

# Transportation Impact Study Hayden Hill Phase 4 Knox County, Tennessee



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#### **EXECUTIVE SUMMARY**

#### Preface:

Safe Harbor Development is proposing to construct a residential development adjacent to Sam Lee Road in Knox County, TN. The name of this proposed residential development is "Hayden Hill Phase 4" and will consist of 152 single-family detached houses on 100.3± acres. This development will be located to the west and across the road from the previously approved residential development of Hayden Hill Phase 1, 2, and 3. Phase 4, along with the first three phases, is anticipated to be fully built-out and occupied by 2023. The primary purpose of this study is to determine and evaluate the potential impacts of Hayden Hill Phase 4 on the adjacent transportation system. This study also includes the analysis of the potential impact of the unconstructed portions of the first three phases of the adjacent residential development. The study includes a review of the operating characteristics of the existing transportation system that will provide access to the proposed development site. Recommendations and mitigation measures will be analyzed and offered where traffic operations have been projected to be below traffic engineering standards.

#### Study Results:

The findings of this study include the following:

- At full build-out and occupancy, Phase 4 of the residential development is expected to generate approximately 1,529 trips on an average weekday. 113 of these trips are estimated to occur during the AM peak hour and 152 trips in the PM peak hour at full build-out and occupancy in the year 2023.
- Adjacent to Phase 4, Hayden Hill Phase 1, 2, and 3 are currently under construction with dozens of homes sold and occupied. This adjacent residential development consists of single-family detached houses and multi-family attached townhouses. The remaining houses yet to be constructed and occupied in this development are expected to generate an additional 2,062 trips on an average weekday. From the remaining house construction, an additional 141 trips are estimated to occur during the AM peak hour and 185 trips in the PM peak hour at full build-out and occupancy in the year 2023.
- The addition of the projected residential development trips is not anticipated to significantly reduce traffic operations at the studied intersections in the year 2023. The minor approaches of the studied intersections and the left-turn movements on Sam Lee Road were calculated to operate satisfactorily with respect to average



vehicle delay.

• The addition of the projected residential development trips is not anticipated to reduce traffic operations on Sam Lee Road. The roadway capacity of Sam Lee Road is more than adequate to handle the additional traffic that will be generated by the residential development.

#### **Recommendations**:

The following recommendations are offered based on the study analyses:

- No specific improvements or upgrades are recommended for the Sam Lee Road at Ironside Boulevard intersection.
- Only a single exiting lane for left and right exiting vehicles is required at the Road "A" entrance and Road "E" entrance for Phase 4. Also, separate left-turn lanes or right-turn lanes on Sam Lee Road into the subdivision entrances are not warranted.
- The proposed entrances, Road "A" and Road "E", for Phase 4 on Sam Lee Road at will need a minimum of 300 feet of intersection sight distance. The designer should ensure that these intersections are given the maximum amount of sight distance to provide clear unobstructed views. The intersection sight distance at these proposed entrances needs to be measured by a licensed surveyor.
- It is recommended that a 24" white stop bar be applied to the pavement of the Road "A" and Road "E" approaches at Sam Lee Road. Stop Signs (R1-1) should be posted at these approaches at Sam Lee Road.
- Intersection sight distance at both entrances on Sam Lee Road must not be impacted by future landscaping or by existing or future vegetation.
- Since the Road "A" intersection is located on a crest vertical curve with horizontal curvature on Sam Lee Road, it is recommended that a Cross Road Intersection Sign (W2-1) be installed in advance of the intersection on each approach of Sam Lee Road.
- If school bus stops occur at the new intersections on Sam Lee Road in the future, it is recommended that School Bus Stop Ahead Signs (S3-1) should be installed in advance of the intersections.
- Since the Road "E" intersection is located near a horizontal curve with a significant vertical road grade, it is recommended that Side Road Intersection Signs (W2-2L and W2-2R) be installed in advance of the intersection on each approach of Sam Lee Road.



- Sam Lee Road currently has areas of distressed pavement. It is recommended that Sam Lee Road be repaved by the County after the residential subdivisions are built, and when completed, re-apply double yellow centerlines on Sam Lee Road, and improve the road shoulders.
- It is recommended that the County reinstall the 30-mph speed limit sign on the west side of Sam Lee Road east of Steele Road. This sign location is located at 11354 Sam Lee Road. The sign is missing, and the post has been pushed over.
- It is recommended that 25-mph speed limit signs be posted on Road "A" and Road "E" in Phase 4 for vehicles traveling into the new residential subdivision.
- No direct access to Sam Lee Road should be provided to Lot 38 in Phase 4. This is the only lot shown on the concept plan adjacent to Sam Lee Road.
- Stop Signs (R1-1), white stop bars and speed limit signage should be installed internally on the new streets of Phase 4 as shown in the report.
- Sight distance at the new intersections in Hayden Hill Phase 4 must not be impacted by new signage or future landscaping. For a posted speed limit of 25-mph in Hayden Hill Phase 4, the intersection sight distance is 250 feet. The stopping sight distance required is 155 feet for a level road grade. The road layout designer should ensure that these sight distance lengths are met, and they should be labeled on the plans.
- All drainage grates and covers for the residential development need to be pedestrian and bicycle safe.
- The internal sidewalks that are proposed for the development should have appropriate ADA compliant curbed ramps at intersection corners and the sidewalks are recommended to be 5 feet minimum in width.
- The United States Postal Service (USPS) has recently implemented changes to its guidelines for delivery in new residential subdivisions. If directed by the local post office, the designer should include an area within the development with a parking area for a centralized mail delivery center.
- All road grade and intersection elements internally and externally should be designed to AASHTO, TDOT, and Knox County specifications and guidelines to ensure proper operation.



#### **DESCRIPTION OF EXISTING CONDITIONS**

#### **STUDY AREA:**

The proposed location of this new residential development is shown on a map in Figure 1. This proposed development is located adjacent to Sam Lee Road in west Knox County, TN. The development will be located to the west and across the road from the previously approved development of Hayden Hill Phase 1, 2, and 3. Phase 4 is to be comprised of six new paved streets and will contain a maximum of 152 single-family detached residential houses on approximately 100.3 acres. To analyze the transportation impacts associated with the proposed development, the following roadways and intersections were reviewed in this report where the greatest impact is expected and as requested by the Knoxville/Knox County Planning Department:

- Sam Lee Road at Ironside Boulevard (Existing Hayden Hill Phase 1, 2, & 3 North Entrance)
- Sam Lee Road at Road "A" (Hayden Hill Phase 4 Entrance)/Narrow Leaf Drive (Existing Hayden Hill Phase 1, 2, & 3 South Entrance)
- Sam Lee Road at Road "E" (Hayden Hill Phase 4 Entrance)

Sam Lee Road will be the sole access roadway for the development to outside destinations. In the vicinity of the study area, there are several other residential subdivisions, individual residences, undeveloped properties, commercial developments, and a church. Besides a few small farm buildings, the proposed development property is currently unoccupied and consists of pastureland and woodlands.

The proposed site property for Hayden Hill Phase 4 is bounded by several single-family residences and undeveloped properties to the west, Sam Lee Road to the south (with developing residential subdivisions across the road that do not have access to Sam Lee Road), undeveloped property and Beaver Creek to the north, and Sam Lee Road to the east with Hayden Hill Phase 1, 2, and 3 across the road.



**Existing Development Site** 





Figure 1 Location Map



#### **EXISTING ROADWAYS:**

Table 1 shows the characteristics of the key existing roadway adjacent to the development property and included in the study:

#### TABLE 1 STUDY CORRIDOR CHARACTERISTICS

NAME	CLASSIFICATION <sup>1</sup>	SPEED LIMIT	LANES	ROAD WIDTH <sup>2</sup>	TRANSIT <sup>3</sup>	PEDESTRIAN FACILITIES	BICYCLE FACILITIES
Sam Lee Road	Major Collector	30 mph	2 undivided	18 feet	None	No sidewalks along roadway	No bike lanes

<sup>1</sup> 2018 Major Road Plan by Knoxville/Knox County Planning

<sup>2</sup> Edge of curb to edge of curb or edge of pavements near project site

<sup>3</sup> According to Knoxville Area Transit System Map

**Sam Lee Road** traverses in a general northeast-southwest direction. Sam Lee Road has many horizontal and vertical curves with two sharp horizontal curves (nearly 90°) to the west of the project site. In the vicinity of these two sharp road curves, the double yellow centerline on Sam Lee Road is delineated by rumble strips. Sam Lee Road adjacent to the project site currently consists of a 2-lane pavement section approximately 18 feet wide with approximately 9-foot lanes with minimal clearance outside the



pavement surface. Sam Lee Road is approximately 2.6 miles in length. Roadway lighting is not currently provided on Sam Lee Road at the studied intersections.

Sam Lee Road intersects Solway Road on the northeastern end and at the southwestern end, it continues for a short distance past the intersection of Steele Road/Swafford Road before transitioning into Couch Mill Road. Solway Road and Steele Road will provide the secondary level access for the generated traffic by the development to outside destinations. Both Solway Road and Steele Road run in a northwest/southeast direction and both provide access to Hardin



Valley Road to the south. Several public schools and a public community college are located to the south on Hardin Valley Road. Refer to Figure 2 below for clarification of the current existing road system.



Figure 2 Existing Roadways Adjacent to Hayden Hill Phase 4

From the proposed development on Sam Lee Road, Pellissippi Parkway is just slightly over 2 miles away via Solway Road. Besides the school facilities to the south, Hardin Valley Road provides access to several other residential subdivisions, numerous retail and commercial businesses, and a variety of eating establishments.

Figure 3 on the following page shows the lane configurations along Sam Lee Road, traffic signage in the study area, and the location where the traffic counts were conducted. The pages following Figure 3 provide an overview of the site study area with photographs.





### **PHOTO EXHIBITS**



Sam Lee Road near Proposed Road "E" Entrance to Hayden Hill Phase 4







Transportation Impact Study Hayden Hill Phase 4



Sam Lee Road near Proposed Road "A" / Narrow Leaf Drive Entrance to Hayden Hill Phase 4







Transportation Impact Study Hayden Hill Phase 4



Sam Lee Road at Ironside Boulevard -Hayden Hill Phase 1, 2, & 3



View of Sam Lee Road at Ironside Boulevard - Hayden Hill Phase 1, 2, & 3 (Looking Northwest)





Sam Lee Road near Proposed Road "E" Entrance to Hayden Hill Phase 4





#### • EXISTING TRANSPORTATION VOLUMES PER MODE:

There is one permanent vehicular traffic count location adjacent to this project site. Counts at this location are conducted by the Tennessee Department of Transportation (TDOT) every year. The count location data is the following:

 Average Daily Traffic (ADT) on Sam Lee Road to the east of the intersection with Ironside Boulevard was reported by the TDOT at 646 vehicles per day in 2018. However, this count station has only been recording at this location for the past 3 years (2016-2018). From 2016 – 2018, this count station has indicated a +21.7% average annual growth rate. The historical traffic count data for this location can be viewed in Appendix A.

Bicycle facilities (lanes) and pedestrian sidewalks are not currently available within the project site study area along Sam Lee Road. Currently, sidewalks are available on one side of Ironside Boulevard and one side of the constructed internal streets in Hayden Hill Phase 1.

• The average daily pedestrian and bicycle traffic along the study corridor is not known. No pedestrians or bicyclists were observed walking or riding along Sam Lee Road. However, several schoolchildren were observed walking to and from the entrance of Hayden Hill along Ironside Boulevard when arriving and departing public school buses.

#### • <u>ON-STREET PARKING</u>:

Currently, on-street parking is not allowed on Sam Lee Road. On-street construction traffic was observed on the streets completed in Hayden Hill Phase 1 & 2.



#### PEDESTRIAN AND BICYCLE FACILITIES:

As stated, pedestrian sidewalks are not provided along Sam Lee Road. 5-foot concrete pedestrian sidewalks are provided in the first phase of Hayden Hill and will be provided on the remaining streets yet to be constructed.

There are not any greenways or parks adjacent to the proposed site. The nearest greenway and park facilities to the proposed residential development are located nearly 2 miles to the southeast at Pellissippi State Community College. The Pellissippi Parkway Greenway runs from Pellissippi State Community College to the south to Carmichael Road and parallels



Pellissippi Parkway on the west side. The greenway is paved and is approximately 1 mile in length.

