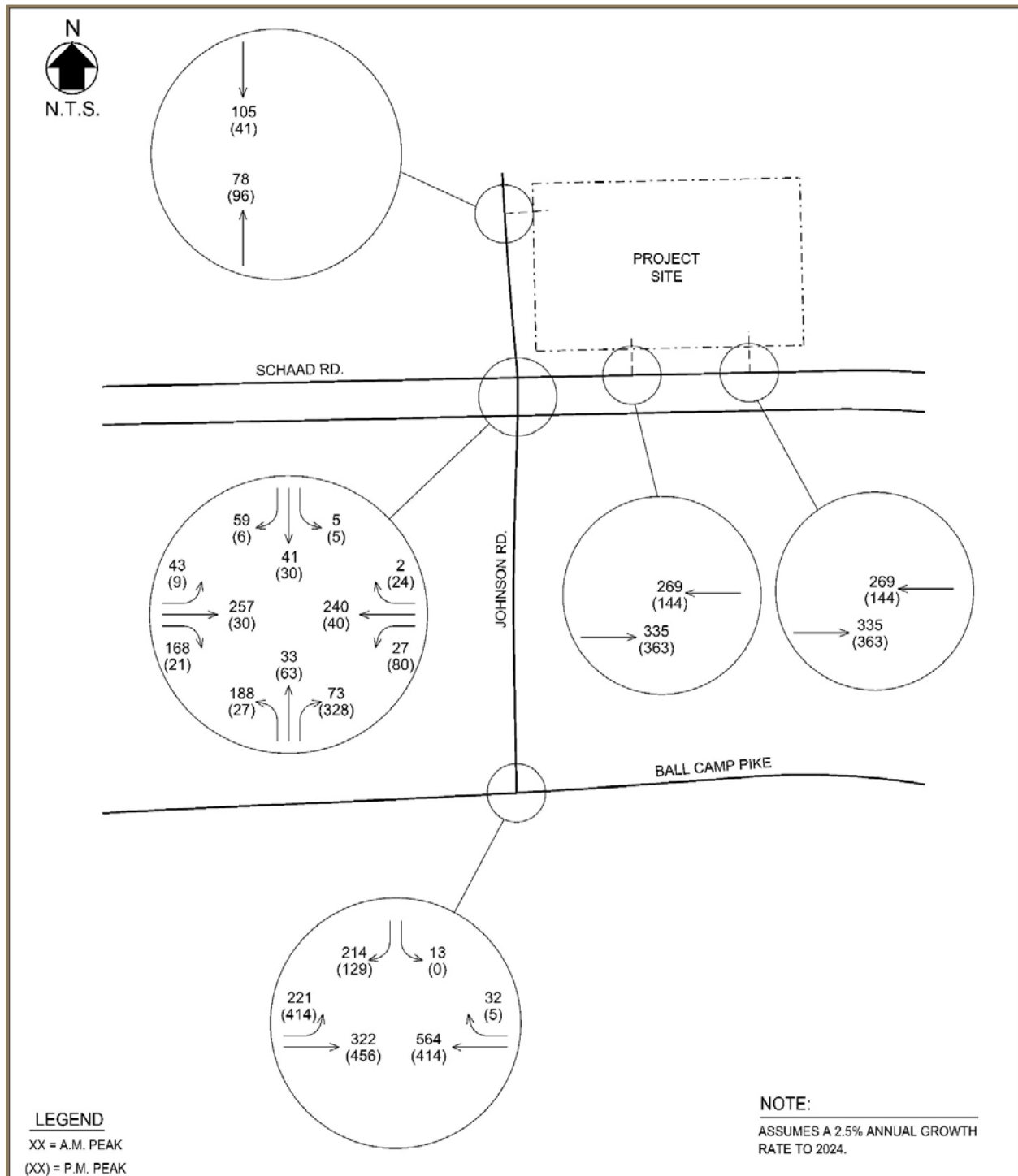


FIGURE 5
2024 BACKGROUND TRAFFIC VOLUMES

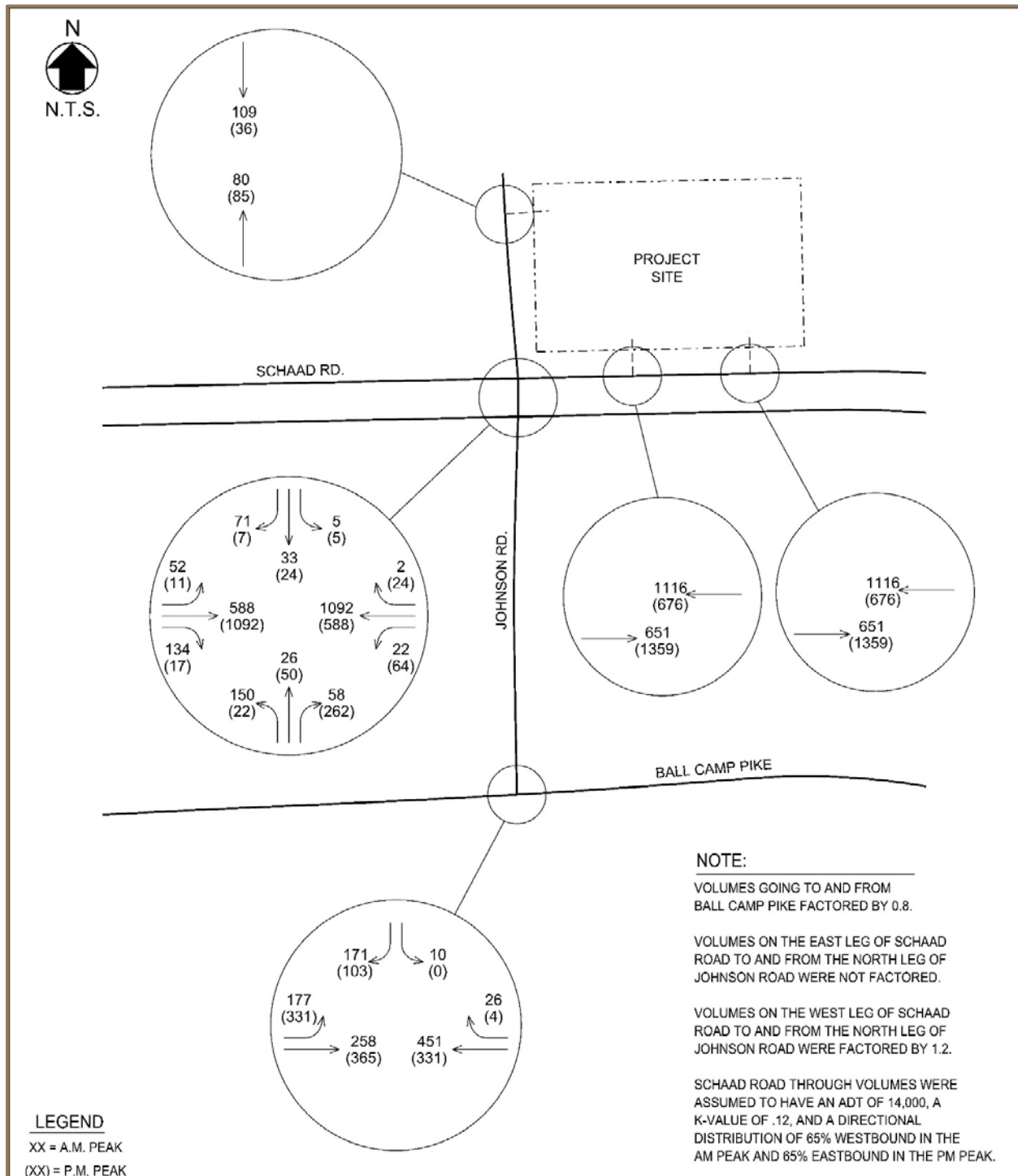


FIGURE 5A
2024 BACKGROUND TRAFFIC VOLUMES WITH SCHAAD EXTENSION

BACKGROUND CAPACITY ANALYSES / LEVELS-OF-SERVICE

As mentioned in the EXISTING CONDITIONS section of this report, capacity analyses for this project were conducted for the study intersections utilizing HCS. These evaluations were conducted for the AM and PM peak hours under existing intersection geometry and traffic control with the background volumes shown in FIGURES 5 and 5A, which includes evaluations both without and with completion of the Schaad Road extension.

The results of these analyses for the background traffic conditions were similar to evaluations of existing conditions, with LOS and delay slightly worsening for each approach and/or movement due to increased background traffic. The most significant delay increase was for the northbound approach at the intersection of Schaad Road at Johnson Road, where the AM peak vehicle delay is expected to worsen from approximately 50 seconds (LOS F) to approximately 80 seconds (LOS F).

Once the Schaad Road extension is constructed, the Johnson Road approaches at the intersection with Schaad Road are expected to experience extreme delay due to the increase through traffic on Schaad Road. In fact, the southbound delay during the PM peak could not be computed by HCS. The delay at the intersection of Ball Camp Pike at Johnson Road is expected to decrease due to reduced through volumes on Ball Camp Pike.

TABLE 3 and 3A provides a summary of the capacity analyses results for background conditions without and with the Schaad Road extension, respectively. More detailed information is contained on the capacity software output summaries in APPENDIX D.

TABLE 3: BACKGROUND CONDITIONS CAPACITY ANALYSES SUMMARY

ID	INTERSECTION	TRAFFIC CONTROL	MOVEMENT / APPROACH	AM PEAK	PM PEAK
1	Schaad at Johnson	Side Street Stop	EBL	A 8.3	A 7.4
			WBL	A 9.2	A 7.5
			NB	F 81.8	B 13.1
			SB	C 18.3	B 12.1
2	Ball Camp at Johnson	Side Street Stop	EBL	B 10.9	B 10.6
			SB	D 27.0	B 12.8

**TABLE 3A: BACKGROUND CONDITIONS CAPACITY ANALYSES SUMMARY
(WITH SCHAAD EXTENSION)**

ID	INTERSECTION	TRAFFIC CONTROL	MOVEMENT / APPROACH	AM PEAK	PM PEAK
1	Schaad at Johnson	Side Street Stop	EBL	C 18.7	A 9.3
			WBL	B 11.4	B 13.4
			NB	F 2108.7	F 171.7
			SB	F 190.0	F error
2	Ball Camp at Johnson	Side Street Stop	EBL	A 9.6	A 9.4
			SB	C 17.2	B 11.4

FUTURE CONDITIONS

SITE CHARACTERISTICS

As previously stated, the conceptual development plan for this project proposes a convenience market with approximately 6,500 square feet of floor area and 16 gas pumps. Approximately 2,000 square feet of the building will be a food service area that will include a kitchen / food preparation area, cooler and freezer, sales counter, and a small seating area with 5 tables. The remainder of the building area will consist of public restrooms, equipment, storage area, and convenience market shelves. A drive-up window will be provided with the food service area, which will be located on the west side of the building facing Johnson Road.

The property for this site is a corner lot with 454 feet of frontage on Schaad Road and 242 feet of frontage on Johnson Road. Three driveways are proposed to access this site; two right-in / right-out driveways on Schaad Road and one full access driveway on Johnson Road. The eastern driveway on Schaad Road will serve as the main ingress for the site with traffic on Schaad Road. This driveway will capture the majority of auto traffic and allows for drive-through / delivery traffic to circulate the exterior of the building to avoid pedestrian conflicts between fueling pumps and the convenience store. The western driveway will serve as the main egress for the site, and it will also serve as ingress for fuel truck maneuvering to the refueling tanks. The proposed egress for the fuel trucks is the driveway on Johnson Road. Both driveways on Schaad Road are needed in order to accommodate fuel truck maneuvering and to encourage separation of passenger auto and drive-through traffic from truck refueling operations as well as to minimize pedestrian-vehicular conflicts within the site of delivery trucks and auto drive-through users. Site circulation exhibits for delivery trucks, fuel trucks, and general auto drive-through traffic are shown in APPENDIX G.

TRIP GENERATION

In order to estimate the expected traffic volumes to be generated by the proposed development, the procedures of the *Trip Generation Manual, Tenth Edition* (Institute of Transportation Engineers – ITE) were utilized. The generated trips were based on weekday morning and evening peak hours of adjacent street traffic trip generation rates. The *Trip Generation Manual's* land use code (LUC) 960, Super Convenience Market / Gas Station was utilized to estimate development traffic. This LUC was chosen based on its characteristic descriptions of the gross floor area of the convenience market having at least 3,000 square feet and the development containing at least 10 fueling positions (gas pumps). Even though this development proposes a food service area with a drive-up window, the characteristics of the food area meet that of the ITE LUC description for a Super Convenience Market / Gas Station, which states "Some commonly sold convenience items include newspapers, freshly brewed coffee, daily-made donuts, bakery items, hot and cold beverages, breakfast items, dairy items, fresh fruits, soups, light meals, ready-to-go and freshly made sandwiches and wraps, and ready-to-go salads." It is not expected that the food area will generate trips similar to a fast-food restaurant; therefore, a restaurant portion of the development was not separated out for trip generation purposes. Due to the low R^2 value (less than 0.75) with these trip generation rates, the average rate was used to calculate trips instead of the regression equation.

Per guidance from a Knoxville-Knox County memorandum regarding pass-by rates for several land uses, a 65% pass-by rate was applied to the trip generation. Pass-by trips are traffic volumes that are currently on the roadway and enter/exit the development as they “pass by” on their way to another destination. This memorandum, along with additional trip generation information from the *Trip Generation Manual* is contained in APPENDIX B. TABLE 4 below summarizes the trip generation results of the development.

TABLE 4: TRIP GENERATION SUMMARY

LAND USE	ITE CODE	SIZE	PASS-BY RATE	WEEKDAY TRIPS	AM PEAK HOUR TRIPS	PM PEAK HOUR TRIPS
Super Convenience Market / Gas Sta.	ITE	6,500 SF	65%	5,444	540	450
Entering	Code			2,722	270	225
Exiting	960			2,722	270	225
TOTAL TRIPS				5,444	540	450
	Entering			2,722	270	225
	Exiting			2,722	270	225
Pass-by Trips				3,539	351	293
	Entering			1,769	176	146
	Exiting			1,769	176	146
Non-Pass-by Trips				1,905	189	157
	Entering			953	94	79
	Exiting			953	94	79

TRIP DISTRIBUTION AND ASSIGNMENT

Proposed trip distribution for this development was determined through a review of existing travel patterns, local knowledge of the study area, proposed site location in relation to the surrounding roadway network, and engineering judgment. Although fueling trucks will utilize the Schaad Road western driveway as ingress, and some passenger vehicles may also use this driveway as ingress, the eastern driveway is intended as the main ingress driveway. Because the expected number of ingress trips to the western driveway are very minor, it was assumed that no vehicles will enter at this driveway for simplicity of trip distribution purposes.

Trip distribution was developed for both scenarios of the development before completion of the Schaad Road extension, and for the scenario of the development after completion of the extension. Detailed trip distribution and trip assignment figures for both scenarios are located in APPENDIX C. The figures are separated by entering and exiting trips and non-pass-by and pass-by trips for each scenario. The trip distribution figures show what percent of generated trips are distributed to the site access points and surrounding roadway. The trip assignment values are calculated by multiplying the trip distribution percent by the generated trip values shown in TABLE 4. FIGURES 6 and 6A summarize total peak hour generated trips without and with completion of the Schaad Road extension, respectively.

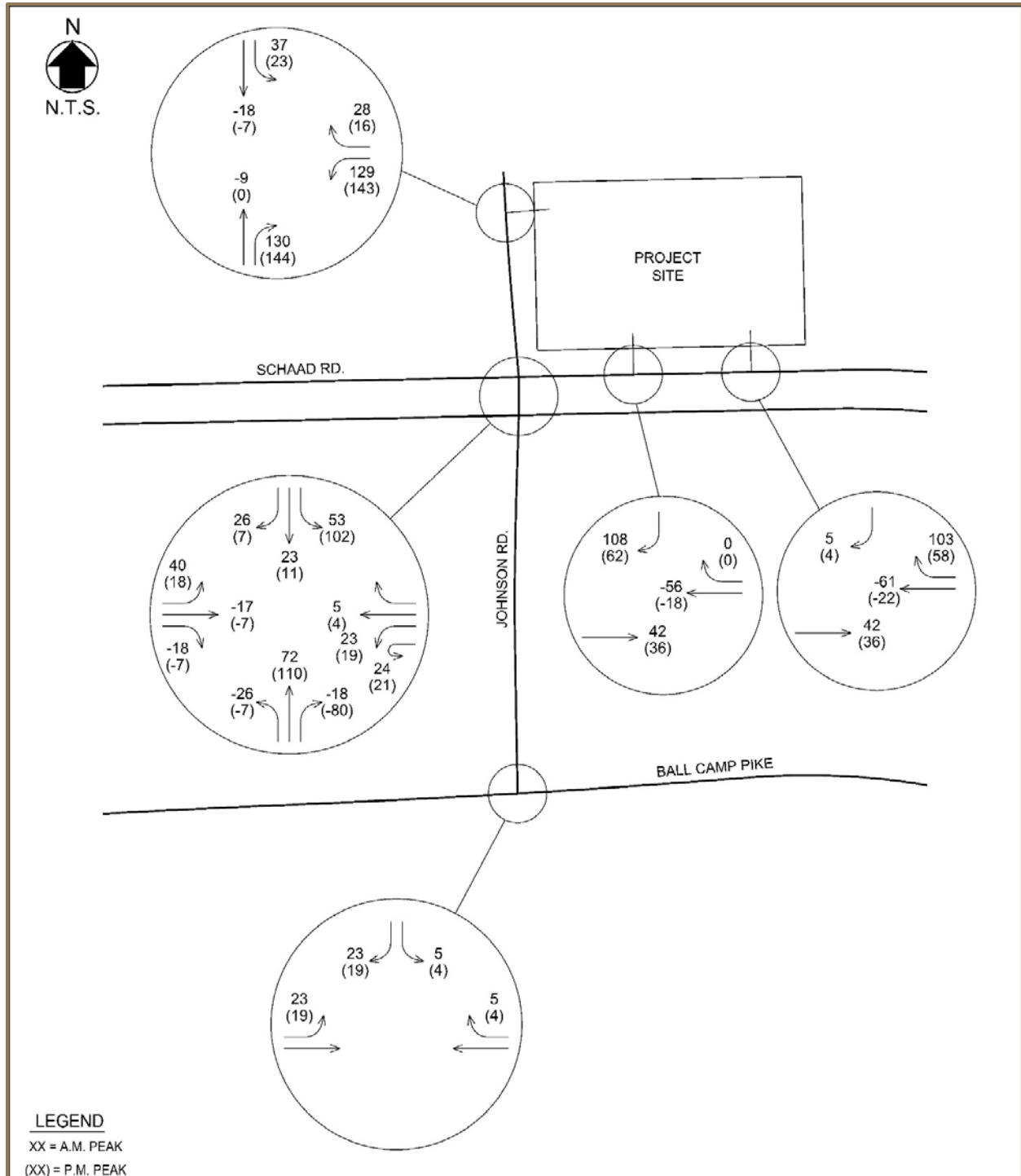


FIGURE 6
TRIP ASSIGNMENT

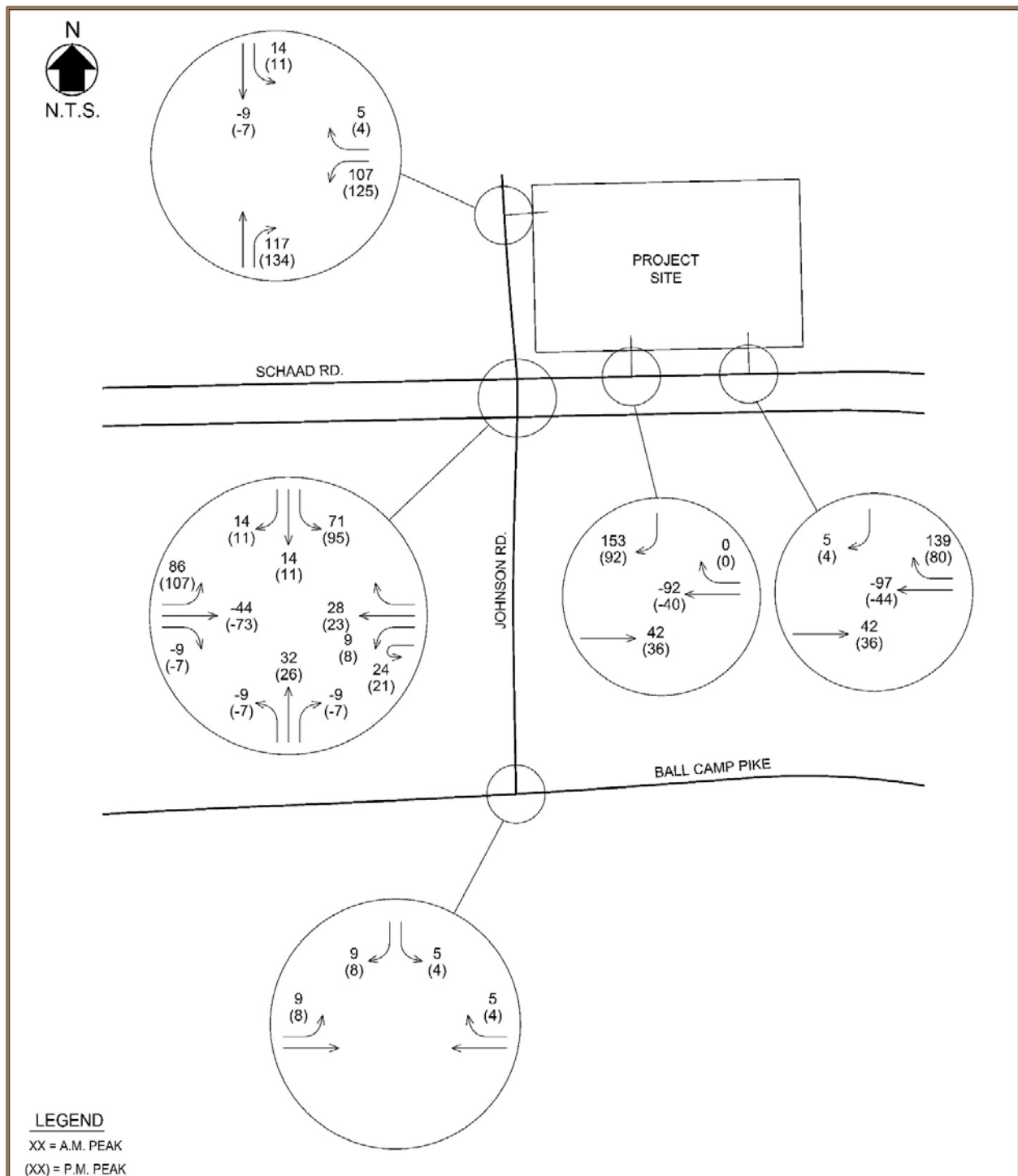


FIGURE 6A
TRIP ASSIGNMENT WITH SCHAAD EXTENSION

FUTURE TRAFFIC VOLUMES

Future projected traffic volumes were developed by adding the trip assignments shown in FIGURES 6 and 6A to the 2024 background traffic volumes developed in the previous section (FIGURES 5 and 5A). Specifically, the following scenarios were developed:

- 2024 Combined Traffic Volumes (FIGURE 7):
 - o 2024 Background Traffic Volumes (FIGURE 5), plus
 - o Trip Assignment (FIGURE 6)
- 2024 Combined Traffic Volumes with Schaad Extension (FIGURE 7A):
 - o 2024 Background Traffic Volumes with Schaad Extension (FIGURE 5A), plus
 - o Trip Assignment with Schaad Extension (FIGURE 6A)

The combined year volumes reflect the existing traffic, the background traffic growth, and the anticipated newly generated traffic from the proposed development. These combined volumes shown on FIGURES 7 (without Schaad extension) and 7A (with Schaad extension) are the volumes used in the analysis of future conditions.

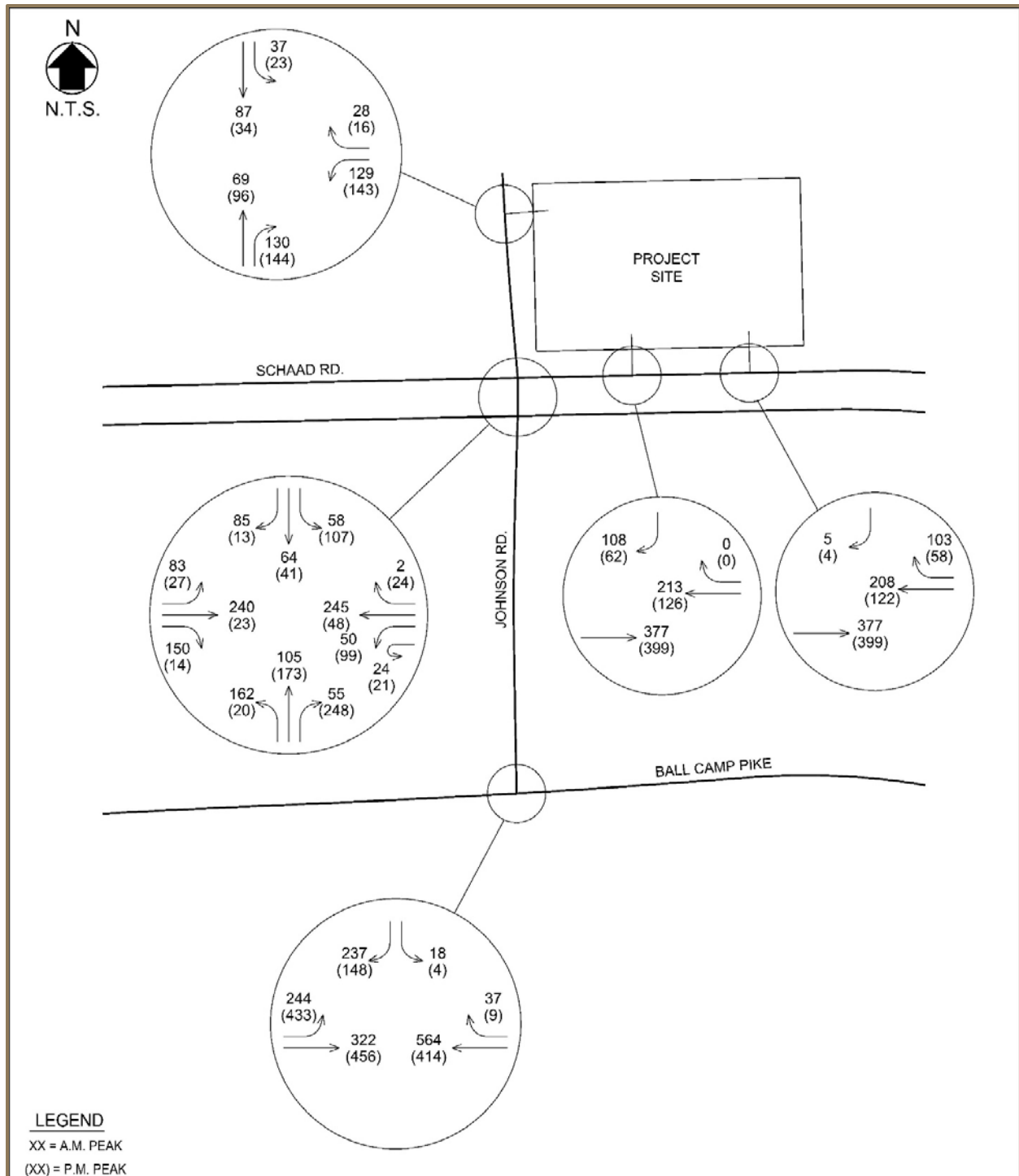


FIGURE 7
2024 COMBINED TRAFFIC VOLUMES

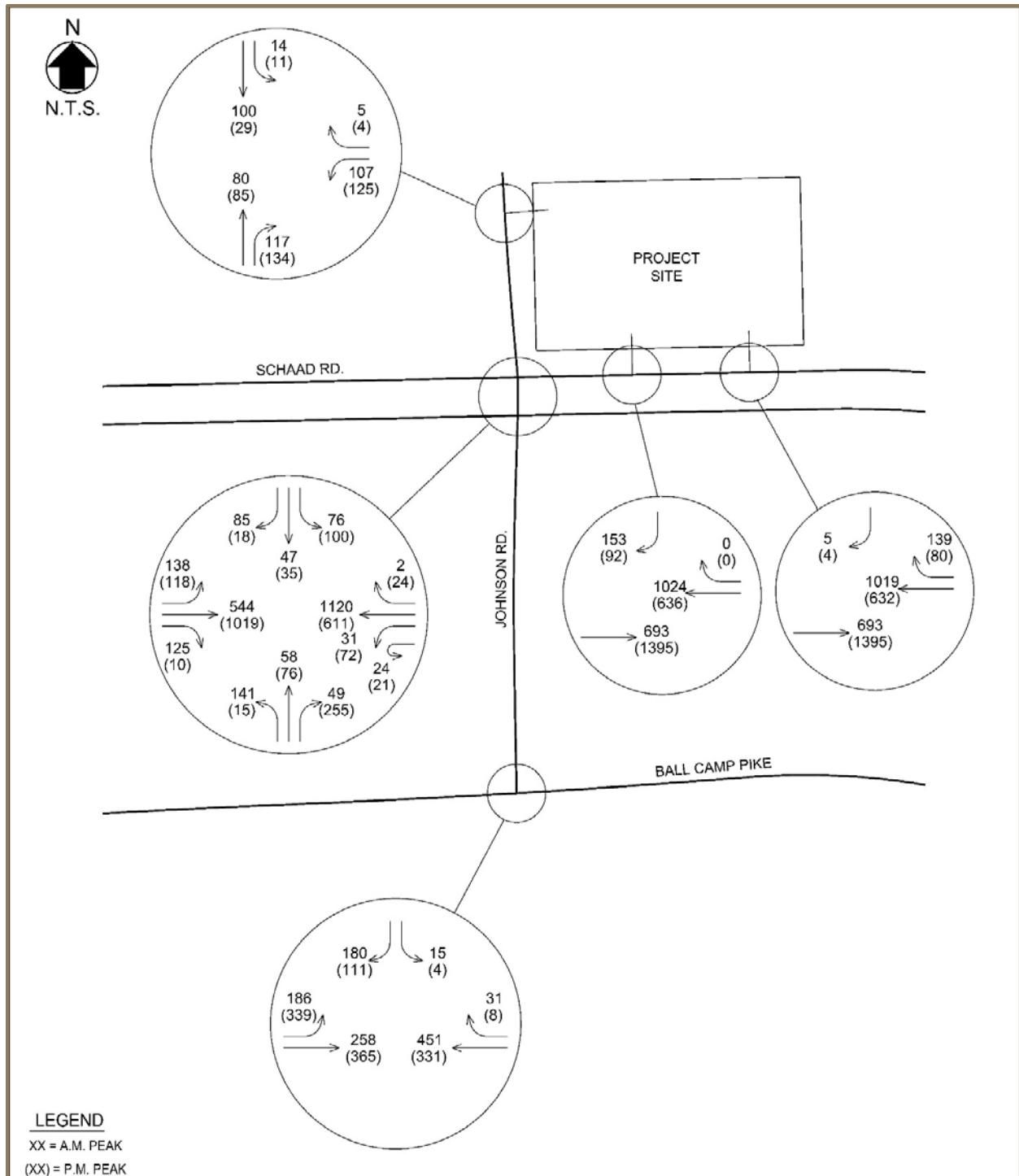


FIGURE 7A
 2024 COMBINED TRAFFIC VOLUMES WITH SCHAAD EXTENSION

FUTURE CAPACITY ANALYSES / LEVELS-OF-SERVICE

As mentioned in the EXISTING CONDITIONS section of this report, capacity analyses for this project were conducted for the existing study intersections of Schaad Road at Johnson Road and Ball Camp Pike at Johnson Road utilizing HCS. These analyses were performed with existing geometry and traffic control in order to develop a baseline for any recommended mitigation measures. Additionally, capacity analyses were conducted for the right-in / right-out development access driveways on Schaad Road as well as the full access driveway on Johnson Road. Analyses for the development driveways were performed based on anticipated geometry and traffic control from the conceptual site plan as well as with any anticipated major street turn lanes per the turn lane warrant evaluations. The turn lane warrants are discussed in the EVALUATIONS section of this report.

The results of these analyses for the combined traffic conditions were that the intersection of Ball Camp Pike at Johnson Road and each of the site driveways will operate at acceptable LOS during both peak periods. However, without mitigation measures the side street approaches at the intersection of Schaad Road at Johnson Road will operate at very poor LOS with extreme delays. This is especially true once the Schaad Road extension is complete, as the side street delays are expected to be so long that HCS provided an "error" message and could not compute the value.

TABLES 5 and 5A provide a summary of the capacity analyses results for combined conditions without and with the Schaad Road extension, respectively. More detailed information is contained on the capacity software output summaries in APPENDIX D.

TABLE 5: FUTURE CONDITIONS CAPACITY ANALYSES SUMMARY

ID	INTERSECTION	TRAFFIC CONTROL	MOVEMENT / APPROACH	AM PEAK	PM PEAK
1	Schaad at Johnson	Side Street Stop	EBL WBL NB SB	A 8.5 B 10.4 F 263.6 F 317.3	A 7.5 A 7.9 C 23.5 E 42.0
2	Ball Camp at Johnson	Side Street Stop	EBL SB	B 11.2 D 32.4	B 10.8 C 16.8
3	Schaad at Eastern RIRO	Side Street Stop	SBR	A 9.2	A 8.7
4	Schaad at Western RIRO	Side Street Stop	SBR	B 10.2	A 9.0
5	Johnson at Full Access	Side Street Stop	WB SBL	B 15.3 A 8.0	B 12.2 A 7.9

TABLE 5A: FUTURE CONDITIONS CAPACITY ANALYSES SUMMARY
(WITH SCHAAD EXTENSION)

ID	INTERSECTION	TRAFFIC CONTROL	MOVEMENT / APPROACH	AM PEAK	PM PEAK
1	Schaad at Johnson	Side Street Stop	EBL WBL NB SB	D 29.0 C 15.6 F error F error	B 10.2 E 41.7 F error F error
2	Ball Camp at Johnson	Side Street Stop	EBL SB	A 9.7 C 18.3	A 9.4 B 13.0
3	Schaad at Eastern RIRO	Side Street Stop	SBR	C 15.7	B 10.9
4	Schaad at Western RIRO	Side Street Stop	SBR	D 33.9	B 12.2
5	Johnson at Full Access	Side Street Stop	WB SBL	B 13.3 A 7.9	B 11.2 A 7.8

EVALUATIONS

INTERSECTION CAPACITY ANALYSES AND TURN LANE EVALUATIONS

Intersection capacity analyses and turn lane warrant evaluations were performed for the study intersections as appropriate. The capacity analyses employed the procedures of the *Highway Capacity Manual* as contained in the *Highway Capacity Software* (HCS7). A description of the fundamentals of these procedures is contained in the APPENDIX D section titled "Capacity and Level-of-Service Concepts." Additionally, *Synchro 10* software was utilized in cases where signalized control was analyzed as a mitigation strategy.

The above evaluations were performed for the study intersections for full build-out development conditions, both without and with the Schaad Road extension. Background conditions assuming no project site development were evaluated, also without and with the Schaad Road extension, and can be used for purposes of comparison to assess the impacts attributable to the development generated traffic. The results of these analyses for the existing, background and combined future traffic conditions are presented and discussed by individual intersection in the subsections below. Capacity analyses summaries are presented for each intersection in these individual subsections, which are accompanied by tables showing LOS and queuing results. More detailed information is contained on the capacity software output summaries contained in APPENDIX D.

Potential mitigation measures were identified at intersections experiencing poor LOS. These mitigation strategies, where applicable, are described for each intersection in their respective subsections. The accompanying LOS and queue length tables show comparisons between the intersection under existing geometry and traffic control to these mitigation strategies in order to provide a quantitative measure of effectiveness of the mitigation.

Turn lane warrant evaluations were performed under combined conditions scenarios, both without and with the Schaad Road extension, to determine if left turn or right turn lanes are warranted at any of the study intersections. Where warranted, the turn lane was included to the capacity analyses inputs. The methods employed for the turn lane warrant evaluations were those developed by M.D. Harmelink, as provided by in a series of tables from the Knox County publication, "Access Control and Driveway Design Policy."

Turn lane warrant evaluations included assessments for a westbound right turn lane at the existing intersection of Schaad Road at Johnson Road, an eastbound left turn lane and a westbound right turn lane at the existing intersection of Ball Camp Pike at Johnson Road, and right turn lanes entering the site at the eastern right-in / right-out driveway on Schaad Road and the full access driveway on Johnson Road. Additionally, southbound left turn lane warrants were evaluated at the proposed intersection of Johnson Road at the site's full access driveway. Since the existing intersection of Schaad Road at Johnson Road already has an eastbound left turn lane, and the site's access driveways on Schaad Road do not allow for left turning ingress movements, left turn lane evaluations were not performed at these intersections.

Per the turn lane warrant thresholds, a westbound right turn lane at the site's eastern right-in / right-out driveway on Schaad Road is warranted. The turn lane should have a storage of 150 feet and a taper of 145 feet per the guidelines from a Knoxville-Knox County Planning memo to Traffic Impact Study Reviewers and Preparers, dated March 10, 1997.

Eastbound left turn lane warrants were met at the existing intersection of Ball Camp Pike at Johnson Road for combined AM and PM conditions, both without and with the Schaad Road extension. Eastbound left turn lane warrants were also met at this intersection with existing traffic in both the AM and PM peak hours. A westbound right turn lane was found to be warranted with combined conditions without the Schaad Road extension; however, the turn lane was no longer warranted after traffic reductions due to the extension being built. Left and right turn lanes were not found to be warranted at any other of the study intersections. The turn lane evaluation worksheets are contained in APPENDIX E.

Intersection #1: Schaad Road at Johnson Road

Capacity analyses show that, under existing geometry and traffic control, the side street approaches begin to experience extreme delays once either the Schaad Road extension is complete or upon full build-out of the development. The extreme delays are further exacerbated once both of these scenarios are in place.

Mitigation strategies analyzed at this intersection included the addition of an exclusive southbound left turn lane, the installation of a traffic signal, and the combination of the above strategies. With signal control, protected-permissive left turn phasing for Schaad Road and permissive-only left turn phasing for Johnson Road was assumed. Various side street phasing strategies were analyzed, but only the indicated phasing results are discussed in this report as they provided the best operation for the intersection.

The analyses indicate that the addition of an exclusive southbound left turn lane alone would do very little to mitigate the extreme delays that are expected. The installation of a traffic signal, however, appears to provide significant benefit to reducing vehicle delay at the intersection with both the extension of Schaad Road and the full build-out of the development. The addition of the southbound left turn lane along with the installation of a traffic signal provides more benefit of reduced vehicle delay, and this combination strategy also provides significant queue length reduction benefit to the southbound approach.

TABLE 6 on the following two pages shows a summary of delay and LOS results for all scenarios analyzed at this intersection. TABLE 7 summarizes the results of the 95th percentile queue lengths for the same scenarios. More detailed information this and all other intersections is contained on the capacity software output summaries in APPENDIX D.