Separate bicycle facilities (lanes) are not currently available within the project site study area along Sam Lee Road.



■ WALK SCORE:



A private company offers an online website at walkscore.com that grades and gives scores to locations within the United States based on "walkability", "bikeability", and transit availability. According to the website, the numerical values assigned for the Walk Score and the Bike Score are based on the distance to the closest amenity in various relevant categories (businesses, schools, parks, etc.) and are graded from 0 to 100. The Transit Score measures how well a location is served by public transit based on distance and type of nearby transit. The Transit Score is also graded from 0 to 100.

Appendix B shows a map and other information for the Walk Score, Bike Score, and Transit Score at the proposed development property (11181 Sam Lee Road). Based on the project location, the location is given a Walk Score of 2. This Walk Score indicates that the site is completely dependent on vehicles for errands and travel. The site is given a Bike Score of 1, which means that there is minimal bike infrastructure but is somewhat bikeable. Also, based on the project location, the site is given a Transit Score of 0 due to no existing nearby public transportation options.

#### TRANSIT SERVICES:

The City of Knoxville has a network of public transit opportunities offered by Knoxville Area Transit (KAT). Bus service is not available in this area of Knox County. The overall KAT bus system map is in Appendix C. The closest public transit bus service is nearly 7 miles away to the south (by roadway) at Parkwest Medical Center. This KAT service is Route 16 "Cedar Bluff Connector". It operates on weekdays and Saturdays and this route map is also included in Appendix C. Other transit services include the East Tennessee Human Resource Agency (ETHRA) and the Community Action Committee (CAC) which provides transportation services when requested along with private taxis, and ride-sharing opportunities (Uber, etc.).



Knox County school buses were observed traveling along Sam Lee Road during the traffic counts, and they were observed stopping at the front of the existing Hayden Hill residential development at Ironside Boulevard several times. Stops were observed at the entrance at 7:25 am, 8:15 am, 3:05 pm, and 3:50 pm. All these stops were buses traveling west towards Solway Road. Each bus stop had approximately a dozen schoolchildren load and unload. Several parents parked their vehicles on Ironside Boulevard during the arrivals and departures. Based on these actions, it is presumed that future school bus stops for schoolchildren in Hayden Hill Phase 4 will also occur at the entrances on Sam Lee Road and the buses will not travel internally in the residential development.



## **PROJECT DESCRIPTION**

#### LOCATION AND SITE PLAN:

The proposed plan layout given by Batson, Himes, Norvell & Poe is shown in Figure 4. As can be seen in the figure, two new streets will tie onto Sam Lee Road on the south and east sides of the development. The residential development will incorporate a portion of the total 100.3 acres with large amounts of open space/common areas. Hayden Hill Phase 4 will contain 152 single-family detached lots and a total of 6 new streets. The size of the single-family detached lots will average approximately 6,250 square feet (.14 acre) to 10,000 square feet (.23 acre) in size with a handful of lots near 17,000 square feet (.39 acre). Each home will have a garage and driveway.

Across Sam Lee Road, Hayden Hill Phase 1, 2, and 3 have been approved for a total of 292 homes. Of those, 210 are single-family detached and 82 are multi-family attached (townhouses). The breakdown of this adjacent residential development is the following:

- Phase 1: 124 single-family detached houses
- Phase 2: 25 single-family detached houses & 82 multi-family attached townhouses
- Phase 3: 61 single-family detached houses

As of the date of this study, 96 houses in Phase 1 have been constructed, sold, and occupied. Several other houses in Phase 1 are currently under construction. In Phase 2, one house and a handful of townhouses have been constructed and are occupied. Several townhouses in Phase 2 are currently under construction. None of the houses in Phase 3 have been constructed. Since this adjacent residential development is not fully built-out, Knoxville/Knox County Planning requested that it be included in the transportation impact study for Hayden Hill Phase 4. The adjacent residential development of Hayden Hill Phase 1, 2, and 3 will have a direct impact on Sam Lee Road and the road will be fully shared with motorists from Hayden Hill Phase 4.

The actual schedule for completion of this new residential development is dependent on economic factors and construction timelines. This project is also contingent on permitting, design, and other issues. However, after consultation with the developer, for this study, it was assumed that the total construction build-out of the development and full occupancy will occur within the next 3 years (2023). Hayden Hill Phase 1, 2, and 3 are expected to be completed and occupied before Phase 4.







#### PROPOSED USES AND ZONING REQUIREMENTS:

The property for the proposed development is within the Knox County limits and is zoned as Planned Residential (PR) with a density of 1-3 units per acre. The existing adjacent surrounding land uses are the following:

- A single property to the north is zoned as Agricultural (A) and consists of a farm with large amounts of pasture. Beaver Creek separates the development property with this farm.
- All the properties to the west and southwest of the proposed development are zoned as Agricultural (A) and currently consists of several single-family residences and undeveloped properties.
- The development is bounded by Sam Lee Road to the south and east. To the south, across Sam Lee Road, the properties are zoned as Low Density Residential (RA) in the Brighton Farms Subdivision and Planned Residential (PR) in the Laurel Ridge Subdivision. These subdivisions do not have access to Sam Lee Road.
- To the southeast across Sam Lee Road, a small 4-acre property is zoned Agricultural (A).
- The property to the east across Sam Lee Road is zoned as Planned Residential (PR) within the Technology Overlay (TO) and contains Phase 1, 2, and 3 of Hayden Hill.

The Planned Residential (PR) zone allows for a variety of land uses primarily within the residential realm. Uses permitted in this zone include single-family dwellings, duplexes, and multi-dwelling structures and developments. The current zoning map is provided in Appendix D.

#### DEVELOPMENT DENSITY:

The proposed density for Hayden Hill Phase 4 is based on a maximum of 152 houses on 100.3 acres. These numbers compute to just over 1.50 dwelling units per acre which is less than the current zoning that allows up to 3 units per acre.



#### • ON-SITE CIRCULATION:

The total length of the six new streets within the development will be just at 6,625 feet (1.25 miles) in length and will be designed and constructed to Knox County, TN specifications. The new streets shown in Figure 4 are labeled Road "A", "B", "C", "D", "E", and "G" (Road "F" not used). The internal roadways for the development will be paved with asphalt, include 8" extruded concrete curbs, and the lane widths will be 13 feet for a total of 26-foot pavement width. The street right-of-way within the development will be 50 feet and each street will have a 5′ concrete sidewalk on at least one side. After construction, the streets will be maintained by Knox County.

#### SERVICE AND DELIVERY VEHICLE ACCESS AND CIRCULATION:

Besides residential passenger vehicles, the new streets will also provide access for service, delivery, maintenance, and fire protection/rescue vehicles. It is not expected that any of these other types of vehicles will impact roadway operations other than when they occasionally enter and exit the development. It is expected that curbside garbage collection services will be provided for this residential subdivision. Concerning fire protection and rescue vehicles, the new roads will be designed and constructed to Knox County specifications and thus expected to be adequate in size. The internal roadways in the subdivision are expected to be able to accommodate these larger types of vehicles along with standard passenger vehicles.



#### TRAFFIC ANALYSIS OF EXISTING AND PROPOSED CONDITIONS

#### **EXISTING TRAFFIC CONDITIONS:**

Traffic counts were conducted on Sam Lee Road as requested by Tarren Barrett, PE, Transportation Engineer for Knoxville/Knox County Planning. Traffic counts were conducted at the intersection of Sam Lee Road at Ironside Boulevard. Traffic counts were obtained on Wednesday, February 4th, 2020, for a total of 5 hours at the intersection. The counts were conducted during the morning and afternoon peak periods from 7 - 9 AM and 3 - 6 PM. Local schools were in session when the traffic counts were conducted. Due to rain during the day of the traffic counts, it is speculated that the construction related traffic for the current phases of Hayden Hill was decreased. Based on the traffic volumes counted, the AM and PM peak hour of traffic were observed at the following times:

Sam Lee Road at Ironside Boulevard (existing entrance for Hayden Hill Phase 1 & 2)
 7:15 – 8:15 AM / 3:30 – 4:30 PM



Narrow Leaf Drive

There is a construction entrance for vehicles working in the existing phases being constructed in Hayden Hill. This construction entrance is marked, and this entrance will be fully opened as Narrow Leaf Drive once construction ends for the existing phases of Hayden Hill. Another construction entrance is located on Sam Lee Road that provides temporary access to the unrelated construction occurring for the Laurel Ridge Subdivision to the south.

The manual tabulated traffic counts can be reviewed in Appendix E. In Figure 5, the volumes shown are from the existing traffic counts during the AM and PM peak hours observed at the intersection. Several school buses were observed during the traffic counts. Most of the traffic observed during the traffic counts were typical passenger vehicles but there was a fair amount of large construction vehicles observed.





Capacity analyses were undertaken to determine the existing Level of Service (LOS) for the intersection of Sam Lee Road at Ironside Boulevard with respect to vehicular traffic. The capacity analyses were calculated by following the methods outlined in the <u>Highway Capacity Manual</u> (HCM) and using Synchro Traffic Software (Version 8).

LOS is a qualitative measurement developed by the transportation profession to express how well an intersection or roadway performs based on a driver's perception. LOS designations include LOS A through LOS F. The designation of LOS A signifies a roadway or intersection operating at best, while LOS F signifies road operations at worst. This grading system provides a reliable straightforward means to communicate road operations to the public. The HCM lists level of service criteria for unsignalized intersections and signalized intersections.



LOS is defined by delay per vehicle (seconds) and roadway facilities are also characterized by the volume-to-capacity ratio (v/c). For example, a delay of 20 seconds at an unsignalized intersection would indicate LOS C and this delay would represent the additional delay a motorist would experience traveling through the intersection. Also, for example, a v/c ratio of 0.75 for an approach at an unsignalized intersection would indicate that the approach at the intersection is operating at 75% of its available capacity. The designations for LOS, which are based on delay, are reported differently for unsignalized and signalized intersections. This is primarily due to motorists having different expectations between the two road facilities. Generally, for most instances, LOS D is considered the upper limit of acceptable delay during peak periods in urban and suburban areas.

For unsignalized intersections, LOS is measured in terms of delay (in seconds). This measure is an attempt to quantify delay that includes travel time, driver discomfort, and fuel consumption. For unsignalized intersections, the analysis assumes that the mainline thru and right-turn traffic does not stop and is not affected by the traffic on the minor/side streets. Thus, the LOS for a twoway stop (or yield) controlled intersection is defined by the delay for each minor approach and for major street left-turn movements. Table 2 lists the level of service criteria for unsignalized



intersections. The analysis results of unsignalized intersections using the HCM methodologies are conservative due to the larger vehicle gap parameters used in the methodology. More often in normal road conditions, drivers are more willing to accept smaller gaps in traffic than what is modeled using the HCM methodology. The unsignalized intersection methodology also does not account for larger gaps sometimes produced by nearby upstream and downstream signalized intersections.

From the capacity calculations for this study, the results from the existing peak hour vehicular traffic can be seen in Table 3 for the intersection. The intersection in the table is shown with a LOS designation, delay (in seconds), and v/c ratio (volume/capacity) for the AM and PM peak hours. Appendix F includes the worksheets from the capacity analyses for the existing peak hour vehicular traffic. As can be seen in Table 3, the studied intersection is shown to operate at good levels during the existing AM and PM peak hours.