TABLE 6: CAPACITY ANALYSES SUMMARY
SCHAAD ROAD AT JOHNSON ROAD

SCENARIO			MOVEMENT / APPROACH	AM PEAK	PM PEAK
2021 Existing	Existing Geometry & Traffic Control	Without Schaad Extension	EBL	A 8.2	A 7.4
			WBL	A 9.0	A 7.5
			NB	F 50.2	B 12.4
			SB	C 16.6	B 11.8
2024 Background	Existing Geometry & Traffic Control	Without Schaad Extension	EBL	A 8.3	A 7.4
			WBL	A 9.2	A 7.5
			NB	F 81.8	B 13.1
			SB	C 18.3	B 12.1
2024 Background	Existing Geometry & Traffic Control	With Schaad Extension	EBL	C 18.7	A 9.3
			WBL	B 11.4	B 13.4
			NB	F 2108.7	F 171.7
			SB	F 190.0	F error
2024 Background	With Exclusive Southbound Left Turn Lane	With Schaad Extension	EBL	C 18.7	A 9.3
			WBL	B 11.4	B 13.4
			NB	F 2108.7	F 171.7
			SB	F 139.4	F error
2024 Background	With Traffic Signal	With Schaad Extension	EB	B 11.7	C 20.6
			WB	C 26.5	A 8.5
			NB	D 43.7	C 22.7
			SB	B 15.9	C 21.4
			Overall	C 22.7	B 17.2
2024 Background	With Traffic Signal and Exclusive Southbound Left Turn Lane	With Schaad Extension	EB	B 11.7	B 19.7
			WB	C 26.5	A 7.7
			NB	D 44.7	C 25.7
			SB	B 15.7	B 18.8
			Overall	C 22.8	B 16.9
2024 Combined	Existing Geometry & Traffic Control	Without Schaad Extension	EBL	A 8.5	A 7.5
			WBL	B 10.4	A 7.9
			NB	F 263.6	C 23.5
			SB	F 317.3	E 42.0
2024 Combined	With Exclusive Southbound Left Turn Lane	Without Schaad Extension	EBL	A 8.5	A 7.5
			WBL	B 10.4	A 7.9
			NB	F 263.6	C 23.5
			SB	F 64.5	D 30.7
2024 Combined	With Traffic Signal	Without Schaad Extension	EB	B 12.7	B 11.5
			WB	B 16.8	B 11.7
			NB	C 22.8	B 19.3
			SB	B 19.1	F 81.2
			Overall	B 17.1	C 28.6
2024 Combined	With Traffic Signal and Exclusive Southbound Left Turn Lane	Without Schaad Extension	EB	B 11.2	B 11.4
			WB	B 14.9	B 11.4
			NB	C 25.3	C 23.0
			SB	B 13.2	E 63.9
			Overall	B 15.9	C 27.2

TABLE 6 (CONT.): CAPACITY ANALYSES SUMMARY
SCHAAD ROAD AT JOHNSON ROAD

SCENARIO			MOVEMENT / APPROACH	AM PEAK	PM PEAK
2024 Combined	Existing Geometry & Traffic Control	With Schaad Extension	EBL	D 29.0	B 10.2
			WBL	C 15.6	E 41.7
			NB	F error	F error
			SB	F error	F error
2024 Combined	With Exclusive Southbound Left Turn Lane	With Schaad Extension	EBL	D 29.0	B 10.2
			WBL	C 15.6	E 41.7
			NB	F error	F error
			SB	F error	F error
2024 Combined	With Traffic Signal	With Schaad Extension	EB	C 21.9	C 29.0
			WB	C 37.3	C 21.4
			NB	E 67.5	B 15.8
			SB	E 57.5	E 62.2
			Overall	D 36.8	C 26.9
2024 Combined	With Traffic Signal and Exclusive Southbound Left Turn Lane	With Schaad Extension	EB	C 21.3	C 24.3
			WB	C 25.7	B 13.7
			NB	E 69.2	C 20.5
			SB	C 29.4	D 53.1
			Overall	C 29.0	C 22.3

TABLE 7: 95TH PERCENTILE QUEUE SUMMARY
SCHAAD ROAD AT JOHNSON ROAD

SCENARIO			MOVEMENT / APPROACH	AM PEAK	PM PEAK
2021 Existing	Existing Geometry & Traffic Control	Without Schaad Extension	EBL	5'	0'
			WBL	3'	5'
			NBL	208'	5'
			NBT/R	30'	65'
			SB	35'	8'
2024 Background	Existing Geometry & Traffic Control	Without Schaad Extension	EBL	5'	0'
			WBL	3'	5'
			NBL	288'	5'
			NBT/R	35'	78'
			SB	43'	8'
2024 Background	Existing Geometry & Traffic Control	With Schaad Extension	EBL	23'	0'
			WBL	5'	13'
			NBL	683'	23'
			NBT/R	185'	445'
			SB	235'	error
2024 Background	With Exclusive Southbound Left Turn Lane	With Schaad Extension	EBL	23'	0'
			WBL	5'	13'
			NBL	683'	23'
			NBT/R	185'	445'
			SBL	10'	error
2024 Background	With Traffic Signal	With Schaad Extension	SBT/R	198'	30'
			EBL	19'	6'
			EBT/R	156'	283'
			WBL	10'	20'
			WBT/R	285'	126'
			NBL	137'	24'
			NBT/R	34'	141'
2024 Background	With Traffic Signal and Exclusive Southbound Left Turn Lane	With Schaad Extension	SB	41'	32'
			EBL	19'	5'
			EBT/R	156'	263'
			WBL	10'	17'
			WBT/R	285'	115'
			NBL	143'	24'
			NBT/R	34'	142'
2024 Combined	Existing Geometry & Traffic Control	Without Schaad Extension	SBL	10'	10'
			SBT/R	39'	27'
			EBL	10'	3'
			WBL	13'	8'
			NBL	463'	5'
2024 Combined	With Exclusive Southbound Left Turn Lane	Without Schaad Extension	NBT/R	193'	168'
			SB	493'	118'
			EBL	10'	3'
			WBL	13'	8'
			NBL	463'	5'
2024 Combined	With Exclusive Southbound Left Turn Lane	Without Schaad Extension	NBT/R	193'	168'
			SBL	123'	78'
			SBT/R	125'	10'

TABLE 7 (CONT.): 95TH PERCENTILE QUEUE SUMMARY
SCHAAD ROAD AT JOHNSON ROAD

SCENARIO			MOVEMENT / APPROACH	AM PEAK	PM PEAK
2024 Combined	With Traffic Signal	Without Schaad Extension	EBL	38'	17'
			EBT/R	60'	13'
			WBL	34'	54'
			WBT/R	66'	21'
			NBL	92'	17'
			NBT/R	65'	188'
			SB	81'	166'
2024 Combined	With Traffic Signal and Exclusive Southbound Left Turn Lane	Without Schaad Extension	EBL	32'	17'
			EBT/R	53'	13'
			WBL	28'	54'
			WBT/R	58'	21'
			NBL	93'	17'
			NBT/R	67'	188'
			SBL	37'	119'
2024 Combined	Existing Geometry & Traffic Control	With Schaad Extension	SBT/R	41'	30'
			EBL	90'	15'
			WBL	18'	73'
			NBL	<i>error</i>	<i>error</i>
			NBT/R	45'	1278'
2024 Combined	With Exclusive Southbound Left Turn Lane	With Schaad Extension	SB	<i>error</i>	<i>error</i>
			EBL	90'	15'
			WBL	18'	73'
			NBL	<i>error</i>	<i>error</i>
			NBT/R	45'	1278'
2024 Combined	With Traffic Signal	With Schaad Extension	SBL	75'	<i>error</i>
			SBT/R	<i>error</i>	160'
			EBL	93'	56'
			EBT/R	156'	344'
			WBL	23'	46'
2024 Combined	With Traffic Signal and Exclusive Southbound Left Turn Lane	With Schaad Extension	WBT/R	342'	198'
			NBL	164'	19'
			NBT/R	75'	141'
			SB	155'	178'
			EBL	94'	32'
			EBT/R	133'	277'
			WBL	18'	27'
2024 Combined			WBT/R	279'	130'
			NBL	154'	17'
			WBT/R	71'	134'
			SBL	74'	110'
			SBT/R	59'	35'

Intersection #2: Ball Camp Pike at Johnson Road

Capacity analyses indicate that this intersection will operate and LOS "D" or better for all approaches during all scenarios analyzed with existing geometry and traffic control. Once the Schaad Road extension is complete, it is expected that traffic volumes at this intersection will reduce. This reduction should result in decreased intersection delay, as shown in TABLE 6A where the LOS with the Schaad Road extension is "C" or better for all approaches. The intersection was also analyzed with potential mitigation, which included installation of an eastbound left turn lane. A westbound right turn lane was not included in the mitigation analysis since it was shown to no longer be warranted upon completion of the Schaad Road extension.

TABLE 6A: CAPACITY ANALYSES SUMMARY
BALL CAMP PIKE AT JOHNSON ROAD

SCENARIO			MOVEMENT / APPROACH	AM PEAK	PM PEAK
2021 Existing	Existing Geometry & Traffic Control	Without Schaad Extension	EBL	B 10.3	B 10.1
			SB	C 22.2	B 12.2
2024 Background	Existing Geometry & Traffic Control	Without Schaad Extension	EBL	B 10.9	B 10.6
			SB	D 27.0	B 12.8
2024 Background	Existing Geometry & Traffic Control	With Schaad Extension	EBL	A 9.6	A 9.4
			SB	C 17.2	B 11.4
2024 Combined	Existing Geometry & Traffic Control	Without Schaad Extension	EBL	B 11.2	B 10.8
			SB	D 32.4	C 16.8
2024 Combined	With Exclusive Eastbound Left Turn Lane	Without Schaad Extension	EBL	B 11.2	B 10.8
			SB	D 31.2	C 15.5
2024 Combined	Existing Geometry & Traffic Control	With Schaad Extension	EBL	A 9.7	A 9.4
			SB	C 18.3	B 13.0
2024 Combined	With Exclusive Eastbound Left Turn Lane	With Schaad Extension	EBL	A 9.7	A 9.4
			SB	C 18.1	B 12.7

TABLE 7A: 95TH PERCENTILE QUEUE SUMMARY
BALL CAMP PIKE AT JOHNSON ROAD

SCENARIO			MOVEMENT / APPROACH	AM PEAK	PM PEAK
2021 Existing	Existing Geometry & Traffic Control	Without	EB	28'	45'
		Schaad	SBL	15'	0'
		Extension	SBR	70'	20'
2024 Background	Existing Geometry & Traffic Control	Without	EB	33'	53'
		Schaad	SBL	20'	0'
		Extension	SBR	93'	23'
2024 Background	Existing Geometry & Traffic Control	With Schaad	EB	20'	33'
		Extension	SBL	8'	0'
			SBR	45'	15'
2024 Combined	Existing Geometry & Traffic Control	Without	EB	38'	58'
		Schaad	SBL	33'	13'
		Extension	SBR	115'	28'
2024 Combined	With Exclusive Eastbound Left Turn Lane	Without	EBL	38'	58'
		Schaad	SBL	30'	8'
		Extension	SBR	115'	28'
2024 Combined	Existing Geometry & Traffic Control	With Schaad	EB	23'	35'
		Extension	SBL	13'	5'
			SBR	50'	18'
2024 Combined	With Exclusive Eastbound Left Turn Lane	With Schaad	EBL	23'	35'
		Extension	SBL	13'	5'
			SBR	50'	18'

Intersection #3: Schaad Road at Eastern Driveway

This access is proposed as a right-in / right-out; therefore, the southbound right turn movement is the only movement that would experience delay and queuing. It is assumed that the majority of vehicles exiting the development onto Schaad Road would utilize the western driveway, so any delay at this intersection would be experienced by very few vehicles. The capacity analyses show that the intersection is expected to operate at good LOS under combined traffic conditions both without and with the Schaad Road extension.

TABLE 6B: CAPACITY ANALYSES SUMMARY
SCHAAD ROAD AT EASTERN DRIVEWAY

SCENARIO			MOVEMENT / APPROACH	AM PEAK	PM PEAK
2024 Combined	Proposed Geometry & Traffic Control	Without Schaad Extension	SBR	A 9.2	A 8.7
2024 Combined	Proposed Geometry & Traffic Control	With Schaad Extension	SBR	C 15.6	B 10.9

TABLE 7B: 95TH PERCENTILE QUEUE SUMMARY
SCHAAD ROAD AT EASTERN DRIVEWAY

SCENARIO			MOVEMENT / APPROACH	AM PEAK	PM PEAK
2024 Combined	Proposed Geometry & Traffic Control	Without Schaad Extension	SBR	0'	0'
2024 Combined	Proposed Geometry & Traffic Control	With Schaad Extension	SBR	3'	0'

Intersection #4: Schaad Road at Western Driveway

This access is proposed as a right-in / right-out; therefore, the southbound right turn movement is the only movement that would experience delay and queuing. It is assumed that the majority of vehicles exiting the development onto Schaad Road would utilize this western driveway as the main egress movement, while the eastern driveway would serve as the main ingress driveway from Schaad Road. The capacity analyses show that the intersection is expected to operate at good LOS under combined traffic conditions without Schaad Road extension. Once the Schaad Road extension is built and brings more through traffic to this intersection, the southbound movement may experience increased delay during the AM peak period. However, this LOS of "D" is still considered "fair", and the eastern driveway is available for alternate vehicle egress.

TABLE 6C: CAPACITY ANALYSES SUMMARY
SCHAAD ROAD AT WESTERN DRIVEWAY

SCENARIO			MOVEMENT / APPROACH	AM PEAK	PM PEAK
2024 Combined	Proposed Geometry & Traffic Control	Without Schaad Extension	SBR	B 10.2	A 9.0
2024 Combined	Proposed Geometry & Traffic Control	With Schaad Extension	SBR	D 33.9	B 12.2

TABLE 7C: 95TH PERCENTILE QUEUE SUMMARY
SCHAAD ROAD AT WESTERN DRIVEWAY

SCENARIO			MOVEMENT / APPROACH	AM PEAK	PM PEAK
2024 Combined	Proposed Geometry & Traffic Control	Without Schaad Extension	SBR	18'	8'
2024 Combined	Proposed Geometry & Traffic Control	With Schaad Extension	SBR	113'	18'

Intersection #5: Johnson Road at Full Access Driveway

Capacity analyses indicate that under combined conditions, the intersection is expected to operate at overall LOS "B" or better on the side street for all peak traffic periods, both without and with the Schaad Road extension.

**TABLE 6D: CAPACITY ANALYSES SUMMARY
JOHNSON ROAD AT FULL ACCESS DRIVEWAY**

SCENARIO			MOVEMENT / APPROACH	AM PEAK	PM PEAK
2024 Combined	Proposed Geometry & Traffic Control	Without Schaad Extension	WB	B 15.3	B 12.2
			SBL	A 8.0	A 7.9
2024 Combined	Proposed Geometry & Traffic Control	With Schaad Extension	WB	B 13.3	B 11.2
			SBL	A 7.9	A 7.8

**TABLE 7D: 95TH PERCENTILE QUEUE SUMMARY
JOHNSON ROAD AT FULL ACCESS DRIVEWAY**

SCENARIO			MOVEMENT / APPROACH	AM PEAK	PM PEAK
2024 Combined	Proposed Geometry & Traffic Control	Without Schaad Extension	WB	48'	28'
			SB	3'	3'
2024 Combined	Proposed Geometry & Traffic Control	With Schaad Extension	WB	28'	20'
			SB	3'	0'

SIGNAL WARRANT EVALUATIONS

The traffic signal volume warrants presented in the latest edition of the *Manual on Uniform Traffic Control Devices* were evaluated to determine for which intersections that traffic signal warrants would be legally satisfied. These evaluations were performed for the intersections of Schaad Road at Johnson Road and Ball Camp Pike at Johnson Road. Because only four hours of traffic data were collected at these intersections, only AM and PM peak hour data were evaluated. Therefore, the traffic signal warrants were only evaluated to determine if the intersections meet the Peak Hour Volume warrant. The results were as follows:

- Schaad Road at Johnson Road:
 - o 2021 Existing: Peak Hour Warrant met for one hour (AM peak)
 - o 2024 Background: Peak Hour Warrant met for one hour (AM peak)
 - o 2024 Background with Schaad extension: Peak Hour Warrant met for both hours
 - o 2024 Combined: Peak Hour Warrant met for one hour (AM peak)
 - o 2024 Combined with Schaad extension: Peak Hour Warrant met for both hours
- Ball Camp Pike at Johnson Road:
 - o 2021 Existing: Warrant not met
 - o 2024 Background: Warrant not met
 - o 2024 Background with Schaad extension: Warrant not met
 - o 2024 Combined: Peak Hour Warrant met for one hour (AM peak)
 - o 2024 Combined with Schaad extension: Warrant not met

Signal warrant evaluation spreadsheets are located in APPENDIX F.

SIGHT DISTANCE ASSESSMENT

Intersection sight distance was reviewed for the proposed project access driveways on Schaad Road and Johnson Road using Knox County sight distance requirements. These assessments included looking left from the two driveways on Schaad Road (right out only) and looking to both the left and right for the driveway on Johnson Road (full access). The measurements were taken for a passenger car eye height of 3.5 feet above the ground.

With a posted speed limit of 45 mph on Schaad Road, Knox County requirements state that the desirable sight distance is 450 feet, or ten times the speed limit. Visual inspection indicated that available sight distance looking left from both Schaad Road driveways is well in excess of 450 feet.

The posted speed limit on the portion of Johnson Road adjacent to the development is 25 mph; therefore, the desirable sight distance is 250 feet. Visual inspection indicated that available sight distance looking left from the Johnson Road driveway extends well beyond Schaad Road and is in excess of 250 feet. Looking to the right, sight distance was measured to be 255 feet. A vertical crest curve restricts sight distance beyond the measured value. Sight distance was measured from the existing roadway elevation, but the grading of the driveway will be slightly higher in elevation 15 feet back from Johnson Road than the existing roadway elevation. Therefore, sight distance of the constructed driveway is anticipated to be greater than the measured value.

PEDESTRIAN CONNECTION ASSESSMENT

Sidewalks currently exist on both sides of Schaad Road and are present across the entire length of the site's frontage on Schaad. The development site plan proposes a pedestrian connection from this existing sidewalk on Schaad Road to the convenience market building's entrance.

CONCLUSIONS & RECOMMENDATIONS

There were several uncertainties in this study related to the projection of future traffic volumes. The first of these is applying a factor to existing volumes to account for traffic reductions due to Covid. While Knox County Schools are in-person, it is likely that traffic is still reduced to some extent; however, it was difficult to determine this extent as well as to determine if traffic will ever normalize. A second uncertainty was the projection of traffic once the Schaad Road extension is complete. Additionally, Johnson Road was serving as a detour route during the time of the traffic counts, which could also have an affect on existing traffic data.

The primary conclusion of this study is that the traffic generated from the proposed development will have significant impacts on the existing intersection of Schaad Road at Johnson Road, while the combination of the proposed development with the extension of Schaad Road will create extreme impacts to side street delays at this intersection. Both the development and the extension of Schaad Road will have only minimal impacts to the intersection of Ball Camp Pike at Johnson Road.

The installation of a traffic signal at the intersection of Schaad Road at Johnson Road is warranted for Peak Hour volumes for existing conditions as well as with either full buildout of the proposed development or the extension of Schaad Road. Additionally, traffic signal installation would improve the LOS at this intersection and would greatly reduce the amount of delay experienced on both approaches of Johnson Road.

An eastbound left turn lane at the intersection of Ball Camp Pike at Johnson Road was found to be warranted under existing conditions. However, due to the uncertainty of what affect the Schaad Road extension will have on this intersection, the installation of a left turn lane is not recommended with this study. Further, the intersection is showing continued good operations with existing geometry and traffic control.

Based on the above conclusions, the following is a list of recommendations to mitigate traffic impacts resulting from increased traffic with the proposed development:

1. Install a traffic signal at the intersection of Schaad Road at Johnson Road. The traffic signal will likely be warranted and would provide benefit with the extension of Schaad Road, regardless of whether the proposed development is built or not.
2. Install an exclusive left turn lane on the southbound Johnson Road approach of the intersection of Schaad Road at Johnson Road. This mitigation strategy would widen this approach to include a total of three lanes: one shared through / right turn lane, one exclusive left turn lane, and one departure lane. The left turn lane should have a minimum storage of 100'. If widened symmetrically to both sides of the roadway, the left turn lane should include a 50' bay taper and a 65' approach taper.
3. Install a right turn lane on Schaad Road for the development's eastern right-in / right-out driveway. The right turn lane should have a storage length of 150' and a taper length of 145'.

CONCLUSIONS & RECOMMENDATIONS | SECTION 7

4. Maintain intersection corner sight distances at the site access points and the intersection of Schaad Road at Johnson Road by ensuring that site grading, landscaping, signing, and other features do not restrict lines of sight.
5. Due to the previously mentioned uncertainty with the projected future traffic volumes, conduct follow-up traffic counts after the completion of the Schaad Road extension project and/or upon completion of the development to verify this traffic impact study's assumptions.

APPENDICES

APPENDIX A | TRAFFIC DATA

APPENDIX B | TRIP GENERATION & INFORMATION

APPENDIX C | TRIP DISTRIBUTION AND ASSIGNMENT FIGURES

APPENDIX D | CAPACITY ANALYSES

APPENDIX E | TURN LANE WARRANT EVALUATIONS

APPENDIX F | SIGNAL WARRANT EVALUATIONS

APPENDIX G | SITE CIRCULATION EXHIBITS

APPENDIX H | TIS COMMENT RESPONSE MEMO

APPENDIX A | TRAFFIC DATA

Project ID: 21-190048-001
Location: Johnson Rd & Schaad Rd
City: Knoxville

Day: Tuesday
Date: 8/31/2021

Groups Printed - Cars, PU, Vans - Heavy Trucks																									
	Johnson Rd Northbound						Johnson Rd Southbound						Schaad Rd Eastbound						Schaad Rd Westbound						
Start Time	Left	Thru	Rgt	Uturn	Peds	App. Total	Left	Thru	Rgt	Uturn	Peds	App. Total	Left	Thru	Rgt	Uturn	Peds	App. Total	Left	Thru	Rgt	Uturn	Peds	App. Total	Int. Total
7:00 AM	41	1	7	0	0	49	1	6	8	0	0	15	3	19	27	0	0	49	3	30	0	0	0	33	146
7:15 AM	53	8	20	0	0	81	0	4	21	0	0	25	10	68	45	2	0	125	5	94	0	0	0	99	330
7:30 AM	48	7	21	0	0	76	2	6	15	0	0	23	18	81	47	0	0	146	7	57	2	1	0	67	312
7:45 AM	3	10	9	0	0	22	1	16	2	0	0	19	2	30	11	0	0	43	6	4	0	0	0	10	94
Total	145	26	57	0	0	228	4	32	46	0	0	82	33	198	130	2	0	363	21	185	2	1	0	209	882
8:00 AM	4	3	10	0	0	17	0	12	1	0	0	13	0	0	5	0	0	5	9	4	0	0	0	13	48
8:15 AM	1	2	6	0	0	9	2	11	0	0	0	13	0	3	5	0	0	8	9	5	0	0	0	14	44
8:30 AM	1	3	9	0	0	13	1	6	1	0	0	8	0	2	4	0	0	6	6	5	1	0	0	12	39
8:45 AM	1	5	8	0	0	14	0	8	2	0	0	10	0	3	3	0	0	6	9	2	0	0	0	11	41
Total	7	13	33	0	0	53	3	37	4	0	0	44	0	8	17	0	0	25	33	16	1	0	0	50	172
BREAK																									
4:00 PM	6	11	36	0	0	53	2	10	1	0	0	13	4	9	10	0	0	23	12	6	1	0	0	19	108
4:15 PM	7	7	40	0	0	54	0	7	1	0	0	8	1	12	7	0	0	20	12	7	3	0	0	22	104
4:30 PM	6	6	46	0	0	58	0	6	1	0	0	7	1	10	5	0	0	16	18	7	0	1	0	26	107
4:45 PM	1	12	60	0	0	73	1	3	1	0	0	5	1	5	6	0	0	12	12	8	3	0	0	23	113
Total	20	36	182	0	0	238	3	26	4	0	0	33	7	36	28	0	0	71	54	28	7	1	0	90	432
5:00 PM	7	10	55	0	0	72	1	4	2	0	0	7	4	6	1	0	0	11	19	7	7	0	0	33	123
5:15 PM	3	14	79	0	0	96	1	11	0	0	0	12	1	10	2	0	0	13	18	8	6	0	0	32	153
5:30 PM	10	12	59	0	0	81	1	5	2	0	0	8	1	2	7	0	0	10	13	8	2	0	0	23	122
5:45 PM	6	8	34	0	0	48	1	6	0	0	0	7	2	7	3	0	0	12	21	3	6	0	0	30	97
Total	26	44	227	0	0	297	4	26	4	0	0	34	8	25	13	0	0	46	71	26	21	0	0	118	495
Grand Total	198	119	499	0	0	816	14	121	58	0	0	193	48	267	188	2	0	505	179	255	31	2	0	467	1981
Apprch %	24.3	14.6	61.2	0.0	0.0		7.3	62.7	30.1	0.0	0.0		9.5	52.9	37.2	0.4	0.0		38.3	54.6	6.6	0.4	0.0		
Total %	10.0	6.0	25.2	0.0	0.0	41.2	0.7	6.1	2.9	0.0	0.0	9.7	2.4	13.5	9.5	0.1	0.0	25.5	9.0	12.9	1.6	0.1	0.0	23.6	
Cars, PU, Vans	198	119	499	0		816	14	121	58	0		193	48	267	188	2		505	179	255	31	2		467	1981
% Cars, PU, Vans	100.0	100.0	100.0	0.0		100.0	100.0	100.0	100.0	0.0		100.0	100.0	100.0	100.0	0.0		100.0	100.0	100.0	100.0	100.0		100.0	100.0

Project ID: 21-190048-001
Location: Johnson Rd & Schaad Rd
City: Knoxville

PEAK HOURS

Day: Tuesday
Date: 8/31/2021

AM

	Johnson Rd Northbound					Johnson Rd Southbound					Schaad Rd Eastbound					Schaad Rd Westbound					
Start Time	Left	Thru	Rgt	Utum	App. Total	Left	Thru	Rgt	Utum	App. Total	Left	Thru	Rgt	Utum	App. Total	Left	Thru	Rgt	Utum	App. Total	Int. Total
Peak Hour Analysis from 07:00 AM - 09:00 AM																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
7:00 AM	41	1	7	0	49	1	6	8	0	15	3	19	27	0	49	3	30	0	0	33	146
7:15 AM	53	8	20	0	81	0	4	21	0	25	10	68	45	2	125	5	94	0	0	99	330
7:30 AM	48	7	21	0	76	2	6	15	0	23	18	81	47	0	146	7	57	2	1	67	312
7:45 AM	3	10	9	0	22	1	16	2	0	19	2	30	11	0	43	6	4	0	0	10	94
Total Volume	145	26	57	0	228	4	32	46	0	82	33	198	130	2	363	21	185	2	1	209	882
% App. Total	63.6	11.4	25.0	0.0	100	4.9	39.0	56.1	0.0	100	9.1	54.5	35.8	0.6	100	10.0	88.5	1.0	0.5	100	
PHF	0.704					0.820					0.622					0.528					0.668
Cars, PU, Vans	145	26	57	0	228	4	32	46	0	82	33	198	130	2	363	21	185	2	1	209	882
% Cars, PU, Vans	100.0	100.0	100.0	0.0	100.0	100.0	100.0	100.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

PM

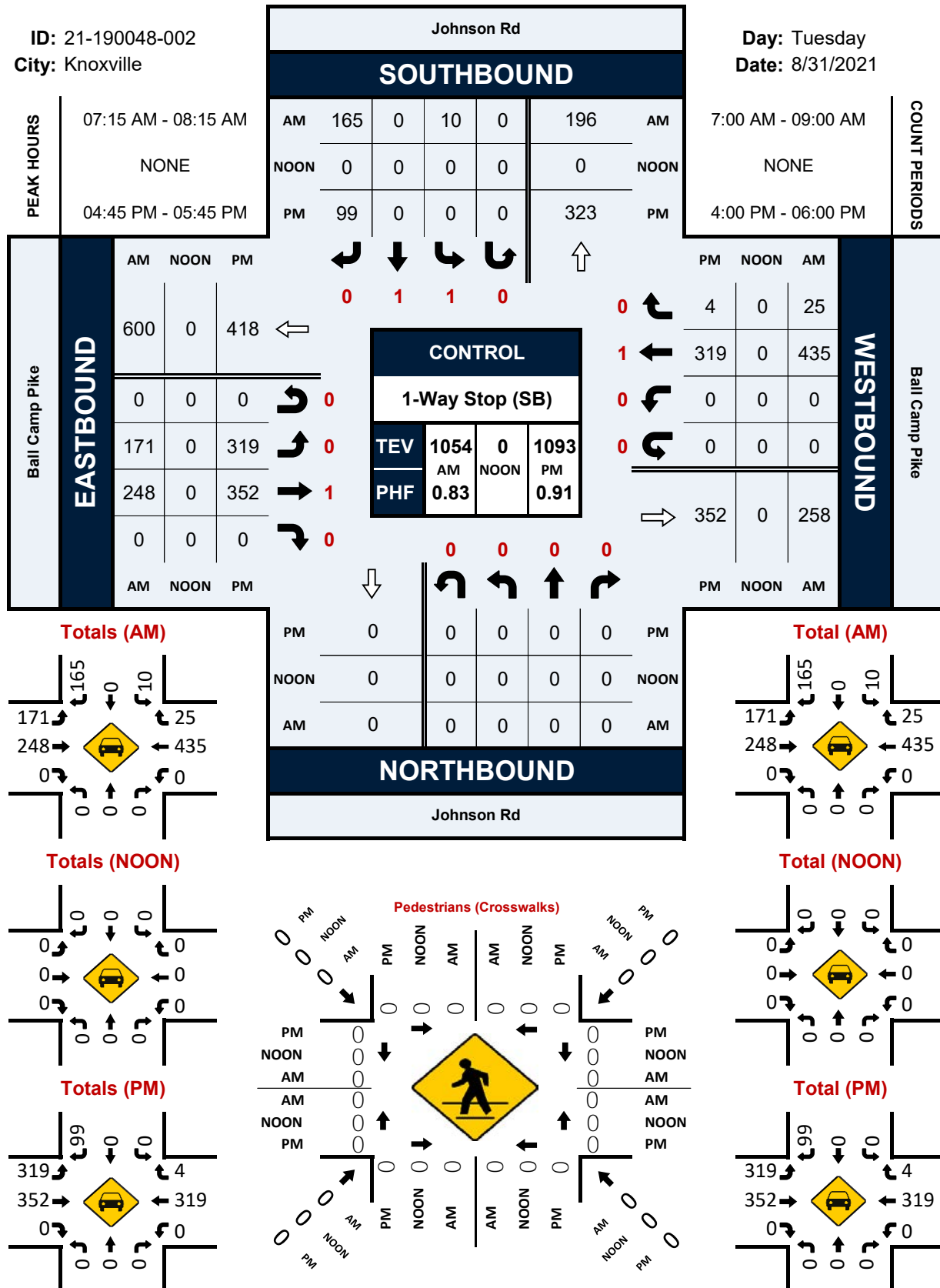
	Johnson Rd Northbound					Johnson Rd Southbound					Schaad Rd Eastbound					Schaad Rd Westbound					
Start Time	Left	Thru	Rgt	Utum	App. Total	Left	Thru	Rgt	Utum	App. Total	Left	Thru	Rgt	Utum	App. Total	Left	Thru	Rgt	Utum	App. Total	Int. Total
Peak Hour Analysis from 04:00 PM - 06:00 PM																					
Peak Hour for Entire Intersection Begins at 04:45 PM																					
4:45 PM	1	12	60	0	73	1	3	1	0	5	1	5	6	0	12	12	8	3	0	23	113
5:00 PM	7	10	55	0	72	1	4	2	0	7	4	6	1	0	11	19	7	7	0	33	123
5:15 PM	3	14	79	0	96	1	11	0	0	12	1	10	2	0	13	18	8	6	0	32	153
5:30 PM	10	12	59	0	81	1	5	2	0	8	1	2	7	0	10	13	8	2	0	23	122
Total Volume	21	48	253	0	322	4	23	5	0	32	7	23	16	0	46	62	31	18	0	111	511
% App. Total	6.5	14.9	78.6	0.0	100	12.5	71.9	15.6	0.0	100	15.2	50.0	34.8	0.0	100	55.9	27.9	16.2	0.0	100	
PHF	0.839					0.667					0.885					0.841					0.835
Cars, PU, Vans	21	48	253	0	322	4	23	5	0	32	7	23	16	0	46	62	31	18	0	111	511
% Cars, PU, Vans	100.0	100.0	100.0	0.0	100.0	100.0	100.0	100.0	0.0	100.0	100.0	100.0	100.0	0.0	100.0	100.0	100.0	100.0	0.0	100.0	100.0

Johnson Rd & Ball Camp Pike

Peak Hour Turning Movement Count

ID: 21-190048-002
City: Knoxville

Day: Tuesday
Date: 8/31/2021



Project ID: 21-190048-002
Location: Johnson Rd & Ball Camp Pike
City: Knoxville

Day: Tuesday
Date: 8/31/2021

Groups Printed - Cars, PU, Vans - Heavy Trucks

Start Time	Johnson Rd Northbound						Johnson Rd Southbound						Ball Camp Pike Eastbound						Ball Camp Pike Westbound						Int. Total
	Left	Thru	Rgt	Uturn	Peds	App. Total	Left	Thru	Rgt	Uturn	Peds	App. Total	Left	Thru	Rgt	Uturn	Peds	App. Total	Left	Thru	Rgt	Uturn	Peds	App. Total	
7:00 AM	0	0	0	0	0	0	0	0	35	0	0	35	39	55	0	0	0	94	0	71	8	0	0	79	208
7:15 AM	0	0	0	0	0	0	2	0	51	0	0	53	78	52	0	0	0	130	0	97	12	0	0	109	292
7:30 AM	0	0	0	0	0	0	4	0	55	0	0	59	54	73	0	0	0	127	0	117	13	0	0	130	316
7:45 AM	0	0	0	0	0	0	4	0	34	0	0	38	23	68	0	0	0	91	0	107	0	0	0	107	236
Total	0	0	0	0	0	0	10	0	175	0	0	185	194	248	0	0	0	442	0	392	33	0	0	425	1052
8:00 AM	0	0	0	0	0	0	0	0	25	0	0	25	16	55	0	0	0	71	0	114	0	0	0	114	210
8:15 AM	0	0	0	0	0	0	0	0	25	0	0	25	10	61	0	0	0	71	0	109	0	0	0	109	205
8:30 AM	0	0	0	0	0	0	0	0	19	0	0	19	14	57	0	0	0	71	0	97	0	0	0	97	187
8:45 AM	0	0	0	0	0	0	0	0	19	0	0	19	15	46	0	0	0	61	0	67	0	0	0	67	147
Total	0	0	0	0	0	0	0	0	88	0	0	88	55	219	0	0	0	274	0	387	0	0	0	387	749
BREAK																									
4:00 PM	0	0	0	0	0	0	0	0	34	0	0	34	51	84	0	0	0	135	0	75	0	0	0	75	244
4:15 PM	0	0	0	0	0	0	1	0	22	0	0	23	54	96	0	0	0	150	0	64	2	0	0	66	239
4:30 PM	0	0	0	0	0	0	1	0	28	0	0	29	55	56	0	0	0	111	0	80	0	0	0	80	220
4:45 PM	0	0	0	0	0	0	0	0	20	0	0	20	75	82	0	0	0	157	0	73	0	0	0	73	250
Total	0	0	0	0	0	0	2	0	104	0	0	106	235	318	0	0	0	553	0	292	2	0	0	294	953
5:00 PM	0	0	0	0	0	0	0	0	24	0	0	24	71	89	0	0	0	160	0	75	1	0	0	76	260
5:15 PM	0	0	0	0	0	0	0	0	31	0	0	31	96	86	0	0	0	182	0	85	1	0	0	86	299
5:30 PM	0	0	0	0	0	0	0	0	24	0	0	24	77	95	0	0	0	172	0	86	2	0	0	88	284
5:45 PM	0	0	0	0	0	0	0	0	30	0	0	30	51	62	0	0	0	113	0	92	0	0	0	92	235
Total	0	0	0	0	0	0	0	0	109	0	0	109	295	332	0	0	0	627	0	338	4	0	0	342	1078
Grand Total	0	0	0	0	0	0	12	0	476	0	0	488	779	1117	0	0	0	1896	0	1409	39	0	0	1448	3832
Apprch %	0.0	0.0	0.0	0.0	0.0		2.5	0.0	97.5	0.0	0.0		41.1	58.9	0.0	0.0	0.0		0.0	97.3	2.7	0.0	0.0		
Total %	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	12.4	0.0	0.0	12.7	20.3	29.1	0.0	0.0	0.0	49.5	0.0	36.8	1.0	0.0	0.0	37.8	
Cars, PU, Vans	0	0	0	0	0	0	12	0	476	0	0	488	779	1117	0	0	0	1896	0	1409	39	0	0	1448	3832
% Cars, PU, Vans	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0	0.0	0.0	100.0	100.0	100.0	0.0	0.0	0.0	100.0	0.0	100.0	100.0	0.0	0.0	100.0	100.0

Project ID: 21-190048-002
Location: Johnson Rd & Ball Camp Pike
City: Knoxville

PEAK HOURS

Day: Tuesday
Date: 8/31/2021

AM

	Johnson Rd Northbound					Johnson Rd Southbound					Ball Camp Pike Eastbound					Ball Camp Pike Westbound					
Start Time	Left	Thru	Rgt	Utum	App. Total	Left	Thru	Rgt	Utum	App. Total	Left	Thru	Rgt	Utum	App. Total	Left	Thru	Rgt	Utum	App. Total	Int. Total
Peak Hour Analysis from 07:00 AM - 09:00 AM																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
7:15 AM	0	0	0	0	0	2	0	51	0	53	78	52	0	0	130	0	97	12	0	109	292
7:30 AM	0	0	0	0	0	4	0	55	0	59	54	73	0	0	127	0	117	13	0	130	316
7:45 AM	0	0	0	0	0	4	0	34	0	38	23	68	0	0	91	0	107	0	0	107	236
8:00 AM	0	0	0	0	0	0	0	25	0	25	16	55	0	0	71	0	114	0	0	114	210
Total Volume	0	0	0	0	0	10	0	165	0	175	171	248	0	0	419	0	435	25	0	460	1054
% App. Total	0.0	0.0	0.0	0.0	0	5.7	0.0	94.3	0.0	100	40.8	59.2	0.0	0.0	100	0.0	94.6	5.4	0.0	100	
PHF						0.742					0.806					0.885					0.834
Cars, PU, Vans	0	0	0	0	0	10	0	165	0	175	171	248	0	0	419	0	435	25	0	460	1054
% Cars, PU, Vans	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0	0.0	100.0	100.0	100.0	0.0	0.0	100.0	0.0	100.0	100.0	0.0	100.0	100.0

PM

	Johnson Rd Northbound					Johnson Rd Southbound					Ball Camp Pike Eastbound					Ball Camp Pike Westbound					
Start Time	Left	Thru	Rgt	Utum	App. Total	Left	Thru	Rgt	Utum	App. Total	Left	Thru	Rgt	Utum	App. Total	Left	Thru	Rgt	Utum	App. Total	Int. Total
Peak Hour Analysis from 04:00 PM - 06:00 PM																					
Peak Hour for Entire Intersection Begins at 04:45 PM																					
4:45 PM	0	0	0	0	0	0	0	20	0	20	75	82	0	0	157	0	73	0	0	73	250
5:00 PM	0	0	0	0	0	0	0	24	0	24	71	89	0	0	160	0	75	1	0	76	260
5:15 PM	0	0	0	0	0	0	0	31	0	31	96	86	0	0	182	0	85	1	0	86	299
5:30 PM	0	0	0	0	0	0	0	24	0	24	77	95	0	0	172	0	86	2	0	88	284
Total Volume	0	0	0	0	0	0	0	99	0	99	319	352	0	0	671	0	319	4	0	323	1093
% App. Total	0.0	0.0	0.0	0.0	0	0.0	0.0	100.0	0.0	100	47.5	52.5	0.0	0.0	100	0.0	98.8	1.2	0.0	100	
PHF						0.798					0.922					0.918					0.914
Cars, PU, Vans	0	0	0	0	0	0	0	99	0	99	319	352	0	0	671	0	319	4	0	323	1093
% Cars, PU, Vans	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0	100.0	100.0	0.0	0.0	100.0	0.0	100.0	100.0	0.0	100.0	100.0

TRAFFIC GROWTH

Source:	TDOT
Location:	Schaad Road
	West of SR-62
Route #:	Schaad Road
Route Type:	
Station:	T47000574
Capacity:	

Count Year	Volume	Growth Rate
2016	2316	-38.13
2017	1433	-4.40
2018	1370	67.74
2019	2298	2.70
2020	2360	

Avg. 1 Year Rate 2016-2020	6.98

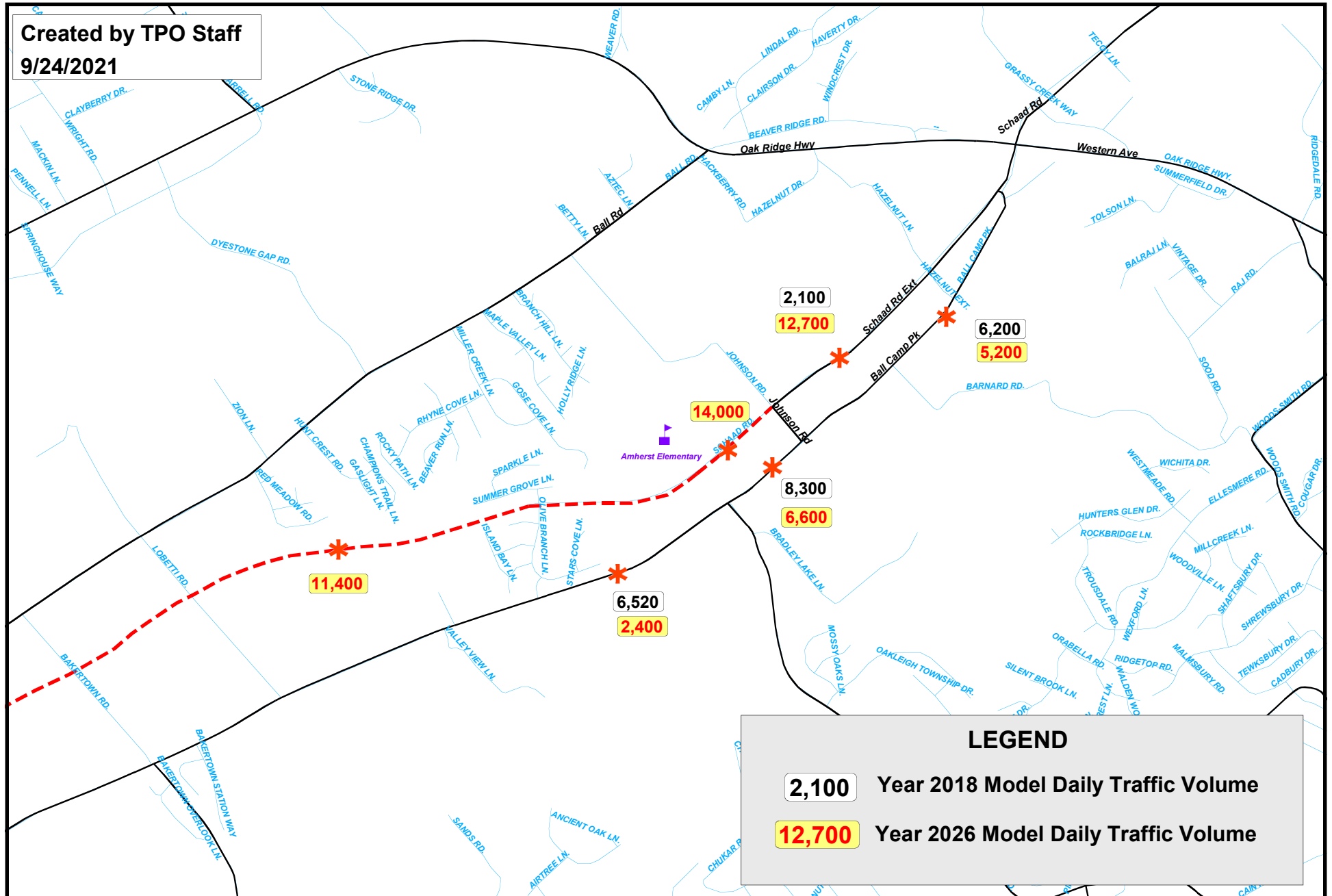
Source:	TDOT
Location:	Ball Camp Pike
	West of Bakertown
Route #:	Ball Camp Pike
Route Type:	
Station:	T47000578
Capacity:	

[illegible]

Avg. 1 Year Rate 2016-2020	2.05

Schaad Road Extension Traffic Projection

Created by TPO Staff
9/24/2021



LEGEND

- 2,100** Year 2018 Model Daily Traffic Volume
- 12,700** Year 2026 Model Daily Traffic Volume

APPENDIX B | TRIP GENERATION & INFORMATION

FULL BUILD-OUT TRIP GENERATION

Land Use	ITE Code	Size	Weekday (Trips / Day)	AM Peak Hour (Trips/HR)	PM Peak Hour (Trips/HR)
Super Convenience Market	960	6,500 sf	5,444	540	450
Entering Trips	65%	Pass-by	2,722	270	225
Exiting Trips			2,722	270	225
TOTAL TRIPS			5,444	540	450
Entering Trips			2,722	270	225
Exiting Trips			2,722	270	225
NET EXTERNAL TRIPS					
<i>Pass-by Trips</i>			3,539	351	293
Entering Trips			1,769	176	146
Exiting Trips			1,769	176	146
<i>Non-Pass-by Trips</i>			1,905	189	157
Entering Trips			953	94	79
Exiting Trips			953	94	79

Land Use: 960

Super Convenience Market/Gas Station

Description

This land use includes gasoline/service stations with convenience markets where there is significant business related to the sale of convenience items and the fueling of motor vehicles. Some commonly sold convenience items include newspapers, freshly brewed coffee, daily-made donuts, bakery items, hot and cold beverages, breakfast items, dairy items, fresh fruits, soups, light meals, ready-to-go and freshly made sandwiches and wraps, and ready-to-go salads. Stores typically also had automated teller machines (ATMs), and public restrooms. The sites included in this land use category have the following two specific characteristics:

- The gross floor area of the convenience market is at least 3,000 gross square feet
- The number of vehicle fueling positions is at least 10

Convenience market with gasoline pumps (Land Use 853) and gasoline/service station with convenience market (Land Use 945) are related uses.