# TABLE 2 LEVEL OF SERVICE AND DELAY FOR UNSIGNALIZED INTERSECTIONS



LEVEL OF SERVICE	DESCRIPTION	CONTROL DELAY (seconds/vehicle)
A	Little or no delay	0 - 10
В	Short Traffic Delays	>10 -15
с	Average Traffic Delays	>15 - 25
D	Long Traffic Delays	>25 - 35
Е	Very Long Traffic Delays	>35 - 50
F	Extreme Traffic Delays	>50

Source: Highway Capacity Manual, 6th Edition





#### TABLE 3 2020 INTERSECTION CAPACITY ANALYSIS RESULTS -SAM LEE ROAD AT IRONSIDE BOULEVARD EXISTING TRAFFIC CONDITIONS

INTERSECTION	OI MOVEME						PM PEAK		
		NT LOS	DELAY	V/C	LOS	DELAY	V/C		
			(seconds)			(seconds)			
am Lee Road at	Northbound Left/Ri	ght A	9.6	0.097	А	9.2	0.041		
onside Boulevard	Westbound Left	А	7.4	0.019	А	7.6	0.028		
am Lee Road at onside Boulevard	Northbound Left/Ri Westbound Left	ght A A	(seconds) 9.6 7.4	0.0 0.0	197 119	197 A 119 A	(seconds) 197 A 9.2 119 A 7.6		

Note: All analyses were calculated in Synchro 8 software and reported using HCM 2010 intersection methodology

<sup>a</sup> Level of Service

<sup>b</sup> Average Delay (sec/vehicle)

° Volume-to-Capacity Ratio





#### • OPENING YEAR TRAFFIC CONDITIONS (WITHOUT PROJECT):

Opening year traffic volume estimates represent the future condition the proposed study area is potentially subject to even without the proposed project being developed (no-build option). As previously stated, the build-out and full occupancy for this proposed new residential development is assumed to occur in the year 2023. This corresponds to three years for the development to reach full capacity and occupancy.

Average Daily Traffic (ADT) on Sam Lee Road was reported by the TDOT at 646 vehicles per day in 2018 (historical traffic data is shown in Appendix A). However, this count station has only been recording at this location for the past 3 years (2016-2018). From 2016 – 2018, this count station has indicated a +21.7% average annual growth rate.

It is believed that the calculated annual growth rate based on a couple of years of data at 21.7% could overestimate future growth. To ensure a more reasonable estimate for this study, a +15% annual growth rate was used to consider any future development in the area and potential rising travel volumes. The results of this growth rate applied to the existing thru traffic volumes at the intersection can be seen in Figure 6 for the year 2023. Figure 6 shows the projected opening year



traffic volumes during the AM and PM peak hours based on an assumed annual growth rate of +15%. The only volumes that are adjusted in Figure 6 are the thru volumes on Sam Lee Road at the intersection at Ironside Boulevard. Traffic growth on Ironside Boulevard and the turning movements on Sam Lee Road will be accounted for later in the report analysis. The volumes shown in Figure 6 could potentially exist in the future even if the proposed residential project is not constructed and if no further houses are constructed in Hayden Hill Phase 1, 2, and 3.

The capacity analyses for the studied intersection were calculated with these additional growth volumes for the year 2023 and the worksheets are shown in Appendix F. For vehicular traffic in the year 2023, the intersection was calculated to operate similarly to the existing conditions during the AM and PM peak hours and the results are shown in Table 4. It is important to point out that these projected calculated LOS designations for this intersection assume that the Hayden Hill Phase 4 development is not constructed and also assumes that no additional houses are constructed and occupied in Hayden Hill Phase 1, 2, and 3.



#### TABLE 4 2023 INTERSECTION CAPACITY ANALYSIS RESULTS -SAM LEE ROAD AT IRONSIDE BOULEVARD OPENING YEAR (WITHOUT PROJECT)

	TRAFFIC	APPROACH/		AM PEAK		PM PEAK		
INTERSECTION	CONTROL	MOVEMENT	LOS	DELAY	V/C	LOS	DELAY	V/C
				(seconds)			(seconds)	
Sam Lee Road at	zed	Northbound Left/Right	В	10.0	0.105	А	9.6	0.044
Ironside Boulevard	STOP 2	Westbound Left	А	7.5	0.019	А	7.7	0.029
	usigi							
	5							

Note: All analyses were calculated in Synchro 8 software and reported using HCM 2010 intersection methodology

<sup>a</sup> Level of Service

<sup>b</sup> Average Delay (sec/vehicle)

<sup>c</sup> Volume-to-Capacity Ratio







#### **TRIP GENERATION:**

The estimated amount of traffic that will be generated by the proposed residential development was calculated based upon rates and equations for peak hour trips provided by <u>Trip Generation</u> <u>Manual, 10th Edition</u>, a publication of the Institute of Transportation Engineers (ITE). A generated trip is a single or one-direction vehicle movement that is either entering or exiting the study site. The <u>Trip Generation Manual</u> is the traditional and most popular resource for determining trip generation rates when traffic impact studies are produced. The Manual lists and includes data for a variety of land uses and correlates trips generated based on different variables such as dwelling units, square footage, etc. The data from ITE for the proposed land use is shown in Appendix G. A summary of this information is presented in the following table:

#### TABLE 5 TRIP GENERATION FOR HAYDEN HILL PHASE 4

152 Single-Family Detached Houses

ITE LAND USE CODE	LAND USE DESCRIPTION	UNITS	GENERATED DAILY TRAFFIC	GE AM 1	ENERATI TRAFFIC PEAK HO	ED 2 OUR	GENERATED TRAFFIC PM PEAK HOUR		
			1	ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
#210	Single-Family	152 Houses	1,529	25%	75%		63%	37%	
	Detached Housing			28	85	113	96	56	152
Tot	al New Volume Site	e Trips	1,529	28	85	113	96	56	152

ITE Trip Generation Manual, 10th Edition

Trips calculated by using Fitted Curve Equation

For Hayden Hill Phase 4, with a maximum of 152 single-family detached houses, it is estimated that 28 vehicles will enter and 85 will exit, for a total of 113 generated trips during the AM Peak Hour in the year 2023. Similarly, it is estimated that 96 vehicles will enter and 56 will exit, for a total of 152 generated trips during the PM Peak Hour in the year 2023. The calculated trips generated for an average weekday could be expected to be approximately 1,529 vehicles for the proposed development in the year 2023. No trip reductions were included in the analysis.

Knoxville/Knox County Planning, in addition to analyzing the impact of Hayden Hill Phase 4, also requested that the unconstructed and/or unoccupied houses in Hayden Hill Phase 1, 2, and 3 be included in the study. As stated earlier, many houses have been built in Phase 1 of Hayden Hill, a handful of houses in Phase 2, and none in Phase 3. To consider the projected amount of


traffic that will be generated by this adjacent residential development on Sam Lee Road, trip generation calculations were performed for the remaining houses yet to be constructed and/or occupied. The following houses are yet to be constructed and/or occupied in Phase 1, 2, and 3 of Hayden Hill: 28 single-family detached houses in Phase 1, 24 single-family detached houses in Phase 2, 82 multi-family attached townhouses in Phase 2, and 61 single-family houses in Phase 3. (Note: At the time of this report, just a handful of houses have been constructed and occupied in Phase 2; however, for this study, to streamline the calculations they were assumed not to be.) Table 6 gives a summary of the projected generated trips for Hayden Hill Phase 1, 2, and 3 once the remaining houses are constructed and occupied. The calculations for this data are shown in Appendix G.

#### TABLE 6

#### TRIP GENERATION FOR HAYDEN HILL PHASE 1, 2, and 3 113 Single-Family Detached Houses Remaining to Build and Occupy in Phase 1, 2, and 3 82 Multi-Family Attached Homes (Townhouses) Remaining to Build and Occupy in Phase 2

ITE LAND USE CODE	LAND USE DESCRIPTION	UNITS	GENERATED GENI GENERATED TR UNITS DAILY AM PE. TRAFFIC		GENERATED TED TRAFFIC ( AM PEAK HOUR C		GENERATED TRAFFIC PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
	Single-Family	Phase 1 -	in the second second	25%	75%		63%	37%	
#210*	Detached Housing	28 Houses	323	6	19	25	19	11	30
	Single-Family	Phase 2 -		25%	75%		63%	37%	
#210*	Detached Housing	24 Houses	280	5	17	22	16	10	26
	Multi-Family	Phase 2 -	1	22%	78%		55%	45%	
LOCAL**	Attached Housing	82 Townhouses	799	10	35	45	36	29	65
	Single-Family	Phase 3 -		25%	75%		63%	37%	
#210*	Detached Housing	61 Houses	660	12	37	49	40	24	64
Tot	al New Volume Sit	te Trips	2,062	33	108	141	111	74	185

\* ITE Trip Generation Manual, 10th Edition

\*\* Knoxville-Knox County Planning Trip Generation Rates

Trips calculated by using Fitted Curve Equation

For the constructed and occupied houses in Phase 1 of Hayden Hill, it is assumed that the trips generated by these dwellings are included and were counted in the existing traffic volumes that were tabulated during the manual traffic count.



Figure 7 is provided to help assist in understanding the phasing of Hayden Hill Phase 1, 2, and 3. Knowing the layout and phasing of this adjacent residential development will be beneficial to understanding the methodology of distributing the trips that will be generated and assigned to Sam Lee Road in the next sections of the report. As can be seen in Figure 7, there are two entrances for this adjacent development. To the north, the subdivision will have access at the intersection of Sam Lee Road at Ironside Boulevard, and to the south, the subdivision will have access at the intersection of Sam Lee Road at Narrow Leaf Drive. Both entrances have been constructed and are operational, however, Sam Lee Road at Narrow Leaf Road is only used by construction traffic at this time.





Figure 7 Plan Layout Hayden Hill Phase 1, 2, and 3



### **TRIP DISTRIBUTION AND ASSIGNMENT:**

Figures 8a, 8b, 8c shows the projected distribution for traffic entering and exiting the adjacent residential development of Hayden Hill Phase 1, 2, and 3 and the proposed residential development of Hayden Hill Phase 4 during the future AM and PM peak hours on Sam Lee Road. The projected distribution of trips is separated due to the different calculated rates for the number of trips generated by the detached houses and the attached townhouses. It is also done to separate the projected trips remaining to be generated by the adjacent residential development from the projected trips that will be generated by the proposed development of Hayden Hill Phase 4. The percentages that are shown in the figures pertain only to the projected trips that will be generated by the developments.

To help determine these percentages, the traffic counts that were conducted at the intersection of Sam Lee Road at Ironside Boulevard during the AM and PM peak hours were reviewed and used. It was assumed that the turning movement counts that were recently obtained would be a reasonable estimate for the future trip distribution. Overall, it was assumed that the projected splits in traffic would be 75% / 25%. Thus, 75% of traffic to/from the east and north to Solway Road and 25% of traffic to/from the west and south to Steele Road.

Figure 8a shows the projected distribution of generated trips from just the single-family detached houses entering and exiting the residential development of Hayden Hill Phase 1, 2, and 3. Figure 8b shows the projected distribution of generated trips only from the multi-family attached houses entering and exiting the residential development of Hayden Hill Phase 2. Lastly, Figure 8c shows the projected distribution of generated trips from the single-family detached houses entering and exiting the residential development of Hayden Hill Phase 4. The percentages shown in Figures 8a and 8b are different due to the physical layout of the adjacent subdivision and the location of the single-family and multi-family houses. They were based on assumed internal travel times, travel distances, and the layout of the individual lots within the development.

There are a variety of nearby developments that will potentially "attract" the projected generated traffic to and from all the phases of Hayden Hill subdivision. Some of the largest being the Hardin Valley Academy (high school), Hardin Valley Middle School, Hardin Valley Elementary School, Pellissippi State Community College, and the nearby highway, Pellissippi Parkway for further travel destinations. All these large "attractors" are located to the south of the proposed residential development and accessible via Hardin Valley Road. Pellissippi Parkway will be the major



adjacent access for further destinations in the surrounding Knoxville area.

Figures 9a, 9b, and 9c show the Traffic Assignment of the computed trips that will be generated by the phases (from Tables 5 and 6) and applied to the intersection movements based on the assumed distribution of trips shown in Figures 8a, 8b, and 8c. The assignment of the generated trips also took into account the difference in trips generated based on the land use type (singlefamily attached vs. multi-family detached) and on the location of the homesites within the developments. To calculated these traffic volumes, it should be noted that the through volumes on Sam Lee Road at Road "A"/Narrow Leaf Drive and at Road "E" were calculated by balancing with the volumes at Ironside Boulevard.