Additional Data

To reflect changing characteristics of the convenience market component of this land use, only data from the past two decades have been included in this land use.

The independent variable, vehicle fueling positions, is defined as the maximum number of vehicles that can be fueled simultaneously. Gasoline/service stations in this land use include “pay-at-the-pump” and traditional fueling stations.

A multi-variable regression analysis based on both the convenience market gross floor area (GFA) and the number of vehicle fueling positions (VFP) produced a series of fitted curve equations. The equations are in the form of:

$$\text{Vehicle Trips} = [(VFP \text{ Factor}) \times (\text{Number of VFP})] + [(GFA \text{ Factor}) \times (GFA)] + (\text{Constant})$$

The values for the VFP factor, GFA factor, and constant are presented in the following table for each time period for which a fitted curve equation could produce an R^2 value of at least 0.50.

Time Period	VFP Factor	GFA Factor	Constant	R ²
Weekday, AM Peak Hour of Generator	10.3	105	-290	0.62
Weekday, PM Peak Hour of Generator	6.91	76.0	-133	0.68
Weekday, AM Peak Hour of Adjacent Street	16.1	135	-483	0.66
Weekday, PM Peak Hour of Adjacent Street	11.5	82.9	-226	0.51

The sites were surveyed in the late 1990's, 2000s and the 2010s in Florida, Iowa, Maryland, Minnesota, New Hampshire, New Jersey, Pennsylvania, Texas, Utah, and Wisconsin.

Source Numbers

617, 813, 844, 850, 864, 865, 867, 869, 882, 888, 904, 938, 954, 960, 962

Super Convenience Market/Gas Station (960)

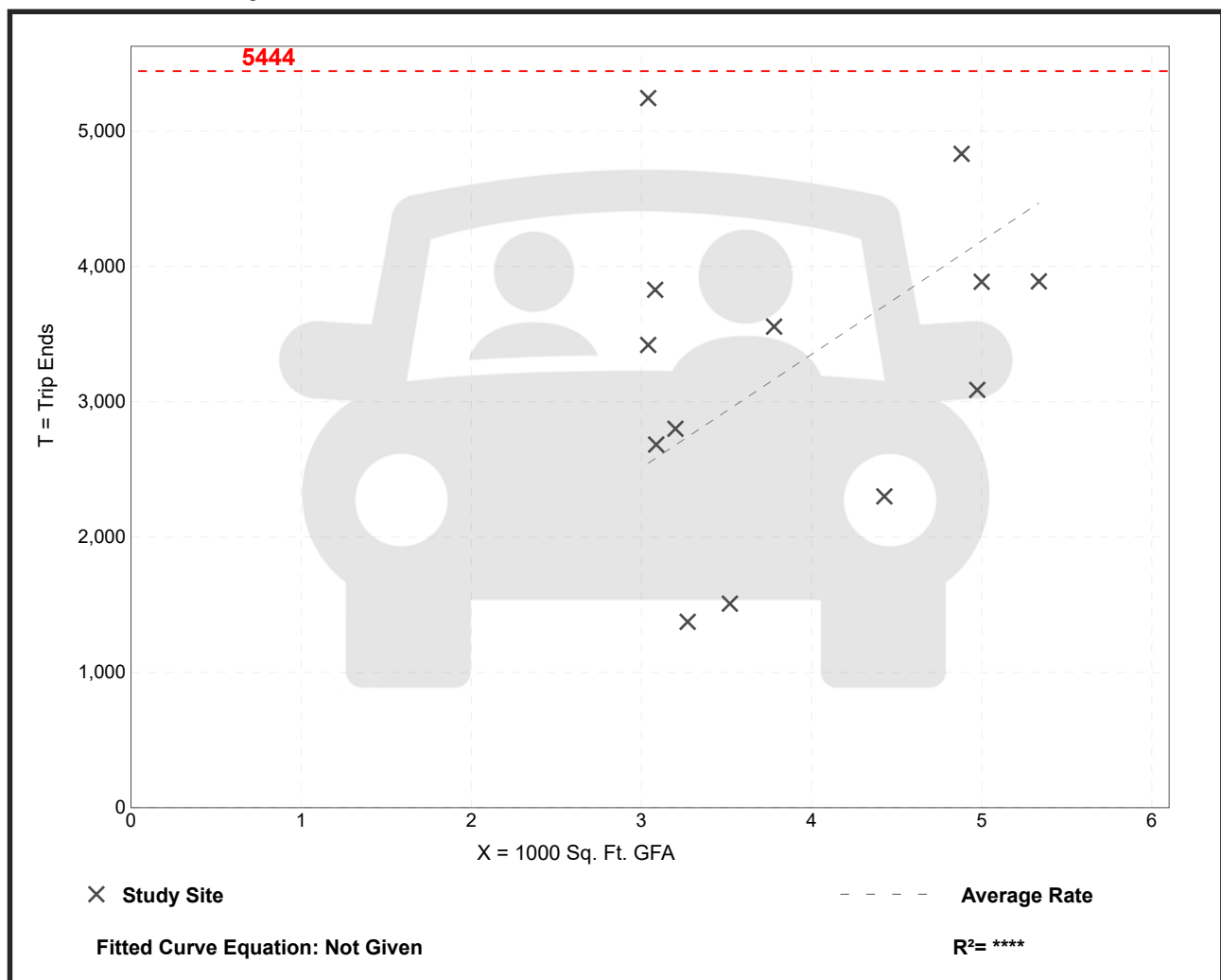
Vehicle Trip Ends vs: 1000 Sq. Ft. GFA
On a: Weekday

Setting/Location: General Urban/Suburban
Number of Studies: 13
Avg. 1000 Sq. Ft. GFA: 4
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
837.58	419.93 - 1725.33	334.67

Data Plot and Equation



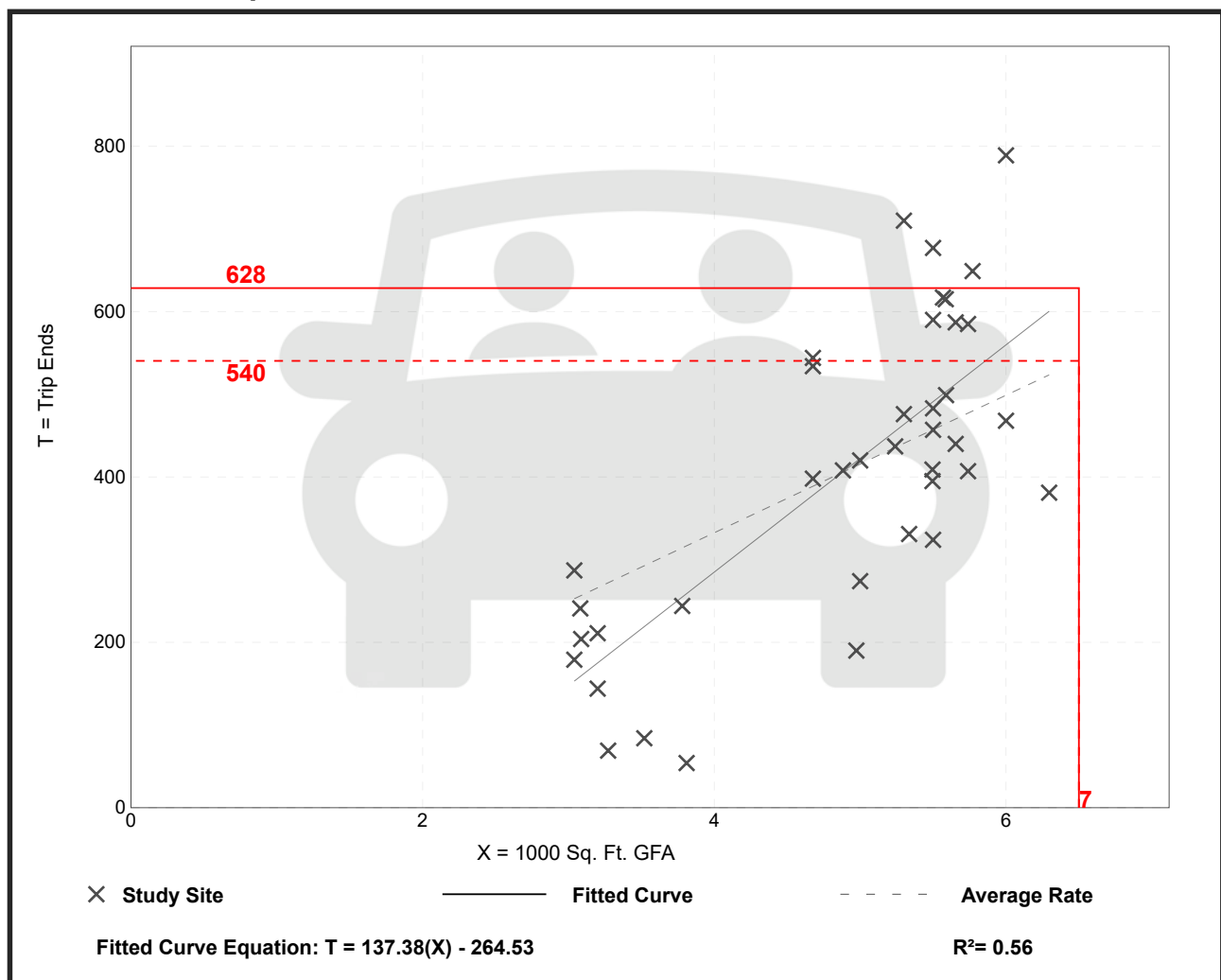
Super Convenience Market/Gas Station (960)

Vehicle Trip Ends vs: 1000 Sq. Ft. GFA
 On a: Weekday,
 Peak Hour of Adjacent Street Traffic,
 One Hour Between 7 and 9 a.m.
 Setting/Location: General Urban/Suburban
 Number of Studies: 39
 Avg. 1000 Sq. Ft. GFA: 5
 Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
83.14	14.17 - 133.96	28.07

Data Plot and Equation



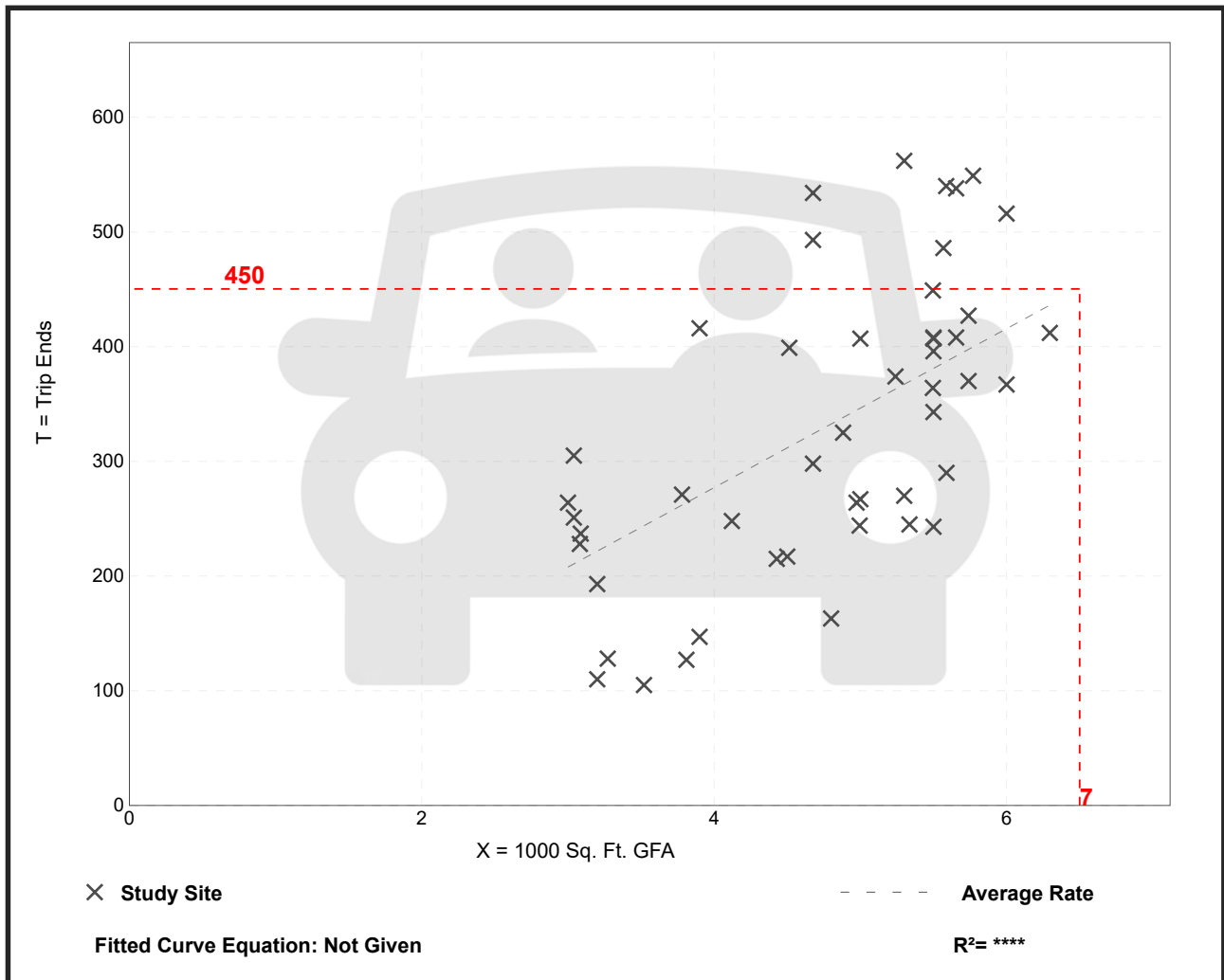
Super Convenience Market/Gas Station (960)

Vehicle Trip Ends vs: 1000 Sq. Ft. GFA
 On a: Weekday,
 Peak Hour of Adjacent Street Traffic,
 One Hour Between 4 and 6 p.m.
 Setting/Location: General Urban/Suburban
 Number of Studies: 48
 Avg. 1000 Sq. Ft. GFA: 5
 Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
69.28	29.83 - 114.20	21.07

Data Plot and Equation



KNOXVILLE-KNOX COUNTY
M P C
METROPOLITAN
P L A N N I N G
C O M M I S S I O N
T E N N E S S E E
M E M O R A N D U M

TO: Traffic Impact Study Reviewers and Preparers
FROM: Cindy Pionke
DATE: March 10, 1997
SUBJECT: Minutes from October 11, 1996 Meeting

Two items were presented for discussion at our last meeting. Hollis Loveday did a presentation on pass-by rates for a few specific land uses and Darcy Sullivan did a presentation on auxiliary lane issues. These specific matters seemed to cause some problems over the past year.

Percentage of pass-by trips for fast-food restaurants, supermarkets, convenience markets and shopping centers were discussed. The following percentages were agreed upon.

LAND USE	PERCENTAGE
Fast-food Restaurant	40
Supermarket	
> 50,000 SF	10
25,000 - 50,000 SF	35
< 25,000 SF	55
Convenience Market	
< 10,000 ADT	60
10,000 - 20,000 ADT	65
20,000 - 30,000 ADT	70
30,000 - 40,000 ADT	75
> 40,000 ADT	80
Shopping Center	
Use GLA formula up to 30%	

Attached is the draft "Procedure for Determining Need for and Design of Auxiliary Lanes on Uncontrolled Approaches to Intersections and Driveways". **Please note that the bay taper rates have changed since we met.** The proposed 15:1 and 20:1 taper rates were previously 14:1 and 16:1, respectively. This procedure is for left and right turn lanes on two-lane roadways. The recommendation for four-lane roadways was to exercise judgment because no particular quantification method leads to consistent results.

There are currently no warrants for when right turn acceleration lanes should be provided. The recommendation is not to provide them unless specific traffic or geometric conditions indicate a clear operational advantage.

Please review this memorandum to see if its contents agrees with what you remember from the meeting. If it does not, please call me so that I can rectify the situation.

LIST OF ATTENDEES AT OCTOBER 11, 1996 MEETING

Participant	Organization	Phone Number
Daniel Armstrong	Wilbur Smith	584-8584
Mark Best	TDOT	594-9170
Mark Geldmeier	City of Knoxville	544-5331
Robin Gorman	Consultant	457-7979
Barbara Hatcher	MPC	215-2500
John Heid	AR/TEC	681-8848
Leo LaCamera	City of Knoxville	215-2072
Hollis Loveday	Wilbur Smith	584-8584
Cindy Pionke	MPC	215-2500
Pam Porter	TDOT	594-9170
John Sexton	Allen & Hoshall	693-7881
Darcy Sullivan	Consultant	577-7965
Jeff Welch	MPC	215-2500

PROCEDURE FOR DETERMINING NEED FOR AND DESIGN OF AUXILIARY LANES ON UNCONTROLLED APPROACHES TO INTERSECTIONS AND DRIVEWAYS

DESIGN FEATURE	LEFT-TURN LANES				RIGHT-TURN LANES			
Design speed	Determine prevailing speed as defined in the Knox County Access Control Policy				Determine prevailing speed as defined in the Knox County Access Control Policy			
Need for Lane	Enter appropriate TABLE in Knox County Access Control Policy with advancing and opposing volumes and determine threshold volume. Compare to threshold volume to actual or projected left-turn volume.				Enter appropriate TABLE in Knox County Access Control Policy with through and right-turn volumes.			
Storage Length	DHV in vph ≤60 61 - 90 91 - 120 121 - 150 151 - 180 >180		Length in feet 50 75 100 125 150 Special Analysis -Traffic Signal May be Required		None required on unconcontrolled approaches			
Prevailing Speed in mph	≤35	36 to 45	46 to 55	>55	≤35	36 to 45	46 to 55	>55
Length of Full Width Deceleration Lane	175 ft.	225 ft.	300 ft.	400 ft.	100 ft.	150 ft.	225 ft.	325 ft.
	All values include a storage length adequate for up to 30 turning vehicles per hour. Additional length should be added where higher volumes are anticipated.				All values assume a 15 mph turning speed at the end of the deceleration lane. Appropriate adjustments should be made for speeds other than 15 mph.			
Bay Taper Rate (Length : Width)	10:1	12:1	15:1	20:1	10:1	12:1	15:1	20:1
	Taper rates should be adjusted where taper is located within a curve with a radius of 500 feet or less: Shorten Tapers located on the inside of the curve and lengthen tapers on the outside of the curve.				Taper rates should be adjusted where taper is located within a curve with a radius of 500 feet or less: Shorten Tapers located on the inside of the curve and lengthen tapers on the outside of the curve.			
Total Length of Turn-lane	Bay taper length plus deceleration length plus storage length adjustment if required.				Bay taper length plus deceleration length plus or minus turning speed adjustment if required			

DRAFT February 22, 1997

APPENDIX C | TRIP DISTRIBUTION AND ASSIGNMENT FIGURES

- FIGURES C-1A - C-1H – Trip Distribution and Assignment without Schaad Road Extension
- FIGURES C-2A - C-2H – Trip Distribution and Assignment with Schaad Road Extension