## • OPENING YEAR TRAFFIC CONDITIONS (WITH PROJECT):

Overall, several additive steps were taken to estimate the <u>total</u> opening year projected traffic volumes at the studied intersections on Sam Lee Road when both residential developments are fully constructed and occupied by the year 2023. The steps are illustrated below for clarity:



To calculate the total future projected traffic volumes at the studied intersections, the calculated peak hour traffic (from ITE Trip Generation and Knoxville-Knox County Planning trip generation rates) generated by the new proposed Phase 4 development and the remaining houses to be built and occupied in Hayden Hill Phase 1, 2, and 3 were added to the 2023 opening year traffic (shown in Figure 6) by following the predicted directional distributions and assignments (shown in Figures 8a, 8b, 8c and 9a, 9b, 9c). This procedure was necessary to obtain the total projected traffic volumes at the time both developments are fully built-out. Figure 10 shows the total projected AM and PM peak hour volumes at the studied intersections for the year 2023.





Capacity analyses were conducted to determine the projected Level of Service for vehicles at the studied intersections for the year 2023 with the development traffic from both subdivisions. Appendix F includes the worksheets for these capacity analyses.

The results of the capacity calculations for the projected 2023 peak hour vehicular traffic volumes at the intersections on Sam Lee Road can be seen in Tables 7a, 7b, 7c, and 7d for the AM and PM peak hours.

Table 7a reports the calculations for Sam Lee Road at Ironside Boulevard in the projected 2023 conditions. Table 7b shows a summary comparison of Sam Lee Road at Ironside Boulevard for the existing conditions, the projected conditions in 2023 without the projects being fully constructed, and the projected opening year conditions with the projects constructed and occupied in the year 2023. The overall vehicle delays at this intersection were projected to be only slightly increased due to the addition of the traffic volumes generated by the residential developments in the year 2023.

Table 7c reports the results for the 4-way intersection of Sam Lee Road at Road "A"/Narrow Leaf Drive in the year 2023 with the projects being constructed and occupied. Lastly, Table 7d reports the results for the 3-way intersection of Sam Lee Road at Road "E" in the year 2023 with the projects being constructed and occupied.

As can be seen in the tables, all the studied intersections on Sam Lee Road are calculated to operate very well with respect to the level of service in the projected conditions in the year 2023.



#### TABLE 7a 2023 INTERSECTION CAPACITY ANALYSIS RESULTS -SAM LEE ROAD AT IRONSIDE BOULEVARD OPENING YEAR (WITH PROJECT)

	TRAFFIC	APPROACH/		AM PEAK			PM PEAK	
INTERSECTION	CONTROL	MOVEMENT	LOS	DELAY	V/C	LOS	DELAY	V/C
				(seconds)			(seconds)	
Sam Lee Road at	zed	Northbound Left/Right	В	12.5	0.267	В	12.0	0.167
Ironside Boulevard	STOP 2	Westbound Left	Α	7.9	0.040	А	8.3	0.087
	Lisisi							
	5							

Note: All analyses were calculated in Synchro 8 software and reported using HCM 2010 intersection methodology

<sup>a</sup> Level of Service

<sup>b</sup> Average Delay (sec/vehicle)

<sup>c</sup> Volume-to-Capacity Ratio





#### TABLE 7b INTERSECTION CAPACITY ANALYSIS SUMMARY SAM LEE ROAD AT IRONSIDE BOULEVARD

LOCATION / PEAK	20	20 EXISTIN	١G	2023 W	THOUT P	ROJECT	2023	WITH PRO	DJECT
HOUK MOVEMENT	LOS <sup>a</sup>	Delay <sup>b</sup>	v/c <sup>c</sup>	LOS <sup>a</sup>	Delay <sup>b</sup>	v/c <sup>c</sup>	LOS <sup>a</sup>	Delay <sup>b</sup>	v/c <sup>c</sup>
Sam Lee Road at Ironside Boule	evard	STOP							
<u>AM Peak</u> Northbound Loft/Right	•	9.6	0.097	P	10.0	0 105	P	12.5	0.267
Westbound Left	A	7.4	0.097	A	7.5	0.105	A	79	0.207
		/.1	0.017		7.0	0.017		7.7	0.010
PM Peak									
Northbound Left/Right	Α	9.2	0.041	Α	9.6	0.044	В	12.0	0.167
Westbound Left	Α	7.6	0.028	A	7.7	0.029	А	8.3	0.087

Note: All analyses were calculated in Synchro 8 software and reported using HCM 2010 intersection methodology

<sup>a</sup> Level of Service

<sup>b</sup> Average Delay (sec/vehicle)

° Volume-to-Capacity Ratio







#### TABLE 7c 2023 INTERSECTION CAPACITY ANALYSIS RESULTS -SAM LEE ROAD AT ROAD "A" / NARROW LEAF DRIVE OPENING YEAR (WITH PROJECT)

	TR	AFFIC	APPROACH/		AM PEAK			PM PEAK	
INTERSECTION	CO	NTROL	MOVEMENT	LOS	DELAY	V/C	LOS	DELAY	V/C
					(seconds)			(seconds)	
Sam Lee Road at		zed	Northbound Left/Thru/Right	А	7.4	0.001	А	7.4	0.002
Road "A"/Narrow Leaf Drive	STOP	ileu	Eastbound Left/Thru/Right	В	11.6	0.102	В	11.5	0.070
		13 13	Westbound Left/Thru/Right	А	9.5	0.065	А	<b>9.</b> 5	0.047
		Ľ	Southbound Left/Thru/Right	А	7.5	0.007	А	7.5	0.023

Note: All analyses were calculated in Synchro 8 software and reported using HCM 2010 intersection methodology

<sup>a</sup> Level of Service

<sup>b</sup> Average Delay (sec/vehicle)

° Volume-to-Capacity Ratio





#### TABLE 7d 2023 INTERSECTION CAPACITY ANALYSIS RESULTS -SAM LEE ROAD AT ROAD "E" OPENING YEAR (WITH PROJECT)

	TRAFFIC	APPROACH/		AM PEAK			PM PEAK	
INTERSECTION	CONTROL	MOVEMENT	LOS	DELAY	V/C	LOS	DELAY	V/C
				(seconds)			(seconds)	
Sam Lee Road at	zeđ	Northbound Left/Thru	А	7.5	0.005	А	7.4	0.016
Road "E"	STOP	Eastbound Left/Right	А	9.4	0.038	А	9.1	0.023
	Insign							

Note: All analyses were calculated in Synchro 8 software and reported using HCM 2010 intersection methodology

<sup>a</sup> Level of Service

<sup>b</sup> Average Delay (sec/vehicle)

<sup>c</sup> Volume-to-Capacity Ratio





### • <u>POTENTIAL SAFETY ISSUES</u>:

The study area was investigated for potential existing and future safety issues. A couple of features of the adjacent transportation system are discussed in the following pages.

### **EVALUATION OF TURN LANE THRESHOLDS**

The Sam Lee Road at Ironside Boulevard intersection, the Sam Lee Road at Road "A"/Narrow Leaf Drive intersection, and the Sam Lee Road at Road "E" intersection were evaluated for the need for separate turn lanes on Sam Lee Road for entering vehicles into the developments in the year 2023. The design policy that was used for these turn lane evaluations is based on "Knox County's Access Control and Driveway Design Policy". This design policy by Knox County relates vehicle volume thresholds based on prevailing speeds for two-lane and four-lane roadways. Using these criteria, a determination was made whether turn lanes are warranted.

Based on the projected traffic volumes at the intersections on Sam Lee Road and according to "Knox County's Access Control and Driveway Design Policy", separate turn lanes are not warranted on Sam Lee Road for entering vehicles. The Knox County turn lane policy worksheets are in Appendix H and the results that are shown in the Appendix are based on the projected volumes during the AM and PM peak hour volumes at the intersections in the year 2023.

The design policy for turn lane warrants relates volume thresholds based on prevailing speeds for two-lane roadways. The speed classification that was chosen for this evaluation was based on the posted speed limit of 30 mph. Thus, this study evaluation used the Knox County classification for speeds of 35 mph or less with the calculated projected volumes.

## **EVALUATION OF SIGHT DISTANCE**

For evaluating intersections, sight distance evaluations can be categorized into two categories: Stopping Sight Distance (SSD) and Intersection Sight Distance (ISD). SSD is the distance required for a motorist to perceive, react, and for the vehicle to come to a complete stop before colliding with an object in the road. For evaluating intersections, this object would be another vehicle entering the intersection from a minor street. SSD can be considered the <u>minimum</u> visibility distance standard for evaluating the safety of an intersection.



ISD is based on the time required to perceive, react, and complete the desired traffic maneuver once a motorist on a minor street decides to perform a traffic maneuver. Three traffic maneuvers are available for vehicles stopped on a minor street at a 4-way intersection: left-turn from the minor road, right-turn from the minor road, and a crossing maneuver from the minor road across the major road. For turns from the minor street, ISD is needed to allow a stopped motorist on a minor street to turn onto a major street without being overtaken by an approaching vehicle. The most critical (longest) ISD is for left turns from the minor street. The ISD for this maneuver includes the time to turn left and to clear half of the intersection without conflicting with the oncoming traffic from the left and to accelerate to the operating speed of the road without causing approaching vehicles from the right to substantially reduce their speed. SSD can be considered

the <u>desirable</u> visibility distance standard for evaluating the safety of an intersection. In general, SSD is generally more important than ISD; however, the ISD must be at least the same distance or greater than SSD to provide safe operations at an intersection.



Based on a posted speed limit of 30 mph on Sam Lee Road; the typical required intersection sight distance would be 300 feet looking each direction at the intersections at Sam Lee Road based on Knox County policy of requiring 10 feet of sight distance per 1 mph of speed. Based on a posted speed limit of 30 mph on Sam Lee Road and a level grade, the SSD is calculated to be 200 feet.

A cursory examination of the sight distances on Sam Lee Road was undertaken. Based on visual observation, it appears that the intersection sight distance from the proposed location of Road "A" in Phase 4 looking to the north and south on Sam Lee Road is adequate. Using a Nikon Laser Rangefinder at the proposed intersection of Sam Lee Road at Road "A" / Narrow Leaf Drive, the intersection sight distance was estimated to be approximately 350 feet to the north and 400 feet to the south looking from the proposed location of Road "A".

Based on visual observation, it appears that the intersection sight distance from the proposed location of Road "E" in Phase 4 looking to the north and south on Sam Lee Road is marginal to



the north and adequate to the south. The road curvature, existing vegetation, and the road embankment along the southeast side of Sam Lee Road reduces sight distance looking towards the north from the proposed location of Road "E" at Sam Lee Road (see photo below). Using a Nikon Laser Rangefinder at the proposed intersection of Sam Lee Road at Road "E", the intersection sight distance was estimated to be approximately 250 feet to the north and 350 feet to the south looking from the proposed location of Road "A". The sight distances for the proposed intersections need to be verified by a licensed surveyor and shown on the design plans.



View of Sight Distance on Sam Lee Road Looking Northeast from Proposed Location of Road "E"



View of Sight Distance on Sam Lee Road Looking Southwest from Proposed Location of Road "E"



View of Sight Distance on Sam Lee Road Looking North from Proposed Location of Road "A" / Narrow Leaf Drive



View of Sight Distance on Sam Lee Road Looking South from Proposed Location of Road "A" / Narrow Leaf Drive



## **CONCLUSIONS & RECOMMENDATIONS**

The following is an overview of recommendations to minimize the traffic impacts of the proposed development on the adjacent road system while attempting to achieve an acceptable level of traffic flow and safety.

- Sam Lee Road at Ironside Boulevard: For the existing and projected conditions in the AM and PM peak hours, this intersection was calculated to operate with little vehicle delays on the approaches. No specific improvements or upgrades are recommended for this existing intersection.
- 2 Sam Lee Road at Road "A" / Narrow Leaf Drive: For the projected conditions in the AM and PM peak hours, this intersection was calculated to operate with little vehicle delays on the approaches.
  - 2a) The analysis shows that only a single exiting lane for left and right exiting vehicles is required at the Road "A" entrance for Phase 4. Also, separate left-turn lanes or rightturn lanes on Sam Lee Road into this subdivision entrance are not warranted due to the low projected volumes.
  - 2b) The Road "A" proposed entrance for Phase 4 on Sam Lee Road will need a minimum of 300 feet of intersection sight distance. Road "A" has been designed on the concept plan to intersect Sam Lee Road at Narrow Leaf Drive. The designer should ensure that this intersection is given the maximum amount of sight distance to provide clear unobstructed views. The intersection sight distance at this proposed location needs to be measured by a licensed surveyor. The overall required sight distance should be measured at the intersection at a minimum of 15 feet from the edge of the roadway per Knox County subdivision regulations (Section 3.04.J.5). The sight distance should be measured from a driver eye height of three and one-half (3.50) feet on the minor road to a height of object at three and one-half (3.50) feet above the pavement surface on the major road.

Clearing lines on the adjacent corners of the intersection should be shown on the plan to provide the necessary intersection sight distance. The sight distance in both



directions at this intersection on Sam Lee Road will need to be maintained in the future.

- 2c) It is recommended that a 24" white stop bar be applied to the pavement of the Road "A" approach at Sam Lee Road. The stop bar should be applied at a minimum of 4 feet away from the edge of Sam Lee Road and should be placed at the desired stopping point that provides the maximum sight distance. A Stop Sign (R1-1) should be posted at this approach at Sam Lee Road.
- 2d) Intersection sight distance at both entrances on Sam Lee Road must not be impacted by future landscaping or by existing or future vegetation.
- 2e) Since this intersection is located on a crest vertical curve with horizontal curvature on Sam Lee Road, it is recommended that a Cross Road Intersection Sign (W2-1) be installed in advance of the intersection on each approach of Sam Lee Road. According to the Manual on Uniform Traffic Control Devices (MUTCD), this intersection warning sign should be installed no closer than 100 feet



to the intersection based on a posted speed limit of 30 mph. For this intersection, it is recommended that these signs be installed between 200 - 250 feet from the intersection with the final placement location directed by Knox County Engineering.

2f) School bus stops occur at the existing intersection of Sam Lee Road at Ironside Boulevard and School Bus Stop Ahead (S3-1) signs are installed in advance of this intersection in both directions. Once this intersection is fully constructed, if school bus stops occur at this 4way intersection in the future, it is recommended that a School Bus Stop Ahead Sign (S3-1) be installed in advance of this intersection in



both directions. For this intersection, it is recommended that these signs be installed 100 feet in advance of the Cross Road Intersection Signs (W2-1) with the final placement location directed by Knox County Engineering.



3 Sam Lee Road at Road "E": For the projected conditions in the AM and PM peak hours, this intersection was calculated to operate with little vehicle delays on the approaches.

- 3a) The analysis shows that only a single exiting lane for left and right exiting vehicles is required at the Road "E" entrance for Phase 4. Also, separate left-turn lanes or right-turn lanes on Sam Lee Road into the subdivision entrance are not warranted due to the low projected volumes.
- 3b) The proposed entrance Road "E" for Phase 4 on Sam Lee Road will need a minimum of 300 feet of intersection sight distance. For the Phase 4 entrance of Sam Lee Road at Road "E", the sight distance looking to the north is marginal and it appears that vegetation (and possibly portions of an embankment) on the south side of Sam Lee Road needs to be removed along the right of way to achieve the necessary sight distance. The designer should ensure that this intersection is given the maximum amount of sight distance to provide clear unobstructed views. The intersection sight distance at this proposed location needs to be measured by a licensed surveyor. The overall required sight distance should be measured at the intersection at a minimum of 15 feet from the edge of the roadway per Knox County subdivision regulations (Section 3.04.J.5). The sight distance should be measured from a driver eye height of three and one-half (3.50) feet on the minor road to a height of object at three and one-half (3.50) feet above the pavement surface on the major road.

Clearing lines on the adjacent corners of the intersection should be shown on the plan to provide the necessary intersection sight distance. The sight distance in both directions at this intersection on Sam Lee Road will need to be maintained in the future.

- 3c) It is recommended that a 24" white stop bar be applied to the pavement of the Road "E" approach at Sam Lee Road. The stop bar should be applied at a minimum of 4 feet away from the edge of Sam Lee Road and should be placed at the desired stopping point that provides the maximum sight distance. A Stop Sign (R1-1) should be posted at this approach at Sam Lee Road.
- 3d) Intersection sight distance at both entrances on Sam Lee Road must not be impacted by future landscaping or by existing or future vegetation.



3e) Since this intersection is located near a horizontal curve with a significant vertical road grade, it is recommended that a Side Road Intersection Sign (W2-2L and W2-2R) be installed in advance of the intersection on each approach of Sam Lee Road. According to the Manual on Uniform Traffic Control Devices (MUTCD), this intersection warning sign should be installed no closer than 100 feet

to the intersection based on a posted speed limit of 30 mph. For this intersection, it is recommended that the warning sign (W2-2L) for northbound traffic (towards Solway Road) be installed between 200 - 250 feet from the intersection with the final placement location directed by Knox County Engineering. Due to road geometrics, for southbound traffic (towards Steele Road), it is recommended that the warning sign (W2-2R) be installed 350 feet from the intersection with the final placement location directed by Knox County Engineering.

- 3f) Once this intersection is fully constructed, if school bus stops occur at this 3-way intersection in the future, it is recommended that a School Bus Stop Ahead Sign (S3-1) be installed in advance of this intersection. For this intersection, it is recommended that these signs be installed approximately 100 feet in advance of the Side Road Signs (W2-2) with the final placement location directed by Knox County Engineering.
- **Sam Lee Road:** Sam Lee Road will be the only access route in between the proposed residential development and outside destinations. The roadway widths of Sam Lee Road were measured at a couple of locations, and for the most part, were found to be around 18 feet in width. The roadway widths were measured from the edge of pavement to the edge of pavement. Overall, the road widths of Sam Lee Road were measured to be adequate to handle the projected amounts and types of traffic that would include typical passenger cars and smaller trucks (i.e., single-unit trucks).







Sam Lee Road currently has many areas of distressed pavement. This pavement distress has been roughly patched in several areas. According to Knox County Engineering, the County is planning on resurfacing Sam Lee Road in the near future. According to Knox County Engineering, the road has been "inventoried for possible improvements in light of the proposed development". However, the County does not plan on



Pavement Distress on Sam Lee Road

resurfacing before the residential developments are constructed to avoid damaging the resurfacing. It is recommended that Sam Lee Road be repaved by the County, and when completed, re-apply double yellow centerlines on Sam Lee Road and improved the road shoulders.

One other recommendation for Sam Lee Road is for the County to reinstall the 30-mph speed limit sign on the west side of Sam Lee Road east of Steele Road. This sign location is located at 11354 Sam Lee Road. The sign is missing, and the post has been pushed over.





5 <u>Hayden Hill Phase 4 Internal Roads</u>: The current concept plan shows six new streets being constructed within the development as shown in Figure 4.

- 5a) It is recommended that 25-mph speed limit signs be posted on Road "A" and Road"E" for vehicles traveling into the new residential subdivision.
- 5b) No direct access to Sam Lee Road should be provided to Lot 38. This is the only lot shown on the concept plan adjacent to Sam Lee Road.
- 5c) Stop Signs (R1-1), white stop bars and speed limit signage should be installed at the locations as shown below:





- 5d) Sight distance at the new intersections in Hayden Hill Phase 4 must not be impacted by new signage or future landscaping. For a posted speed limit of 25-mph in Hayden Hill Phase 4, the intersection sight distance is 250 feet. The stopping sight distance required is 155 feet for a level road grade. The road layout designer should ensure that these sight distance lengths are met, and they should be labeled on the plans.
- 5e) All drainage grates and covers for the residential development need to be pedestrian and bicycle safe.
- 5f) The internal sidewalks that are proposed for the development should have appropriate ADA compliant curbed ramps at intersection corners and the sidewalks are recommended to be 5 feet minimum in width.
- 5g) The United States Postal Service (USPS) has recently implemented changes to its guidelines for delivery in new residential subdivisions. If directed by the local post office, the designer should include an area within the development with a parking area for a centralized mail delivery center.



5h) All road grade and intersection elements internally and externally should be designed to AASHTO, TDOT, and Knox County specifications and guidelines to ensure proper operation.



APPENDIX A

HISTORICAL TRAFFIC COUNT DATA

## **Historical Traffic Counts**

Organization: TDOT

Station ID #: 000557

Location: Sam Lee Road (east of Ironside Boulevard)







# **APPENDIX B**

WALK SCORE

# WALKSCORE

(from walkscore.com)

Walk Score° 🖓	Get Scores Find Apartm	ents My Favorites	Add to Your Site
O Type an address, nei	ighborhood or city	Go	
11181 Sam Lee Knoxville, Tennessee, 37 Commute to Downtown Farr & 24 min & 60+ min	Road 932 <sup>agut</sup> ⊘ ∦ 60+min View Routes	Add scores	to your site
♥ Favorite 🕮 Map	় Nearby Apartments		
Walk Score 2 Almost all erra car.	ent ands require a		
Transit Score Minimal Tra It is possible t	o get on a bus.	~ ~ ~	
Bike Score Minimal bike i	Bikeable infrastructure.	110	Com
About your score		1	Negde





#### ×

## Scores for 11181 Sam Lee Road



Walk S	core	Transit Score	Bike Score
Bike Score n lanes and tr	neasures wh ails, hills, ro	ether an area is good for ad connectivity, and desti	biking based on bike inations.
90-100	Biker's Par	adise	
70-89	Very Bikea	s can be accomplished on a ble	ыке
50-60	Biking is con	venient for most trips	
50-09	Some bike in	nfrastructure	
0-49	Somewhat Minimal bik	<b>Bikeable</b> e infrastructure	




**APPENDIX C** 

### KNOXVILLE AREA TRANSIT MAP AND INFORMATION



## FARE INFORMATION

With a base fare of \$1.50, KAT offers a variety of passes. Please note that only the fares marked with an asterisk can be purchased when boarding the bus. Others are available at KAT's Customer Service Counter at Knoxville Station (301 Church Ave.) or by mail via katbus.com.

FARE TYPE	<b>REGULAR FARE</b>	REDUCED FARE	Sec.
One-Ride Pass*	\$1.50	\$0.75	
1 Day Pass*	\$4.00	\$2.00	1
7 Day Pass	\$15.00	\$7.50	
30 Day Pass	\$50.00	\$25.00	
20 Ride Pass	\$25.00	\$12.50	1-
Transfer*	\$0.50	\$0.25	
	the second se		

### REDUCED FARE INFORMATION

A reduced fare is available to those who qualify. Qualifying individuals include seniors age 65 or over, Medicare card holders, students under the age of 18, and persons with disabilities. Proper identification (Medicare card or a valid KAT I.D. card) is required before boarding. For more information on how to obtain a discounted-fare I.D. visit katbus.com/fares or call 637-3000.

### **BUS STOPS ONLY!**

KAT buses stop ONLY at locations designated by bus stop signs. Generally, bus stops are located at least every ¼ mile along the route.

### Ride for change

### KAT HOLIDAYS

KAT buses do not run on the following holidays: Thanksgiving

- New Year's Day
- Independence Day
- Christmas

Please note that KAT's Knoxville Station Customer Service counter is also closed during those days.

- KAT buses run on a Saturday schedule on the following holidays:
- Martin Luther King, Jr. Day
  Day after Thanksgiving Memorial Day • Labor Day
- - Christmas Eve

KAT's administrative offices are closed on all holidays listed above.