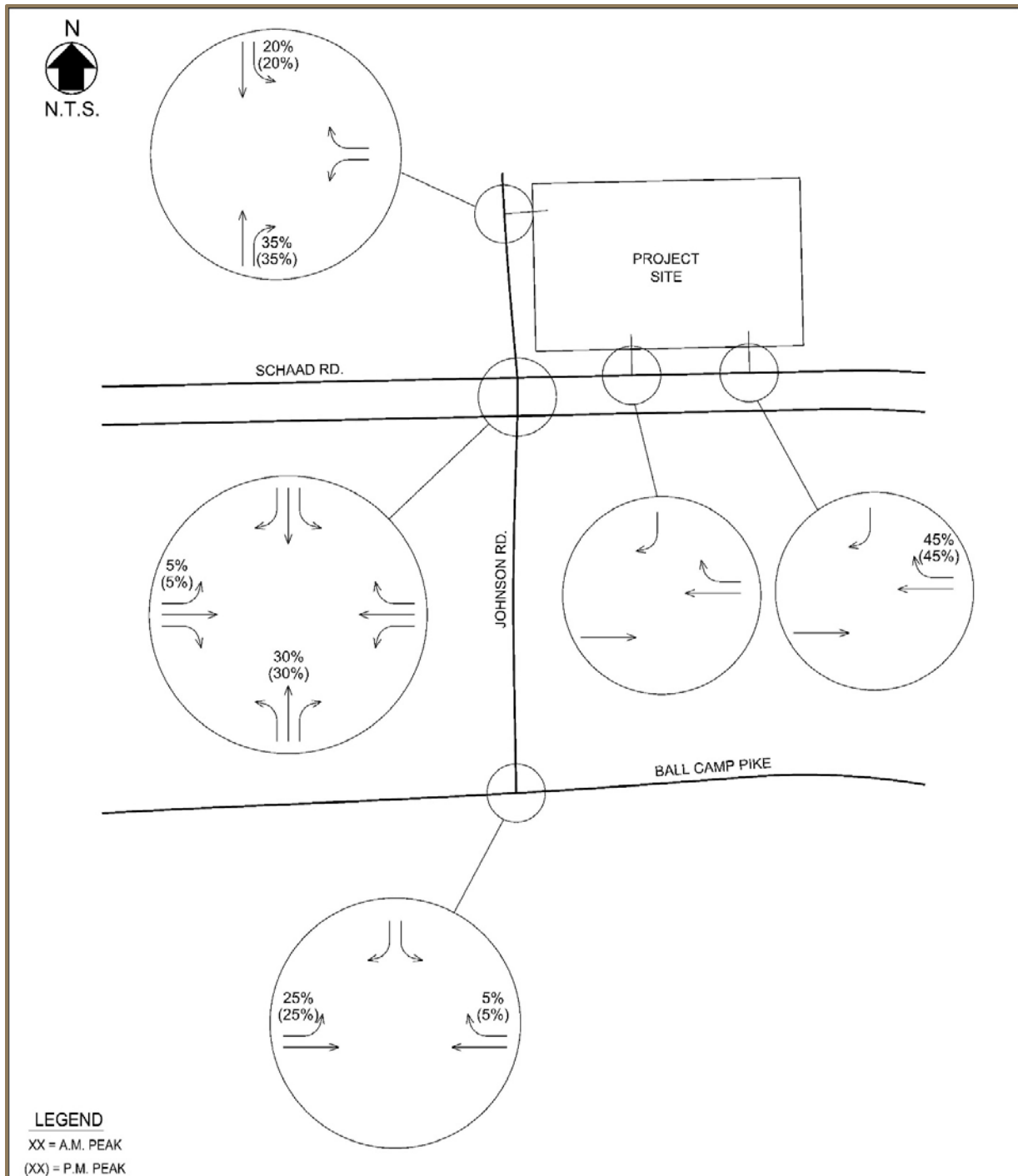


FIGURE C-1A
 TRIP DISTRIBUTION – NON-PASS-BY ENTERING WITHOUT SCHAAD EXTENSION

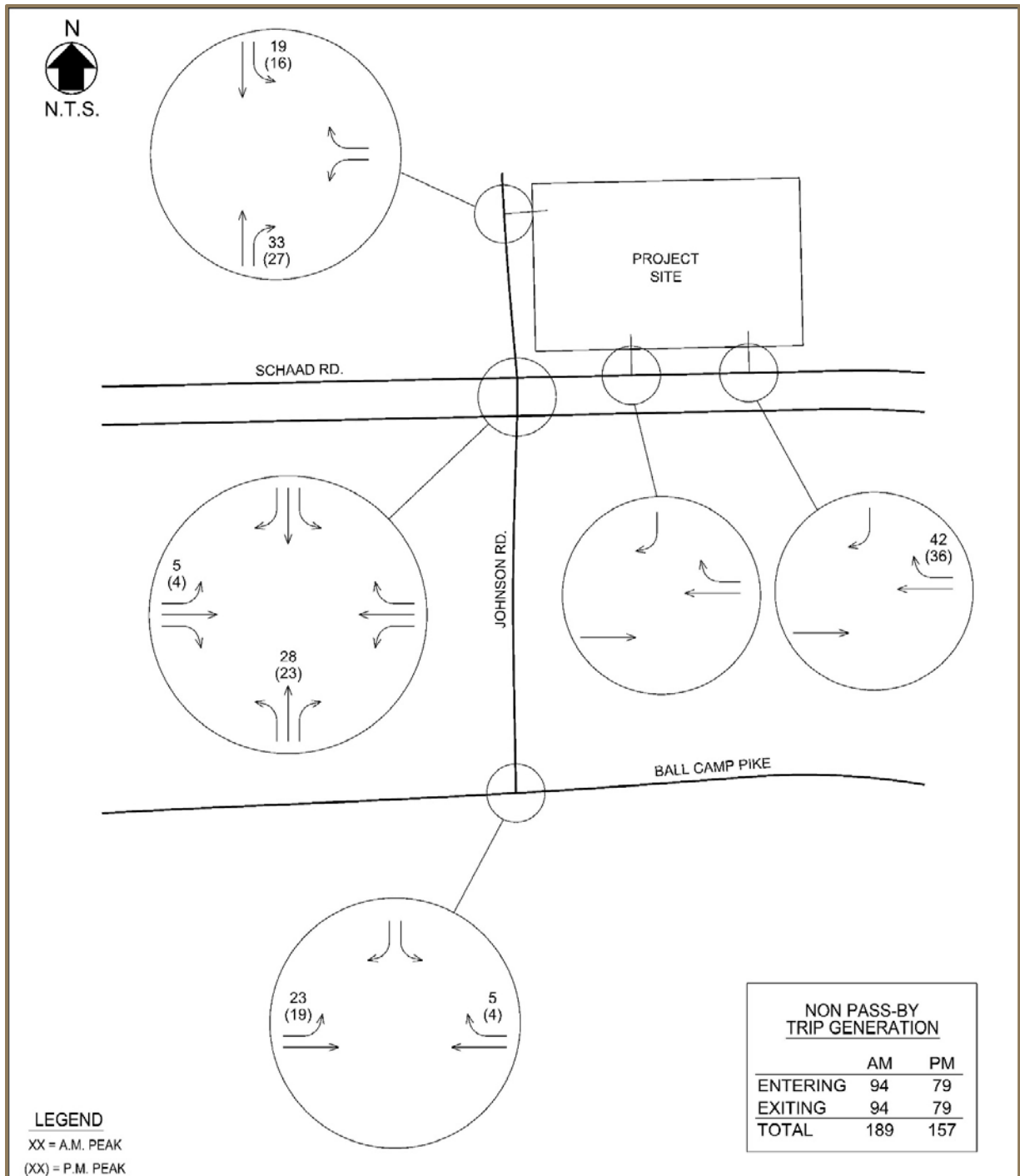


FIGURE C-1B
 TRIP ASSIGNMENT – NON-PASS-BY ENTERING WITHOUT SCHAAD EXTENSION

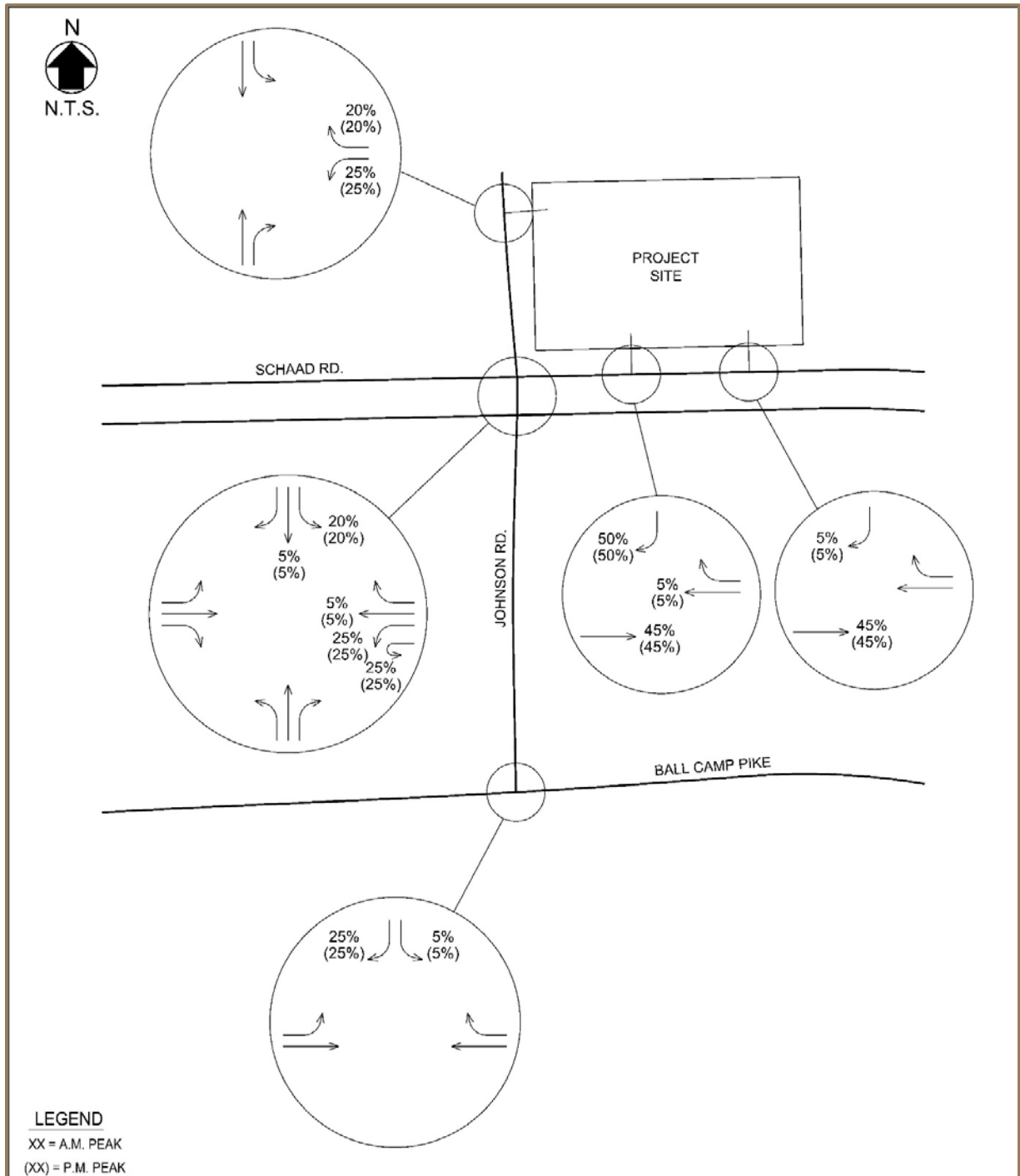


FIGURE C-1C
 TRIP DISTRIBUTION – NON-PASS-BY EXITING WITHOUT SCHAAD EXTENSION

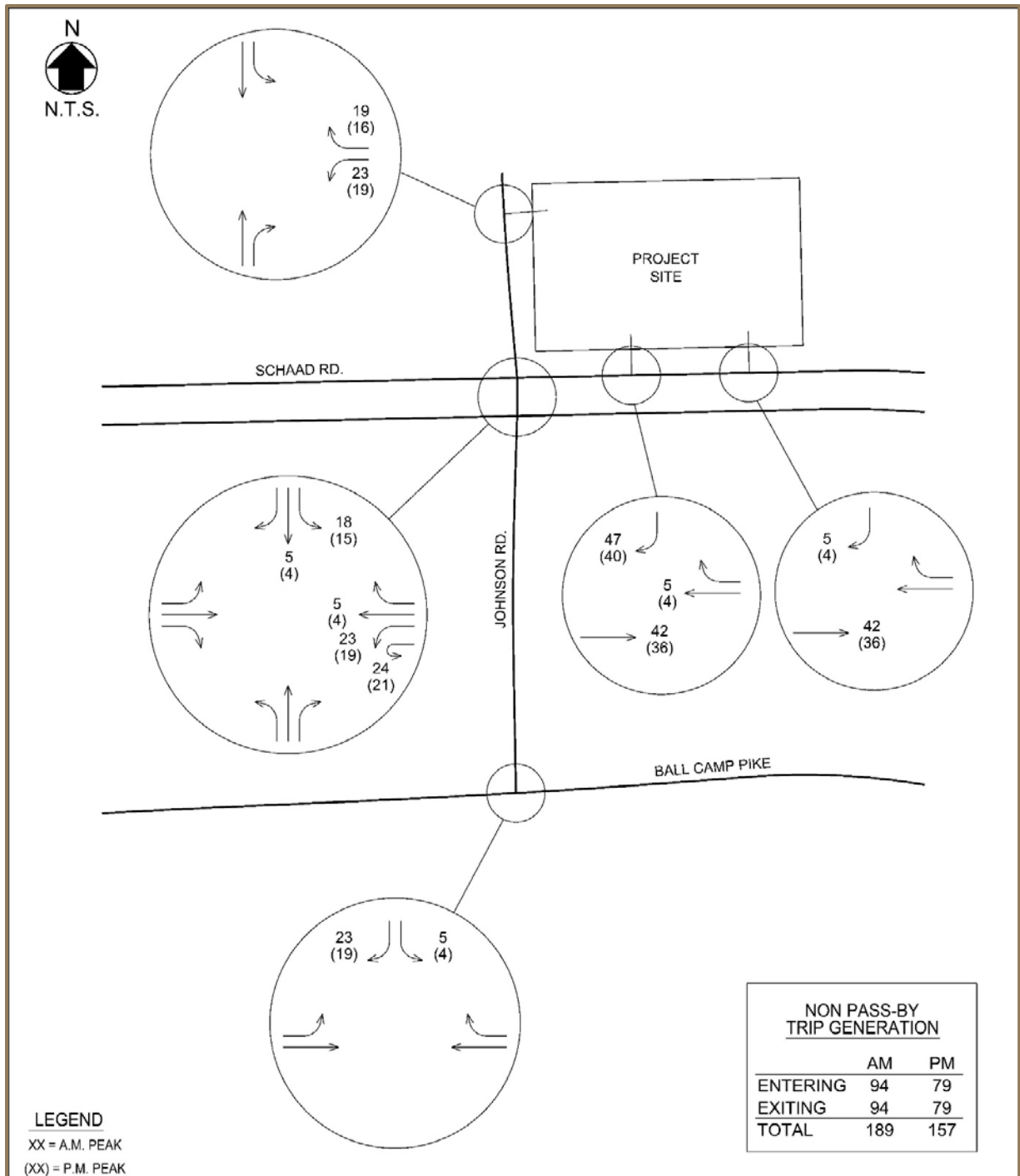


FIGURE C-1D
 TRIP ASSIGNMENT – NON-PASS-BY EXITING WITHOUT SCHAAD EXTENSION

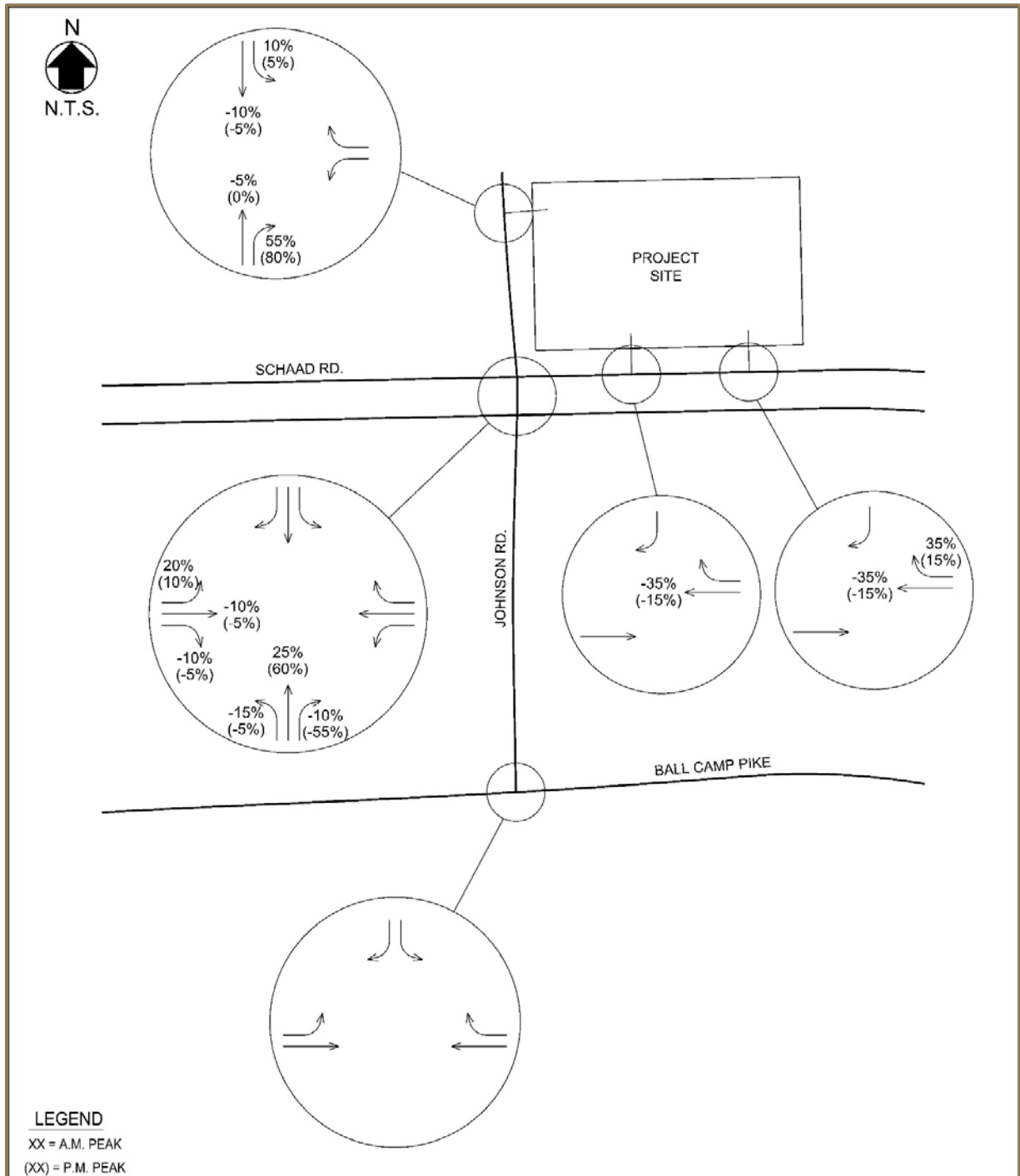


FIGURE C-1E
 TRIP DISTRIBUTION – PASS-BY ENTERING WITHOUT SCHAAD EXTENSION

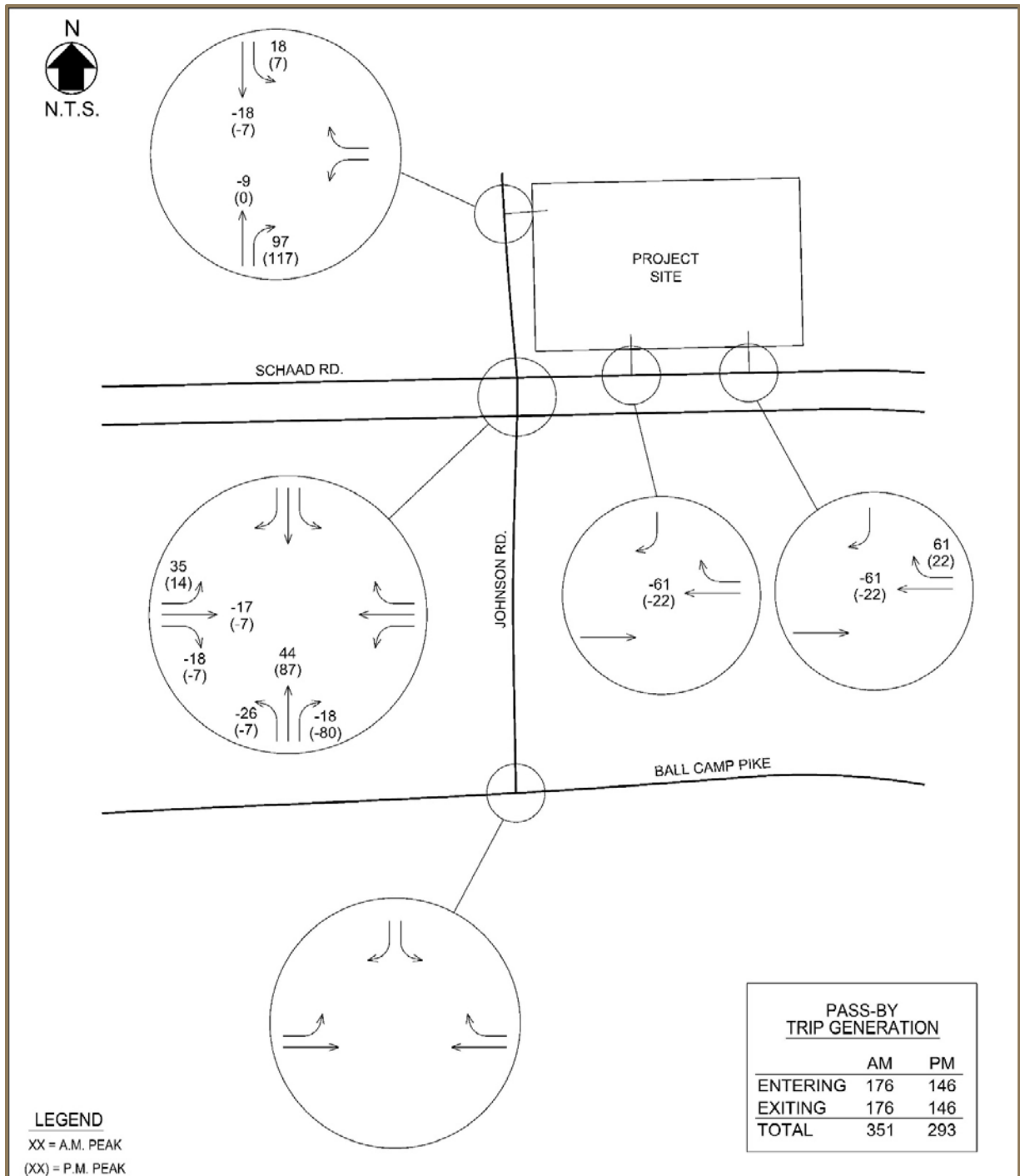


FIGURE C-1F
 TRIP ASSIGNMENT – PASS-BY ENTERING WITHOUT SCHAAD EXTENSION

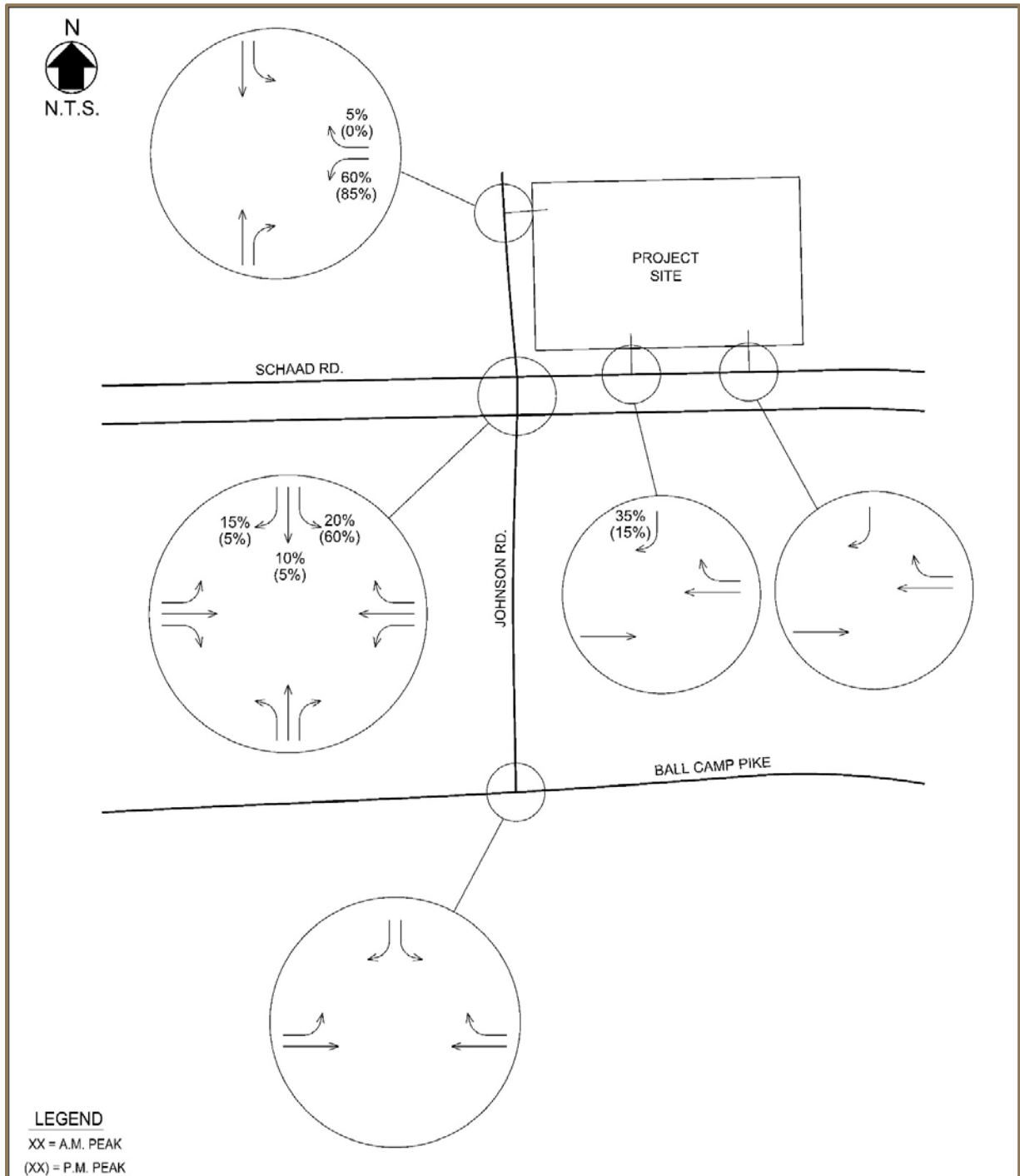


FIGURE C-1G
TRIP DISTRIBUTION – PASS-BY EXITING WITHOUT SCHAAD EXTENSION

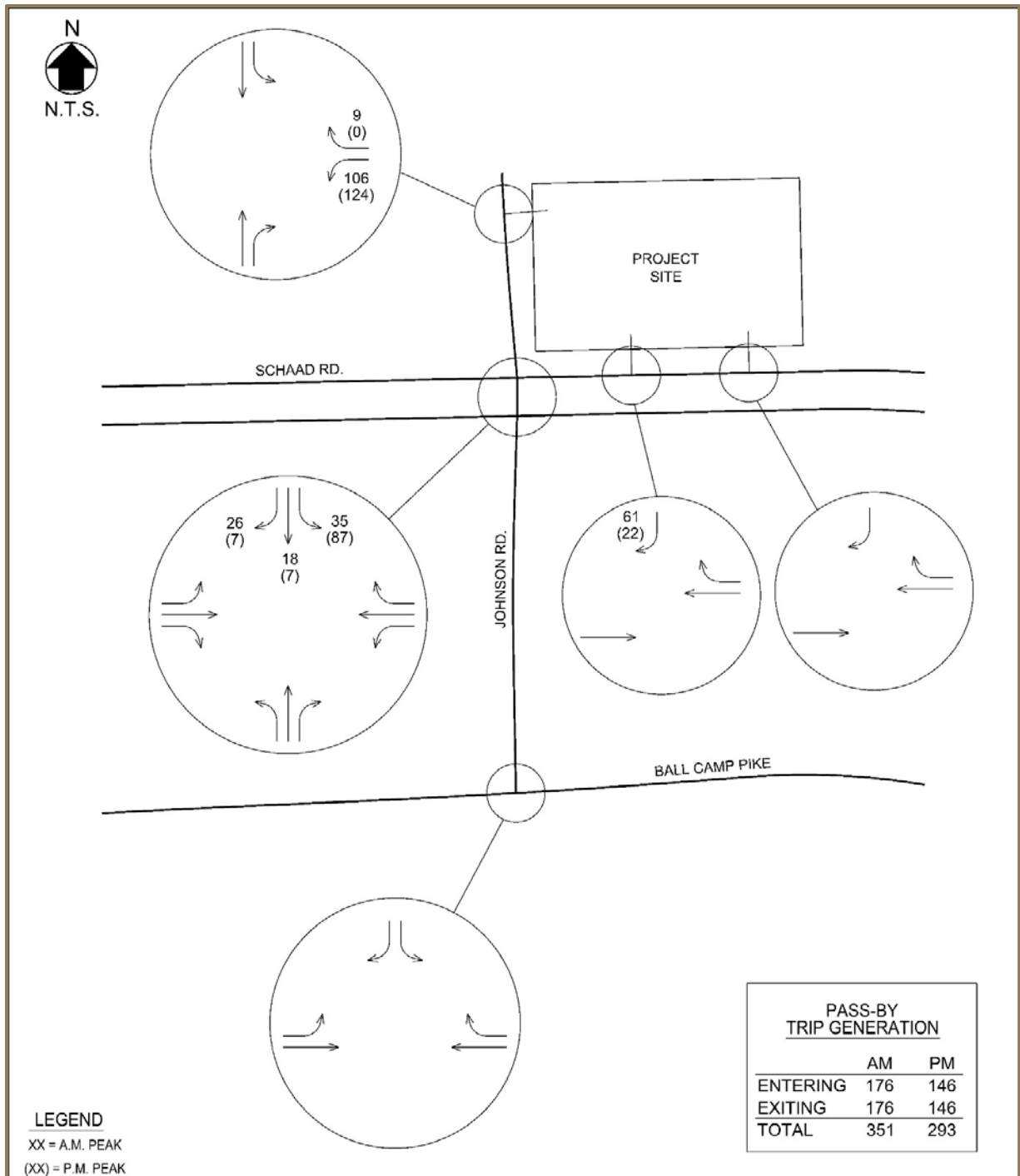


FIGURE C-1H
 TRIP ASSIGNMENT – PASS-BY EXITING WITHOUT SCHAAD EXTENSION

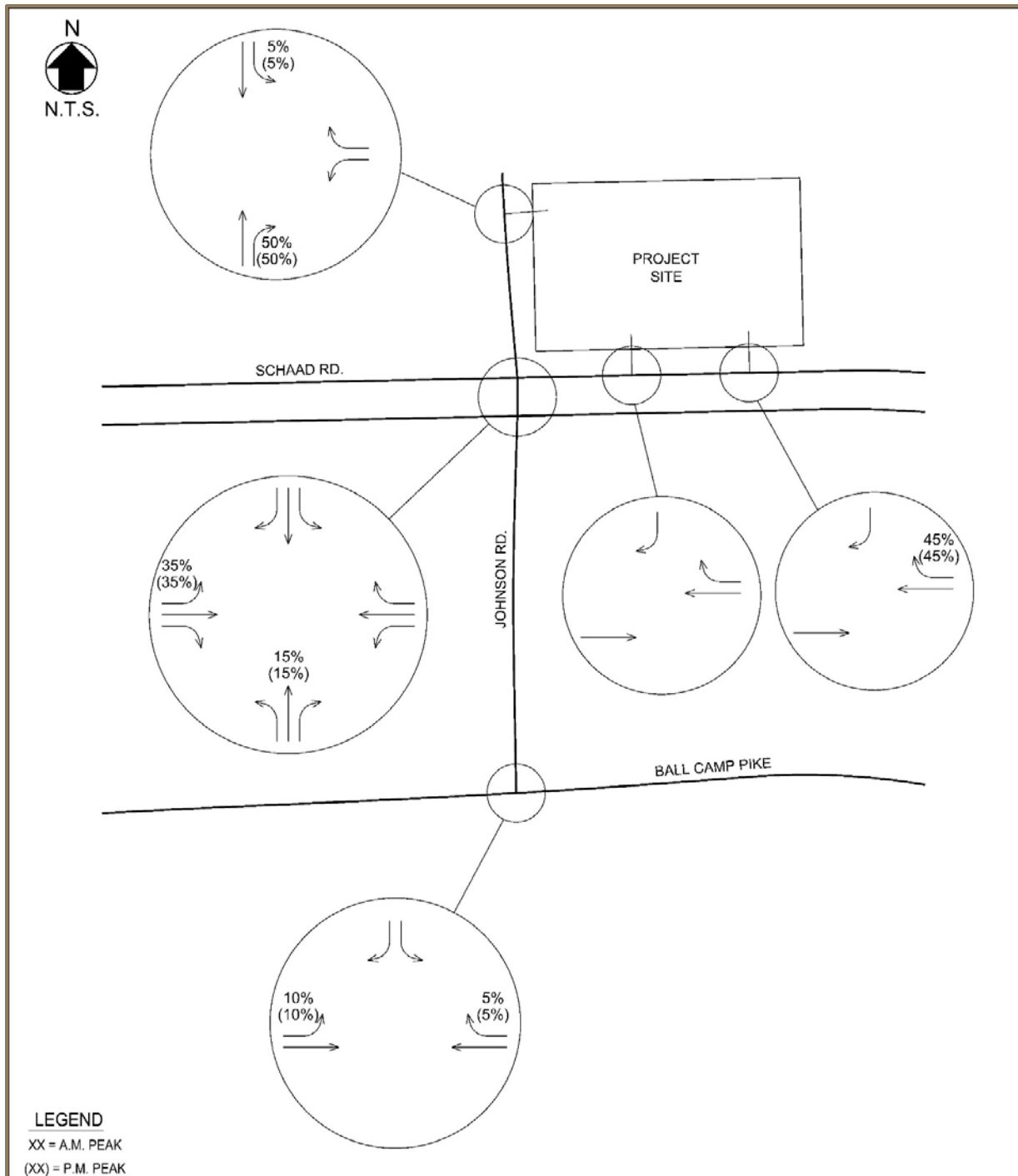


FIGURE C-2A
 TRIP DISTRIBUTION – NON-PASS-BY ENTERING WITH SCHAAD EXTENSION

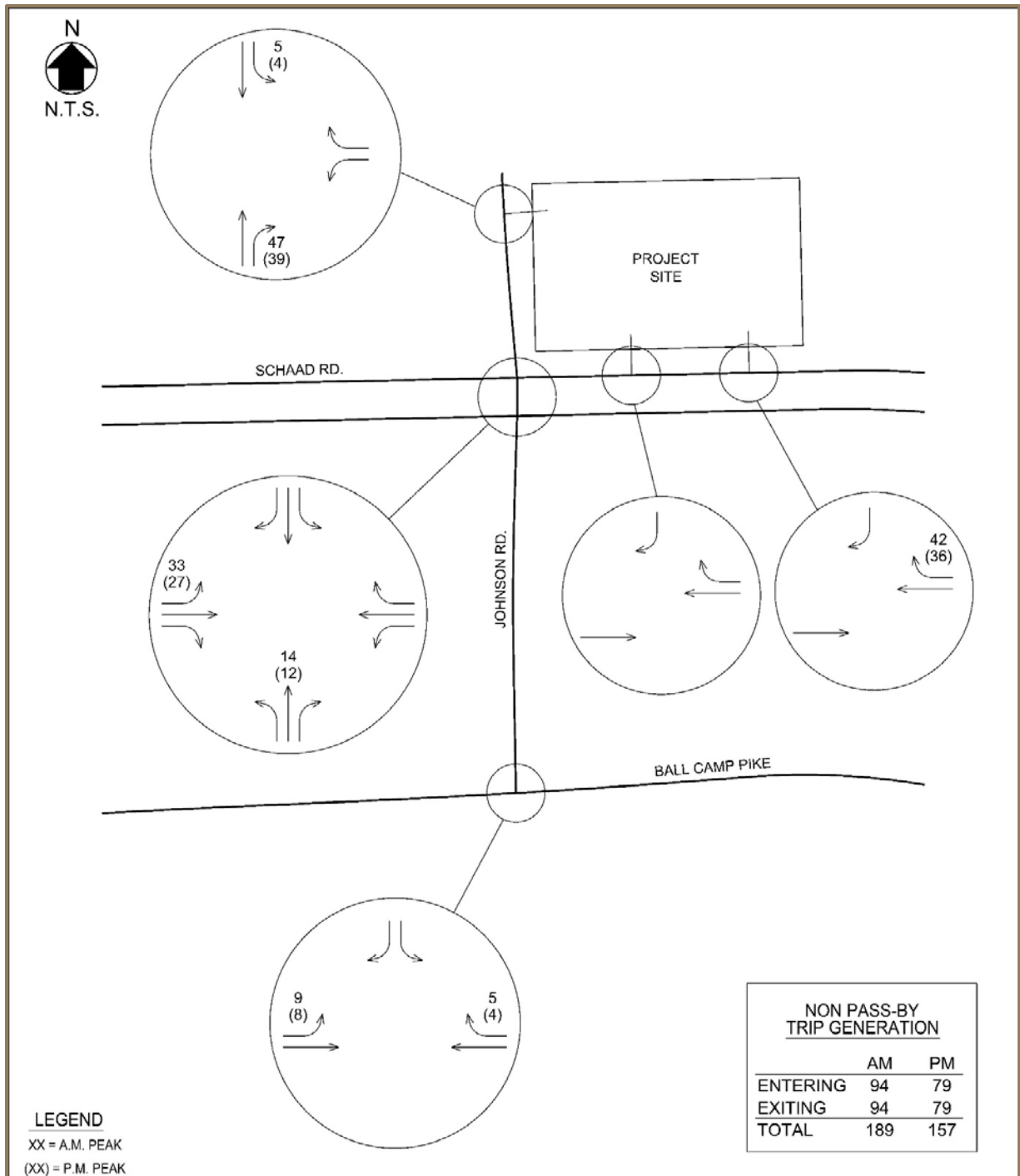


FIGURE C-2B
 TRIP ASSIGNMENT – NON-PASS-BY ENTERING WITH SCHAAD EXTENSION

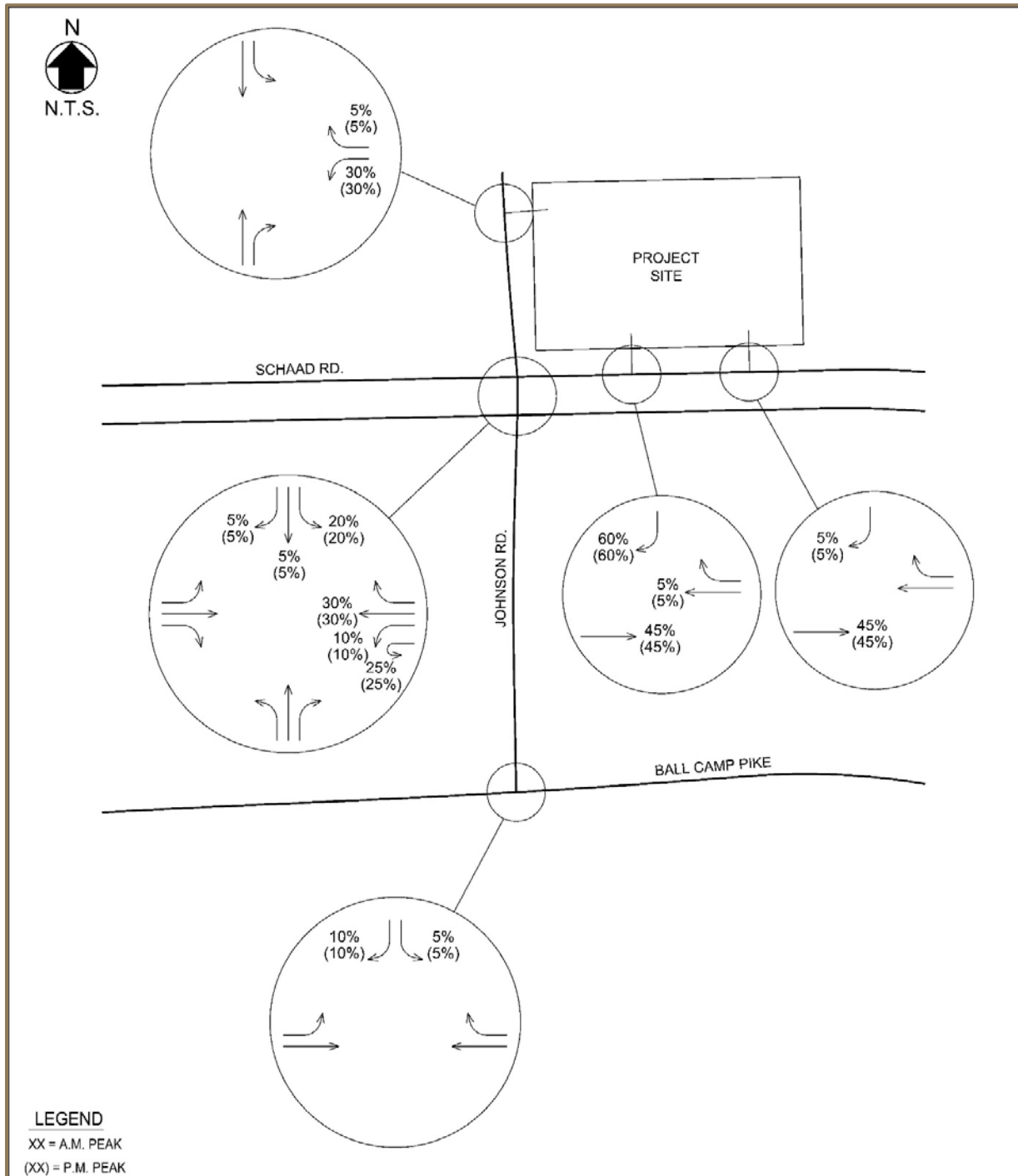


FIGURE C-2C
 TRIP DISTRIBUTION – NON-PASS-BY EXITING WITH SCHAAD EXTENSION

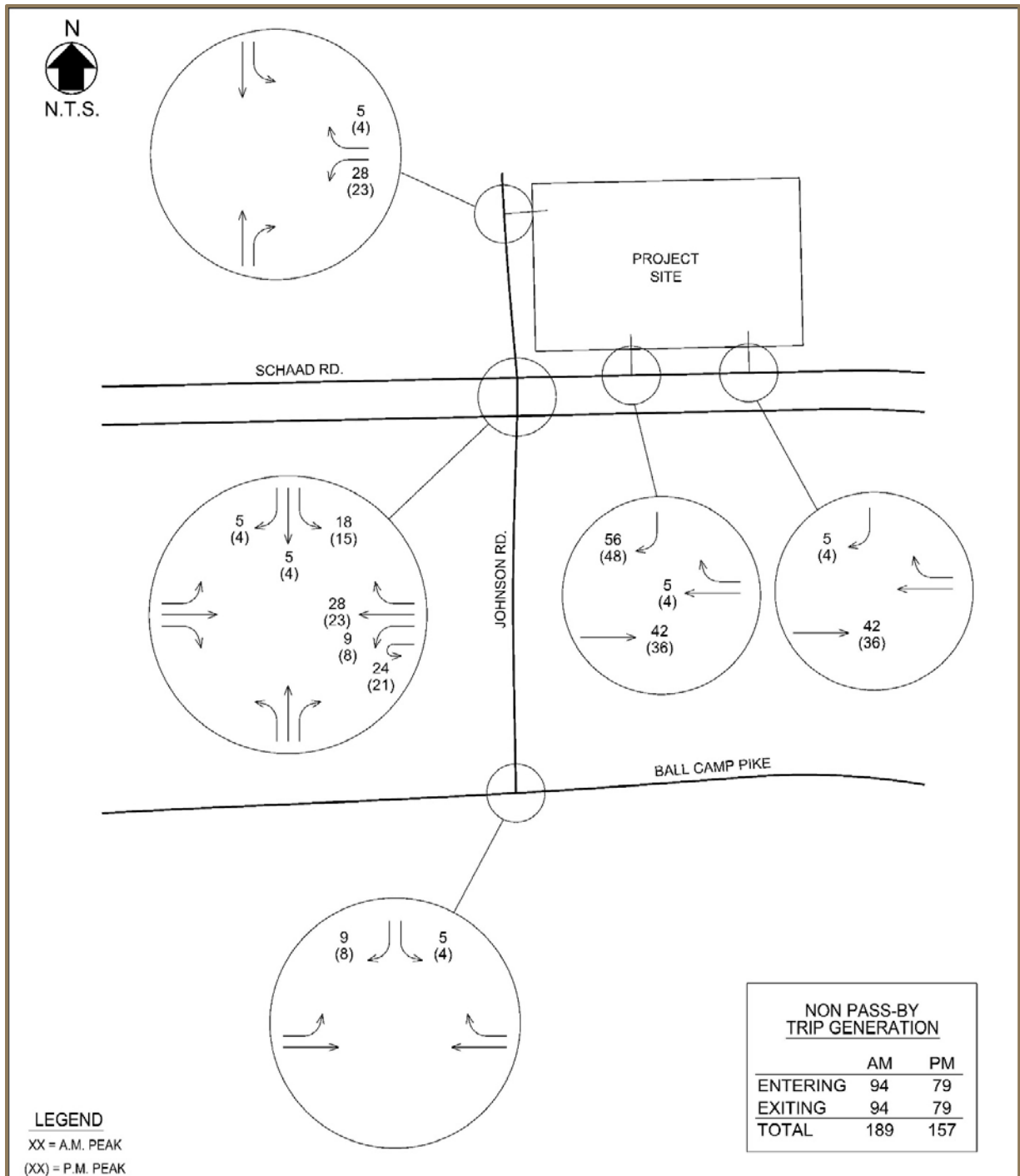


FIGURE C-2D
 TRIP ASSIGNMENT – NON-PASS-BY EXITING WITH SCHAAD EXTENSION

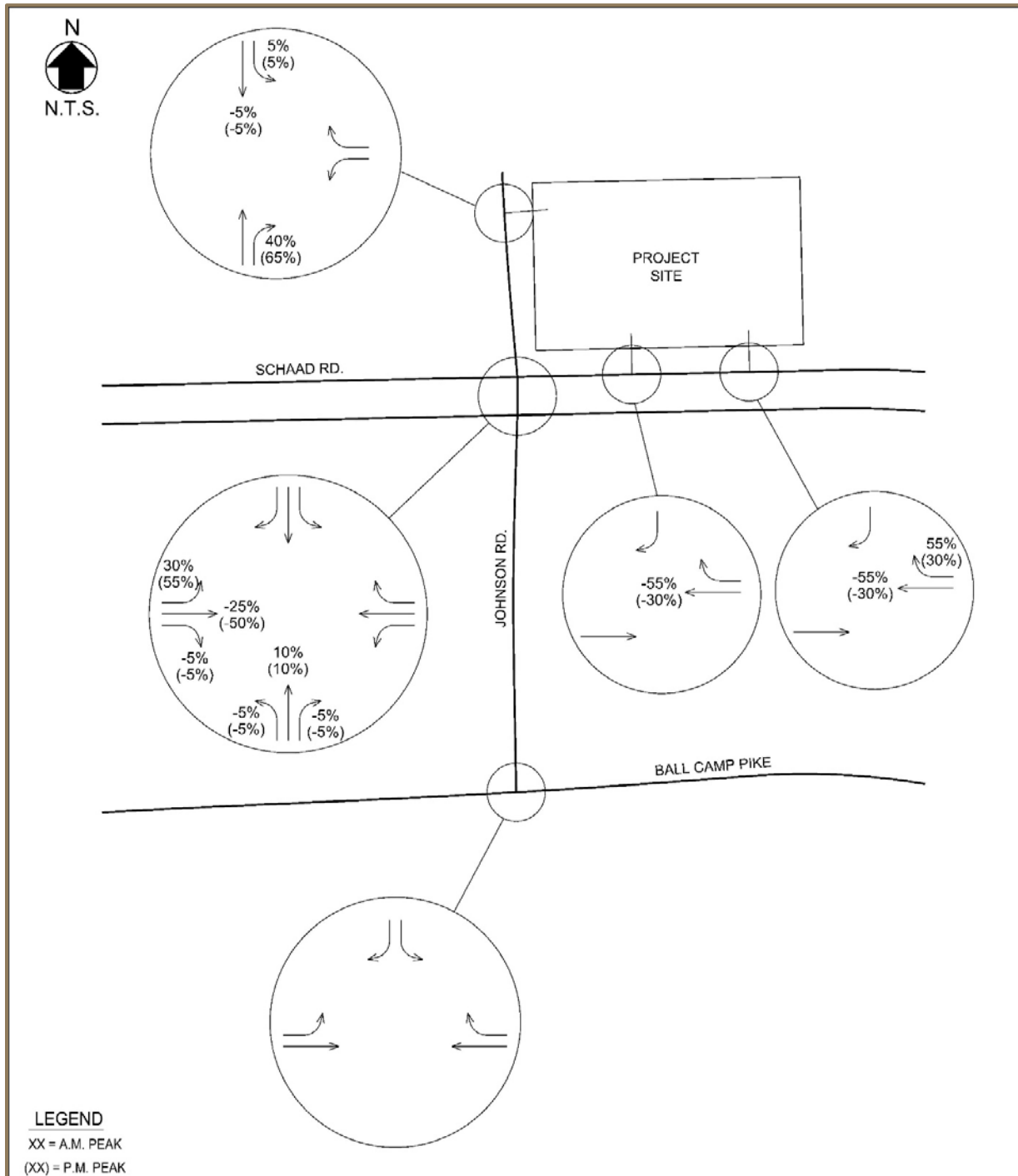


FIGURE C-2E
 TRIP DISTRIBUTION – PASS-BY ENTERING WITH SCHAAD EXTENSION

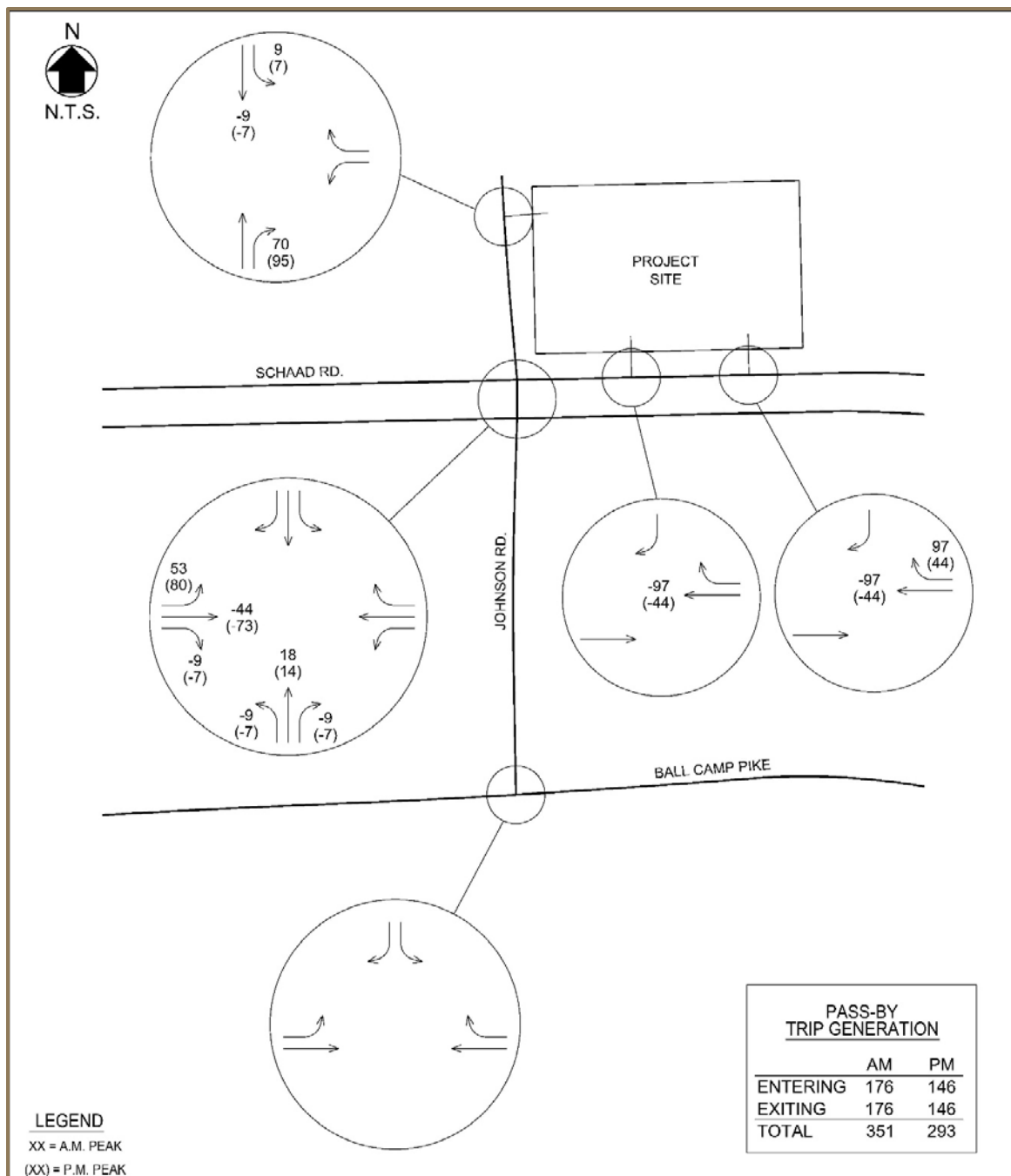


FIGURE C-2F
 TRIP ASSIGNMENT – PASS-BY ENTERING WITH SCHAAD EXTENSION

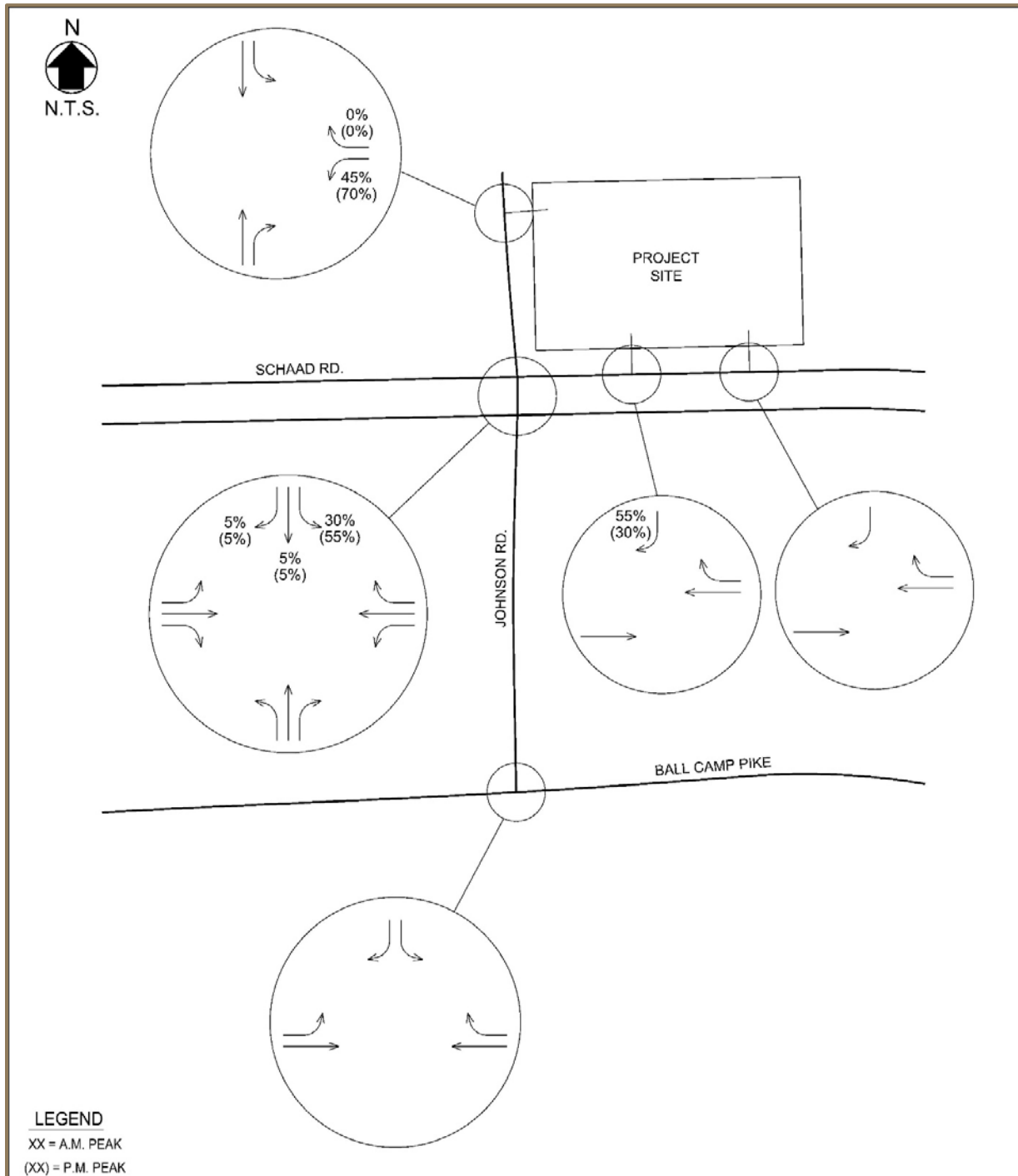


FIGURE C-2G
 TRIP DISTRIBUTION – PASS-BY EXITING WITH SCHAAD EXTENSION

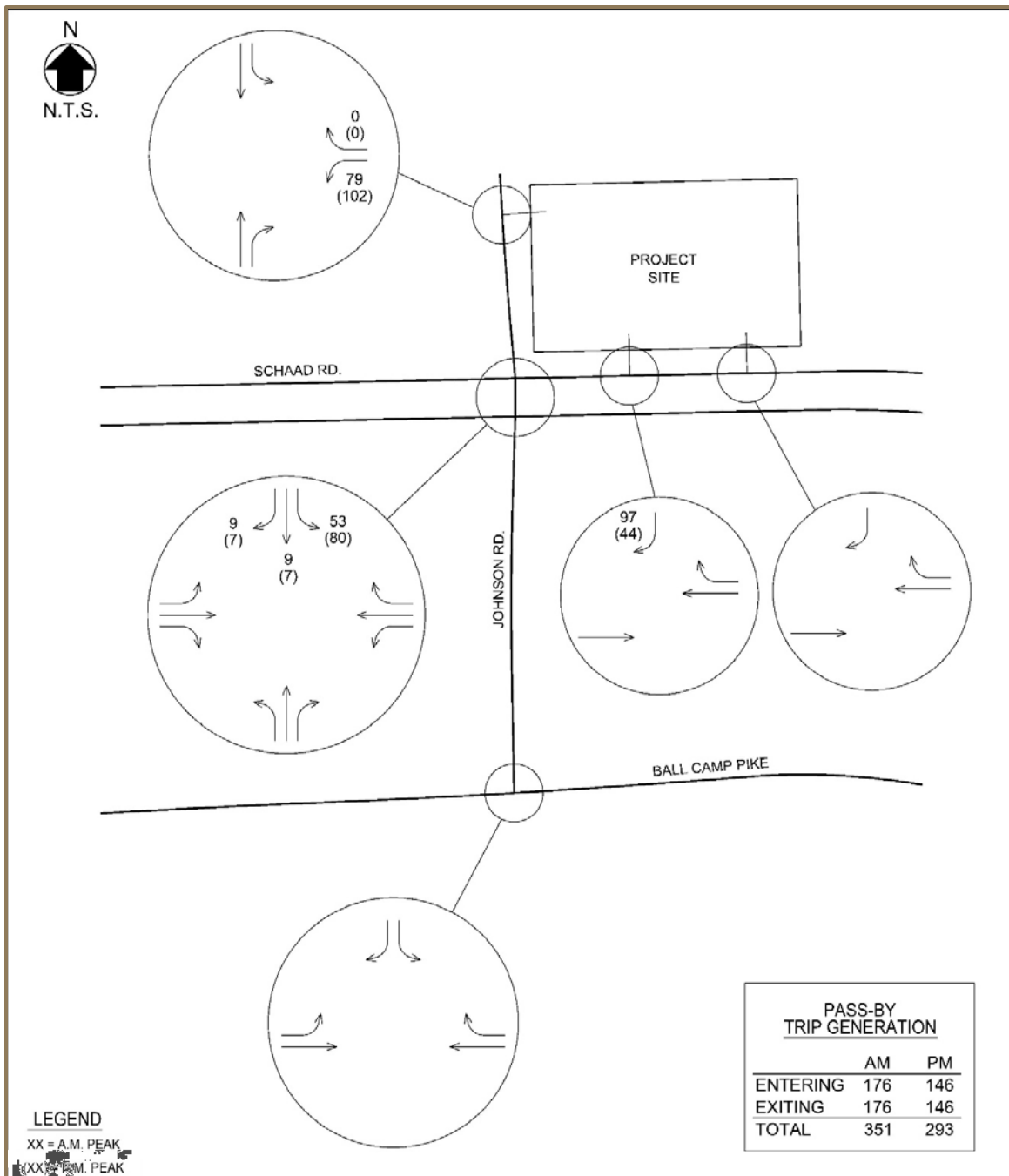


FIGURE C-2H
 TRIP ASSIGNMENT – PASS-BY EXITING WITH SCHAAD EXTENSION

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

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

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

LOS CRITERIA: SIGNALIZED & UNSIGNALIZED INTERSECTIONS

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

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

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

HCS7 Two-Way Stop-Control Report

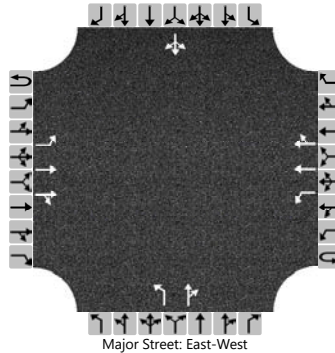
General Information

Analyst	TSN
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	9/23/2021
Analysis Year	2021
Time Analyzed	AM Peak
Intersection Orientation	East-West
Project Description	Existing 2021 AM

Site Information

Intersection	Johnson Rd at Schaad Rd
Jurisdiction	Knox County
East/West Street	Schaad Rd
North/South Street	Johnson Rd
Peak Hour Factor	0.67
Analysis Time Period (hrs)	0.25

Lanes



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	1	2	0	0	1	2	0		1	1	0		0	1	0
Configuration		L	T	TR		L	T	TR		L		TR			LTR	
Volume (veh/h)	2	40	238	156	1	25	222	2		174	31	68		5	38	55
Percent Heavy Vehicles (%)	3	3			3	3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized																
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)	6.4	4.1			6.4	4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)	6.46	4.16			6.46	4.16				7.56	6.56	6.96		7.56	6.56	6.96
Base Follow-Up Headway (sec)	2.5	2.2			2.5	2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)	2.53	2.23			2.53	2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

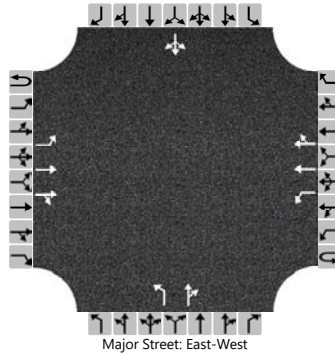
Flow Rate, v (veh/h)		63				39				260		148			146	
Capacity, c (veh/h)		1184				944				288		508			455	
v/c Ratio		0.05				0.04				0.90		0.29			0.32	
95% Queue Length, Q ₉₅ (veh)		0.2				0.1				8.3		1.2			1.4	
Control Delay (s/veh)		8.2				9.0				70.2		15.0			16.6	
Level of Service (LOS)		A				A				F		B			C	
Approach Delay (s/veh)	0.8				0.9				50.2				16.6			
Approach LOS									F				C			