### **CEDAR BLUFF CONNECTOR** (Weekdays and Saturdays)

### **SERVES:**

- ★ Cedar Bluff
- **Knoxville Catholic High School**
- Kroger at The Landing
- Parkwest Hospital

Social Security Administration Walmart Windsor Square



Information Updated: January 6, 2020

	Going	from Wal Mart	to Windsor S	quare	Going from	e to Wal Mart	
	Transfer to	o:					Rts. 11 & 90
	Walmart	Park Village at Woodpark	Parkwest Hospital	Windsor Square	Parkwest Hospital	Cedar Bluff at Fox Lonas	Walmart
	1	2	3	4	5	6	7
			WEEKDA	Y SCHED	ULE		
A.M.	6:15	6:27	6:32	6:42	6:50	6:54	7:10
	7:15	7:27	7:32	7:42	7:50	7:54	8:10
	8:15	8:27	8:32	8:42	8:50	8:54	9:10
	9:15	9:27	9:32	9:42	9:50	9:54	10:10
	10:15	10:27	10:32	10:42	10:50	10:54	11:10
	11:15	11:27	11:32	11:42	11:50	11:54	12:10
P.M.	12:15	12:27	12:32	12:42	12:50	12:54	1:10
	1:15	1:27	1:32	1:42	1:50	1:54	2:10
	2:15	2:27	2:32	2:42	2:50	2:54	3:10
	3:15	3:27	3:32	3:42	3:50	3:54	4:10
	4:15	4:27	4:32	4:42	4:50	4:54	5:10
	5:15	5:27	5:32	5:42	5:50	5:54	6:10
	6:15	6:27	6:32	6:42	6:50	6:54	7:10
	7:15	7:27	7:32	7:42	7:50	7:54	8:10
	8:15	8:27	8:32	8:42	8:50	8:54	9:10
	9:15	9:27	9:32	9:42	9:50	9:54	10:10
			SATURDA	<b>AY SCHED</b>	ULE		
A.M.	7:15	7:27	7:32	7:42	7:50	7:54	8:10
	8:15	8:27	8:32	8:42	8:50	8:54	9:10
	9:15	9:27	9:32	9:42	9:50	9:54	10:10
	10:15	10:27	10:32	10:42	10:50	10:54	11:10
	11:15	11:27	11:32	11:42	11:50	11:54	12:10
P.M.	12:15	12:27	12:32	12:42	12:50	12:54	1:10
	1:15	1:27	1:32	1:42	1:50	1:54	2:10
	2:15	2:27	2:32	2:42	2:50	2:54	3:10
	3:15	3:27	3:32	3:42	3:50	3:54	4:10
	4:15	4:27	4:32	4:42	4:50	4:54	5:10
	5:15	5:27	5:32	5:42	5:50	5:54	6:10
	6:15	6:27	6:32	6:42	6:50	6:54	7:10
	7:15	7:27	7:32	7:42	7:50	7:54	8:10
	8:15	8:27	8:32	8:42	8:50	8:54	9:10
	9:15	9:27	9:32	9:42	9:50	9:54	10:10

Need help reading this schedule?

Need other general information on how to ride? Click here to Download the General Schedule Information pdf available from katbus.com

### APPENDIX D

ZONING MAP



**APPENDIX E** 

MANUAL TRAFFIC COUNTS

### TRAFFIC COUNT DATA

Major Street: Sam Lee Road (EB-WB) Minor Street: Ironside Boulevard (NB) Traffic Control: Stop Control on Minor Street 2/4/2020 (Wednesday) Rain/Cool Conducted by: Ajax Engineering

	Sam Le	ee Road	Ironside I	Boulevard	Sam Lee Road			
TIME	WESTE	BOUND	NORTH	BOUND	EASTB	OUND	VEHICLE	PEAK
BEGIN	LT	THRU	LT	RT	THRU	RT	TOTAL	HOUR
7:00 AM	4	8	4	13	2	1	32	
7:15 AM	1	17	8	10	8	1	45	7:15 AM - 8:15 AM
7:30 AM	5	21	3	13	20	1	63	
7:45 AM	7	6	0	6	24	1	44	
8:00 AM	5	6	1	7	13	2	34	
8:15 AM	5	1	0	10	22	1	39	
8:30 AM	8	2	0	7	1	0	18	
8:45 AM	4	0	0	10	2	0	16	
TOTAL	39	61	16	76	92	7	291	
3:00 PM	4	3	1	5	7	1	21	
3:15 PM	6	2	0	9	1	0	18	
3:30 PM	6	6	1	8	11	1	33	3:30 PM - 4:30 PM
3:45 PM	10	6	0	3	33	4	56	
4:00 PM	8	6	0	4	5	1	24	
4:15 PM	9	6	1	4	3	1	24	
4:30 PM	7	6	3	5	2	0	23	
4:45 PM	9	5	0	1	5	1	21	
5:00 PM	12	10	1	2	3	2	30	
5:15 PM	14	11	1	7	9	0	42	
5:30 PM	12	7	1	4	4	1	29	
5:45 PM	11	8	1	6	6	1	33	
TOTAL	108	76	10	58	89	13	354	

2020 AM Peak Hour

7:15 AM - 8:15 AM

1							
	Sam Le	e Road	Ironside I	Boulevard	Sam Lee Road		
TIME	WESTE	OUND	NORTH	BOUND	EASTBOUND		
BEGIN	LT	THRU	LT	RT	THRU	RT	
7:15 AM	1	17	8	10	8	1	
7:30 AM	5	21	3	13	20	1	
7:45 AM	7	6	0	6	24	1	
8:00 AM	5	6	1	7	13	2	
TOTAL	18	50	12	36	65	5	
PHF	0.64	0.60	0.38	0.69	0.68	0.63	

2020 PM Peak Hour

3:30 PM - 4:30 PM

	Sam Le	e Road	Ironside I	Boulevard	Sam Lee Road		
TIME	WESTE	BOUND	NORTH	BOUND	EASTBOUND		
BEGIN	LT	THRU	LT	RT	THRU	RT	
3:30 PM	6	6	1	8	11	1	
3:45 PM	10	6	0	3	33	4	
4:00 PM	8	6	0	4	5	1	
4:15 PM	9	6	1	4	3	1	
TOTAL	33	24	2	19	52	7	
PHF	0.83	1.00	0.50	0.59	0.39	0.44	

**APPENDIX F** 

CAPACITY ANALYSES - HCM WORKSHEETS (SYNCHRO 8)

**EXISTING TRAFFIC CONDITIONS** 

### Intersection

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	65	5	18	50	12	36
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	68	63	64	60	38	69
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	96	8	28	83	32	52

Major/Minor	Major1		Major2		Minor1		
Conflicting Flow All	0	0	104	0	240	100	
Stage 1	-	-	-	-	100	-	
Stage 2	-	-	-	-	140	-	
Critical Hdwy	-	-	4.1	-	6.4	6.2	
Critical Hdwy Stg 1	-	-	-	-	5.4	-	
Critical Hdwy Stg 2	-	-	-	-	5.4	-	
Follow-up Hdwy	-	-	2.2	-	3.5	3.3	
Pot Cap-1 Maneuver	-	-	1500	-	753	961	
Stage 1	-	-	-	-	929	-	
Stage 2	-	-	-	-	892	-	
Platoon blocked, %	-	-		-			
Mov Cap-1 Maneuver	-	-	1500	-	738	961	
Mov Cap-2 Maneuver	-	-	-	-	738	-	
Stage 1	-	-	-	-	929	-	
Stage 2	-	-	-	-	874	-	

Approach	EB	WB	NB	
HCM Control Delay, s	0	1.9	9.6	
HCM LOS			А	

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	863	-	-	1500	-	
HCM Lane V/C Ratio	0.097	-	-	0.019	-	
HCM Control Delay (s)	9.6	-	-	7.4	0	
HCM Lane LOS	А	-	-	А	А	
HCM 95th %tile Q(veh)	0.3	-	-	0.1	-	

### Intersection

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	52	7	33	24	2	19
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	39	44	83	100	50	59
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	133	16	40	24	4	32

Major/Minor	Major1		Major2		Minor1		
Conflicting Flow All	0	0	149	0	245	141	
Stage 1	-	-	-	-	141	-	
Stage 2	-	-	-	-	104	-	
Critical Hdwy	-	-	4.1	-	6.4	6.2	
Critical Hdwy Stg 1	-	-	-	-	5.4	-	
Critical Hdwy Stg 2	-	-	-	-	5.4	-	
Follow-up Hdwy	-	-	2.2	-	3.5	3.3	
Pot Cap-1 Maneuver	-	-	1445	-	748	912	
Stage 1	-	-	-	-	891	-	
Stage 2	-	-	-	-	925	-	
Platoon blocked, %	-	-		-			
Mov Cap-1 Maneuver	-	-	1445	-	727	912	
Mov Cap-2 Maneuver	-	-	-	-	727	-	
Stage 1	-	-	-	-	891	-	
Stage 2	-	-	-	-	899	-	

Approach	EB	WB	NB	
HCM Control Delay, s	0	4.7	9.2	
HCM LOS			А	

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	887	-	-	1445	-	
HCM Lane V/C Ratio	0.041	-	-	0.028	-	
HCM Control Delay (s)	9.2	-	-	7.6	0	
HCM Lane LOS	А	-	-	А	А	
HCM 95th %tile Q(veh)	0.1	-	-	0.1	-	

**OPENING YEAR TRAFFIC CONDITIONS (WITHOUT PROJECT)** 

### Intersection

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	94	5	18	73	12	36
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	68	63	64	60	38	69
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	138	8	28	122	32	52

Major/Minor	Major1		Major2		Minor1		
Conflicting Flow All	0	0	146	0	320	142	
Stage 1	-	-	-	-	142	-	
Stage 2	-	-	-	-	178	-	
Critical Hdwy	-	-	4.1	-	6.4	6.2	
Critical Hdwy Stg 1	-	-	-	-	5.4	-	
Critical Hdwy Stg 2	-	-	-	-	5.4	-	
Follow-up Hdwy	-	-	2.2	-	3.5	3.3	
Pot Cap-1 Maneuver	-	-	1448	-	678	911	
Stage 1	-	-	-	-	890	-	
Stage 2	-	-	-	-	858	-	
Platoon blocked, %	-	-		-			
Mov Cap-1 Maneuver	-	-	1448	-	664	911	
Mov Cap-2 Maneuver	-	-	-	-	664	-	
Stage 1	-	-	-	-	890	-	
Stage 2	-	-	-	-	840	-	

Approach	EB	WB	NB	
HCM Control Delay, s	0	1.4	10	
HCM LOS			В	

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	799	-	-	1448	-	
HCM Lane V/C Ratio	0.105	-	-	0.019	-	
HCM Control Delay (s)	10	-	-	7.5	0	
HCM Lane LOS	В	-	-	А	А	
HCM 95th %tile Q(veh)	0.4	-	-	0.1	-	

2

### Intersection

Movement	EBT	EBR	WBL	WBT	NBL	NBR	
Vol, veh/h	75	7	33	35	2	19	
Conflicting Peds, #/hr	0	0	0	0	0	0	
Sign Control	Free	Free	Free	Free	Stop	Stop	
RT Channelized	-	None	-	None	-	None	
Storage Length	-	-	-	-	0	-	
Veh in Median Storage, #	0	-	-	0	0	-	
Grade, %	0	-	-	0	0	-	
Peak Hour Factor	39	44	83	100	50	59	
Heavy Vehicles, %	0	0	0	0	0	0	
Mvmt Flow	192	16	40	35	4	32	

Major/Minor	Major1		Major2		Minor1		
Conflicting Flow All	0	0	208	0	315	200	
Stage 1	-	-	-	-	200	-	
Stage 2	-	-	-	-	115	-	
Critical Hdwy	-	-	4.1	-	6.4	6.2	
Critical Hdwy Stg 1	-	-	-	-	5.4	-	
Critical Hdwy Stg 2	-	-	-	-	5.4	-	
Follow-up Hdwy	-	-	2.2	-	3.5	3.3	
Pot Cap-1 Maneuver	-	-	1375	-	682	846	
Stage 1	-	-	-	-	838	-	
Stage 2	-	-	-	-	915	-	
Platoon blocked, %	-	-		-			
Mov Cap-1 Maneuver	-	-	1375	-	662	846	
Mov Cap-2 Maneuver	-	-	-	-	662	-	
Stage 1	-	-	-	-	838	-	
Stage 2	-	-	-	-	888	-	

Approach	EB	WB	NB	
HCM Control Delay, s	0	4.1	9.6	
HCM LOS			А	

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT		
Capacity (veh/h)	821	-	-	1375	-		
HCM Lane V/C Ratio	0.044	-	-	0.029	-		
HCM Control Delay (s)	9.6	-	-	7.7	0		
HCM Lane LOS	А	-	-	А	А		
HCM 95th %tile Q(veh)	0.1	-	-	0.1	-		

**OPENING YEAR TRAFFIC CONDITIONS (WITH PROJECT)** 

### Intersection

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	187	7	33	103	18	88
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	68	63	64	60	38	69
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	275	11	52	172	47	128

Major/Minor	Major1		Major2		Minor1		
Conflicting Flow All	0	0	286	0	556	281	
Stage 1	-	-	-	-	281	-	
Stage 2	-	-	-	-	275	-	
Critical Hdwy	-	-	4.1	-	6.4	6.2	
Critical Hdwy Stg 1	-	-	-	-	5.4	-	
Critical Hdwy Stg 2	-	-	-	-	5.4	-	
Follow-up Hdwy	-	-	2.2	-	3.5	3.3	
Pot Cap-1 Maneuver	-	-	1288	-	496	763	
Stage 1	-	-	-	-	771	-	
Stage 2	-	-	-	-	776	-	
Platoon blocked, %	-	-		-			
Mov Cap-1 Maneuver	-	-	1288	-	474	763	
Mov Cap-2 Maneuver	-	-	-	-	474	-	
Stage 1	-	-	-	-	771	-	
Stage 2	-	-	-	-	741	-	

Approach	EB	WB	NB	
HCM Control Delay, s	0	1.8	12.5	
HCM LOS			В	

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	655	-	-	1288	-	
HCM Lane V/C Ratio	0.267	-	-	0.04	-	
HCM Control Delay (s)	12.5	-	-	7.9	0	
HCM Lane LOS	В	-	-	А	А	
HCM 95th %tile Q(veh)	1.1	-	-	0.1	-	

### Intersection

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	54	0	2	20	0	30	1	110	7	9	94	18
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	5	-	-	-5	-	-	5	-	-	5	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	0	0	0	0	0	0	0	0	0	0	0	0
Mvmt Flow	60	0	2	22	0	33	1	122	8	10	104	20

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	279	266	114	264	272	126	124	0	0	130	0	0
Stage 1	134	134	-	128	128	-	-	-	-	-	-	-
Stage 2	145	132	-	136	144	-	-	-	-	-	-	-
Critical Hdwy	8.1	7.5	6.7	6.1	5.5	5.7	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	7.1	6.5	-	5.1	4.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	7.1	6.5	-	5.1	4.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	627	597	929	746	688	946	1475	-	-	1468	-	-
Stage 1	842	760	-	912	823	-	-	-	-	-	-	-
Stage 2	828	762	-	906	813	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	601	592	929	740	683	946	1475	-	-	1468	-	-
Mov Cap-2 Maneuver	601	592	-	740	683	-	-	-	-	-	-	-
Stage 1	841	755	-	911	822	-	-	-	-	-	-	-
Stage 2	798	761	-	898	807	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	11.6	9.5	0.1	0.6
HCM LOS	В	А		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1\	WBLn1	SBL	SBT	SBR	
Capacity (veh/h)	1475	-	-	609	851	1468	-	-	
HCM Lane V/C Ratio	0.001	-	-	0.102	0.065	0.007	-	-	
HCM Control Delay (s)	7.4	0	-	11.6	9.5	7.5	0	-	
HCM Lane LOS	А	А	-	В	А	А	А	-	
HCM 95th %tile Q(veh)	0	-	-	0.3	0.2	0	-	-	

### Intersection

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	9	20	6	109	113	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	10	22	7	121	126	3

Major/Minor	Minor2		Major1		Major2		
Conflicting Flow All	261	127	129	0	-	0	
Stage 1	127	-	-	-	-	-	
Stage 2	134	-	-	-	-	-	
Critical Hdwy	6.4	6.2	4.1	-	-	-	
Critical Hdwy Stg 1	5.4	-	-	-	-	-	
Critical Hdwy Stg 2	5.4	-	-	-	-	-	
Follow-up Hdwy	3.5	3.3	2.2	-	-	-	
Pot Cap-1 Maneuver	732	929	1469	-	-	-	
Stage 1	904	-	-	-	-	-	
Stage 2	897	-	-	-	-	-	
Platoon blocked, %				-	-	-	
Mov Cap-1 Maneuver	728	929	1469	-	-	-	
Mov Cap-2 Maneuver	728	-	-	-	-	-	
Stage 1	904	-	-	-	-	-	
Stage 2	893	-	-	-	-	-	

Approach	EB	NB	SB	
HCM Control Delay, s	9.4	0.4	0	
HCM LOS	А			

Minor Lane/Major Mvmt	NBL	NBT EBLn1	SBT	SBR	
Capacity (veh/h)	1469	- 856	-	-	
HCM Lane V/C Ratio	0.005	- 0.038	-	-	
HCM Control Delay (s)	7.5	0 9.4	-	-	
HCM Lane LOS	А	A A	-	-	
HCM 95th %tile Q(veh)	0	- 0.1	-	-	

### Intersection

Movement	EBT	EBR	WBL	WBT	NBL	NBR	
Vol, veh/h	137	13	86	138	6	54	
Conflicting Peds, #/hr	0	0	0	0	0	0	
Sign Control	Free	Free	Free	Free	Stop	Stop	
RT Channelized	-	None	-	None	-	None	
Storage Length	-	-	-	-	0	-	
Veh in Median Storage, #	0	-	-	0	0	-	
Grade, %	0	-	-	0	0	-	
Peak Hour Factor	39	44	83	100	50	59	
Heavy Vehicles, %	0	0	0	0	0	0	
Mvmt Flow	351	30	104	138	12	92	

Major/Minor	Major1		Major2		Minor1		
Conflicting Flow All	0	0	381	0	711	366	
Stage 1	-	-	-	-	366	-	
Stage 2	-	-	-	-	345	-	
Critical Hdwy	-	-	4.1	-	6.4	6.2	
Critical Hdwy Stg 1	-	-	-	-	5.4	-	
Critical Hdwy Stg 2	-	-	-	-	5.4	-	
Follow-up Hdwy	-	-	2.2	-	3.5	3.3	
Pot Cap-1 Maneuver	-	-	1189	-	403	684	
Stage 1	-	-	-	-	706	-	
Stage 2	-	-	-	-	722	-	
Platoon blocked, %	-	-		-			
Mov Cap-1 Maneuver	-	-	1189	-	365	684	
Mov Cap-2 Maneuver	-	-	-	-	365	-	
Stage 1	-	-	-	-	706	-	
Stage 2	-	-	-	-	653	-	

Approach	EB	WB	NB	
HCM Control Delay, s	0	3.6	12	
HCM LOS			В	

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	621	-	-	1189	-	
HCM Lane V/C Ratio	0.167	-	-	0.087	-	
HCM Control Delay (s)	12	-	-	8.3	0	
HCM Lane LOS	В	-	-	А	А	
HCM 95th %tile Q(veh)	0.6	-	-	0.3	-	

3

### Intersection

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	36	0	1	15	0	20	2	94	21	31	52	61
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	5	-	-	-5	-	-	5	-	-	5	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	0	0	0	0	0	0	0	0	0	0	0	0
Mvmt Flow	40	0	1	17	0	22	2	104	23	34	58	68

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	293	293	92	282	315	116	126	0	0	128	0	0
Stage 1	161	161	-	121	121	-	-	-	-	-	-	-
Stage 2	132	132	-	161	194	-	-	-	-	-	-	-
Critical Hdwy	8.1	7.5	6.7	6.1	5.5	5.7	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	7.1	6.5	-	5.1	4.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	7.1	6.5	-	5.1	4.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	611	573	959	729	659	957	1473	-	-	1470	-	-
Stage 1	809	735	-	919	827	-	-	-	-	-	-	-
Stage 2	845	762	-	885	785	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	585	558	959	714	642	957	1473	-	-	1470	-	-
Mov Cap-2 Maneuver	585	558	-	714	642	-	-	-	-	-	-	-
Stage 1	808	717	-	918	826	-	-	-	-	-	-	-
Stage 2	825	761	-	862	765	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	11.5	9.5	0.1	1.6
HCM LOS	В	А		

Minor Lane/Major Mvmt	NBL	NBT	NBR E	BLn1V	VBLn1	SBL	SBT	SBR	
Capacity (veh/h)	1473	-	-	591	835	1470	-	-	
HCM Lane V/C Ratio	0.002	-	-	0.07	0.047	0.023	-	-	
HCM Control Delay (s)	7.4	0	-	11.5	9.5	7.5	0	-	
HCM Lane LOS	А	А	-	В	А	А	А	-	
HCM 95th %tile Q(veh)	0	-	-	0.2	0.1	0.1	-	-	

### Intersection

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	6	13	22	111	57	11
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	7	14	24	123	63	12

Major/Minor	Minor2		Major1		Major2		
Conflicting Flow All	241	69	76	0	-	0	
Stage 1	69	-	-	-	-	-	
Stage 2	172	-	-	-	-	-	
Critical Hdwy	6.4	6.2	4.1	-	-	-	
Critical Hdwy Stg 1	5.4	-	-	-	-	-	
Critical Hdwy Stg 2	5.4	-	-	-	-	-	
Follow-up Hdwy	3.5	3.3	2.2	-	-	-	
Pot Cap-1 Maneuver	752	1000	1536	-	-	-	
Stage 1	959	-	-	-	-	-	
Stage 2	863	-	-	-	-	-	
Platoon blocked, %				-	-	-	
Mov Cap-1 Maneuver	739	1000	1536	-	-	-	
Mov Cap-2 Maneuver	739	-	-	-	-	-	
Stage 1	959	-	-	-	-	-	
Stage 2	848	-	-	-	-	-	

Approach	EB	NB	SB	
HCM Control Delay, s	9.1	1.2	0	
HCM LOS	А			

Minor Lane/Major Mvmt	NBL	NBT EBLn1	SBT	SBR	
Capacity (veh/h)	1536	- 900	-	-	
HCM Lane V/C Ratio	0.016	- 0.023	-	-	
HCM Control Delay (s)	7.4	0 9.1	-	-	
HCM Lane LOS	А	A A	-	-	
HCM 95th %tile Q(veh)	0	- 0.1	-	-	

APPENDIX G

ITE AND KNOXVILLE-KNOX COUNTY TRIP GENERATION RATES

### Land Use: 210 Single-Family Detached Housing

### Description

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

#### **Additional Data**

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

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

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

Time-of-day distribution data for this land use are presented in Appendix A. For the six general urban/suburban sites with data, the overall highest vehicle volumes during the AM and PM on a weekday were counted between 7:15 and 8:15 a.m. and 4:00 and 5:00 p.m., respectively. For the two sites with Saturday data, the overall highest vehicle volume was counted between 3:00 and 4:00 p.m. For the one site with Sunday data, the overall highest vehicle volume was counted between 10:15 and 11:15 a.m.

The sites were surveyed in the 1980s, the 1990s, the 2000s, and the 2010s in California, Connecticut, Delaware, Illinois, Indiana, Maryland, Minnesota, Montana, New Jersey, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Vermont, and Virginia.