HCS7 Two-Way Stop-Control Report

General Information

Analyst	TSN	Intersection	Johnson Rd at Schaad Rd
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	9/23/2021	East/West Street	Schaad Rd
Analysis Year	2021	North/South Street	Johnson Rd
Time Analyzed	PM Peak	Peak Hour Factor	0.83
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Existing 2021 PM		

Lanes



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	1	2	0	0	1	2	0		1	1	0		0	1	0
Configuration		L	T	TR		L	T	TR		L		TR			LTR	
Volume (veh/h)	0	8	28	19	0	74	37	22		25	58	304		5	28	6
Percent Heavy Vehicles (%)	3	3			3	3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized																
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.16				4.16				7.56	6.56	6.96		7.56	6.56	6.96
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.23				2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		10				89				30		436			47	
Capacity, c (veh/h)		1520				1539				594		917			577	
v/c Ratio		0.01				0.06				0.05		0.48			0.08	
95% Queue Length, Q ₉₅ (veh)		0.0				0.2				0.2		2.6			0.3	
Control Delay (s/veh)		7.4				7.5				11.4		12.4			11.8	
Level of Service (LOS)		A				A				B		B			B	
Approach Delay (s/veh)	1.1				4.2				12.4				11.8			
Approach LOS									B				B			

HCS7 Two-Way Stop-Control Report

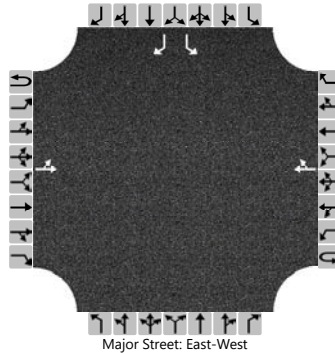
General Information

Analyst	TSN
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	9/23/2021
Analysis Year	2021
Time Analyzed	AM Peak
Intersection Orientation	East-West
Project Description	Existing 2021 AM

Site Information

Intersection	Johnson Rd at Ball Camp
Jurisdiction	Knox County
East/West Street	Ball Camp Pike
North/South Street	Johnson Rd
Peak Hour Factor	0.83
Analysis Time Period (hrs)	0.25

Lanes



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		1	0	1
Configuration		LT						TR						L		R
Volume (veh/h)		205	298				522	30						12		198
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized													No			
Median Type Storage	Undivided															

Critical and Follow-up Headways

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

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		247												14		239
Capacity, c (veh/h)		919												89		469
v/c Ratio		0.27												0.16		0.51
95% Queue Length, Q ₉₅ (veh)		1.1												0.6		2.8
Control Delay (s/veh)		10.3												53.3		20.3
Level of Service (LOS)		B												F		C
Approach Delay (s/veh)	6.3												22.2			
Approach LOS													C			

HCS7 Two-Way Stop-Control Report

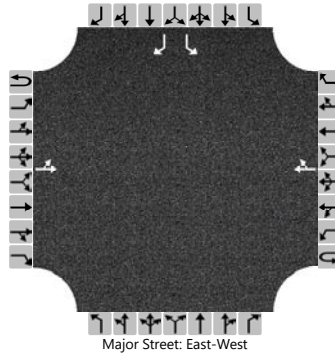
General Information

Analyst	TSN
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	9/23/2021
Analysis Year	2021
Time Analyzed	PM Peak
Intersection Orientation	East-West
Project Description	Existing 2021 PM

Site Information

Intersection	Johnson Rd at Ball Camp
Jurisdiction	Knox County
East/West Street	Ball Camp Pike
North/South Street	Johnson Rd
Peak Hour Factor	0.91
Analysis Time Period (hrs)	0.25

Lanes



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		1	0	1
Configuration		LT						TR						L		R
Volume (veh/h)		383	422				383	5						0		119
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized													No			
Median Type Storage	Undivided															

Critical and Follow-up Headways

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

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		421												0		131
Capacity, c (veh/h)		1128												48		628
v/c Ratio		0.37												0.00		0.21
95% Queue Length, Q ₉₅ (veh)		1.8												0.0		0.8
Control Delay (s/veh)		10.1												80.0		12.2
Level of Service (LOS)		B												F		B
Approach Delay (s/veh)	7.5												12.2			
Approach LOS													B			

HCS7 Two-Way Stop-Control Report

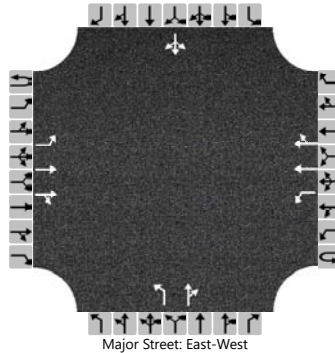
General Information

Analyst	BJH
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	10/12/2021
Analysis Year	2024
Time Analyzed	AM Peak
Intersection Orientation	East-West
Project Description	Background 2024 AM

Site Information

Intersection	Johnson Rd at Schaad Rd
Jurisdiction	Knox County
East/West Street	Schaad Rd
North/South Street	Johnson Rd
Peak Hour Factor	0.67
Analysis Time Period (hrs)	0.25

Lanes



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	1	2	0	0	1	2	0		1	1	0		0	1	0
Configuration		L	T	TR		L	T	TR		L		TR			LTR	
Volume (veh/h)	2	43	257	168	1	27	240	2		188	33	73		5	41	59
Percent Heavy Vehicles (%)	3	3			3	3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized																
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)	6.4	4.1			6.4	4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)	6.46	4.16			6.46	4.16				7.56	6.56	6.96		7.56	6.56	6.96
Base Follow-Up Headway (sec)	2.5	2.2			2.5	2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)	2.53	2.23			2.53	2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		67				42				281		158			157	
Capacity, c (veh/h)		1157				906				261		482			426	
v/c Ratio		0.06				0.05				1.07		0.33			0.37	
95% Queue Length, Q ₉₅ (veh)		0.2				0.1				11.5		1.4			1.7	
Control Delay (s/veh)		8.3				9.2				118.9		16.1			18.3	
Level of Service (LOS)		A				A				F		C			C	
Approach Delay (s/veh)	0.8				1.0				81.8				18.3			
Approach LOS									F				C			

HCS7 Two-Way Stop-Control Report

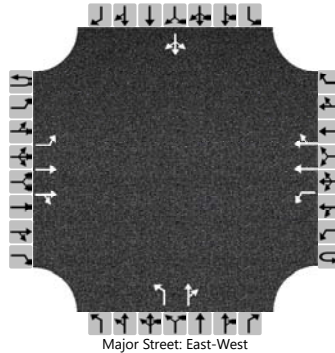
General Information

Analyst	BJH
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	10/12/2021
Analysis Year	2024
Time Analyzed	PM Peak
Intersection Orientation	East-West
Project Description	Background 2024 PM

Site Information

Intersection	Johnson Rd at Schaad Rd
Jurisdiction	Knox County
East/West Street	Schaad Rd
North/South Street	Johnson Rd
Peak Hour Factor	0.83
Analysis Time Period (hrs)	0.25

Lanes



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	1	2	0	0	1	2	0		1	1	0		0	1	0
Configuration		L	T	TR		L	T	TR		L		TR			LTR	
Volume (veh/h)	0	9	30	21	0	80	40	24		27	63	328		5	30	6
Percent Heavy Vehicles (%)	3	3			3	3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized																
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.16				4.16				7.56	6.56	6.96		7.56	6.56	6.96
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.23				2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		11				96				33		471			49	
Capacity, c (veh/h)		1512				1532				571		907			554	
v/c Ratio		0.01				0.06				0.06		0.52			0.09	
95% Queue Length, Q ₉₅ (veh)		0.0				0.2				0.2		3.1			0.3	
Control Delay (s/veh)		7.4				7.5				11.7		13.2			12.1	
Level of Service (LOS)		A				A				B		B			B	
Approach Delay (s/veh)	1.1				4.2				13.1				12.1			
Approach LOS									B				B			

HCS7 Two-Way Stop-Control Report

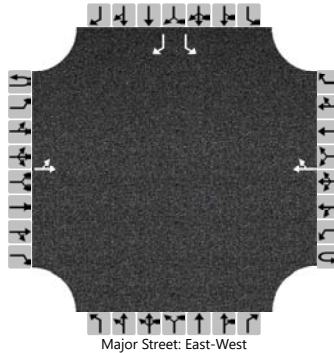
General Information

Analyst	BJH
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	10/12/2021
Analysis Year	2024
Time Analyzed	AM Peak
Intersection Orientation	East-West
Project Description	Background 2024 AM

Site Information

Intersection	Johnson Rd at Ball Camp
Jurisdiction	Knox County
East/West Street	Ball Camp Pike
North/South Street	Johnson Rd
Peak Hour Factor	0.83
Analysis Time Period (hrs)	0.25

Lanes



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		1	0	1
Configuration		LT						TR						L		R
Volume (veh/h)		221	322				564	32						13		214
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized													No			
Median Type Storage	Undivided															

Critical and Follow-up Headways

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

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		266												16		258
Capacity, c (veh/h)		878												69		438
v/c Ratio		0.30												0.23		0.59
95% Queue Length, Q ₉₅ (veh)		1.3												0.8		3.7
Control Delay (s/veh)		10.9												71.5		24.3
Level of Service (LOS)		B												F		C
Approach Delay (s/veh)	6.9												27.0			
Approach LOS													D			

HCS7 Two-Way Stop-Control Report

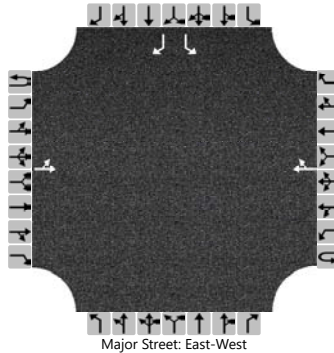
General Information

Analyst	BJH
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	10/12/2021
Analysis Year	2024
Time Analyzed	PM Peak
Intersection Orientation	East-West
Project Description	Background 2024 PM

Site Information

Intersection	Johnson Rd at Ball Camp
Jurisdiction	Knox County
East/West Street	Ball Camp Pike
North/South Street	Johnson Rd
Peak Hour Factor	0.91
Analysis Time Period (hrs)	0.25

Lanes



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		1	0	1
Configuration		LT						TR						L		R
Volume (veh/h)		414	456				414	5						0		129
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized													No			
Median Type Storage	Undivided															

Critical and Follow-up Headways

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

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		455												0		142
Capacity, c (veh/h)		1095												34		601
v/c Ratio		0.42												0.00		0.24
95% Queue Length, Q ₉₅ (veh)		2.1												0.0		0.9
Control Delay (s/veh)		10.6												112.3		12.8
Level of Service (LOS)		B												F		B
Approach Delay (s/veh)	8.2												12.8			
Approach LOS													B			

HCS7 Two-Way Stop-Control Report

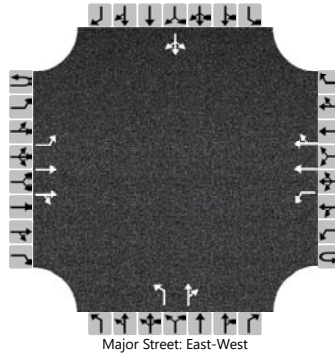
General Information

Analyst	BJH
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	10/12/2021
Analysis Year	2024
Time Analyzed	AM Peak
Intersection Orientation	East-West
Project Description	Background 2024 AM with Schaad Extension

Site Information

Intersection	Johnson Rd at Schaad Rd
Jurisdiction	Knox County
East/West Street	Schaad Rd
North/South Street	Johnson Rd
Peak Hour Factor	0.67
Analysis Time Period (hrs)	0.25

Lanes



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	1	2	0	0	1	2	0		1	1	0		0	1	0
Configuration		L	T	TR		L	T	TR		L		TR			LTR	
Volume (veh/h)	2	52	588	134	1	22	1092	2		150	26	58		5	33	71
Percent Heavy Vehicles (%)	3	3			3	3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized																
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)	6.4	4.1			6.4	4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)	6.46	4.16			6.46	4.16				7.56	6.56	6.96		7.56	6.56	6.96
Base Follow-Up Headway (sec)	2.5	2.2			2.5	2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)	2.53	2.23			2.53	2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		81				34				224		125				163
Capacity, c (veh/h)		344				594				30		117				140
v/c Ratio		0.23				0.06				7.52		1.07				1.17
95% Queue Length, Q ₉₅ (veh)		0.9				0.2				27.3		7.4				9.4
Control Delay (s/veh)		18.7				11.4				3191.7		174.8				190.0
Level of Service (LOS)		C				B				F		F				F
Approach Delay (s/veh)	1.3				0.2				2108.7				190.0			
Approach LOS									F				F			

HCS7 Two-Way Stop-Control Report

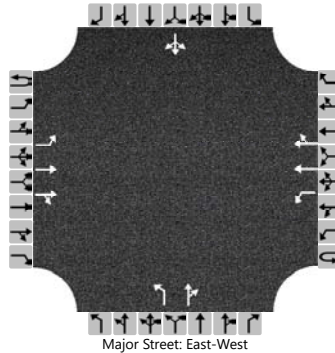
General Information

Analyst	BJH
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	10/12/2021
Analysis Year	2024
Time Analyzed	PM Peak
Intersection Orientation	East-West
Project Description	Background 2024 PM with Schaad Extension

Site Information

Intersection	Johnson Rd at Schaad Rd
Jurisdiction	Knox County
East/West Street	Schaad Rd
North/South Street	Johnson Rd
Peak Hour Factor	0.83
Analysis Time Period (hrs)	0.25

Lanes



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	1	2	0	0	1	2	0		1	1	0		0	1	0
Configuration		L	T	TR		L	T	TR		L		TR			LTR	
Volume (veh/h)	0	11	1092	17	0	64	588	24		22	50	262		5	24	7
Percent Heavy Vehicles (%)	3	3			3	3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized																
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.16				4.16				7.56	6.56	6.96		7.56	6.56	6.96
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.23				2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		13				77				27		376			43	
Capacity, c (veh/h)		858				507				110		296				
v/c Ratio		0.02				0.15				0.24		1.27				
95% Queue Length, Q ₉₅ (veh)		0.0				0.5				0.9		17.8				
Control Delay (s/veh)		9.3				13.4				47.9		180.4				
Level of Service (LOS)		A				B				E		F				
Approach Delay (s/veh)	0.1				1.3				171.7							
Approach LOS									F							

HCS7 Two-Way Stop-Control Report

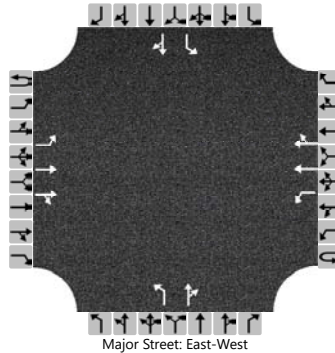
General Information

Analyst	BJH
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	10/12/2021
Analysis Year	2024
Time Analyzed	AM Peak
Intersection Orientation	East-West
Project Description	Background 2024 AM with Schaad Extension with SBL

Site Information

Intersection	Johnson Rd at Schaad Rd
Jurisdiction	Knox County
East/West Street	Schaad Rd
North/South Street	Johnson Rd
Peak Hour Factor	0.67
Analysis Time Period (hrs)	0.25

Lanes



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	1	2	0	0	1	2	0		1	1	0		1	1	0
Configuration		L	T	TR		L	T	TR		L		TR		L		TR
Volume (veh/h)	2	52	588	134	1	22	1092	2		150	26	58		5	33	71
Percent Heavy Vehicles (%)	3	3			3	3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized																
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)	6.4	4.1			6.4	4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)	6.46	4.16			6.46	4.16				7.56	6.56	6.96		7.56	6.56	6.96
Base Follow-Up Headway (sec)	2.5	2.2			2.5	2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)	2.53	2.23			2.53	2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

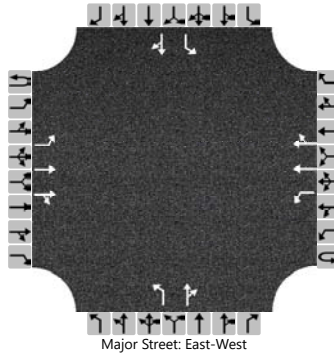
Flow Rate, v (veh/h)		81				34				224		125		7		155
Capacity, c (veh/h)		344				594				30		117		57		150
v/c Ratio		0.23				0.06				7.52		1.07		0.13		1.03
95% Queue Length, Q ₉₅ (veh)		0.9				0.2				27.3		7.4		0.4		7.9
Control Delay (s/veh)		18.7				11.4				3191.7		174.8		77.9		142.3
Level of Service (LOS)		C				B				F		F		F		F
Approach Delay (s/veh)	1.3				0.2				2108.7				139.4			
Approach LOS									F				F			

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Johnson Rd at Schaad Rd
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	10/12/2021	East/West Street	Schaad Rd
Analysis Year	2024	North/South Street	Johnson Rd
Time Analyzed	PM Peak	Peak Hour Factor	0.83
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Background 2024 PM with Schaad Extension with SBL		

Lanes



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	1	2	0	0	1	2	0		1	1	0		1	1	0
Configuration		L	T	TR		L	T	TR		L		TR		L		TR
Volume (veh/h)	0	11	1092	17	0	64	588	24		22	50	262		5	24	7
Percent Heavy Vehicles (%)	3	3			3	3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized																
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways




















Base Critical Headway (sec)		4.1				4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.16				4.16				7.56	6.56	6.96		7.56	6.56	6.96
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.23				2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		13				77				27		376		6		37
Capacity, c (veh/h)		858				507				110		296				120
v/c Ratio		0.02				0.15				0.24		1.27				0.31
95% Queue Length, Q ₉₅ (veh)		0.0				0.5				0.9		17.8				1.2
Control Delay (s/veh)		9.3				13.4				47.9		180.4				48.1
Level of Service (LOS)		A				B				E		F				E
Approach Delay (s/veh)	0.1				1.3				171.7							
Approach LOS									F							

Lanes, Volumes, Timings
1: Johnson Road & Schaad Road

E-Z Stop Food Mart TIS
2024 Background AM with Schaad Extension

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	52	588	134	22	1092	2	150	26	58	5	33	71
Future Volume (vph)	52	588	134	22	1092	2	150	26	58	5	33	71
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.972						0.896			0.922	
Flt Protected	0.950			0.950			0.950				0.997	
Satd. Flow (prot)	1770	3440	0	1770	3539	0	1770	1669	0	0	1712	0
Flt Permitted	0.094			0.211			0.682				0.982	
Satd. Flow (perm)	175	3440	0	393	3539	0	1270	1669	0	0	1687	0
Satd. Flow (RTOR)		49						87			77	
Peak Hour Factor	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.92
Shared Lane Traffic (%)												
Lane Group Flow (vph)	78	1078	0	33	1633	0	224	126	0	0	133	0
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6			8			4		
Detector Phase	5	2		1	6		8	8		4	4	
Switch Phase												
Minimum Initial (s)	6.0	15.0		6.0	15.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	12.0	21.0		12.0	21.0		14.0	14.0		14.0	14.0	
Total Split (s)	12.0	46.0		12.0	46.0		22.0	22.0		22.0	22.0	
Total Split (%)	15.0%	57.5%		15.0%	57.5%		27.5%	27.5%		27.5%	27.5%	
Maximum Green (s)	6.0	40.0		6.0	40.0		16.0	16.0		16.0	16.0	
Yellow Time (s)	4.0	4.5		4.0	4.5		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	1.5		2.0	1.5		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0			0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0			6.0	
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	Min		None	Min		None	None		None	None	
Act Effect Green (s)	44.8	42.5		42.5	38.0		15.6	15.6			15.6	
Actuated g/C Ratio	0.60	0.57		0.57	0.51		0.21	0.21			0.21	
v/c Ratio	0.33	0.55		0.10	0.91		0.85	0.30			0.32	
Control Delay	10.0	11.8		5.9	26.9		60.8	13.3			15.9	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0			0.0	
Total Delay	10.0	11.8		5.9	26.9		60.8	13.3			15.9	
LOS	A	B		A	C		E	B			B	
Approach Delay		11.7			26.5			43.7			15.9	
Approach LOS		B			C			D			B	
Queue Length 50th (ft)	12	118		5	376		110	16			23	
Queue Length 95th (ft)	19	156		10	285		#137	34			41	
Internal Link Dist (ft)		668			807			402			378	
Turn Bay Length (ft)	120			140			130					
Base Capacity (vph)	235	2106		336	1935		278	433			429	
Starvation Cap Reductn	0	0		0	0		0	0			0	
Spillback Cap Reductn	0	0		0	0		0	0			0	
Storage Cap Reductn	0	0		0	0		0	0			0	
Reduced v/c Ratio	0.33	0.51		0.10	0.84		0.81	0.29			0.31	

Timing Plan: AM Peak
Cannon & Cannon, Inc.

Synchro 10 Report
Page 1




















Intersection Summary	
Cycle Length: 80	
Actuated Cycle Length: 74.9	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.91	
Intersection Signal Delay: 22.7	Intersection LOS: C
Intersection Capacity Utilization 65.2%	ICU Level of Service C
Analysis Period (min) 15	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 1: Johnson Road & Schaad Road

 12 s	 46 s	 22 s
 12 s	 46 s	 22 s

Lanes, Volumes, Timings
1: Johnson Road & Schaad Road

E-Z Stop Food Mart TIS
2024 Background PM with Schaad Extension


												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	11	1092	17	64	588	24	22	50	262	5	24	7
Future Volume (vph)	11	1092	17	64	588	24	22	50	262	5	24	7
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.998			0.994			0.874			0.975	
Flt Protected	0.950			0.950			0.950				0.993	
Satd. Flow (prot)	1770	3532	0	1770	3518	0	1770	1628	0	0	1803	0
Flt Permitted	0.372			0.142			0.729				0.531	
Satd. Flow (perm)	693	3532	0	265	3518	0	1358	1628	0	0	964	0
Satd. Flow (RTOR)		3			8			223			8	
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Shared Lane Traffic (%)												
Lane Group Flow (vph)	13	1336	0	77	737	0	27	376	0	0	43	0
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6			8			4		
Detector Phase	5	2		1	6		8	8		4	4	
Switch Phase												
Minimum Initial (s)	6.0	15.0		6.0	15.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	12.0	21.0		12.0	21.0		14.0	14.0		14.0	14.0	
Total Split (s)	12.0	31.0		12.0	31.0		17.0	17.0		17.0	17.0	
Total Split (%)	20.0%	51.7%		20.0%	51.7%		28.3%	28.3%		28.3%	28.3%	
Maximum Green (s)	6.0	25.0		6.0	25.0		11.0	11.0		11.0	11.0	
Yellow Time (s)	4.0	4.5		4.0	4.5		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	1.5		2.0	1.5		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0			0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0			6.0	
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	Min		None	Min		None	None		None	None	
Act Effect Green (s)	27.0	23.9		29.1	28.1		10.0	10.0			10.0	
Actuated g/C Ratio	0.51	0.45		0.55	0.53		0.19	0.19			0.19	
v/c Ratio	0.03	0.83		0.24	0.39		0.10	0.77			0.23	
Control Delay	4.9	20.8		6.8	8.6		21.6	22.8			21.4	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0			0.0	
Total Delay	4.9	20.8		6.8	8.6		21.6	22.8			21.4	
LOS	A	C		A	A		C	C			C	
Approach Delay		20.6			8.5			22.7			21.4	
Approach LOS		C			A			C			C	
Queue Length 50th (ft)	2	227		10	57		8	50			11	
Queue Length 95th (ft)	6	#283		20	126		24	#141			32	
Internal Link Dist (ft)		668			807			402			378	
Turn Bay Length (ft)	120			140			130					
Base Capacity (vph)	482	1740		324	2016		293	527			215	
Starvation Cap Reductn	0	0		0	0		0	0			0	
Spillback Cap Reductn	0	0		0	0		0	0			0	
Storage Cap Reductn	0	0		0	0		0	0			0	
Reduced v/c Ratio	0.03	0.77		0.24	0.37		0.09	0.71			0.20	

Timing Plan: PM Peak
Cannon & Cannon, Inc.

Synchro 10 Report
Page 1

Intersection Summary	
Cycle Length: 60	
Actuated Cycle Length: 52.6	
Natural Cycle: 60	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.83	
Intersection Signal Delay: 17.2	Intersection LOS: B
Intersection Capacity Utilization 69.5%	ICU Level of Service C
Analysis Period (min) 15	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	





















Splits and Phases: 1: Johnson Road & Schaad Road

 12 s	 31 s	 17 s
 12 s	 31 s	 17 s

Lanes, Volumes, Timings

1: Johnson Road & Schaad Road

E-Z Stop Food Mart TIS
2024 Background with Schaad Extension AM SBL Lane

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	52	588	134	22	1092	2	150	26	58	5	33	71
Future Volume (vph)	52	588	134	22	1092	2	150	26	58	5	33	71
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.972						0.896			0.908	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3440	0	1770	3539	0	1770	1669	0	1770	1691	0
Flt Permitted	0.094			0.211			0.676			0.676		
Satd. Flow (perm)	175	3440	0	393	3539	0	1259	1669	0	1259	1691	0
Satd. Flow (RTOR)		49						87			77	
Peak Hour Factor	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.92
Shared Lane Traffic (%)												
Lane Group Flow (vph)	78	1078	0	33	1633	0	224	126	0	7	126	0
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6			8			4		
Detector Phase	5	2		1	6		8	8		4	4	
Switch Phase												
Minimum Initial (s)	6.0	15.0		6.0	15.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	12.0	21.0		12.0	21.0		14.0	14.0		14.0	14.0	
Total Split (s)	12.0	46.0		12.0	46.0		22.0	22.0		22.0	22.0	
Total Split (%)	15.0%	57.5%		15.0%	57.5%		27.5%	27.5%		27.5%	27.5%	
Maximum Green (s)	6.0	40.0		6.0	40.0		16.0	16.0		16.0	16.0	
Yellow Time (s)	4.0	4.5		4.0	4.5		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	1.5		2.0	1.5		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	Min		None	Min		None	None		None	None	
Act Effect Green (s)	44.8	42.5		42.5	38.0		15.6	15.6		15.6	15.6	
Actuated g/C Ratio	0.60	0.57		0.57	0.51		0.21	0.21		0.21	0.21	
v/c Ratio	0.33	0.55		0.10	0.91		0.86	0.30		0.03	0.31	
Control Delay	10.0	11.8		5.9	26.9		62.4	13.3		26.2	15.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	10.0	11.8		5.9	26.9		62.4	13.3		26.2	15.1	
LOS	A	B		A	C		E	B		C	B	
Approach Delay		11.7			26.5			44.7			15.7	
Approach LOS		B			C			D			B	
Queue Length 50th (ft)	12	118		5	376		110	16		3	20	
Queue Length 95th (ft)	19	156		10	285		#143	34		10	39	
Internal Link Dist (ft)		668			807			402			378	
Turn Bay Length (ft)	120			140			130			150		
Base Capacity (vph)	235	2106		336	1935		275	433		275	429	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.33	0.51		0.10	0.84		0.81	0.29		0.03	0.29	

Timing Plan: AM Peak
Cannon & Cannon, Inc.

Synchro 10 Report
Page 1

Intersection Summary	
Cycle Length: 80	
Actuated Cycle Length: 74.9	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.91	
Intersection Signal Delay: 22.8	Intersection LOS: C
Intersection Capacity Utilization 65.2%	ICU Level of Service C
Analysis Period (min) 15	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

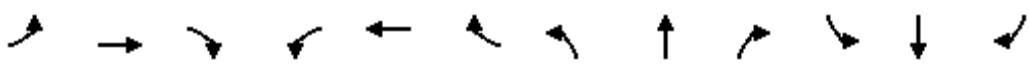








Splits and Phases: 1: Johnson Road & Schaad Road

 12 s	 46 s	 22 s
 12 s	 46 s	 22 s

Lanes, Volumes, Timings

1: Johnson Road & Schaad Road

E-Z Stop Food Mart TIS
2024 Background with Schaad Extension PM SBL Lane

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	11	1092	17	64	588	24	22	50	262	5	24	7
Future Volume (vph)	11	1092	17	64	588	24	22	50	262	5	24	7
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.998			0.994			0.874			0.968	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3532	0	1770	3518	0	1770	1628	0	1770	1803	0
Flt Permitted	0.372			0.150			0.733			0.488		
Satd. Flow (perm)	693	3532	0	279	3518	0	1365	1628	0	909	1803	0
Satd. Flow (RTOR)		3			9			237			8	
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Shared Lane Traffic (%)												
Lane Group Flow (vph)	13	1336	0	77	737	0	27	376	0	6	37	0
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6			8			4		
Detector Phase	5	2		1	6		8	8		4	4	
Switch Phase												
Minimum Initial (s)	6.0	15.0		6.0	15.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	12.0	21.0		12.0	21.0		14.0	14.0		14.0	14.0	
Total Split (s)	12.0	29.0		12.0	29.0		14.0	14.0		14.0	14.0	
Total Split (%)	21.8%	52.7%		21.8%	52.7%		25.5%	25.5%		25.5%	25.5%	
Maximum Green (s)	6.0	23.0		6.0	23.0		8.0	8.0		8.0	8.0	
Yellow Time (s)	4.0	4.5		4.0	4.5		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	1.5		2.0	1.5		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	Min		None	Min		None	None		None	None	
Act Effect Green (s)	25.6	22.4		27.7	26.7		8.2	8.2		8.2	8.2	
Actuated g/C Ratio	0.52	0.45		0.56	0.54		0.17	0.17		0.17	0.17	
v/c Ratio	0.03	0.83		0.23	0.39		0.12	0.80		0.04	0.12	
Control Delay	4.2	19.8		5.9	7.8		22.0	26.0		21.0	18.5	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	4.2	19.8		5.9	7.8		22.0	26.0		21.0	18.5	
LOS	A	B		A	A		C	C		C	B	
Approach Delay		19.7			7.7			25.7			18.8	
Approach LOS		B			A			C			B	
Queue Length 50th (ft)	1	204		8	46		8	43		2	8	
Queue Length 95th (ft)	5	#263		17	115		24	#142		10	27	
Internal Link Dist (ft)		668			807			402			378	
Turn Bay Length (ft)	120			140			130			150		
Base Capacity (vph)	493	1688		342	1992		226	468		151	306	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.03	0.79		0.23	0.37		0.12	0.80		0.04	0.12	

Timing Plan: PM Peak
Cannon & Cannon, Inc.

Synchro 10 Report
Page 1

Intersection Summary	
Cycle Length: 55	
Actuated Cycle Length: 49.3	
Natural Cycle: 55	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.83	
Intersection Signal Delay: 16.9	Intersection LOS: B
Intersection Capacity Utilization 69.5%	ICU Level of Service C
Analysis Period (min) 15	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 1: Johnson Road & Schaad Road

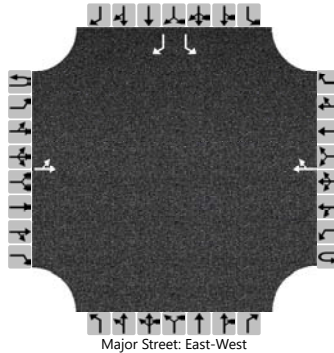
 12 s	 29 s	 14 s
 12 s	 29 s	 14 s

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Johnson Rd at Ball Camp
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	10/12/2021	East/West Street	Ball Camp Pike
Analysis Year	2024	North/South Street	Johnson Rd
Time Analyzed	AM Peak	Peak Hour Factor	0.83
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Background 2024 AM with Schaad Extension		

Lanes



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		1	0	1
Configuration		LT						TR						L		R
Volume (veh/h)		177	258				451	26						10		171
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized													No			
Median Type Storage	Undivided															

Critical and Follow-up Headways

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

Delay, Queue Length, and Level of Service

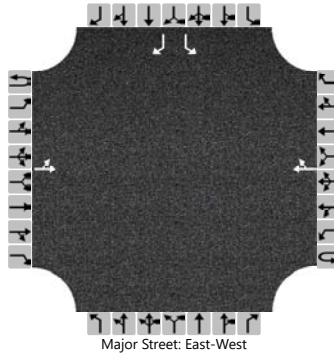
Flow Rate, v (veh/h)		213												12		206
Capacity, c (veh/h)		993												132		527
v/c Ratio		0.21												0.09		0.39
95% Queue Length, Q ₉₅ (veh)		0.8												0.3		1.8
Control Delay (s/veh)		9.6												35.1		16.2
Level of Service (LOS)		A												E		C
Approach Delay (s/veh)	5.4												17.2			
Approach LOS													C			

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Johnson Rd at Ball Camp
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	10/12/2021	East/West Street	Ball Camp Pike
Analysis Year	2024	North/South Street	Johnson Rd
Time Analyzed	PM Peak	Peak Hour Factor	0.91
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Background 2024 PM with Schaad Extension		

Lanes



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		1	0	1
Configuration		LT						TR						L		R
Volume (veh/h)		331	365				331	4						0		103
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized													No			
Median Type Storage	Undivided															

Critical and Follow-up Headways

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

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		364												0		113
Capacity, c (veh/h)		1185												82		677
v/c Ratio		0.31												0.00		0.17
95% Queue Length, Q ₉₅ (veh)		1.3												0.0		0.6
Control Delay (s/veh)		9.4												49.2		11.4
Level of Service (LOS)		A												E		B
Approach Delay (s/veh)	6.4												11.4			
Approach LOS													B			

HCS7 Two-Way Stop-Control Report

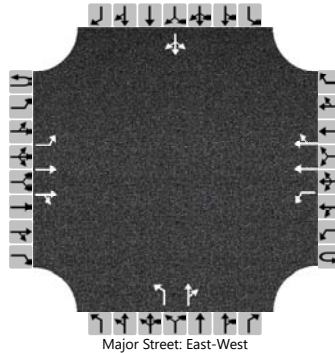
General Information

Analyst	BJH
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	12/01/2021
Analysis Year	2024
Time Analyzed	AM Peak
Intersection Orientation	East-West
Project Description	Combined 2024 AM

Site Information

Intersection	Johnson Rd at Schaad Rd
Jurisdiction	Knox County
East/West Street	Schaad Rd
North/South Street	Johnson Rd
Peak Hour Factor	0.67
Analysis Time Period (hrs)	0.25

Lanes



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	1	2	0	0	1	2	0		1	1	0		0	1	0
Configuration		L	T	TR		L	T	TR		L		TR			LTR	
Volume (veh/h)	2	83	240	150	24	50	245	2		162	105	55		58	64	85
Percent Heavy Vehicles (%)	3	3			3	3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized																
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)	6.4	4.1			6.4	4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)	6.46	4.16			6.46	4.16				7.56	6.56	6.96		7.56	6.56	6.96
Base Follow-Up Headway (sec)	2.5	2.2			2.5	2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)	2.53	2.23			2.53	2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		127				110				242		239			309	
Capacity, c (veh/h)		1161				775				133		270			198	
v/c Ratio		0.11				0.14				1.82		0.88			1.56	
95% Queue Length, Q ₉₅ (veh)		0.4				0.5				18.5		7.7			19.7	
Control Delay (s/veh)		8.5				10.4				455.2		69.7			317.3	
Level of Service (LOS)		A				B				F		F			F	
Approach Delay (s/veh)	1.5				2.4				263.6				317.3			
Approach LOS									F				F			

HCS7 Two-Way Stop-Control Report

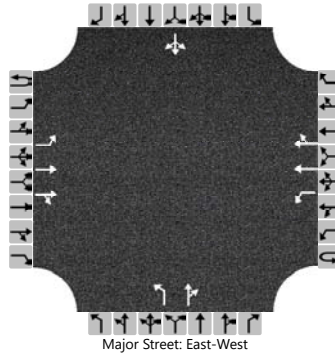
General Information

Analyst	BJH
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	12/01/2021
Analysis Year	2024
Time Analyzed	PM Peak
Intersection Orientation	East-West
Project Description	Combined 2024 PM

Site Information

Intersection	Johnson Rd at Schaad Rd
Jurisdiction	Knox County
East/West Street	Schaad Rd
North/South Street	Johnson Rd
Peak Hour Factor	0.83
Analysis Time Period (hrs)	0.25

Lanes



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	1	2	0	0	1	2	0		1	1	0		0	1	0
Configuration		L	T	TR		L	T	TR		L		TR			LTR	
Volume (veh/h)	0	27	23	14	21	99	48	24		20	173	248		107	41	13
Percent Heavy Vehicles (%)	3	3			3	3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized																
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1			6.4	4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.16			6.46	4.16				7.56	6.56	6.96		7.56	6.56	6.96
Base Follow-Up Headway (sec)		2.2			2.5	2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.23			2.53	2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		33				145				24		507			194	
Capacity, c (veh/h)		1500				1400				432		682			281	
v/c Ratio		0.02				0.10				0.06		0.74			0.69	
95% Queue Length, Q ₉₅ (veh)		0.1				0.3				0.2		6.7			4.7	
Control Delay (s/veh)		7.5				7.9				13.8		24.0			42.0	
Level of Service (LOS)		A				A				B		C			E	
Approach Delay (s/veh)	3.1				4.9				23.5				42.0			
Approach LOS									C				E			

HCS7 Two-Way Stop-Control Report

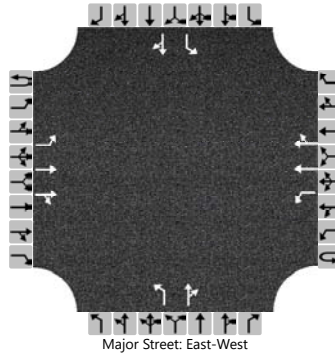
General Information

Analyst	BJH
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	12/01/2021
Analysis Year	2024
Time Analyzed	AM Peak
Intersection Orientation	East-West
Project Description	Combined 2024 AM with SBL

Site Information

Intersection	Johnson Rd at Schaad Rd
Jurisdiction	Knox County
East/West Street	Schaad Rd
North/South Street	Johnson Rd
Peak Hour Factor	0.67
Analysis Time Period (hrs)	0.25

Lanes



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	1	2	0	0	1	2	0		1	1	0		1	1	0
Configuration		L	T	TR		L	T	TR		L		TR		L		TR
Volume (veh/h)	2	83	240	150	24	50	245	2		162	105	55		58	64	85
Percent Heavy Vehicles (%)	3	3			3	3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized																
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)	6.4	4.1			6.4	4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)	6.46	4.16			6.46	4.16				7.56	6.56	6.96		7.56	6.56	6.96
Base Follow-Up Headway (sec)	2.5	2.2			2.5	2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)	2.53	2.23			2.53	2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		127				110				242		239		87		222
Capacity, c (veh/h)		1161				775				133		270		101		318
v/c Ratio		0.11				0.14				1.82		0.88		0.86		0.70
95% Queue Length, Q ₉₅ (veh)		0.4				0.5				18.5		7.7		4.9		5.0
Control Delay (s/veh)		8.5				10.4				455.2		69.7		130.1		39.0
Level of Service (LOS)		A				B				F		F		F		E
Approach Delay (s/veh)	1.5				2.4				263.6				64.5			
Approach LOS									F				F			

HCS7 Two-Way Stop-Control Report

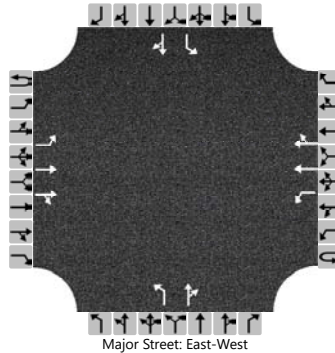
General Information

Analyst	BJH
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	12/04/2021
Analysis Year	2024
Time Analyzed	PM Peak
Intersection Orientation	East-West
Project Description	Combined 2024 PM with SBL

Site Information

Intersection	Johnson Rd at Schaad Rd
Jurisdiction	Knox County
East/West Street	Schaad Rd
North/South Street	Johnson Rd
Peak Hour Factor	0.83
Analysis Time Period (hrs)	0.25

Lanes



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	1	2	0	0	1	2	0		1	1	0		1	1	0
Configuration		L	T	TR		L	T	TR		L		TR		L		TR
Volume (veh/h)	0	27	23	14	21	99	48	24		20	173	248		107	41	13
Percent Heavy Vehicles (%)	3	3			3	3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized																
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways




















Base Critical Headway (sec)		4.1			6.4	4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.16			6.46	4.16				7.56	6.56	6.96		7.56	6.56	6.96
Base Follow-Up Headway (sec)		2.2			2.5	2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.23			2.53	2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		33				145				24		507		129		65
Capacity, c (veh/h)		1500				1400				432		682		227		533
v/c Ratio		0.02				0.10				0.06		0.74		0.57		0.12
95% Queue Length, Q ₉₅ (veh)		0.1				0.3				0.2		6.7		3.1		0.4
Control Delay (s/veh)		7.5				7.9				13.8		24.0		39.8		12.7
Level of Service (LOS)		A				A				B		C		E		B
Approach Delay (s/veh)	3.1				4.9				23.5				30.7			
Approach LOS									C				D			

Lanes, Volumes, Timings
1: Johnson Road & Schaad Road

E-Z Stop Food Mart TIS
2024 Combined AM

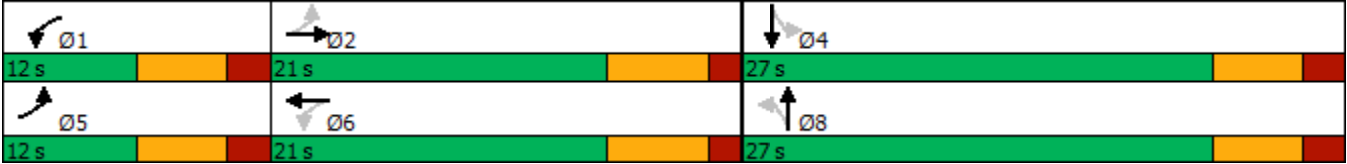
												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	85	240	150	74	245	2	162	105	55	58	64	85
Future Volume (vph)	85	240	150	74	245	2	162	105	55	58	64	85
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.942			0.999			0.949			0.955	
Flt Protected	0.950			0.950			0.950				0.984	
Satd. Flow (prot)	1770	3334	0	1770	3536	0	1770	1768	0	0	1750	0
Flt Permitted	0.532			0.381			0.591				0.805	
Satd. Flow (perm)	991	3334	0	710	3536	0	1101	1768	0	0	1432	0
Satd. Flow (RTOR)		219			1			48			46	
Peak Hour Factor	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.92
Shared Lane Traffic (%)												
Lane Group Flow (vph)	127	582	0	110	369	0	242	239	0	0	275	0
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6			8			4		
Detector Phase	5	2		1	6		8	8		4	4	
Switch Phase												
Minimum Initial (s)	6.0	15.0		6.0	15.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	12.0	21.0		12.0	21.0		14.0	14.0		14.0	14.0	
Total Split (s)	12.0	21.0		12.0	21.0		27.0	27.0		27.0	27.0	
Total Split (%)	20.0%	35.0%		20.0%	35.0%		45.0%	45.0%		45.0%	45.0%	
Maximum Green (s)	6.0	15.0		6.0	15.0		21.0	21.0		21.0	21.0	
Yellow Time (s)	4.0	4.5		4.0	4.5		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	1.5		2.0	1.5		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0			0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0			6.0	
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	Min		None	Min		None	None		None	None	
Act Effect Green (s)	20.0	15.6		20.0	15.6		16.0	16.0			16.0	
Actuated g/C Ratio	0.38	0.29		0.38	0.29		0.30	0.30			0.30	
v/c Ratio	0.27	0.51		0.28	0.35		0.73	0.42			0.59	
Control Delay	11.3	13.0		11.6	18.3		31.2	14.4			19.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0			0.0	
Total Delay	11.3	13.0		11.6	18.3		31.2	14.4			19.1	
LOS	B	B		B	B		C	B			B	
Approach Delay		12.7			16.8			22.8			19.1	
Approach LOS		B			B			C			B	
Queue Length 50th (ft)	23	54		20	54		71	49			63	
Queue Length 95th (ft)	38	60		34	66		92	65			81	
Internal Link Dist (ft)		668			807			402			378	
Turn Bay Length (ft)	120			140			130					
Base Capacity (vph)	466	1136		393	1042		453	757			617	
Starvation Cap Reductn	0	0		0	0		0	0			0	
Spillback Cap Reductn	0	0		0	0		0	0			0	
Storage Cap Reductn	0	0		0	0		0	0			0	
Reduced v/c Ratio	0.27	0.51		0.28	0.35		0.53	0.32			0.45	

Timing Plan: AM Peak
Cannon & Cannon, Inc.

Synchro 10 Report
Page 1


Intersection Summary	
Cycle Length: 60	
Actuated Cycle Length: 53	
Natural Cycle: 60	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.73	
Intersection Signal Delay: 17.1	Intersection LOS: B
Intersection Capacity Utilization 58.2%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 1: Johnson Road & Schaad Road



Lanes, Volumes, Timings
1: Johnson Road & Schaad Road

E-Z Stop Food Mart TIS
2024 Combined PM







												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	27	23	14	120	48	24	20	173	248	107	41	13
Future Volume (vph)	27	23	14	120	48	24	20	173	248	107	41	13
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.943			0.950			0.912			0.989	
Flt Protected	0.950			0.950			0.950				0.968	
Satd. Flow (prot)	1770	3337	0	1770	3362	0	1770	1699	0	0	1783	0
Flt Permitted	0.698			0.641			0.672				0.290	
Satd. Flow (perm)	1300	3337	0	1194	3362	0	1252	1699	0	0	534	0
Satd. Flow (RTOR)		17			29			133			8	
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Shared Lane Traffic (%)												
Lane Group Flow (vph)	33	45	0	145	87	0	24	507	0	0	194	0
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6			8			4		
Detector Phase	5	2		1	6		8	8		4	4	
Switch Phase												
Minimum Initial (s)	6.0	15.0		6.0	15.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	12.0	21.0		12.0	21.0		14.0	14.0		14.0	14.0	
Total Split (s)	12.0	21.0		12.0	21.0		27.0	27.0		27.0	27.0	
Total Split (%)	20.0%	35.0%		20.0%	35.0%		45.0%	45.0%		45.0%	45.0%	
Maximum Green (s)	6.0	15.0		6.0	15.0		21.0	21.0		21.0	21.0	
Yellow Time (s)	4.0	4.5		4.0	4.5		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	1.5		2.0	1.5		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0			0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0			6.0	
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	Min		None	Min		None	None		None	None	
Act Effect Green (s)	19.7	15.1		22.0	19.7		21.2	21.2			21.2	
Actuated g/C Ratio	0.34	0.26		0.38	0.34		0.37	0.37			0.37	
v/c Ratio	0.07	0.05		0.28	0.07		0.05	0.72			0.97	
Control Delay	10.0	12.6		11.8	11.6		13.4	19.5			81.2	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0			0.0	
Total Delay	10.0	12.6		11.8	11.6		13.4	19.5			81.2	
LOS	A	B		B	B		B	B			F	
Approach Delay		11.5			11.7			19.3			81.2	
Approach LOS		B			B			B			F	
Queue Length 50th (ft)	6	4		30	5		6	115			~68	
Queue Length 95th (ft)	17	13		54	21		17	188			#166	
Internal Link Dist (ft)		668			807			402			378	
Turn Bay Length (ft)	120			140			130					
Base Capacity (vph)	495	888		517	1170		460	708			201	
Starvation Cap Reductn	0	0		0	0		0	0			0	
Spillback Cap Reductn	0	0		0	0		0	0			0	
Storage Cap Reductn	0	0		0	0		0	0			0	
Reduced v/c Ratio	0.07	0.05		0.28	0.07		0.05	0.72			0.97	

Timing Plan: PM Peak
Cannon & Cannon, Inc.

Synchro 10 Report
Page 1





















Intersection Summary	
Cycle Length: 60	
Actuated Cycle Length: 57.6	
Natural Cycle: 60	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.97	
Intersection Signal Delay: 28.6	Intersection LOS: C
Intersection Capacity Utilization 61.5%	ICU Level of Service B
Analysis Period (min) 15	
~ Volume exceeds capacity, queue is theoretically infinite.	
Queue shown is maximum after two cycles.	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 1: Johnson Road & Schaad Road

 Ø1 12 s	 Ø2 21 s	 Ø4 27 s
 Ø5 12 s	 Ø6 21 s	 Ø8 27 s

Lanes, Volumes, Timings
1: Johnson Road & Schaad Road

E-Z Stop Food Mart TIS
2024 Combined AM SBL Lane

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	85	240	150	74	245	2	162	105	55	58	64	85
Future Volume (vph)	85	240	150	74	245	2	162	105	55	58	64	85
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.942			0.999			0.949			0.927	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3334	0	1770	3536	0	1770	1768	0	1770	1727	0
Flt Permitted	0.532			0.392			0.639			0.610		
Satd. Flow (perm)	991	3334	0	730	3536	0	1190	1768	0	1136	1727	0
Satd. Flow (RTOR)		224			1			48			88	
Peak Hour Factor	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.92
Shared Lane Traffic (%)												
Lane Group Flow (vph)	127	582	0	110	369	0	242	239	0	87	188	0
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6			8			4		
Detector Phase	5	2		1	6		8	8		4	4	
Switch Phase												
Minimum Initial (s)	6.0	15.0		6.0	15.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	12.0	21.0		12.0	21.0		14.0	14.0		14.0	14.0	
Total Split (s)	12.0	21.0		12.0	21.0		22.0	22.0		22.0	22.0	
Total Split (%)	21.8%	38.2%		21.8%	38.2%		40.0%	40.0%		40.0%	40.0%	
Maximum Green (s)	6.0	15.0		6.0	15.0		16.0	16.0		16.0	16.0	
Yellow Time (s)	4.0	4.5		4.0	4.5		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	1.5		2.0	1.5		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	Min		None	Min		None	None		None	None	
Act Effect Green (s)	19.9	15.4		19.9	15.4		13.8	13.8		13.8	13.8	
Actuated g/C Ratio	0.39	0.30		0.39	0.30		0.27	0.27		0.27	0.27	
v/c Ratio	0.26	0.50		0.27	0.34		0.75	0.46		0.28	0.35	
Control Delay	9.5	11.5		9.7	16.5		34.5	16.0		18.0	11.0	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	9.5	11.5		9.7	16.5		34.5	16.0		18.0	11.0	
LOS	A	B		A	B		C	B		B	B	
Approach Delay		11.2			14.9			25.3			13.2	
Approach LOS		B			B			C			B	
Queue Length 50th (ft)	21	50		18	51		70	49		22	24	
Queue Length 95th (ft)	32	53		28	58		93	67		37	41	
Internal Link Dist (ft)		668			807			402			378	
Turn Bay Length (ft)	120			140			130			150		
Base Capacity (vph)	486	1175		415	1082		388	609		370	622	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.26	0.50		0.27	0.34		0.62	0.39		0.24	0.30	

Timing Plan: AM Peak
Cannon & Cannon, Inc.

Synchro 10 Report
Page 1





















Intersection Summary	
Cycle Length: 55	
Actuated Cycle Length: 50.5	
Natural Cycle: 55	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.75	
Intersection Signal Delay: 15.9	Intersection LOS: B
Intersection Capacity Utilization 55.1%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 1: Johnson Road & Schaad Road

 12 s	 21 s	 22 s
 12 s	 21 s	 22 s

Lanes, Volumes, Timings
1: Johnson Road & Schaad Road

E-Z Stop Food Mart TIS
2024 Combined PM SBL Lane







												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	27	23	14	120	48	24	20	173	248	107	41	13
Future Volume (vph)	27	23	14	120	48	24	20	173	248	107	41	13
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.943			0.950			0.912			0.963	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3337	0	1770	3362	0	1770	1699	0	1770	1794	0
Flt Permitted	0.698			0.647			0.715			0.227		
Satd. Flow (perm)	1300	3337	0	1205	3362	0	1332	1699	0	423	1794	0
Satd. Flow (RTOR)		17			29			133			16	
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Shared Lane Traffic (%)												
Lane Group Flow (vph)	33	45	0	145	87	0	24	507	0	129	65	0
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6			8			4		
Detector Phase	5	2		1	6		8	8		4	4	
Switch Phase												
Minimum Initial (s)	6.0	15.0		6.0	15.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	12.0	21.0		12.0	21.0		14.0	14.0		14.0	14.0	
Total Split (s)	12.0	21.0		12.0	21.0		27.0	27.0		27.0	27.0	
Total Split (%)	20.0%	35.0%		20.0%	35.0%		45.0%	45.0%		45.0%	45.0%	
Maximum Green (s)	6.0	15.0		6.0	15.0		21.0	21.0		21.0	21.0	
Yellow Time (s)	4.0	4.5		4.0	4.5		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	1.5		2.0	1.5		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	Min		None	Min		None	None		None	None	
Act Effect Green (s)	20.0	15.6		22.3	20.1		17.6	17.6		17.6	17.6	
Actuated g/C Ratio	0.37	0.29		0.41	0.37		0.32	0.32		0.32	0.32	
v/c Ratio	0.06	0.05		0.26	0.07		0.06	0.79		0.95	0.11	
Control Delay	9.9	12.6		11.4	11.5		13.4	23.5		90.4	11.3	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	9.9	12.6		11.4	11.5		13.4	23.5		90.4	11.3	
LOS	A	B		B	B		B	C		F	B	
Approach Delay		11.4			11.4			23.0			63.9	
Approach LOS		B			B			C			E	
Queue Length 50th (ft)	6	4		30	5		6	115		43	12	
Queue Length 95th (ft)	17	13		54	21		17	188		#119	30	
Internal Link Dist (ft)		668			807			402			378	
Turn Bay Length (ft)	120			140			130			150		
Base Capacity (vph)	531	965		556	1256		532	759		169	727	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.06	0.05		0.26	0.07		0.05	0.67		0.76	0.09	

Timing Plan: PM Peak
Cannon & Cannon, Inc.

Synchro 10 Report
Page 1

Intersection Summary	
Cycle Length: 60	
Actuated Cycle Length: 54.5	
Natural Cycle: 60	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.95	
Intersection Signal Delay: 27.2	Intersection LOS: C
Intersection Capacity Utilization 59.3%	ICU Level of Service B
Analysis Period (min) 15	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 1: Johnson Road & Schaad Road

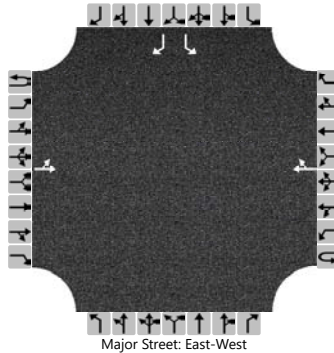
 Ø1	 Ø2	 Ø4
12 s	21 s	27 s
 Ø5	 Ø6	 Ø8
12 s	21 s	27 s

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Johnson Rd at Ball Camp
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	12/01/2021	East/West Street	Ball Camp Pike
Analysis Year	2024	North/South Street	Johnson Rd
Time Analyzed	AM Peak	Peak Hour Factor	0.83
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Combined 2024 AM		

Lanes



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		1	0	1
Configuration		LT						TR						L		R
Volume (veh/h)		244	322				564	37						18		237
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized													No			
Median Type Storage	Undivided															

Critical and Follow-up Headways

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

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		294												22		286
Capacity, c (veh/h)		874												59		437
v/c Ratio		0.34												0.37		0.65
95% Queue Length, Q ₉₅ (veh)		1.5												1.3		4.6
Control Delay (s/veh)		11.2												97.1		27.5
Level of Service (LOS)		B												F		D
Approach Delay (s/veh)	7.6												32.4			
Approach LOS													D			

HCS7 Two-Way Stop-Control Report

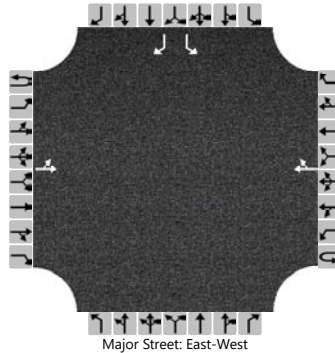
General Information

Analyst	BJH
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	12/01/2021
Analysis Year	2024
Time Analyzed	PM Peak
Intersection Orientation	East-West
Project Description	Combined 2024 PM

Site Information

Intersection	Johnson Rd at Ball Camp
Jurisdiction	Knox County
East/West Street	Ball Camp Pike
North/South Street	Johnson Rd
Peak Hour Factor	0.91
Analysis Time Period (hrs)	0.25

Lanes



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		1	0	1
Configuration		LT						TR						L		R
Volume (veh/h)		433	456				414	9						4		148
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized													No			
Median Type Storage	Undivided															

Critical and Follow-up Headways

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

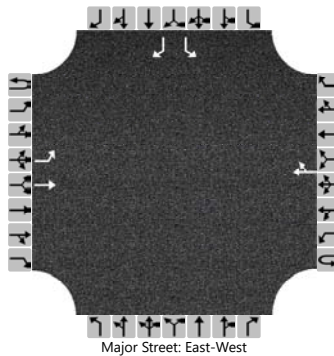
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		476												4		163
Capacity, c (veh/h)		1091												29		599
v/c Ratio		0.44												0.15		0.27
95% Queue Length, Q ₉₅ (veh)		2.3												0.5		1.1
Control Delay (s/veh)		10.8												148.1		13.2
Level of Service (LOS)		B												F		B
Approach Delay (s/veh)	8.6												16.8			
Approach LOS													C			

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	BJH	Intersection	Johnson Rd at Ball Camp
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	12/10/2021	East/West Street	Ball Camp Pike
Analysis Year	2024	North/South Street	Johnson Rd
Time Analyzed	AM Peak	Peak Hour Factor	0.83
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Combined 2024 AM with EBL		

Lanes



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	1	1	0	0	0	1	0		0	0	0		1	0	1
Configuration		L	T					TR						L		R
Volume (veh/h)		244	322				564	37						18		237
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized													No			
Median Type Storage	Undivided															

Critical and Follow-up Headways

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

Delay, Queue Length, and Level of Service

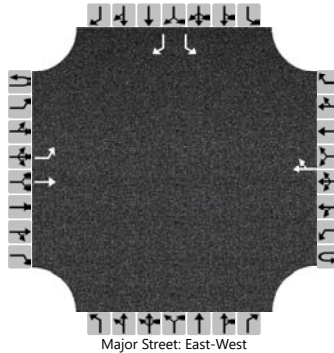
Flow Rate, v (veh/h)		294												22		286
Capacity, c (veh/h)		874												69		437
v/c Ratio		0.34												0.31		0.65
95% Queue Length, Q ₉₅ (veh)		1.5												1.2		4.6
Control Delay (s/veh)		11.2												79.6		27.5
Level of Service (LOS)		B												F		D
Approach Delay (s/veh)	4.8												31.2			
Approach LOS													D			

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Johnson Rd at Ball Camp
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	12/01/2021	East/West Street	Ball Camp Pike
Analysis Year	2024	North/South Street	Johnson Rd
Time Analyzed	PM Peak	Peak Hour Factor	0.91
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Combined 2024 PM with EBL		

Lanes



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	1	1	0	0	0	1	0		0	0	0		1	0	1
Configuration		L	T					TR						L		R
Volume (veh/h)		433	456				414	9						4		148
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized													No			
Median Type Storage	Undivided															

Critical and Follow-up Headways

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

Delay, Queue Length, and Level of Service

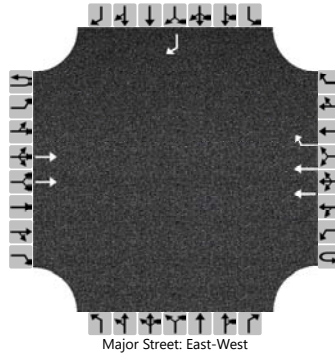
Flow Rate, v (veh/h)		476												4		163
Capacity, c (veh/h)		1091												42		599
v/c Ratio		0.44												0.11		0.27
95% Queue Length, Q ₉₅ (veh)		2.3												0.3		1.1
Control Delay (s/veh)		10.8												100.9		13.2
Level of Service (LOS)		B												F		B
Approach Delay (s/veh)	5.3												15.5			
Approach LOS													C			

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Schaad at Eastern Access
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	12/01/2021	East/West Street	Schaad Road
Analysis Year	2024	North/South Street	Eastern RIRO Driveay
Time Analyzed	AM Peak	Peak Hour Factor	0.67
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Combined 2024 AM		

Lanes



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	2	0	0	0	2	1		0	0	0		0	0	1
Configuration			T				T	R								R
Volume (veh/h)			377				208	103								5
Percent Heavy Vehicles (%)																3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized					No								No			
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)																6.9
Critical Headway (sec)																6.96
Base Follow-Up Headway (sec)																3.3
Follow-Up Headway (sec)																3.33

Delay, Queue Length, and Level of Service

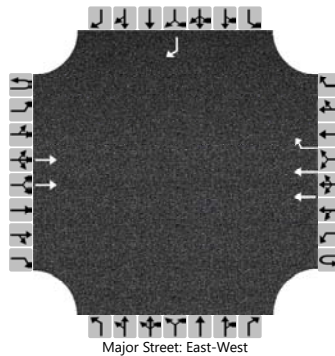
Flow Rate, v (veh/h)																7
Capacity, c (veh/h)																860
v/c Ratio																0.01
95% Queue Length, Q ₉₅ (veh)																0.0
Control Delay (s/veh)																9.2
Level of Service (LOS)																A
Approach Delay (s/veh)													9.2			
Approach LOS													A			

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Schaad at Eastern Access
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	12/01/2021	East/West Street	Schaad Road
Analysis Year	2024	North/South Street	Eastern RIRO Driveay
Time Analyzed	PM Peak	Peak Hour Factor	0.83
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Combined 2024 PM		

Lanes



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	2	0	0	0	2	1		0	0	0		0	0	1
Configuration			T				T	R								R
Volume (veh/h)			399				122	58								4
Percent Heavy Vehicles (%)																3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized					No								No			
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)																6.9
Critical Headway (sec)																6.96
Base Follow-Up Headway (sec)																3.3
Follow-Up Headway (sec)																3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)																5
Capacity, c (veh/h)																970
v/c Ratio																0.00
95% Queue Length, Q ₉₅ (veh)																0.0
Control Delay (s/veh)																8.7
Level of Service (LOS)																A
Approach Delay (s/veh)													8.7			
Approach LOS													A			

HCS7 Two-Way Stop-Control Report

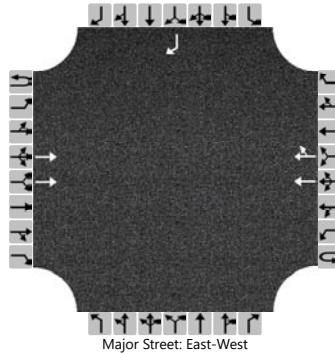
General Information

Analyst	BJH
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	12/01/2021
Analysis Year	2024
Time Analyzed	AM Peak
Intersection Orientation	East-West
Project Description	Combined 2024 AM

Site Information

Intersection	Schaad at Western Access
Jurisdiction	Knox County
East/West Street	Schaad Road
North/South Street	Western RIRO Driveway
Peak Hour Factor	0.67
Analysis Time Period (hrs)	0.25

Lanes



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	2	0	0	0	2	0		0	0	0		0	0	1
Configuration			T				T	TR								R
Volume (veh/h)			377				213	0								108
Percent Heavy Vehicles (%)																3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized													No			
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)																6.9
Critical Headway (sec)																6.96
Base Follow-Up Headway (sec)																3.3
Follow-Up Headway (sec)																3.33

Delay, Queue Length, and Level of Service

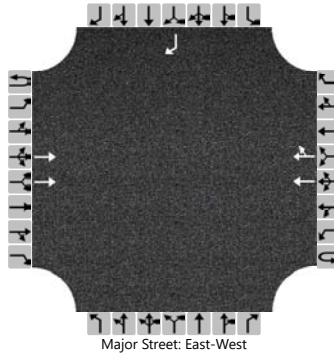
Flow Rate, v (veh/h)																161
Capacity, c (veh/h)																855
v/c Ratio																0.19
95% Queue Length, Q ₉₅ (veh)																0.7
Control Delay (s/veh)																10.2
Level of Service (LOS)																B
Approach Delay (s/veh)													10.2			
Approach LOS													B			

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Schaad at Western Access
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	12/01/2021	East/West Street	Schaad Road
Analysis Year	2024	North/South Street	Western RIRO Driveway
Time Analyzed	PM Peak	Peak Hour Factor	0.83
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Combined 2024 PM		

Lanes



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	2	0	0	0	2	0		0	0	0		0	0	1
Configuration			T				T	TR								R
Volume (veh/h)			399				126	0								62
Percent Heavy Vehicles (%)																3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized													No			
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)																6.9
Critical Headway (sec)																6.96
Base Follow-Up Headway (sec)																3.3
Follow-Up Headway (sec)																3.33

Delay, Queue Length, and Level of Service

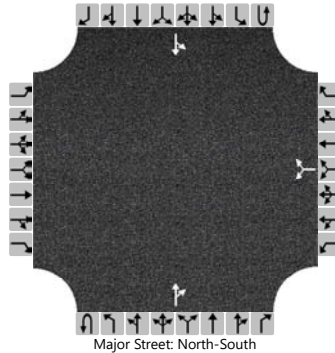
Flow Rate, v (veh/h)																75
Capacity, c (veh/h)																967
v/c Ratio																0.08
95% Queue Length, Q ₉₅ (veh)																0.3
Control Delay (s/veh)																9.0
Level of Service (LOS)																A
Approach Delay (s/veh)													9.0			
Approach LOS													A			

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Johnson at Full Access
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	12/01/2021	East/West Street	Full Access Driveway
Analysis Year	2024	North/South Street	Johnson Road
Time Analyzed	AM Peak	Peak Hour Factor	0.67
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Combined 2024 AM		

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LR					TR		LT		
Volume (veh/h)						129		28			69	130		37	87	
Percent Heavy Vehicles (%)						3		3						3		
Proportion Time Blocked																
Percent Grade (%)					0											
Right Turn Channelized																
Median Type Storage	Undivided															

Critical and Follow-up Headways

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

Delay, Queue Length, and Level of Service

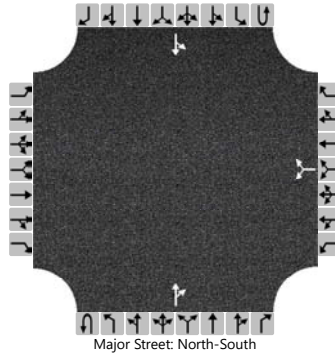
Flow Rate, v (veh/h)						234								55		
Capacity, c (veh/h)						582								1259		
v/c Ratio						0.40								0.04		
95% Queue Length, Q ₉₅ (veh)						1.9								0.1		
Control Delay (s/veh)						15.3								8.0		
Level of Service (LOS)						C								A		
Approach Delay (s/veh)					15.3								2.6			
Approach LOS					C											

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Johnson at Full Access
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	12/01/2021	East/West Street	Full Access Driveway
Analysis Year	2024	North/South Street	Johnson Road
Time Analyzed	PM Peak	Peak Hour Factor	0.83
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Combined 2024 PM		

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LR					TR		LT		
Volume (veh/h)						143		16			96	144		23	34	
Percent Heavy Vehicles (%)						3		3						3		
Proportion Time Blocked																
Percent Grade (%)					0											
Right Turn Channelized																
Median Type Storage	Undivided															

Critical and Follow-up Headways

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

Delay, Queue Length, and Level of Service

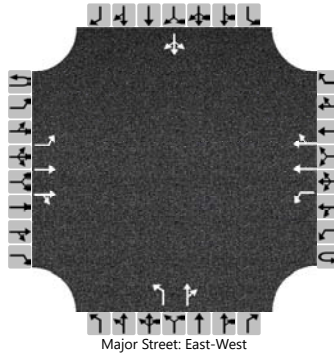
Flow Rate, v (veh/h)						192								28		
Capacity, c (veh/h)						688								1267		
v/c Ratio						0.28								0.02		
95% Queue Length, Q ₉₅ (veh)						1.1								0.1		
Control Delay (s/veh)						12.2								7.9		
Level of Service (LOS)						B								A		
Approach Delay (s/veh)					12.2								3.3			
Approach LOS					B											

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Johnson Rd at Schaad Rd
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	12/01/2021	East/West Street	Schaad Rd
Analysis Year	2024	North/South Street	Johnson Rd
Time Analyzed	AM Peak	Peak Hour Factor	0.67
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Combined 2024 AM with Schaad Extension		

Lanes



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	1	2	0	0	1	2	0		1	1	0		0	1	0
Configuration		L	T	TR		L	T	TR		L		TR			LTR	
Volume (veh/h)	2	138	544	125	24	31	1120	2		141	58	49		76	47	85
Percent Heavy Vehicles (%)	3	3			3	3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized																
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)	6.4	4.1			6.4	4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)	6.46	4.16			6.46	4.16				7.56	6.56	6.96		7.56	6.56	6.96
Base Follow-Up Headway (sec)	2.5	2.2			2.5	2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)	2.53	2.23			2.53	2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

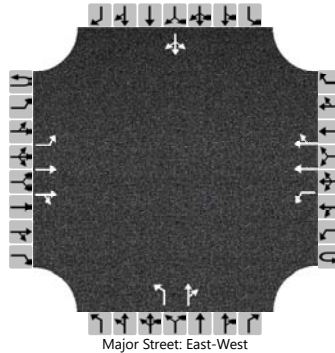
Flow Rate, v (veh/h)		209			82				210		160			310		
Capacity, c (veh/h)		353			422						409					
v/c Ratio		0.59			0.19						0.39					
95% Queue Length, Q ₉₅ (veh)		3.6			0.7						1.8					
Control Delay (s/veh)		29.0			15.6						19.3					
Level of Service (LOS)		D			C						C					
Approach Delay (s/veh)	5.0				0.7											
Approach LOS																

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Johnson Rd at Schaad Rd
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	12/01/2021	East/West Street	Schaad Rd
Analysis Year	2024	North/South Street	Johnson Rd
Time Analyzed	PM Peak	Peak Hour Factor	0.83
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Combined 2024 PM with Schaad Extension		

Lanes



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	1	2	0	0	1	2	0		1	1	0		0	1	0
Configuration		L	T	TR		L	T	TR		L		TR			LTR	
Volume (veh/h)	0	118	1019	10	21	72	611	24		15	76	255		100	35	18
Percent Heavy Vehicles (%)	3	3			3	3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized																
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1			6.4	4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.16			6.46	4.16				7.56	6.56	6.96		7.56	6.56	6.96
Base Follow-Up Headway (sec)		2.2			2.5	2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.23			2.53	2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

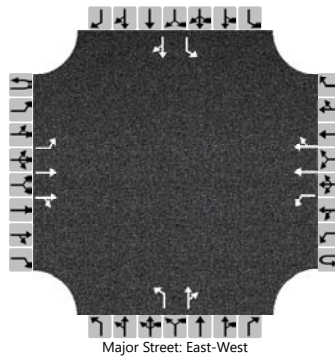
Flow Rate, v (veh/h)		142				112				18		399			184	
Capacity, c (veh/h)		837				206						13				
v/c Ratio		0.17				0.55						30.66				
95% Queue Length, Q ₉₅ (veh)		0.6				2.9						51.1				
Control Delay (s/veh)		10.2				41.7						13910.2				
Level of Service (LOS)		B				E						F				
Approach Delay (s/veh)	1.0				5.3											
Approach LOS																

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Johnson Rd at Schaad Rd
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	12/01/2021	East/West Street	Schaad Rd
Analysis Year	2024	North/South Street	Johnson Rd
Time Analyzed	AM Peak	Peak Hour Factor	0.67
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Combined 2024 AM with Schaad Extension with SBL		

Lanes



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	1	2	0	0	1	2	0		1	1	0		1	1	0
Configuration		L	T	TR		L	T	TR		L		TR		L		TR
Volume (veh/h)	2	138	544	125	24	31	1120	2		141	58	49		76	47	85
Percent Heavy Vehicles (%)	3	3			3	3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized																
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)	6.4	4.1			6.4	4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)	6.46	4.16			6.46	4.16				7.56	6.56	6.96		7.56	6.56	6.96
Base Follow-Up Headway (sec)	2.5	2.2			2.5	2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)	2.53	2.23			2.53	2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

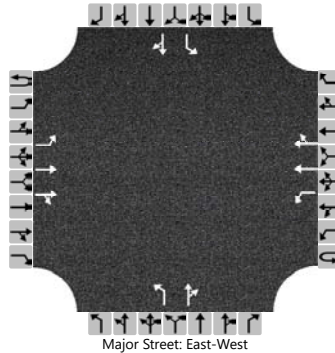
Flow Rate, v (veh/h)		209			82				210		160		113			197
Capacity, c (veh/h)		353			422						409		205			
v/c Ratio		0.59			0.19						0.39		0.55			
95% Queue Length, Q ₉₅ (veh)		3.6			0.7						1.8		3.0			
Control Delay (s/veh)		29.0			15.6						19.3		42.5			
Level of Service (LOS)		D			C						C		E			
Approach Delay (s/veh)	5.0				0.7											
Approach LOS																

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Johnson Rd at Schaad Rd
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	12/01/2021	East/West Street	Schaad Rd
Analysis Year	2024	North/South Street	Johnson Rd
Time Analyzed	PM Peak	Peak Hour Factor	0.83
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Combined 2024 PM with Schaad Extension with SBL		

Lanes



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	1	2	0	0	1	2	0		1	1	0		1	1	0
Configuration		L	T	TR		L	T	TR		L		TR		L		TR
Volume (veh/h)	0	118	1019	10	21	72	611	24		15	76	255		100	35	18
Percent Heavy Vehicles (%)	3	3			3	3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized																
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways




















Base Critical Headway (sec)		4.1			6.4	4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.16			6.46	4.16				7.56	6.56	6.96		7.56	6.56	6.96
Base Follow-Up Headway (sec)		2.2			2.5	2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.23			2.53	2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		142				112				18		399		120		64
Capacity, c (veh/h)		837				206						13				42
v/c Ratio		0.17				0.55						30.66				1.52
95% Queue Length, Q ₉₅ (veh)		0.6				2.9						51.1				6.4
Control Delay (s/veh)		10.2				41.7						13910.2				474.7
Level of Service (LOS)		B				E						F				F
Approach Delay (s/veh)	1.0				5.3											
Approach LOS																

Lanes, Volumes, Timings
1: Johnson Road & Schaad Road

E-Z Stop Food Mart TIS
2024 Combined AM with Schaad Extension

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	140	544	125	55	1120	2	141	58	49	76	47	85
Future Volume (vph)	140	544	125	55	1120	2	141	58	49	76	47	85
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.972						0.932			0.955	
Flt Protected	0.950			0.950			0.950				0.980	
Satd. Flow (prot)	1770	3440	0	1770	3539	0	1770	1736	0	0	1743	0
Flt Permitted	0.083			0.233			0.508				0.757	
Satd. Flow (perm)	155	3440	0	434	3539	0	946	1736	0	0	1347	0
Satd. Flow (RTOR)		45						43			26	
Peak Hour Factor	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.92
Shared Lane Traffic (%)												
Lane Group Flow (vph)	209	999	0	82	1675	0	210	160	0	0	275	0
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6			8			4		
Detector Phase	5	2		1	6		8	8		4	4	
Switch Phase												
Minimum Initial (s)	6.0	15.0		6.0	15.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	12.0	21.0		12.0	21.0		14.0	14.0		14.0	14.0	
Total Split (s)	14.0	52.0		12.0	50.0		26.0	26.0		26.0	26.0	
Total Split (%)	15.6%	57.8%		13.3%	55.6%		28.9%	28.9%		28.9%	28.9%	
Maximum Green (s)	8.0	46.0		6.0	44.0		20.0	20.0		20.0	20.0	
Yellow Time (s)	4.0	4.5		4.0	4.5		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	1.5		2.0	1.5		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0			0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0			6.0	
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	Min		None	Min		None	None		None	None	
Act Effect Green (s)	54.8	48.4		50.0	44.0		20.0	20.0			20.0	
Actuated g/C Ratio	0.61	0.54		0.56	0.49		0.22	0.22			0.22	
v/c Ratio	0.88	0.53		0.25	0.97		1.00	0.38			0.86	
Control Delay	56.0	14.7		8.3	38.7		100.2	24.6			57.5	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0			0.0	
Total Delay	56.0	14.7		8.3	38.7		100.2	24.6			57.5	
LOS	E	B		A	D		F	C			E	
Approach Delay		21.9			37.3			67.5			57.5	
Approach LOS		C			D			E			E	
Queue Length 50th (ft)	69	185		16	464		120	56			138	
Queue Length 95th (ft)	#93	156		23	342		#164	75			155	
Internal Link Dist (ft)		668			807			402			378	
Turn Bay Length (ft)	120			140			130					
Base Capacity (vph)	237	1870		330	1730		210	419			319	
Starvation Cap Reductn	0	0		0	0		0	0			0	
Spillback Cap Reductn	0	0		0	0		0	0			0	
Storage Cap Reductn	0	0		0	0		0	0			0	
Reduced v/c Ratio	0.88	0.53		0.25	0.97		1.00	0.38			0.86	

Timing Plan: AM Peak
Cannon & Cannon, Inc.

Synchro 10 Report
Page 1


Intersection Summary	
Cycle Length: 90	
Actuated Cycle Length: 90	
Natural Cycle: 90	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 1.00	
Intersection Signal Delay: 36.8	Intersection LOS: D
Intersection Capacity Utilization 72.3%	ICU Level of Service C
Analysis Period (min) 15	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 1: Johnson Road & Schaad Road



Lanes, Volumes, Timings
1: Johnson Road & Schaad Road

E-Z Stop Food Mart TIS
2024 Combined PM with Schaad Extension

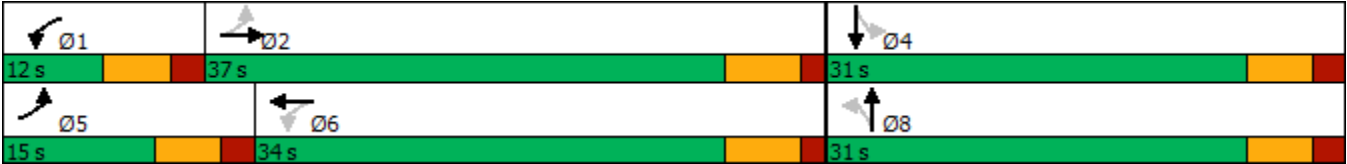
												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	118	1019	10	93	611	24	15	76	255	100	35	18
Future Volume (vph)	118	1019	10	93	611	24	15	76	255	100	35	18
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999			0.994			0.885			0.984	
Flt Protected	0.950			0.950			0.950				0.968	
Satd. Flow (prot)	1770	3536	0	1770	3518	0	1770	1649	0	0	1774	0
Flt Permitted	0.244			0.146			0.663				0.364	
Satd. Flow (perm)	455	3536	0	272	3518	0	1235	1649	0	0	667	0
Satd. Flow (RTOR)		1			5			204			9	
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Shared Lane Traffic (%)												
Lane Group Flow (vph)	142	1240	0	112	765	0	18	399	0	0	184	0
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6			8			4		
Detector Phase	5	2		1	6		8	8		4	4	
Switch Phase												
Minimum Initial (s)	6.0	15.0		6.0	15.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	12.0	21.0		12.0	21.0		14.0	14.0		14.0	14.0	
Total Split (s)	15.0	37.0		12.0	34.0		31.0	31.0		31.0	31.0	
Total Split (%)	18.8%	46.3%		15.0%	42.5%		38.8%	38.8%		38.8%	38.8%	
Maximum Green (s)	9.0	31.0		6.0	28.0		25.0	25.0		25.0	25.0	
Yellow Time (s)	4.0	4.5		4.0	4.5		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	1.5		2.0	1.5		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0			0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0			6.0	
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	Min		None	Min		None	None		None	None	
Act Effect Green (s)	35.7	29.3		31.8	27.4		23.0	23.0			23.0	
Actuated g/C Ratio	0.48	0.40		0.43	0.37		0.31	0.31			0.31	
v/c Ratio	0.39	0.88		0.46	0.58		0.05	0.61			0.86	
Control Delay	12.7	30.9		16.8	22.1		19.7	15.6			62.2	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0			0.0	
Total Delay	12.7	30.9		16.8	22.1		19.7	15.6			62.2	
LOS	B	C		B	C		B	B			E	
Approach Delay		29.0			21.4			15.8			62.2	
Approach LOS		C			C			B			E	
Queue Length 50th (ft)	33	300		26	162		6	76			82	
Queue Length 95th (ft)	56	344		46	198		19	141			#178	
Internal Link Dist (ft)		668			807			402			378	
Turn Bay Length (ft)	120			140			130					
Base Capacity (vph)	389	1549		244	1409		435	714			241	
Starvation Cap Reductn	0	0		0	0		0	0			0	
Spillback Cap Reductn	0	0		0	0		0	0			0	
Storage Cap Reductn	0	0		0	0		0	0			0	
Reduced v/c Ratio	0.37	0.80		0.46	0.54		0.04	0.56			0.76	

Timing Plan: PM Peak
Cannon & Cannon, Inc.

Synchro 10 Report
Page 1





















Intersection Summary	
Cycle Length: 80	
Actuated Cycle Length: 73.7	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.88	
Intersection Signal Delay: 26.9	Intersection LOS: C
Intersection Capacity Utilization 81.8%	ICU Level of Service D
Analysis Period (min) 15	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 1: Johnson Road & Schaad Road



Lanes, Volumes, Timings
1: Johnson Road & Schaad Road

E-Z Stop Food Mart TIS
2024 Combined AM with Schaad Extension SBL Lane

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	140	544	125	55	1120	2	141	58	49	76	47	85
Future Volume (vph)	140	544	125	55	1120	2	141	58	49	76	47	85
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.972						0.932			0.915	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3440	0	1770	3539	0	1770	1736	0	1770	1704	0
Flt Permitted	0.092			0.234			0.629			0.634		
Satd. Flow (perm)	171	3440	0	436	3539	0	1172	1736	0	1181	1704	0
Satd. Flow (RTOR)		52						46			72	
Peak Hour Factor	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.92
Shared Lane Traffic (%)												
Lane Group Flow (vph)	209	999	0	82	1675	0	210	160	0	113	162	0
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6			8			4		
Detector Phase	5	2		1	6		8	8		4	4	
Switch Phase												
Minimum Initial (s)	6.0	15.0		6.0	15.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	12.0	21.0		12.0	21.0		14.0	14.0		14.0	14.0	
Total Split (s)	12.0	48.0		12.0	48.0		20.0	20.0		20.0	20.0	
Total Split (%)	15.0%	60.0%		15.0%	60.0%		25.0%	25.0%		25.0%	25.0%	
Maximum Green (s)	6.0	42.0		6.0	42.0		14.0	14.0		14.0	14.0	
Yellow Time (s)	4.0	4.5		4.0	4.5		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	1.5		2.0	1.5		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	Min		None	Min		None	None		None	None	
Act Effect Green (s)	48.3	43.5		47.0	41.0		14.0	14.0		14.0	14.0	
Actuated g/C Ratio	0.61	0.55		0.59	0.52		0.18	0.18		0.18	0.18	
v/c Ratio	0.93	0.52		0.23	0.91		1.01	0.46		0.54	0.45	
Control Delay	64.0	12.4		6.3	26.6		102.2	25.9		40.8	21.4	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	64.0	12.4		6.3	26.6		102.2	25.9		40.8	21.4	
LOS	E	B		A	C		F	C		D	C	
Approach Delay		21.3			25.7			69.2			29.4	
Approach LOS		C			C			E			C	
Queue Length 50th (ft)	55	154		12	372		~110	51		52	40	
Queue Length 95th (ft)	#94	133		18	279		#154	71		74	59	
Internal Link Dist (ft)		668			807			402			378	
Turn Bay Length (ft)	120			140			130			150		
Base Capacity (vph)	225	1918		360	1881		208	345		209	361	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.93	0.52		0.23	0.89		1.01	0.46		0.54	0.45	

Timing Plan: AM Peak
Cannon & Cannon, Inc.

Synchro 10 Report
Page 1





















Intersection Summary	
Cycle Length: 80	
Actuated Cycle Length: 79	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 1.01	
Intersection Signal Delay: 29.0	Intersection LOS: C
Intersection Capacity Utilization 74.3%	ICU Level of Service D
Analysis Period (min) 15	
~ Volume exceeds capacity, queue is theoretically infinite.	
Queue shown is maximum after two cycles.	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 1: Johnson Road & Schaad Road



Lanes, Volumes, Timings
1: Johnson Road & Schaad Road

E-Z Stop Food Mart TIS
2024 Combined PM with Schaad Extension SBL Lane

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	118	1019	10	93	611	24	15	76	255	100	35	18
Future Volume (vph)	118	1019	10	93	611	24	15	76	255	100	35	18
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999			0.994			0.885			0.948	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3536	0	1770	3518	0	1770	1649	0	1770	1766	0
Flt Permitted	0.301			0.195			0.715			0.392		
Satd. Flow (perm)	561	3536	0	363	3518	0	1332	1649	0	730	1766	0
Satd. Flow (RTOR)		2			8			253			22	
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Shared Lane Traffic (%)												
Lane Group Flow (vph)	142	1240	0	112	765	0	18	399	0	120	64	0
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6			8			4		
Detector Phase	5	2		1	6		8	8		4	4	
Switch Phase												
Minimum Initial (s)	6.0	15.0		6.0	15.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	12.0	21.0		12.0	21.0		14.0	14.0		14.0	14.0	
Total Split (s)	12.0	27.0		12.0	27.0		16.0	16.0		16.0	16.0	
Total Split (%)	21.8%	49.1%		21.8%	49.1%		29.1%	29.1%		29.1%	29.1%	
Maximum Green (s)	6.0	21.0		6.0	21.0		10.0	10.0		10.0	10.0	
Yellow Time (s)	4.0	4.5		4.0	4.5		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	1.5		2.0	1.5		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	Min		None	Min		None	None		None	None	
Act Effect Green (s)	25.0	20.5		25.0	20.5		10.2	10.2		10.2	10.2	
Actuated g/C Ratio	0.48	0.39		0.48	0.39		0.20	0.20		0.20	0.20	
v/c Ratio	0.34	0.89		0.33	0.55		0.07	0.76		0.85	0.18	
Control Delay	7.7	26.1		8.1	14.6		19.6	20.5		73.1	15.4	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	7.7	26.1		8.1	14.6		19.6	20.5		73.1	15.4	
LOS	A	C		A	B		B	C		E	B	
Approach Delay		24.3			13.7			20.5			53.1	
Approach LOS		C			B			C			D	
Queue Length 50th (ft)	17	195		13	98		5	44		39	12	
Queue Length 95th (ft)	32	#277		27	130		17	#134		#110	35	
Internal Link Dist (ft)		668			807			402			378	
Turn Bay Length (ft)	120			140			130			150		
Base Capacity (vph)	412	1457		340	1453		261	526		142	364	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.34	0.85		0.33	0.53		0.07	0.76		0.85	0.18	

Timing Plan: PM Peak
Cannon & Cannon, Inc.

Synchro 10 Report
Page 1

Intersection Summary	
Cycle Length: 55	
Actuated Cycle Length: 51.9	
Natural Cycle: 55	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.89	
Intersection Signal Delay: 22.3	Intersection LOS: C
Intersection Capacity Utilization 80.0%	ICU Level of Service D
Analysis Period (min) 15	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

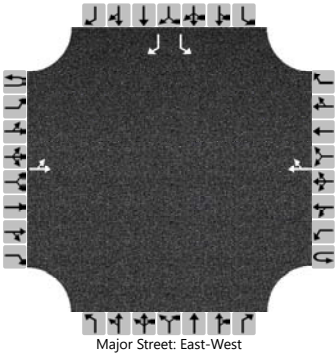
Splits and Phases: 1: Johnson Road & Schaad Road

 Ø1	 Ø2	 Ø4
12 s	27 s	16 s
 Ø5	 Ø6	 Ø8
12 s	27 s	16 s

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	BJH	Intersection	Johnson Rd at Ball Camp
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	12/01/2021	East/West Street	Ball Camp Pike
Analysis Year	2024	North/South Street	Johnson Rd
Time Analyzed	AM Peak	Peak Hour Factor	0.83
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Combined 2024 AM with Schaad Extension		

Lanes



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		1	0	1
Configuration		LT						TR						L		R
Volume (veh/h)		186	258				451	31						15		180
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized													No			
Median Type Storage	Undivided															

Critical and Follow-up Headways

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

Delay, Queue Length, and Level of Service

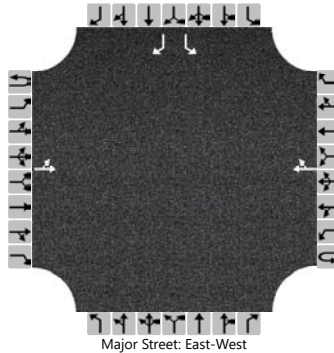
Flow Rate, v (veh/h)		224												18		217
Capacity, c (veh/h)		988												125		525
v/c Ratio		0.23												0.14		0.41
95% Queue Length, Q ₉₅ (veh)		0.9												0.5		2.0
Control Delay (s/veh)		9.7												38.7		16.6
Level of Service (LOS)		A												E		C
Approach Delay (s/veh)	5.6												18.3			
Approach LOS													C			

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Johnson Rd at Ball Camp
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	12/01/2021	East/West Street	Ball Camp Pike
Analysis Year	2024	North/South Street	Johnson Rd
Time Analyzed	PM Peak	Peak Hour Factor	0.91
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Combined 2024 PM with Schaad Extension		

Lanes



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		1	0	1
Configuration		LT						TR						L		R
Volume (veh/h)		339	365				331	8						4		111
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized													No			
Median Type Storage	Undivided															

Critical and Follow-up Headways

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

Delay, Queue Length, and Level of Service

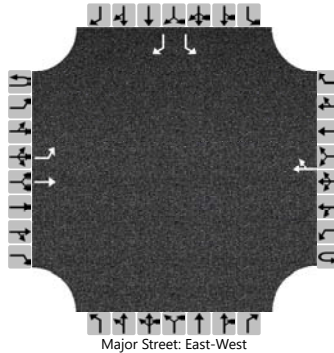
Flow Rate, v (veh/h)		373												4		122
Capacity, c (veh/h)		1180												78		675
v/c Ratio		0.32												0.06		0.18
95% Queue Length, Q ₉₅ (veh)		1.4												0.2		0.7
Control Delay (s/veh)		9.4												54.0		11.5
Level of Service (LOS)		A												F		B
Approach Delay (s/veh)	6.5												13.0			
Approach LOS													B			

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Johnson Rd at Ball Camp
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	12/01/2021	East/West Street	Ball Camp Pike
Analysis Year	2024	North/South Street	Johnson Rd
Time Analyzed	AM Peak	Peak Hour Factor	0.83
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Combined 2024 AM with Schaad Extension with EBL		

Lanes



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	1	1	0	0	0	1	0		0	0	0		1	0	1
Configuration		L	T					TR						L		R
Volume (veh/h)		186	258				451	31						15		180
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized													No			
Median Type Storage	Undivided															

Critical and Follow-up Headways

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

Delay, Queue Length, and Level of Service

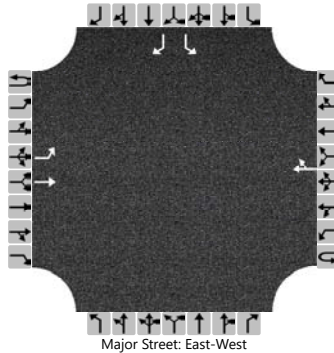
Flow Rate, v (veh/h)		224												18		217
Capacity, c (veh/h)		988												133		525
v/c Ratio		0.23												0.14		0.41
95% Queue Length, Q ₉₅ (veh)		0.9												0.5		2.0
Control Delay (s/veh)		9.7												36.3		16.6
Level of Service (LOS)		A												E		C
Approach Delay (s/veh)	4.1												18.1			
Approach LOS													C			

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Johnson Rd at Ball Camp
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	12/01/2021	East/West Street	Ball Camp Pike
Analysis Year	2024	North/South Street	Johnson Rd
Time Analyzed	PM Peak	Peak Hour Factor	0.91
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Combined 2024 PM with Schaad Extension with EBL		

Lanes



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	1	1	0	0	0	1	0		0	0	0		1	0	1
Configuration		L	T					TR						L		R
Volume (veh/h)		339	365				331	8						4		111
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized													No			
Median Type Storage	Undivided															

Critical and Follow-up Headways

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

Delay, Queue Length, and Level of Service

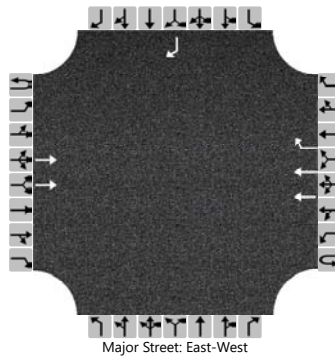
Flow Rate, v (veh/h)		373												4		122
Capacity, c (veh/h)		1180												90		675
v/c Ratio		0.32												0.05		0.18
95% Queue Length, Q ₉₅ (veh)		1.4												0.2		0.7
Control Delay (s/veh)		9.4												47.2		11.5
Level of Service (LOS)		A												E		B
Approach Delay (s/veh)	4.6												12.7			
Approach LOS													B			

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Schaad at Eastern Access
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	12/01/2021	East/West Street	Schaad Road
Analysis Year	2024	North/South Street	Eastern RIRO Driveay
Time Analyzed	AM Peak	Peak Hour Factor	0.67
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Combined 2024 AM with Schaad Extension		

Lanes



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	2	0	0	0	2	1		0	0	0		0	0	1
Configuration			T				T	R								R
Volume (veh/h)			693				1019	139								5
Percent Heavy Vehicles (%)																3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized					No								No			
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)																6.9
Critical Headway (sec)																6.96
Base Follow-Up Headway (sec)																3.3
Follow-Up Headway (sec)																3.33

Delay, Queue Length, and Level of Service

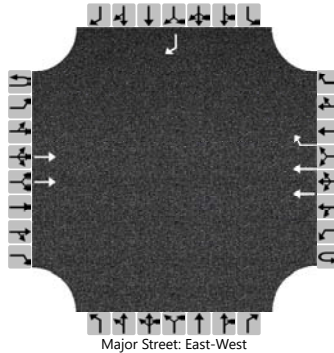
Flow Rate, v (veh/h)																7
Capacity, c (veh/h)																346
v/c Ratio																0.02
95% Queue Length, Q ₉₅ (veh)																0.1
Control Delay (s/veh)																15.6
Level of Service (LOS)																C
Approach Delay (s/veh)													15.6			
Approach LOS													C			

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Schaad at Eastern Access
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	12/01/2021	East/West Street	Schaad Road
Analysis Year	2024	North/South Street	Eastern RIRO Driveay
Time Analyzed	PM Peak	Peak Hour Factor	0.83
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Combined 2024 PM with Schaad Extension		

Lanes



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	2	0	0	0	2	1		0	0	0		0	0	1
Configuration			T				T	R								R
Volume (veh/h)			1395				632	80								4
Percent Heavy Vehicles (%)																3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized					No								No			
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)																6.9
Critical Headway (sec)																6.96
Base Follow-Up Headway (sec)																3.3
Follow-Up Headway (sec)																3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)																5
Capacity, c (veh/h)																614
v/c Ratio																0.01
95% Queue Length, Q ₉₅ (veh)																0.0
Control Delay (s/veh)																10.9
Level of Service (LOS)																B
Approach Delay (s/veh)													10.9			
Approach LOS													B			

HCS7 Two-Way Stop-Control Report

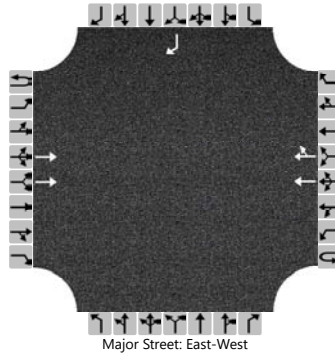
General Information

Analyst	BJH
Agency/Co.	Cannon & Cannon, Inc.
Date Performed	12/01/2021
Analysis Year	2024
Time Analyzed	AM Peak
Intersection Orientation	East-West
Project Description	Combined 2024 AM with Schaad Extension

Site Information

Intersection	Schaad at Western Access
Jurisdiction	Knox County
East/West Street	Schaad Road
North/South Street	Western RIRO Driveway
Peak Hour Factor	0.67
Analysis Time Period (hrs)	0.25

Lanes



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	2	0	0	0	2	0		0	0	0		0	0	1
Configuration			T				T	TR								R
Volume (veh/h)			693				1024	0								153
Percent Heavy Vehicles (%)																3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized													No			
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)																6.9
Critical Headway (sec)																6.96
Base Follow-Up Headway (sec)																3.3
Follow-Up Headway (sec)																3.33

Delay, Queue Length, and Level of Service

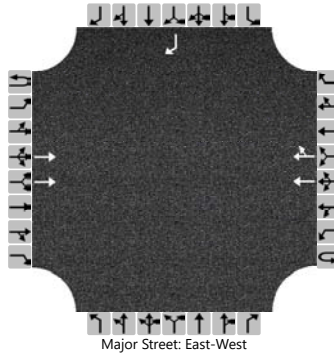
Flow Rate, v (veh/h)																228
Capacity, c (veh/h)																344
v/c Ratio																0.66
95% Queue Length, Q ₉₅ (veh)																4.5
Control Delay (s/veh)																33.9
Level of Service (LOS)																D
Approach Delay (s/veh)													33.9			
Approach LOS													D			

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Schaad at Western Access
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	12/01/2021	East/West Street	Schaad Road
Analysis Year	2024	North/South Street	Western RIRO Driveway
Time Analyzed	PM Peak	Peak Hour Factor	0.83
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Combined 2024 PM with Schaad Extension		

Lanes



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	2	0	0	0	2	0		0	0	0		0	0	1
Configuration			T				T	TR								R
Volume (veh/h)			1395				636	0								92
Percent Heavy Vehicles (%)																3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized													No			
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)																6.9
Critical Headway (sec)																6.96
Base Follow-Up Headway (sec)																3.3
Follow-Up Headway (sec)																3.33

Delay, Queue Length, and Level of Service

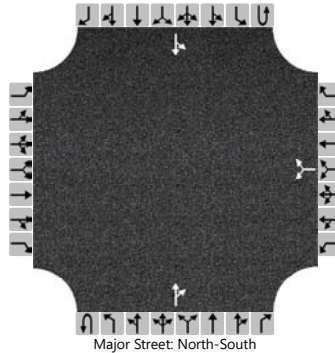
Flow Rate, v (veh/h)																111
Capacity, c (veh/h)																612
v/c Ratio																0.18
95% Queue Length, Q ₉₅ (veh)																0.7
Control Delay (s/veh)																12.2
Level of Service (LOS)																B
Approach Delay (s/veh)													12.2			
Approach LOS													B			

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Johnson at Full Access
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	12/01/2021	East/West Street	Full Access Driveway
Analysis Year	2024	North/South Street	Johnson Road
Time Analyzed	AM Peak	Peak Hour Factor	0.67
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Combined 2024 AM with Schaad Extension		

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LR					TR		LT		
Volume (veh/h)						107		5			80	117		14	100	
Percent Heavy Vehicles (%)						3		3						3		
Proportion Time Blocked																
Percent Grade (%)					0											
Right Turn Channelized																
Median Type Storage	Undivided															

Critical and Follow-up Headways

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

Delay, Queue Length, and Level of Service

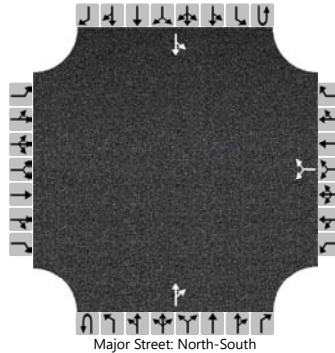
Flow Rate, v (veh/h)						167								21		
Capacity, c (veh/h)						602								1262		
v/c Ratio						0.28								0.02		
95% Queue Length, Q ₉₅ (veh)						1.1								0.1		
Control Delay (s/veh)						13.3								7.9		
Level of Service (LOS)						B								A		
Approach Delay (s/veh)					13.3								1.1			
Approach LOS					B											

HCS7 Two-Way Stop-Control Report

General Information

Analyst	BJH	Intersection	Johnson at Full Access
Agency/Co.	Cannon & Cannon, Inc.	Jurisdiction	Knox County
Date Performed	12/01/2021	East/West Street	Full Access Driveway
Analysis Year	2024	North/South Street	Johnson Road
Time Analyzed	PM Peak	Peak Hour Factor	0.83
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Combined 2024 PM with Schaad Extension		

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LR					TR		LT		
Volume (veh/h)						125		4			85	134		11	29	
Percent Heavy Vehicles (%)						3		3						3		
Proportion Time Blocked																
Percent Grade (%)					0											
Right Turn Channelized																
Median Type Storage	Undivided															

Critical and Follow-up Headways

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

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						155								13		
Capacity, c (veh/h)						737								1294		
v/c Ratio						0.21								0.01		
95% Queue Length, Q ₉₅ (veh)						0.8								0.0		
Control Delay (s/veh)						11.2								7.8		
Level of Service (LOS)						B								A		
Approach Delay (s/veh)					11.2								2.2			
Approach LOS					B											

APPENDIX E | TURN LANE WARRANT EVALUATIONS

Schaad Road at Johnson Road
Combined 2024 AM Volumes
without Schaad Road extension
Westbound Right Turn Lane NOT Warranted

TABLE 6B

RIGHT-TURN LANE VOLUME THRESHOLDS
FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 46 TO 55 MPH

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	< 100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399
Fewer Than 25 25 - 49 50 - 99		No				
100 - 149 150 - 199						Yes
200 - 249 250 - 299				Yes	Yes	Yes
300 - 349 350 - 399			Yes Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499		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

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

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

Westbound Through Volume = $245 * 0.6 = 147$
Westbound Right Turn Volume = 2

Schaad Road at Johnson Road
 Combined 2024 PM Volumes
 without Schaad Road extension
 Westbound Right Turn Lane NOT Warranted

TABLE 6B

RIGHT-TURN LANE VOLUME THRESHOLDS
 FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 46 TO 55 MPH

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	<100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399
Fewer Than 25 25 - 49 50 - 99	No					
100 - 149 150 - 199						Yes
200 - 249 250 - 299				Yes	Yes Yes	Yes Yes
300 - 349 350 - 399			Yes Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499		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

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

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

Westbound Through Volume = $48 * 0.6 = 29$
 Westbound Right Turn Volume = 24

Schaad Road at Johnson Road
 Combined 2024 AM Volumes
 with Schaad Road extension
 Westbound Right Turn Lane NOT Warranted

TABLE 6B

RIGHT-TURN LANE VOLUME THRESHOLDS
 FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 46 TO 55 MPH

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

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 600	+ / > 600
Fewer Than 25 25 - 49 50 - 99			Yes	Yes Yes	Yes Yes	No Yes Yes
100 - 149 150 - 199	Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
200 - 249 250 - 299	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
300 - 349 350 - 399	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

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

Westbound Through Volume = $1120 * 0.6 = 672$
 Westbound Right Turn Volume = 2

Schaad Road at Johnson Road
 Combined 2024 PM Volumes
 with Schaad Road extension
 Westbound Right Turn Lane NOT Warranted

TABLE 6B

RIGHT-TURN LANE VOLUME THRESHOLDS
 FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 46 TO 55 MPH

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

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	No		Yes	Yes Yes	Yes Yes	Yes Yes
100 - 149 150 - 199	Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
200 - 249 250 - 299	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
300 - 349 350 - 399	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

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

Westbound Through Volume = $611 * 0.6 = 367$
 Westbound Right Turn Volume = 24

Ball Camp Pike at Johnson Road
Combined 2024 AM Volumes
without Schaad Road extension
Westbound Right Turn Lane IS Warranted

TABLE 5B

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

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

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

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

Westbound Through Volume = 564
Westbound Right Turn Volume = 37

Ball Camp Pike at Johnson Road
 Combined 2024 PM Volumes
 without Schaad Road extension
 Westbound Right Turn Lane NOT Warranted

TABLE 5B

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

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

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 600	+ / > 600
Fewer Than 25 25 - 49 50 - 99		No		Yes	Yes Yes	Yes Yes
100 - 149 150 - 199		Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
200 - 249 250 - 299	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
300 - 349 350 - 399	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

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

Westbound Through Volume = 414
 Westbound Right Turn Volume = 9

Ball Camp Pike at Johnson Road
 Combined 2024 AM Volumes
 with Schaad Road extension
 Westbound Right Turn Lane NOT Warranted

TABLE 5B

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

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

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 600	+ / > 600
Fewer Than 25 25 - 49 50 - 99		No		Yes	Yes Yes	Yes Yes
100 - 149 150 - 199		Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
200 - 249 250 - 299	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
300 - 349 350 - 399	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

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

Westbound Through Volume = 451
 Westbound Right Turn Volume = 31

Ball Camp Pike at Johnson Road
 Combined 2024 PM Volumes
 with Schaad Road extension
 Westbound Right Turn Lane NOT Warranted

TABLE 5B

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

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	< 100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399
Fewer Than 25 25 - 49 50 - 99					No	
100 - 149 150 - 199						
200 - 249 250 - 299					Yes	Yes
300 - 349 350 - 399			Yes	Yes	Yes	Yes
400 - 449 450 - 499		Yes	Yes	Yes	Yes	Yes
500 - 549 550 - 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 - 600	+ / > 600
Fewer Than 25 25 - 49 50 - 99				Yes	Yes	Yes
100 - 149 150 - 199		Yes	Yes	Yes	Yes	Yes
200 - 249 250 - 299	Yes	Yes	Yes	Yes	Yes	Yes
300 - 349 350 - 399	Yes	Yes	Yes	Yes	Yes	Yes
400 - 449 450 - 499	Yes	Yes	Yes	Yes	Yes	Yes
500 - 549 550 - 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.

Westbound Through Volume = 331
 Westbound Right Turn Volume = 8

Ball Camp Pike at Johnson Road
Existing 2021 AM Volumes
without Schaad Road extension
Left Turn Lane IS Warranted

TABLE 5A

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

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

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

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	= / > 600
100 - 149	70	60	50	45	40	35
150 - 199	60	55	45	40	35	30
200 - 249	55	50	40	35	30	30
250 - 299	50	45	35	30	30	30
300 - 349	45	40	35	30	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

Westbound Volume = 552
Eastbound Through Volume = 298
Eastbound Left Turn Volume = 205

Ball Camp Pike at Johnson Road
Existing 2021 PM Volumes
without Schaad Road extension
Left Turn Lane IS Warranted

TABLE 5A

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

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

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

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	= / > 600
100 - 149	70	60	50	45	40	35
150 - 199	60	55	45	40	35	30
200 - 249	55	50	40	35	30	30
250 - 299	50	45	35	30	30	30
300 - 349	45	40	35	30	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

Westbound Volume = 388
Eastbound Through Volume = 422
Eastbound Left Turn Volume = 383

Ball Camp Pike at Johnson Road
Combined 2024 AM Volumes
without Schaad Road extension
Left Turn Lane IS Warranted

TABLE 5A

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

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

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

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	= / > 600
100 - 149	70	60	50	45	40	35
150 - 199	60	55	45	40	35	30
200 - 249	55	50	40	35	30	30
250 - 299	50	45	35	30	30	30
300 - 349	45	40	35	30	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

Westbound Volume = 601
Eastbound Through Volume = 322
Eastbound Left Turn Volume = 244

Ball Camp Pike at Johnson Road
Combined 2024 PM Volumes
without Schaad Road extension
Left Turn Lane IS Warranted

TABLE 5A

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

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

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

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	= / > 600
100 - 149	70	60	50	45	40	35
150 - 199	60	55	45	40	35	30
200 - 249	55	50	40	35	30	30
250 - 299	50	45	35	30	30	30
300 - 349	45	40	35	30	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

Westbound Volume = 423
Eastbound Through Volume = 456
Eastbound Left Turn Volume = 433

Ball Camp Pike at Johnson Road
Combined 2024 AM Volumes
with Schaad Road extension
Left Turn Lane IS Warranted

TABLE 5A

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

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

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

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	= / > 600
100 - 149	70	60	50	45	40	35
150 - 199	60	55	45	40	35	30
200 - 249	55	50	40	35	30	30
250 - 299	50	45	35	30	30	30
300 - 349	45	40	35	30	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

Westbound Volume = 482
Eastbound Through Volume = 258
Eastbound Left Turn Volume = 186

Ball Camp Pike at Johnson Road
Combined 2024 PM Volumes
with Schaad Road extension
Left Turn Lane IS Warranted

TABLE 5A

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

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

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

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	= / > 600
100 - 149	70	60	50	45	40	35
150 - 199	60	55	45	40	35	30
200 - 249	55	50	40	35	30	30
250 - 299	50	45	35	30	30	30
300 - 349	45	40	35	30	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

Westbound Volume = 339
Eastbound Through Volume = 365
Eastbound Left Turn Volume = 339

Schaad Road at Eastern RIRO Driveway
 Combined 2024 AM Volumes
 without Schaad Road extension
 Westbound Right Turn Lane NOT Warranted

TABLE 6B

RIGHT-TURN LANE VOLUME THRESHOLDS
 FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 46 TO 55 MPH

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	<100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399
Fewer Than 25 25 - 49 50 - 99						
100 - 149 150 - 199		No				Yes
200 - 249 250 - 299				Yes	Yes	Yes
300 - 349 350 - 399			Yes Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499		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

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

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

Westbound Through Volume = $208 * 0.6 = 125$
 Westbound Right Turn Volume = 103

Schaad Road at Eastern RIRO Driveway
 Combined 2024 PM Volumes
 without Schaad Road extension
 Westbound Right Turn Lane NOT Warranted

TABLE 6B

RIGHT-TURN LANE VOLUME THRESHOLDS
 FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 46 TO 55 MPH

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	< 100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399
Fewer Than 25 25 - 49 50 - 99	No					
100 - 149 150 - 199						Yes
200 - 249 250 - 299				Yes	Yes	Yes
300 - 349 350 - 399			Yes Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499		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

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

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

Westbound Through Volume = $122 * 0.6 = 73$
 Westbound Right Turn Volume = 58

Schaad Road at Eastern RIRO Driveway
Combined 2024 AM Volumes
with Schaad Road extension
Westbound Right Turn Lane IS Warranted

TABLE 6B

RIGHT-TURN LANE VOLUME THRESHOLDS:
FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 46 TO 55 MPH

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

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

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

Westbound Through Volume = $1019 * 0.6 = 611$
Westbound Right Turn Volume = 139

Schaad Road at Eastern RIRO Driveway
 Combined 2024 PM Volumes
 with Schaad Road extension
 Westbound Right Turn Lane NOT Warranted

TABLE 6B

RIGHT-TURN LANE VOLUME THRESHOLDS
 FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 46 TO 55 MPH

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

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	No		Yes	Yes Yes	Yes Yes	Yes Yes
100 - 149 150 - 199	Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
200 - 249 250 - 299	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
300 - 349 350 - 399	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

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

Westbound Through Volume = $632 * 0.6 = 379$
 Westbound Right Turn Volume = 80

Johnson Road at Full Access Driveway
 Combined 2024 AM Volumes
 without Schaad Road extension
 Right Turn Lane NOT Warranted

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						
100 - 149 150 - 199	No					
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.

Northbound Through Volume = 69
 Northbound Right Turn Volume = 130

Johnson Road at Full Access Driveway
Combined 2024 PM Volumes
without Schaad Road extension
Right Turn Lane NOT Warranted

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						
100 - 149 150 - 199	No					
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.

Northbound Through Volume = 96
Northbound Right Turn Volume = 144

Johnson Road at Full Access Driveway
Combined 2024 AM Volumes
with Schaad Road extension
Right Turn Lane NOT Warranted

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						
100 - 149 150 - 199	No					
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.

Northbound Through Volume = 80
Northbound Right Turn Volume = 117

Johnson Road at Full Access Driveway
Combined 2024 PM Volumes
with Schaad Road extension
Right Turn Lane NOT Warranted

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						
100 - 149 150 - 199	No					
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.

Northbound Through Volume = 85
Northbound Right Turn Volume = 134

Johnson Road at Full Access Driveway
Combined 2024 AM Volumes
without Schaad Road extension
Left Turn Lane NOT Warranted

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

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

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

Northbound Volume = 199
Southbound Through Volume = 87
Southbound Left Turn Volume = 37

Johnson Road at Full Access Driveway
Combined 2024 PM Volumes
without Schaad Road extension
Left Turn Lane NOT Warranted

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

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

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

Northbound Volume = 240
Southbound Through Volume = 34
Southbound Left Turn Volume = 23

Johnson Road at Full Access Driveway
Combined 2024 AM Volumes
with Schaad Road extension
Left Turn Lane NOT Warranted

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

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

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

Northbound Volume = 197
Southbound Through Volume = 100
Southbound Left Turn Volume = 14

Johnson Road at Full Access Driveway
Combined 2024 PM Volumes
with Schaad Road extension
Left Turn Lane NOT Warranted

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

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

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

Northbound Volume = 219
Southbound Through Volume = 29
Southbound Left Turn Volume = 11

APPENDIX F | SIGNAL WARRANT EVALUATIONS

TRAFFIC SIGNAL WARRANT ANALYSIS - VOLUME WARRANTS

[illegible]

TRAFFIC SIGNAL WARRANT ANALYSIS - VOLUME WARRANTS

Intersection : Schaad Road at Johnson Road City or County : Knox County State : Tennessee	Date of Count: 31-Aug-21 Day of Week of Count: Average Weekday	Are warranting volumes to be adjusted for speeds or built up area? Yes Adjustment factor for day of week and month of year of count 1.00 Number of Lanes: Major Street . . . 2 Minor Street . . . 2
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Major Street	Minor Street	Warrant #1A (8 Hr. - Min. Vol.)	Warrant #1B (8 Hr. - Interruption)	Combination (Warrants 1A & 1B)	Warrant #2 (Four Hour Vols.)	Warrant #3 (Peak Hour Vols.)						
Time	Actual Volume App #1 App #2 Total	Adjusted Total Volume	Actual Volume - Volume	Adjusted Total Volume	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor
Beginning												
6:00 am	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
7:00	468 269 737	737	294	294	175 210	117 420	146 263	120 245	240 123	240 123	240 123	240 123
8:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
9:00 am	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
10:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
11:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
12:00 noon	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
1:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
2:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
3:00 pm	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
4:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
5:00	60 144 204	204	418	418	49 299	32 597	40 373	0 0	0 0	0 0	0 0	0 0
6:00 pm	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
7:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
8:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0

Note: , No adjus ment made

- Where more than one minor approach exists use the higher approach volume.
- Number of hours shown is the minimum meeting the MUTCD requirements. Additional hours outside of the count period may meet the MUTCD specified volume levels.

Warranting Volumes 420 140	Warranting Volumes 630 70	Warranting Volumes 504 112	Warranting Volumes From MUTCD Fig. 4-8	Warranting Volumes From MUTCD Fig. 4-6
Total Hours Meeting Warrant = 1 .	Total Hours Meeting Warrant = 1 .	Total Hours Meeting Warrant = 1 .	Total Hours Meeting Warrant = 1 .	Total Hours Meeting Warrant = 1 .
Warrant Met No	Warrant Met No	Warrant Met No	Warrant Me No	Warrant Me Yes

***** Major Street volume is so low that no Minor Street warrant exists

Comments: (include any information which may be useful to the reviewer)

Major Street - Schaad Road
 Minor Street - Johnson Road
 All volumes included.

Volumes represent 2024 Background conditions.
 Volumes represent AM and PM peak hours.

Analysis Prepared by: CANNON AND CANNON, INC. Brian J. Haas, P.E., PTOE	Date: 10/15/21 Time: 09:52	Developed by: T. Darcy Sullivan, P.E. Distributed by: Tennessee Transportation Assistance Program (TTAP)
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TRAFFIC SIGNAL WARRANT ANALYSIS - VOLUME WARRANTS

Intersection : Schaad Road at Johnson Road City or County : Knox County State : Tennessee				Date of Count: 31-Aug-21 Day of Week of Count: Average Weekday		Are warranting volumes to be adjusted for speeds or built up area? Yes Adjustment factor for day of week and month of year of count 1.00 Number of Lanes: Major Street . . . 2 Minor Street . . . 2			
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Major Street							Minor Street	
Time	Actual Volume			Adjusted Total	Actual Volume		Adjusted Total	
Beginning	App #1	App #2	Total	Volume	-	Volume	Volume	
6:00 am	0	0	0	0	0	0	0	
7:00	774	1116	1890	1890	234	234	234	
8:00	0	0	0	0	0	0	0	
9:00 am	0	0	0	0	0	0	0	
10:00	0	0	0	0	0	0	0	
11:00	0	0	0	0	0	0	0	
12:00 noon	0	0	0	0	0	0	0	
1:00	0	0	0	0	0	0	0	
2:00	0	0	0	0	0	0	0	
3:00 pm	0	0	0	0	0	0	0	
4:00	0	0	0	0	0	0	0	
5:00	1120	676	1796	1796	334	334	334	
6:00 pm	0	0	0	0	0	0	0	
7:00	0	0	0	0	0	0	0	
8:00	0	0	0	0	0	0	0	

Warrant #1A (8 Hr. - Min. Vol.)		Warrant #1B (8 Hr. - Interruption)		Combination (Warrants 1A & 1B)		Warrant #2 (Four Hour Vols.)		Warrant #3 (Peak Hour Vols.)	
Percent of Warrant		Percent of Warrant		Percent of Warrant		Warrant	Percent of	Warrant	Percent of
Major	Minor	Major	Minor	Major	Minor	Volume	Warrant	Volume	Warrant
0	0	0	0	0	0	0	*****	0	*****
450	167	300	334	375	209	80	293	100	234
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
428	239	285	477	356	298	80	418	100	334
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****

Warranting Volumes 420 140 Total Hours Meeting Warrant = 2 . Warrant Met No	Warranting Volumes 630 70 Total Hours Meeting Warrant = 2 . Warrant Met No	Warranting Volumes 504 112 Total Hours Meeting Warrant = 2 . Warrant Met No	Warranting Volumes From MUTCD Fig. 4-8 Total Hours Meeting Warrant = 2 . Warrant Met No	Warranting Volumes From MUTCD Fig. 4-6 Total Hours Meeting Warrant = 2 . Warrant Met Yes
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***** Major Street volume is so low that no Minor Street warrant exists

Comments: (include any information which may be useful to the reviewer)	
Major Street - Schaad Road Minor Street - Johnson Road All volumes included.	Volumes represent 2024 Background conditions with Schaad Road extension. Volumes represent AM and PM peak hours.

Analysis Prepared by: CANNON AND CANNON, INC. Brian J. Haas, P.E., PTOE	Date: 10/15/21 Time: 09:52	Developed by: T. Darcy Sullivan, P.E. Distributed by: Tennessee Transportation Assistance Program (TTAP)
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TRAFFIC SIGNAL WARRANT ANALYSIS - VOLUME WARRANTS

Intersection : Schaad Road at Johnson Road City or County : Knox County State : Tennessee						Date of Count: 31-Aug-21 Day of Week of Count: Average Weekday						Are warranting volumes to be adjusted for speeds or built up area? Yes Adjustment factor for day of week and month of year of count 1.00 Number of Lanes: Major Street : 2 Minor Street : 2					
<div style="text-align: center;">Major Street</div> <div style="display: flex; justify-content: space-between;"> <div>Time</div> <div>Actual Volume</div> <div>Adjusted Total Volumr ,</div> <div>Actual Volume -</div> <div>Adjusted Total Volumr ,</div> </div> <hr/> <div>Beginning App #1 App #2 Total</div> <div>-----</div> <div>6:00 am 0 0 0 0 0</div> <div>7:00 475 321 796 796 322 322</div> <div>8:00 0 0 0 0 0 0</div> <div>9:00 am 0 0 0 0 0 0</div> <div>10:00 0 0 0 0 0 0</div> <div>11:00 0 0 0 0 0 0</div> <div>12:00 noon 0 0 0 0 0 0</div> <div>1:00 0 0 0 0 0 0</div> <div>2:00 0 0 0 0 0 0</div> <div>3:00 pm 0 0 0 0 0 0</div> <div>4:00 0 0 0 0 0 0</div> <div>5:00 65 192 257 257 441 441</div> <div>6:00 pm 0 0 0 0 0 0</div> <div>7:00 0 0 0 0 0 0</div> <div>8:00 0 0 0 0 0 0</div>							<div style="text-align: center;">Warrant #1A (8 Hr. - Min. Vol.)</div> <div style="display: flex; justify-content: space-around;">Percent of Warrant</div> <div style="display: flex; justify-content: space-around;">Major Minor</div> <div>-----</div> <div>0 0</div> <div>190 230</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div>		<div style="text-align: center;">Warrant #1B (8 Hr. - Interruption)</div> <div style="display: flex; justify-content: space-around;">Percent of Warrant</div> <div style="display: flex; justify-content: space-around;">Major Minor</div> <div>-----</div> <div>0 0</div> <div>126 460</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div>		<div style="text-align: center;">Combination (Warrants 1A & 1B)</div> <div style="display: flex; justify-content: space-around;">Percent of Warrant</div> <div style="display: flex; justify-content: space-around;">Major Minor</div> <div>-----</div> <div>0 0</div> <div>158 288</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div> <div>0 0</div>		<div style="text-align: center;">Warrant #2 (Four Hour Vols.)</div> <div style="display: flex; justify-content: space-around;">Warrant of Percent of</div> <div style="display: flex; justify-content: space-around;">Volume Warrant</div> <div>-----</div> <div>0 *****</div> <div>100 322</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div>		<div style="text-align: center;">Warrant #3 (Peak Hour Vols.)</div> <div style="display: flex; justify-content: space-around;">Warrant of Percent of</div> <div style="display: flex; justify-content: space-around;">Volume Warrant</div> <div>-----</div> <div>0 *****</div> <div>210 153</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div> <div>0 *****</div>		
Note: No adjus ment made - Where more than one minor approach exists use the higher approach volume - Number of hours shown is the minimum meeting the MUTCD requirements. Additional hours outside of the count period may meet the MUTCD specified volume levels.							Warranting Volumes 420 140 Total Hours Meeting Warrant = 1 . Warrant Met No		Warranting Volumes 630 70 Total Hours Meeting Warrant = 1 . Warrant Met No		Warranting Volumes 504 112 Total Hours Meeting Warrant = 1 . Warrant Met No		Warranting Volumes From MUTCD Fig. 4-8 Total Hours Meeting Warrant = 1 . Warrant Me No		Warranting Volumes From MUTCD Fig. 4-6 Total Hours Meeting Warrant = 1 . Warrant Me Yes		
***** Major Street volume is so low that no Minor Street warrant exists																	
Comments: (include any information which may be useful to the reviewer)																	
Major Street – Schaad Road Minor Street – Johnson Road All volumes included.							Volumes represent 2024 Combined conditions. Volumes represent AM and PM peak hours.										
Analysis Prepared by: CANNON AND CANNON, INC. Brian J. Haas, P.E., PTOE							Date: 12/01/21 Time: 13:12			Developed by: T. Darcy Sullivan, P.E. Distributed by: Tennessee Transportation Assistance Program (TTAP)							
VC/R1																	

TRAFFIC SIGNAL WARRANT ANALYSIS - VOLUME WARRANTS

Intersection : Schaad Road at Johnson Road City or County : Knox County State : Tennessee	Date of Count: 31-Aug-21 Day of Week of Count: Average Weekday	Are warranting volumes to be adjusted for speeds or built up area? Yes Adjustment factor for day of week and month of year of count 1.00 Number of Lanes: Major Street . . . 2 Minor Street . . . 2
--	---	--

Major Street	Minor Street	Warrant #1A (8 Hr. - Min. Vol.)	Warrant #1B (8 Hr. - Interruption)	Combination (Warrants 1A & 1B)	Warrant #2 (Four Hour Vols.)	Warrant #3 (Peak Hour Vols.)
Time	Actual Volume App #1 App #2 Total ----- Beginning	Adjusted Total Volur , ----- Major Minor	Actual Volume ----- Major Minor	Adjusted Total Volur , ----- Major Minor	Percent of Warrant ----- Major Minor	Percent of Warrant ----- Major Minor
6:00 am	0 0 0	0 0	0 0	0 0	0 0	0 0
7:00	807 1177 1984	472 177	315 354	394 221	80 310	100 248
8:00	0 0 0	0 0	0 0	0 0	0 0	0 0
9:00 am	0 0 0	0 0	0 0	0 0	0 0	0 0
10:00	0 0 0	0 0	0 0	0 0	0 0	0 0
11:00	0 0 0	0 0	0 0	0 0	0 0	0 0
12:00 noon	0 0 0	0 0	0 0	0 0	0 0	0 0
1:00	0 0 0	0 0	0 0	0 0	0 0	0 0
2:00	0 0 0	0 0	0 0	0 0	0 0	0 0
3:00 pm	0 0 0	0 0	0 0	0 0	0 0	0 0
4:00	0 0 0	0 0	0 0	0 0	0 0	0 0
5:00	1147 728 1875	446 247	298 494	372 309	80 433	100 346
6:00 pm	0 0 0	0 0	0 0	0 0	0 0	0 0
7:00	0 0 0	0 0	0 0	0 0	0 0	0 0
8:00	0 0 0	0 0	0 0	0 0	0 0	0 0
Note: , No adjus ment made - Where more than one minor approach exists use the higher approach volume. - Number of hours shown is the minimum meeting the MUTCD requirements. Additional hours outside of the count period may meet the MUTCD specified volume levels.		Warranting Volumes 420 140 Total Hours Meeting Warrant = 2 . Warrant Met No	Warranting Volumes 630 70 Total Hours Meeting Warrant = 2 . Warrant Met No	Warranting Volumes 504 112 Total Hours Meeting Warrant = 2 . Warrant Met No	Warranting Volumes From MUTCD Fig. 4-8 Total Hours Meeting Warrant = 2 . Warrant Me No	Warranting Volumes From MUTCD Fig. 4-6 Total Hours Meeting Warrant = 2 . Warrant Me Yes

***** Major Street volume is so low that no
Minor Street warrant exists

Comments: (include any information which may be useful to the reviewer) <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> Major Street - Schaad Road Minor Street - Johnson Road All volumes included. </div>	<div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> Volumes represent 2024 Combined conditions with Schaad Road extension. Volumes represent AM and PM peak hours. </div>
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Analysis Prepared by: CANNON AND CANNON, INC. Brian J. Haas, P.E., PTOE	Date: 12/01/21 Time: 13:12	Developed by: T. Darcy Sullivan, P.E. Distributed by: Tennessee Transportation Assistance Program (TTAP)
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TRAFFIC SIGNAL WARRANT ANALYSIS - VOLUME WARRANTS

Intersection : Ball Camp Pike at Johnson Road City or County : Knox County State : Tennessee	Date of Count: 31-Aug-21 Day of Week of Count: Average Weekday	Are warranting volumes to be adjusted for speeds or built up area? No Adjustment factor for day of week and month of year of count 1.00 Number of Lanes: Major Street . . . 1 Minor Street . . . 2
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Major Street	Minor Street	Warrant #1A (8 Hr. - Min. Vol.)	Warrant #1B (8 Hr. - Interruption)	Combination (Warrants 1A & 1B)	Warrant #2 (Four Hour Vols.)	Warrant #3 (Peak Hour Vols.)					
Time	Actual Volume App #1 App #2 Total	Adjusted Total Volume	Actual Volume - Volume	Adjusted Total Volume	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor
Beginning											
6:00 am	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
7:00	503 552 1055	1055	210	210	211 105	141 210	176 131	130 162	250 84	0 84	0 84
8:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	
9:00 am	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	
10:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	
11:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	
12:00 noon	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	
1:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	
2:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	
3:00 pm	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	
4:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	
5:00	805 388 1193	1193	119	119	239 60	159 119	199 74	100 119	210 57	0 57	0 57
6:00 pm	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	
7:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	
8:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	
		Warranting Volumes 500 200		Warranting Volumes 750 100		Warranting Volumes 600 160		Warranting Volumes From MUTCD Fig. 4-7		Warranting Volumes From MUTCD Fig. 4-5	
		Total Hours Meeting Warrant = 1 . Warrant Met No		Total Hours Meeting Warrant = 2 . Warrant Met No		Total Hours Meeting Warrant = 1 . Warrant Met No		Total Hours Meeting Warrant = 2 . Warrant Met No		Total Hours Meeting Warrant = 0 . Warrant Met No	

Note: . No adjus ment made
 - Where more than one minor approach exists use the higher approach volume.
 - Number of hours shown is the minimum meeting the MUTCD requirements. Additional hours outside of the count period may meet the MUTCD specified volume levels.

***** Major Street volume is so low that no Minor Street warrant exists

Comments: (include any information which may be useful to the reviewer) Major Street - Ball Camp Pike Minor Street - Johnson Road All volumes included.	Volumes represent 2021 Existing conditions. Volumes represent AM and PM peak hours.
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Analysis Prepared by: CANNON AND CANNON, INC. Brian J. Haas, P.E., PTOE	Date: 10/15/21 Time: 09:53	Developed by: T. Darcy Sullivan, P.E. Distributed by: Tennessee Transportation Assistance Program (TTAP)
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TRAFFIC SIGNAL WARRANT ANALYSIS - VOLUME WARRANTS

Intersection :	Ball Camp Pike at Johnson Road	Date of Count:	31-Aug-21	Are warranting volumes to be adjusted for speeds or built up area?	No
City or County :	Knox County	Day of Week of Count:	Average Weekday	Adjustment factor for day of week and month of year of count	1.00
State :	Tennessee			Number of Lanes: Major Street . . . 1 Minor Street . . . 1	

Major Street					Minor Street	
Time	Actual Volume			Adjusted Total Volume	Actual Volume	Adjusted Total Volume
Beginning	App #1	App #2	Total	Volu	-	Volu
6:00 am	0	0	0	0	0	0
7:00	0	522	522	522	198	198
8:00	0	0	0	0	0	0
9:00 am	0	0	0	0	0	0
10:00	0	0	0	0	0	0
11:00	0	0	0	0	0	0
12:00 noon	0	0	0	0	0	0
1:00	0	0	0	0	0	0
2:00	0	0	0	0	0	0
3:00 pm	0	0	0	0	0	0
4:00	0	0	0	0	0	0
5:00	0	383	383	383	119	119
6:00 pm	0	0	0	0	0	0
7:00	0	0	0	0	0	0
8:00	0	0	0	0	0	0

Warrant #1A (8 Hr. - Min. Vol.)	
Percent of Warrant	
Major	Minor
0	0
104	132
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
77	79

Warrant #1B (8 Hr. - Interruption)	
Percent of Warrant	
Major	Minor
0	0
70	264
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
51	159

Combination (Warrants 1A & 1B)	
Percent of Warrant	
Major	Minor
0	0
87	165
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
64	99

Warrant #2 (Four Hour Vols.)	
Warrant	Percent of Warrant
Volume	
0	****
240	83
0	****
0	****
0	****
0	****
0	****
0	****
0	****
0	****
0	****
0	****

Warrant #3 (Peak Hour Vols.)	
Warrant	Percent of Warrant
Volume	
0	****
400	50
0	****
0	****
0	****
0	****
0	****
0	****
0	****
0	****
0	****
0	****

Note:

- No adjus ment made
- Where more than one minor approach exists use the higher approach volume
- Number of hours shown is the minimum meeting the MUTCD requirements. Additional hours outside of the count period may meet the MUTCD specified volume levels.

Warranting Volumes	
500	150
Total Hours Meeting Warrant =	1
Warrant Met	No

Warranting Volumes	
750	75
Total Hours Meeting Warrant =	0
Warrant Met	No

Warranting Volumes	
600	120
Total Hours Meeting Warrant =	0
Warrant Met	No

Warranting Volumes	
From MUTCD Fig. 4-7	
Total Hours Meeting Warrant =	0
Warrant Me	No

**** Major Street volume is so low that no Minor Street warrant exists

Comments: (include any information which may be useful to the reviewer)	Volumes represent 2021 Existing conditions. Volumes represent AM and PM peak hours.
Major Street = Ball Camp Pike Minor Street = Johnson Road Only westbound through and southbound right turn volumes included.	

Analysis Prepared by: CANNON AND CANNON, INC. Brian J. Haas, P.E., PTOE	Date: 10/15/21 Time: 09:53	Developed by: T. Darcy Sullivan, P.E. Distributed by: Tennessee Transportation Assistance Program (TTAP)	VC/R1
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TRAFFIC SIGNAL WARRANT ANALYSIS - VOLUME WARRANTS

Intersection : Ball Camp Pike at Johnson Road City or County : Knox County State : Tennessee	Date of Count: 31-Aug-21 Day of Week of Count: Average Weekday	Are warranting volumes to be adjusted for speeds or built up area? No Adjustment factor for day of week and month of year of count 1.00 Number of Lanes: Major Street . . . 1 Minor Street . . . 2
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Major Street	Minor Street	Warrant #1A (8 Hr. - Min. Vol.)	Warrant #1B (8 Hr. - Interruption)	Combination (Warrants 1A & 1B)	Warrant #2 (Four Hour Vols.)	Warrant #3 (Peak Hour Vols.)				
Time	Actual Volume App #1 App #2 Total	Adjusted Total Volume	Actual Volume - Volume	Adjusted Total Volume	Percent of Warrant	Percent of Warrant	Percent of Warrant	Percent of Warrant	Percent of Warrant	Percent of Warrant
Beginning	App #1 App #2 Total	Volume	-	Volume	Major Minor	Major Minor	Major Minor	Major Minor	Volume Warrant	Volume Warrant
6:00 am	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 *****	0 *****
7:00	543 596 1139	1139	227	227	228 114	152 227	190 142	110 206	110 *****	230 99
8:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 *****	0 *****
9:00 am	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 *****	0 *****
10:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 *****	0 *****
11:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 *****	0 *****
12:00 noon	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 *****	0 *****
1:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 *****	0 *****
2:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 *****	0 *****
3:00 pm	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 *****	0 *****
4:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 *****	0 *****
5:00	870 419 1289	1289	129	129	258 65	172 129	215 81	90 143	90 *****	190 68
6:00 pm	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 *****	0 *****
7:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 *****	0 *****
8:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 *****	0 *****
Note: . No adjus ment made . Where more than one minor approach exists use the higher approach volume. . Number of hours shown is the minimum meeting the MUTCD requirements. Additional hours outside of the count period may meet the MUTCD specified volume levels.		Warranting Volumes 500 200 Total Hours Meeting Warrant = 1 . Warrant Met No	Warranting Volumes 750 100 Total Hours Meeting Warrant = 2 . Warrant Met No	Warranting Volumes 600 160 Total Hours Meeting Warrant = 1 . Warrant Met No	Warranting Volumes From MUTCD Fig. 4-7 Total Hours Meeting Warrant = 2 . Warrant Me No	Warranting Volumes From MUTCD Fig. 4-5 Total Hours Meeting Warrant = 0 . Warrant Me No				

***** Major Street volume is so low that no Minor Street warrant exists

Comments: (include any information which may be useful to the reviewer)	Volumes represent 2024 Background conditions. Volumes represent AM and PM peak hours.
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Analysis Prepared by: CANNON AND CANNON, INC. Brian J. Haas, P.E., PTOE	Date: 10/15/21 Time: 09:54	Developed by: T. Darcy Sullivan, P.E. Distributed by: Tennessee Transportation Assistance Program (TTAP)
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TRAFFIC SIGNAL WARRANT ANALYSIS - VOLUME WARRANTS

Intersection : Ball Camp Pike at Johnson Road City or County : Knox County State : Tennessee	Date of Count: 31-Aug-21 Day of Week of Count: Average Weekday	Are warranting volumes to be adjusted for speeds or built up area? No Adjustment factor for day of week and month of year of count 1.00 Number of Lanes: Major Street . . . 1 Minor Street . . . 1
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Major Street	Minor Street	Warrant #1A (8 Hr. - Min. Vol.)	Warrant #1B (8 Hr. - Interruption)	Combination (Warrants 1A & 1B)	Warrant #2 (Four Hour Vols.)	Warrant #3 (Peak Hour Vols.)					
Time	Actual Volume App #1 App #2 Total	Adjusted Total Volume	Actual Volume - Volume	Adjusted Total Volume	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor
Beginning											
6:00 am	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
7:00	0 564	564 564	0 214	0 214	113 143	75 285	94 178	230 93	380 56	0 56	0 56
8:00	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
9:00 am	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
10:00	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
11:00	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
12:00 noon	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
1:00	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
2:00	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
3:00 pm	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
4:00	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
5:00	0 414	414 414	0 129	0 129	83 86	55 172	69 108	300 43	0 43	0 43	0 43
6:00 pm	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
7:00	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
8:00	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0

Note: , No adjus ment made

- Where more than one minor approach exists use the higher approach volume.
- Number of hours shown is the minimum meeting the MUTCD requirements. Additional hours outside of the count period may meet the MUTCD specified volume levels.

Warranting Volumes	Warranting Volumes	Warranting Volumes	Warranting Volumes	Warranting Volumes
500 150	750 75	600 120	From MUTCD Fig. 4-7	From MUTCD Fig. 4-5
Total Hours Meeting Warrant = 1 .	Total Hours Meeting Warrant = 0 .	Total Hours Meeting Warrant = 0 .	Total Hours Meeting Warrant = 0 .	Total Hours Meeting Warrant = 0 .
Warrant Met No	Warrant Met No	Warrant Met No	Warrant Me No	Warrant Me No

***** Major Street volume is so low that no Minor Street warrant exists

Comments: (include any information which may be useful to the reviewer)

Major Street - Ball Camp Pike

Minor Street - Johnson Road

Only westbound through and southbound right turn volumes included.

Volumes represent 2024 Background conditions.

Volumes represent AM and PM peak hours.

Analysis Prepared by: CANNON AND CANNON, INC. Brian J. Haas, P.E., PTOE	Date: 10/15/21 Time: 09:54	Developed by: T. Darcy Sullivan, P.E. Distributed by: Tennessee Transportation Assistance Program (TTAP)
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TRAFFIC SIGNAL WARRANT ANALYSIS - VOLUME WARRANTS

[illegible]

TRAFFIC SIGNAL WARRANT ANALYSIS - VOLUME WARRANTS

Intersection : Ball Camp Pike at Johnson Road City or County : Knox County State : Tennessee	Date of Count: 31-Aug-21 Day of Week of Count: Average Weekday	Are warranting volumes to be adjusted for speeds or built up area? No Adjustment factor for day of week and month of year of count 1.00 Number of Lanes: Major Street . . . 1 Minor Street . . . 1
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Major Street	Minor Street	Warrant #1A (8 Hr. - Min. Vol.)	Warrant #1B (8 Hr. - Interruption)	Combination (Warrants 1A & 1B)	Warrant #2 (Four Hour Vols.)	Warrant #3 (Peak Hour Vols.)					
Time	Actual Volume App #1 App #2 Total	Adjusted Total Volume	Actual Volume - Volume	Adjusted Total Volume	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor
Beginning											
6:00 am	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
7:00	0 451 451	451	171	171	90 114	60 228	75 143	280 61	440 39	0 39	0 39
8:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
9:00 am	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
10:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
11:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
12:00 noon	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
1:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
2:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
3:00 pm	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
4:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
5:00	0 331 331	331	103	103	66 69	44 137	55 86	0 0	0 0	0 0	0 0
6:00 pm	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
7:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
8:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
		Warranting Volumes		Warranting Volumes		Warranting Volumes		Warranting Volumes		Warranting Volumes	
		500 150		750 75		600 120		From MUTCD Fig. 4-7		From MUTCD Fig. 4-5	
		Total Hours Meeting		Total Hours Meeting		Total Hours Meeting		Total Hours Meeting		Total Hours Meeting	
		Warrant = 0 .		Warrant = 0 .		Warrant = 0 .		Warrant = 0 .		Warrant = 0 .	
		Warrant Met No		Warrant Met No		Warrant Met No		Warrant Met No		Warrant Met No	

Note: , No adjus ment made
 - Where more than one minor approach exists use the higher approach volume.
 - Number of hours shown is the minimum meeting the MUTCD requirements. Additional hours outside of the count period may meet the MUTCD specified volume levels.

***** Major Street volume is so low that no Minor Street warrant exists

Comments: (include any information which may be useful to the reviewer) Major Street - Ball Camp Pike Minor Street - Johnson Road Only westbound through and southbound right turn volumes included.	Volumes represent 2024 Background conditions with Schaad Road extension. Volumes represent AM and PM peak hours.
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Analysis Prepared by: CANNON AND CANNON, INC. Brian J. Haas, P.E., PTOE	Date: 10/15/21 Time: 09:54	Developed by: T. Darcy Sullivan, P.E. Distributed by: Tennessee Transportation Assistance Program (TTAP)
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TRAFFIC SIGNAL WARRANT ANALYSIS - VOLUME WARRANTS

Intersection : Ball Camp Pike at Johnson Road City or County : Knox County State : Tennessee	Date of Count: 31-Aug-21 Day of Week of Count: Average Weekday	Are warranting volumes to be adjusted for speeds or built up area? No Adjustment factor for day of week and month of year of count 1.00 Number of Lanes: Major Street . . . 1 Minor Street . . . 2
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Major Street	Minor Street	Warrant #1A (8 Hr. - Min. Vol.)	Warrant #1B (8 Hr. - Interruption)	Combination (Warrants 1A & 1B)	Warrant #2 (Four Hour Vols.)	Warrant #3 (Peak Hour Vols.)					
Time	Actual Volume App #1 App #2 Total	Adjusted Total Volume	Actual Volume - Total	Adjusted Total Volume	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor	Percent of Warrant Major Minor
Beginning											
6:00 am	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
7:00	566 601 1167	1167	255	255	233 128	156 255	195 159	110 232	220 116	220 116	220 116
8:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
9:00 am	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
10:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
11:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
12:00 noon	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
1:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
2:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
3:00 pm	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
4:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
5:00	889 423 1312	1312	152	152	262 76	175 152	219 95	90 169	180 84	180 84	180 84
6:00 pm	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
7:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
8:00	0 0 0	0	0	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
		Warranting Volumes 500 200		Warranting Volumes 750 100		Warranting Volumes 600 160		Warranting Volumes From MUTCD Fig. 4-7		Warranting Volumes From MUTCD Fig. 4-5	
		Total Hours Meeting Warrant = 1 .		Total Hours Meeting Warrant = 2 .		Total Hours Meeting Warrant = 1 .		Total Hours Meeting Warrant = 2 .		Total Hours Meeting Warrant = 1 .	
		Warrant Met No		Warrant Met No		Warrant Met No		Warrant Met No		Warrant Met Yes	

Note: . No adjus ment made
 - Where more than one minor approach exists use the higher approach volume.
 - Number of hours shown is the minimum meeting the MUTCD requirements. Additional hours outside of the count period may meet the MUTCD specified volume levels.

***** Major Street volume is so low that no Minor Street warrant exists

Comments: (include any information which may be useful to the reviewer) <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> Major Street - Ball Camp Pike Minor Street - Johnson Road All volumes included. </div>	<div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> Volumes represent 2024 Combined conditions. Volumes represent AM and PM peak hours. </div>
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Analysis Prepared by: CANNON AND CANNON, INC. Brian J. Haas, P.E., PTOE	Date: 12/01/21 Time: 13:15	Developed by: T. Darcy Sullivan, P.E. Distributed by: Tennessee Transportation Assistance Program (TTAP)
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TRAFFIC SIGNAL WARRANT ANALYSIS - VOLUME WARRANTS

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TRAFFIC SIGNAL WARRANT ANALYSIS - VOLUME WARRANTS

Intersection : Ball Camp Pike at Johnson Road City or County : Knox County Date of Count: 31-Aug-21 State : Tennessee Day of Week of Count: Average Weekday				Are warranting volumes to be adjusted for speeds or built up area? No Adjustment factor for day of week and month of year of count 1.00 Number of Lanes: Major Street : 1 Minor Street : 2			
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Major Street						Minor Street	
Time	Actual Volume		Adjusted Total	Actual Volume	Adjusted Total		
Beginning	App #1	App #2	Total	Volur ,	-	Volur ,	
6:00 am	0	0	0	0	0	0	0
7:00	444	482	926	926	195	195	0
8:00	0	0	0	0	0	0	0
9:00 am	0	0	0	0	0	0	0
10:00	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0
12:00 noon	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0
3:00 pm	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0
5:00	704	339	1043	1043	115	115	0
6:00 pm	0	0	0	0	0	0	0
7:00	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	0

Note: , No adjus ment made

- Where more than one minor approach exists use the higher approach volume.
- Number of hours shown is the minimum meeting the MUTCD requirements. Additional hours outside of the count period may meet the MUTCD specified volume levels.

Warrant #1A (8 Hr. - Min. Vol.)		Warrant #1B (8 Hr. - Interruption)		Combination (Warrants 1A & 1B)		Warrant #2 (Four Hour Vols.)		Warrant #3 (Peak Hour Vols.)	
Percent of Warrant		Percent of Warrant		Percent of Warrant		Warrant	Percent of	Warrant	Percent of
Major	Minor	Major	Minor	Major	Minor	Volume	Warrant	Volume	Warrant
0	0	0	0	0	0	0	*****	0	*****
185	98	123	195	154	122	160	122	300	65
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
209	58	139	115	174	72	130	88	260	44
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****

***** Major Street volume is so low that no Minor Street warrant exists

Comments: (include any information which may be useful to the reviewer)

Major Street - Ball Camp Pike
 Minor Street - Johnson Road
 All volumes included.

Volumes represent 2024 Combined conditions with Schaad Road extension.
 Volumes represent AM and PM peak hours.

TRAFFIC SIGNAL WARRANT ANALYSIS - VOLUME WARRANTS

Intersection : Ball Camp Pike at Johnson Road City or County : Knox County Date of Count: 31-Aug-21 State : Tennessee Day of Week of Count: Average Weekday				Are warranting volumes to be adjusted for speeds or built up area? No Adjustment factor for day of week and month of year of count 1.00 Number of Lanes: Major Street : 1 Minor Street : 1			
--	--	--	--	---	--	--	--

Major Street						Minor Street	
Time	Actual Volume		Adjusted Total	Actual Volume	Adjusted Total		
Beginning	App #1	App #2	Total	Volur ,	-	Volur ,	
6:00 am	0	0	0	0	0	0	0
7:00	0	451	451	451	180	180	0
8:00	0	0	0	0	0	0	0
9:00 am	0	0	0	0	0	0	0
10:00	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0
12:00 noon	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0
3:00 pm	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0
5:00	0	331	331	331	111	111	0
6:00 pm	0	0	0	0	0	0	0
7:00	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	0

Note: , No adjus ment made

- Where more than one minor approach exists use the higher approach volume.
- Number of hours shown is the minimum meeting the MUTCD requirements. Additional hours outside of the count period may meet the MUTCD specified volume levels.

Warrant #1A (8 Hr. - Min. Vol.)		Warrant #1B (8 Hr. - Interruption)		Combination (Warrants 1A & 1B)		Warrant #2 (Four Hour Vols.)		Warrant #3 (Peak Hour Vols.)	
Percent of Warrant		Percent of Warrant		Percent of Warrant		Warrant	Percent of Warrant	Warrant	Percent of Warrant
Major	Minor	Major	Minor	Major	Minor	Volume		Volume	
0	0	0	0	0	0	0	*****	0	*****
90	120	60	240	75	150	280	64	440	41
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
66	74	44	148	55	93	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****
0	0	0	0	0	0	0	*****	0	*****

Warranting Volumes
500 150

Total Hours Meeting
Warrant = 0 .
Warrant Met **No**

Warranting Volumes
750 75

Total Hours Meeting
Warrant = 0 .
Warrant Met **No**

Warranting Volumes
600 120

Total Hours Meeting
Warrant = 0 .
Warrant Met **No**

Warranting Volumes
From MUTCD Fig. 4-7

Total Hours Meeting
Warrant = 0 .
Warrant Me **No**

Warranting Volumes
From MUTCD Fig. 4-5

Total Hours Meeting
Warrant = 0 .
Warrant Me **No**

***** Major Street volume is so low that no Minor Street warrant exists

Comments: (include any information which may be useful to the reviewer)

Major Street - Ball Camp Pike

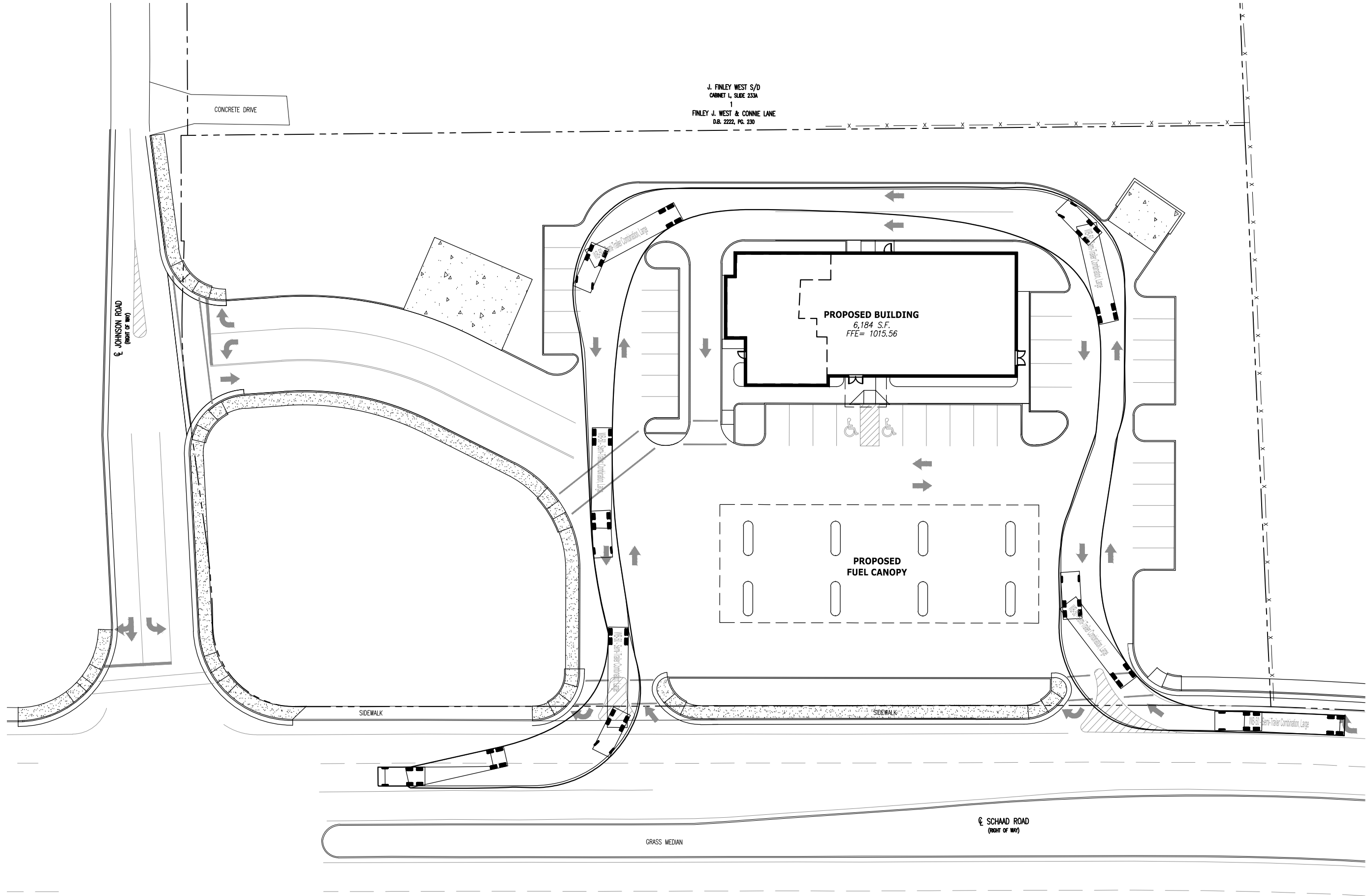
Minor Street - Johnson Road

Only westbound through and southbound right turn volumes included.

Volumes represent 2024 Combined conditions with Schaad Road extension.
 Volumes represent AM and PM peak hours.

Analysis Prepared by: CANNON AND CANNON, INC. Brian J. Haas, P.E., PTOE	Date: 12/01/21 Time: 13:18	Developed by: T. Darcy Sullivan, P.E. Distributed by: Tennessee Transportation Assistance Program (TTAP)
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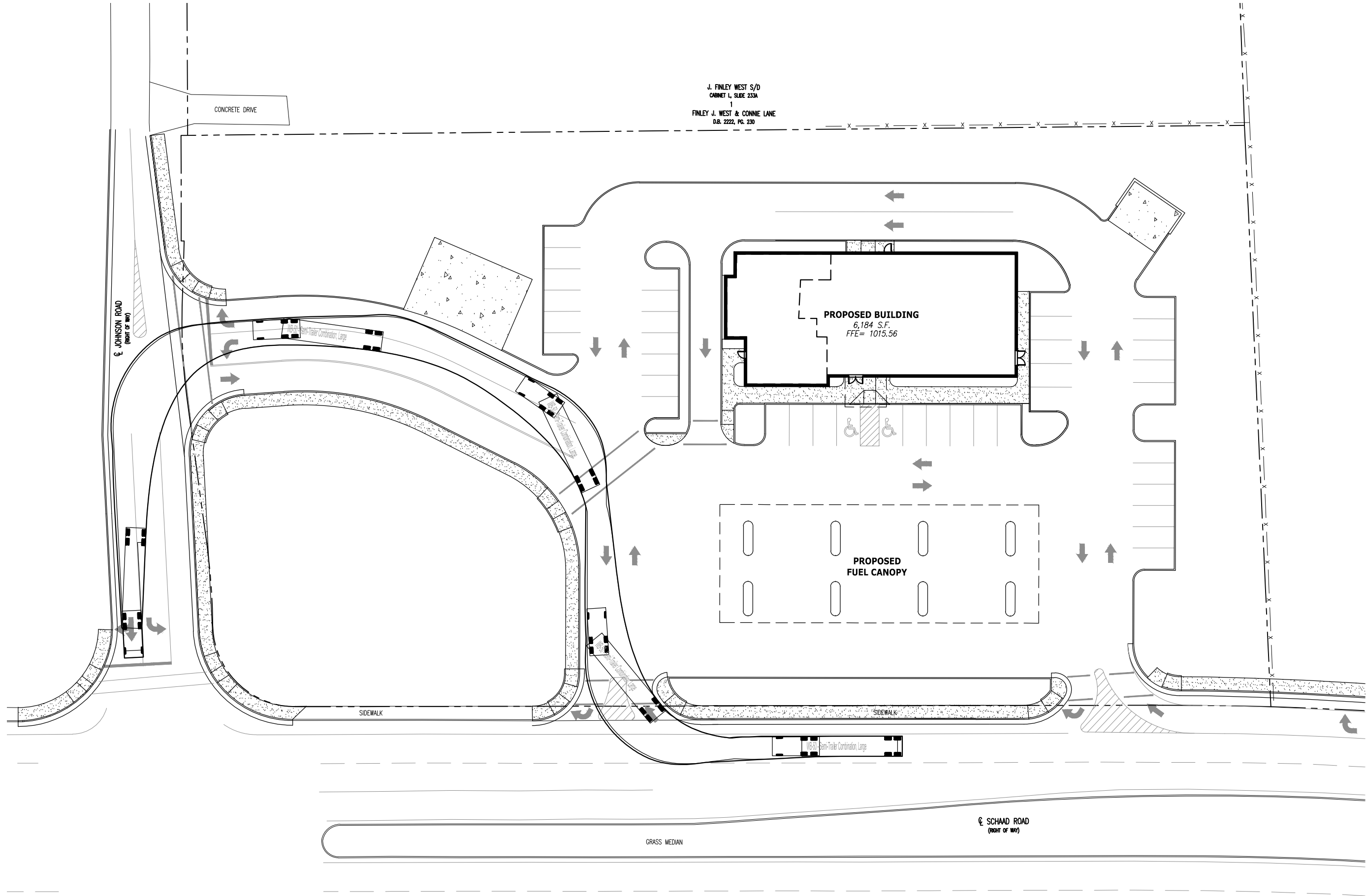
APPENDIX G | SITE CIRCULATION EXHIBITS



TURNING MOVEMENT/CIRCULATION EXHIBIT
DELIVERY TRUCK (WB-50)

CCI PROJ. NO.	01634-0001
DATE	NOVEMBER 22, 2021
SCALE	1" = 40'
DRAWN	JRH
CHECKED	DN

CANNON & CANNON INC
CONSULTING ENGINEERS · FIELD SURVEYORS
TEL 865.670.8555 | 8550 Kingston Pike
WWW.CANNON-CANNON.COM | Knoxville, TN 37919

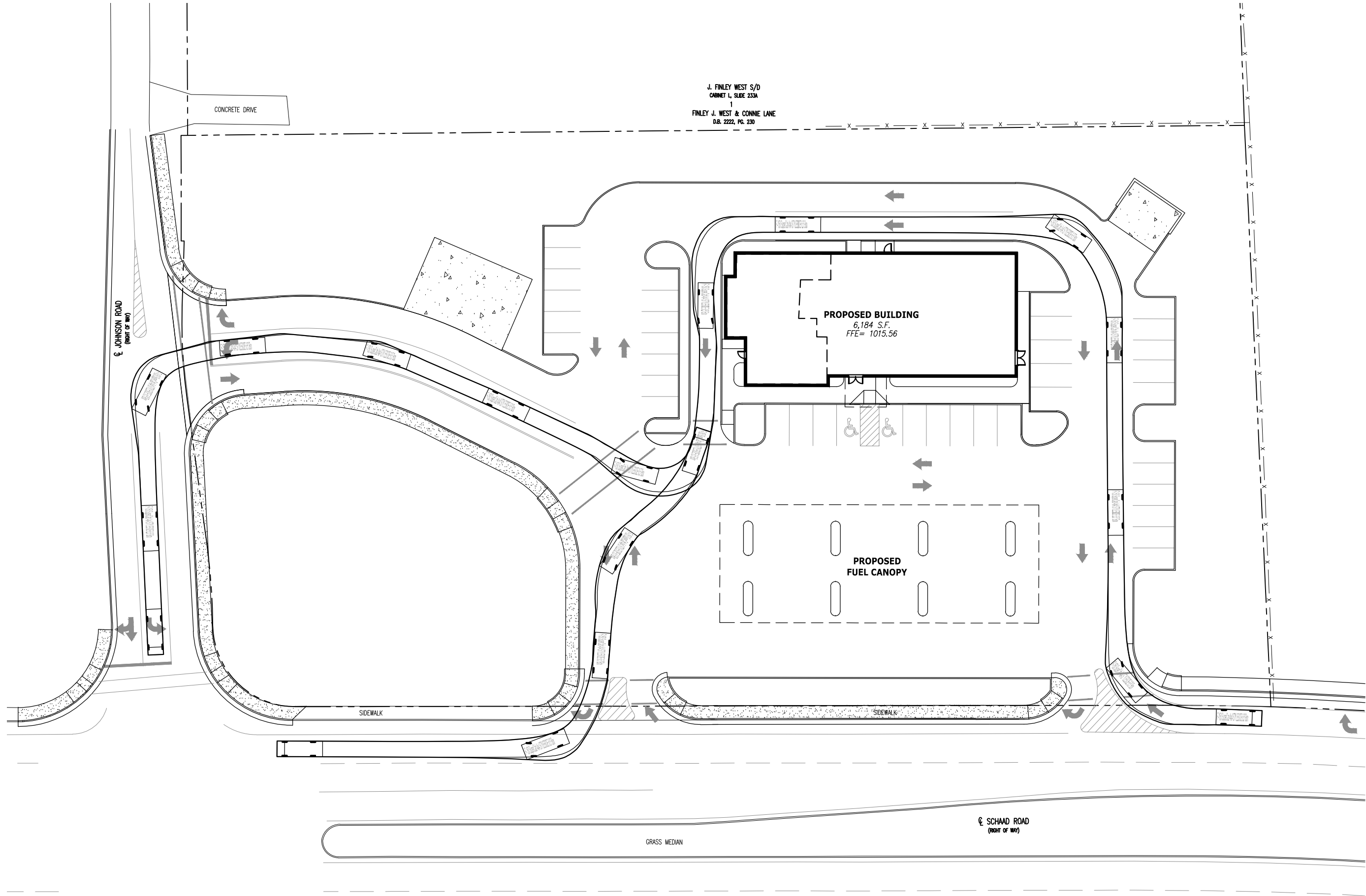


**TURNING MOVEMENT/CIRCULATION EXHIBIT
REFUELING TRUCK (WB-50)**

CCI PROJ. NO.	01634-0001
DATE	NOVEMBER 22, 2021
SCALE	1" = 40'
DRAWN	JRH
CHECKED	DN

**CANNON & CANNON INC**
CONSULTING ENGINEERS · FIELD SURVEYORS

TEL 865.670.8555 || 8550 Kingston Pike
Knoxville, TN 37919
WWW.CANNON-CANNON.COM



TURNING MOVEMENT/CIRCULATION EXHIBIT
DRIVE-THRU (GENERAL AUTO)

CCI PROJ. NO.	01634-0001
DATE	NOVEMBER 22, 2021
SCALE	1" = 40'
DRAWN	JRH
CHECKED	DN

**CANNON & CANNON INC**
CONSULTING ENGINEERS · FIELD SURVEYORS

TEL 865.670.8555

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Knoxville, TN 37919

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APPENDIX H | TIS COMMENT RESPONSE MEMO

Date: November 22, 2021

Project Name: E-Z Stop Food Mart Schaad Road Development

To: Knox County Engineering and Knoxville-Knox County Planning

Subject: TIS Comment Response Document for E-Z Stop Food Mart Schaad Road Development

Review Comments Dated: November 12, 2021

Dear Knox County Engineering and Knoxville-Knox County Planning staff,

The following comment response document is submitted to address comments dated November 12, 2021:

1. **Reviewer Comment:** Please verify the proposed uses analyzed in the TIS are consistent with what are being planning for this site and update as necessary. There appears to be accommodation for a drive-thru window and previous discussion about a possible restaurant use planned on this site but the TIS states only a convenience market and fuel pumps. Provide documentation of on-site circulation needs if drive-thru restaurant is being proposed and determine the potential need for revised trip generation calculations.

Response: Although there is a proposed food service area and pick-up window, it is not expected that this area will generate the amount of trips that are typical with a separate restaurant land use. Additionally, the characteristics of the food service area are consistent with the ITE description of LUC 960. Additional commentary has been provided in the TIS report on Page 15 under both the new "Site Characteristics" subsection and the "Trip Generation" subsection.

2. **Reviewer Comment:** According to the Knox County Access Control and Driveway Design Policy, a corner lot with frontage on an Arterial roadway will be permitted one driveway (based on the development's frontage width) unless there is a need demonstrated in a traffic access and impact study concluding that the adverse impacts of such additional points of access will be outweighed by overall improvements in circulation and safety. Based on this, please provide justification and need for two access points on Schaad Rd as well as any operational issues that may result from the proximity of the westernmost access to Johnson Rd. Also please address the fact that the TIS assigns zero entering vehicles to the western access in terms of how it would be necessary.

Response: A new subsection on Page 15 titled "Site Characteristics" has been added. This subsection describes site circulation and the need for two driveways on Schaad Road. Appendix G has been added, which contains exhibits showing site circulation for various vehicle types. The only apparent operational issue is that once the Schaad Road extension is complete, the westbound through queue at the intersection of Schaad Road at Johnson Road will likely extend beyond the western driveway during the AM peak period.

3. **Reviewer Comment:** Please verify if you were specifically directed to include a 20% Covid factor to increase count volumes since it has not been required for other studies for several months now with schools being fully in-person. Wholesale revision to remove the factor from your analyses will not be specifically required, but please include a broad statement in the conclusions section about the uncertainty involved with this TIS's traffic projections for a number of aspects including the use of a Covid factor and the completion of Schaad Rd that will significantly affect traffic patterns specifically at Johnson Rd which is currently serving as a "detour" route. A recommendation for follow-up traffic counts after completion of the road project and this development to verify the TIS's assumptions and traffic signal warrants seems appropriate.

Response: We were not specifically directed to include the 20% Covid factor and were not aware that it was no longer being used. Commentary has been added to the Conclusions and Recommendations section regarding the uncertainty of traffic volumes along with a recommendation to collect additional traffic data at a future time.

4. **Reviewer Comment:** Following are several text edits that are needed:
- a. Page 1 – Please specify the "southbound Johnson Road approach" in Item 2.
 - b. Page 4 – Change "at" to "and" last line of first paragraph.
 - c. Page 5 – Add "/right turn" to the description of the right lanes on Schaad Road.
 - d. Page 14 – Change "worse" to "worsen" last line of second paragraph.
 - e. Page 15 – We typically prefer to use the trip generation regression equations over the average rates. Please explain why the average rate was used for the AM peak hour trip generation.
 - f. Pages 18 and 21 – The AM southbound right turn trip assignment volume on Johnson Road at the site driveway should be 12 instead of 14 based on the associated Appendix worksheets.
 - g. Page 24 – Please add turn lane warrant analyses for the intersection of Ball Camp Pike at Johnson Road.
 - h. Page 25 – Change Table 6A to Table 7 in the last paragraph.
 - i. Page 35 – Change the eye height from 2.5 feet to 3.5 feet in the last line of the first paragraph under SIGHT DISTANCE ASSESSMENT.
 - j. Page 37 – Please specify the "southbound Johnson Road approach" in Item 2.

Response:

- a. This has been added.
- b. This has been corrected.
- c. This has been added
- d. This has been corrected.

- e. The average rate was used due to the R^2 value being under 0.75, which is typical practice. Commentary has been added regarding this decision to Page 15 of the “Trip Generation” subsection.
 - f. This has been corrected. However, the building size has since slightly increased, which resulted in a wholesale revision of traffic assignment volumes.
 - g. This has been added. Analyses indicate that a westbound right turn lane is warranted only prior to the completion of the Schaad Road extension. An eastbound left turn lane is warranted for all scenarios, including with existing traffic. An installation of an eastbound left turn lane would likely improve operations for eastbound through traffic, but it would not significantly improve operations for other movements. Because of both this and the uncertainty of future traffic once the Schaad Road extension is complete, the installation of a left turn lane was not recommended.
 - h. This has been corrected.
 - i. This has been corrected.
 - j. This has been added.
5. **Reviewer Comment:** Following are inconsistencies/errors in the appendices that need to be addressed:
- a. **The turning movement count data appears to be from a different project.**
 - b. **The cordon line trip distribution splits do not add up to 100% in Figures C-1E, C-1G and C-2G (Appendix pages C-6, C-8 and C-16).**
 - c. **In Figures C-1G and C-1H (Appendix page C-8 and C-9) please include the directional splits and volumes for the pass-by traffic exiting the western site driveway on Schaad Road and showing up as westbound through traffic at the intersection of Schaad Road/Johnson Road.**
 - d. **In Figures C-2G and C-2H (Appendix page C-16 and C-17) please include the directional splits and volumes for the pass-by traffic exiting the western site driveway on Schaad Road and showing up as westbound through traffic at the intersection of Schaad Road/Johnson Road.**

Response:

- a. This has been corrected to include the correct turning movement count data.
- b. This figure technically represents a combination of pass-by traffic and diverted link traffic, where the diverted trips will divert from Schaad Road to Johnson Road. Since the intersection of Schaad Road at Johnson Road contains both of these types of trips, then the sum of the percentages on each leg of the intersection may not equal the sum of the percentages on upstream or downstream intersections.
- c. Since these pass-by trips are existing traffic, the westbound traffic is only shown entering and exiting the site. This traffic is already passing westbound through the intersection of Schaad Road at Johnson Road, so there is a net of zero for this movement.

- d. Since these pass-by trips are existing traffic, the westbound traffic is only shown entering and exiting the site. This traffic is already passing westbound through the intersection of Schaad Road at Johnson Road, so there is a net of zero for this movement.

In addition to the above revisions, the building size slightly increased, which caused a wholesale revision to the trip assignment and combined volume values. This revision did not cause any significant changes to the analyses nor did it result in revised recommendations.

Sincerely,



Brian J. Haas, P.E., PTOE