#### Source Numbers

100, 105, 114, 126, 157, 167, 177, 197, 207, 211, 217, 267, 275, 293, 300, 319, 320, 356, 357, 367, 384, 387, 407, 435, 522, 550, 552, 579, 598, 601, 603, 614, 637, 711, 716, 720, 728, 735, 868, 903, 925, 936



1

## Single-Family Detached Housing (210)

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

	Setting/Location:	General Urban/Suburban
	Number of Studies:	159
Avg. N	lum. of Dwelling Units:	264
	Directional Distribution:	50% entering, 50% exiting

### Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
9.44	4.81 - 19.39	2.10

### **Data Plot and Equation**



2 Trip Generation Manual 10th Edition • Volume 2: Data • Residential (Land Uses 200-299)



# Single-Family Detached Housing (210)

Vehicle Trip Ends vs: On a:	Dwelling Units Weekday, Peak Hour of Adjacent Street Traffic, One Hour Between 7 and 9 a.m.
Setting/Location:	General Urban/Suburban
Number of Studies:	173
Ava, Num, of Dwelling Units;	219
Directional Distribution:	25% entering, 75% exiting

Average Rate	Range of Rates	Standard Deviation
0.74	0.33 - 2.27	0.27

### **Data Plot and Equation**





# Single-Family Detached Housing (210)

Vehicle Trip Ends vs: On a:	Dwelling Units Weekday,
	Peak Hour of Adjacent Street Traffic,
	One Hour Between 4 and 6 p.m.
Setting/Location:	General Urban/Suburban
Number of Studies:	190
Avg. Num. of Dwelling Units:	242
Directional Distribution:	63% entering, 37% exiting

Average Rate	Range of Rates	Standard Deviation
0.99	0.44 - 2.98	0.31

### **Data Plot and Equation**



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### Local Apartment Trip Generation Study

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

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



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





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### Local Apartment Trip Generation Study

Average Vehicle Trip Ends vs: On a:	Dwelling Units Weekday, Peak Hour of Adjacent Street Traffic, One Hour Between 7 and 9 a.m.
Number of Studies:	13
Average Number of Dwelling Units:	193
Directional Distribution:	22% entering, 78% exiting

### **Trip Generation Per Dwelling Unit**

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

### **Data Plot and Equation**



### **Local Apartment Trip Generation Study**

Average Vehicle Trip Ends vs: On a:	Dwelling Units Weekday, Peak Hour of Adjacent Street Traffic, One Hour Between 4 and 6 p.m.
Number of Studies:	13
Average Number of Dwelling Units:	193
Directional Distribution:	55% entering, 45% exiting

### **Trip Generation Per Dwelling Unit**

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



### TRIP GENERATION FOR HAYDEN HILL PHASE 4

152 Single-Family Detached Houses

ITE LAND USE CODE	LAND USE DESCRIPTION	UNITS	GENERATED DAILY TRAFFIC	GENERATED TRAFFIC AM PEAK HOUR		GI PM	GENERATED TRAFFIC PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
	Single-Family			25%	75%		63%	37%	
#210	Detached Housing	152 Houses	1,529	28	85	113	96	56	152
То	tal New Volume Site	Trips	1,529	28	85	113	96	56	152

ITE Trip Generation Manual, 10th Edition

Trips calculated by using Fitted Curve Equation

### TRIP GENERATION FOR HAYDEN HILL PHASE 4 152 Single-Family Detached Houses

### 152 Residential Houses = X

### Weekday:

Fitted Curve Equation:	Ln(T) =	= 0.92 Ln(X	) + 2.71		
	Ln(T) =	0.92 *	5.02	+	2.71
	Ln(T) =	7.33			
	T =	1,529 trij	ps		

### Peak Hour of Adjacent Traffic between 7 and 9 am:

	T =	113 trips	
	T =	0.71 * 152	+ 4.80
Fitted Curve Equation:	T = 0.71	(X) + 4.80	

### Peak Hour of Adjacent Traffic between 4 and 6 pm:

	T =	152 trips	
	Ln(T) =	5.02	
	Ln(T) =	0.96 * 5.02	+ 0.20
Fitted Curve Equation:	Ln(T) =	0.96 Ln(X) + 0.2	

### TRIP GENERATION FOR HAYDEN HILL PHASE 1, 2, and 3

113 Single-Family Detached Houses Remaining to Build and Occupy in Phase 1, 2, and 3 82 Multi-Family Attached Homes (Townhouses) Remaining to Build and Occupy in Phase 2

				GENERATED		GI	ENERATE	D	
			GENERATED TRAFFIC		TRAFFIC				
ITE LAND	LAND USE	UNITS	DAILY	AM	PEAK HC	OUR	PM	РЕАК НС	UR
USE CODE	DESCRIPTION		TRAFFIC						
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
	Single-Family	Phase 1 - 28		25%	75%		63%	37%	
#210* Detac	Detached Housing	g Houses	323	6	19	25	19	11	30
#210*	Single-Family Detached Housing	Phase 2 - 24 Houses	280	25%	75%		63%	37%	
				5	17	22	16	10	26
	Multi-Family	Phase 2 - 82		22%	78%		55%	45%	
LOCAL**	Attached Housing	Townhouses	799	10	35	45	36	29	65
#210*	Single-Family Phase 3 Detached Housing Ho	Phase 3 61	660	25%	75%		63%	37%	
		Houses		12	37	49	40	24	64
Total New Volume Site Trips		2,062	33	108	141	111	74	185	

\* ITE Trip Generation Manual, 10th Edition

\*\* Knoxville-Knox County Planning Trip Generation Rates

Trips calculated by using Fitted Curve Equation

### **TRIP GENERATION FOR HAYDEN HILL PHASE 1** 28 Single-Family Detached Houses Remaining to Build and Occupy

### 28 Residential Houses = X

### Weekday:

Fitted Curve Equation:	Ln(T) = 0.92 Ln(X) + 2.71			
	Ln(T) =	0.92 * 3.33	+ 2.71	
	Ln(T) =	5.78		
	T =	323 trips		

### Peak Hour of Adjacent Traffic between 7 and 9 am:

		P	
	T =	25 trips	
	T =	0.71 * 28	+ 4.80
Fitted Curve Equation:	T = 0.71	(X) + 4.80	

### Peak Hour of Adjacent Traffic between 4 and 6 pm:

	T =	30 trips	
	Ln(T) =	3.40	
	Ln(T) =	0.96 * 3.33	+ 0.20
Fitted Curve Equation:	Ln(T) =		

### TRIP GENERATION FOR HAYDEN HILL PHASE 2 24 Single-Family Detached Houses Remaining to Build and Occupy

### 24 Residential Houses = X

### <u>Weekday:</u>

Fitted Curve Equation:	Ln(T) = 0.92 Ln(X) + 2.71			
	Ln(T) =	0.92 * 3.18	+ 2.71	
	Ln(T) =	5.63		
	T =	280 trips		

### Peak Hour of Adjacent Traffic between 7 and 9 am:

	T =	22 trips	
	T =	0.71 * 24	+ 4.80
Fitted Curve Equation:	T = 0.71	(X) + 4.80	

### Peak Hour of Adjacent Traffic between 4 and 6 pm:

	T =	26 trips	
	Ln(T) =	3.25	
	Ln(T) =	0.96 * 3.18	+ 0.20
Fitted Curve Equation:	Ln(T) =		

### TRIP GENERATION FOR HAYDEN HILL PHASE 2 82 Multi-Family Attached Homes (Townhouses) Remaining to Build and Occupy

82 Residential Units = X

### <u>Weekday:</u>

	T =	<b>799</b> t	trips	5
	T =	15.193	*	52.543
Fitted Curve Equation:	$T = 15.193(X)^{0.899}$			

### Peak Hour of Adjacent Traffic between 7 and 9 am:

				-
	T =	45 1	trips	_
	T =	0.758	*	58.663
Fitted Curve Equation:	$T = 0.758(X)^{0.924}$			

### Peak Hour of Adjacent Traffic between 4 and 6 pm:

Fitted Curve Equation: T = 0.669(X)+10.069

T = 0.669 \* 82 + 10.069 T = 65 trips
# TRIP GENERATION FOR HAYDEN HILL PHASE 3 61 Single-Family Detached Houses Remaining to Build and Occupy

## 61 Residential Houses = X

## <u>Weekday:</u>

Fitted Curve Equation:	Ln(T) =	: 0.92 Ln(X) + 2.71	
	Ln(T) =	0.92 * 4.11	+ 2.71
	Ln(T) =	6.49	
	T =	660 trips	

### Peak Hour of Adjacent Traffic between 7 and 9 am:

	T =	49 trips	
	T =	0.71 * 61	+ 4.80
Fitted Curve Equation:	T = 0.71	I(X) + 4.80	

### Peak Hour of Adjacent Traffic between 4 and 6 pm:

	T =	64 trips	
	Ln(T) =	4.15	
	Ln(T) =	0.96 * 4.11	+ 0.20
Fitted Curve Equation:	Ln(T) =	0.96 Ln(X) + 0.2	

APPENDIX H

KNOX COUNTY TURN LANE VOLUME THRESHOLD WORKSHEETS

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

OPPOSING	103 OU	OUGH VOLUME PLUS RIGHT-TURN VOLUME *				
VOLUME	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	350 - 399
100 - 149	300	235	185	145	120	100
194 150 - 199	245	200	160	130	110	90
200 - 249	205	170	140	115	100	80
250 - 299	175	Sam Lee Road at	125	105	90	70
300 - 349	155 II	ronside Boulevard	110	95	\$0	65
350 - 399	135 2		100	85	70	60
400 - 449	120 W	B Left Turns = 33	90	75	65	55
450 - 499	105		80	70	60	50
500 - 549	95	Turn Lane NOT	70	65	55	50
550 - 599	85	Warranted	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

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

OPPOSING	THROU	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
VOLUME	350 - 399	400 - 449	450 - 499	51%) - 549	550 - 599	= / > 600	
100 - 149	100	80	70	60	55	50	
150 - 199	90	75	65	55	50	45	
200 - 249	80	72	- 460	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 Marc	30	30	30	30	30	30	

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

.

	RIGHT-TURN	THRO	UG <sup>194</sup> JM	E PLUS LEF	Γ-TURN	VOLUMI	<u>}</u> *-
	VOLUME	<100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399
,	7 Fewer Than 25 25 - 49 50 - 99		Sam	Lee Road at			
	100 - 149 150 - 199			ide Boulevard			
	200 - 249 250 - 299	·	EB Ri	ght Turns = 7			Yes
	300 - 349 350 - 399			Varranted	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 ar More	Yes	Yes	Yes	Yes	Yes	Yes

RIGHT-TURN	THRO	UGH VOLUME PLUS LEFT-TURN VOLUME *				
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	Y'es 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

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

OPPOSING	117 01	117 OUGH VOLUME PLUS RIGHT-TURN VOLUME *				
VOLUME	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	350 - 399
120 <b>100 - 149</b>	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	Sam Lee Road at	125	105	90	70
300 - 349	155	Road "A"/Narrow	110	95	\$0	65
350 - 399	135	Leaf Drive	100	85	70	60
400 - 449	120	2023 Projected AM	90	75	65	55
450 - 499		NB Left Turns = 1	80	70	60	50
500 - 549	95	Turn Lane NOT	70	65	55	50
550 - 599	85	Warranted	65	60	50	45
600 - 649	75 L	60	60	55	45	40
650 - 699	70		55	50	40	35
700 - 749	65	55	50	45	35	30
750 or More	60	50	45	40	35	30

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

OPPOSING	THROU	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
VOLUME	350 - 399	400 - 449	450 - 499	51%) - 549	550 - 599	= / > 600	
100 - 149	100	80	70	60	55	50	
150 - 199	90	75	65	55	50	45	
200 - 249	80	72	- 460	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		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 Marc	30	30	30	30	30	30	

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

.

RIGHT-TURN	THRO	UG <sup>111</sup> JM	E PLUS LEF	T-TURN	VOLUM	<u>}</u> *-
VOLUME	<100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399
7 Fewer Than 25 25 - 49 50 - 99		Sam	Lee Road at			
100 - 149 150 - 199		Road L	"A"/Narrow eaf Drive			
200 - 249 250 - 299		2023 I NB Ri	Projected AM ght Turns = 7			Yes
300 - 349 350 - 399		Turr	Lane NOT	Yes	Yes Yes	Yes Yes
400 - 449 450 - 499		- Curr	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599		Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 ar More	Yes	Yes	Yes	Yes	Yes	Yes

RIGHT-TURN	THRO	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
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	

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

OPPOSING	112 OU	GH VOLUME I	PLUS RIGH	T-TURN	VOLUMI	c *
VOLUME	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	350 - 399
118 <b>100 - 149</b>	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	Sam Lee Road at	125	105	90	70
300 - 349	155 I	Road "A"/Narrow	110	95	\$0	65
350 - 399	135	Leaf Drive	100	85	70	60
<b>400 - 44</b> 9	120 22	2023 Projected AM	90	75	65	55
450 - 499		SB Left Turns = 9	80	70	60	50
500 - 549	95	Turn Lane NOT	70	65	55	50
550 - 599	85	Warranted	65	60	50	45
600 - 649	75 Lu	60	60	55	45	40
650 - 699	70		55	50	40	35
700 - 749	65	55	50	45	35	30
750 or More	60	50	45	40	35	30

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

OPPOSING	THROU	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *						
VOLUME	350 - 399	400 - 449	450 - 499	51%) - 549	550 - 599	= / > 600		
100 - 149	100	80	70	60	55	50		
150 - 199	90	75	65	55	50	45		
200 - 249	80	72	- 460	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		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 Marc	30	30	30	30	30	30		

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

	RIGHT-TURN	THRC	<b>UG</b> 102 JM	E PLUS LEFT-TURN VOLUME *-					
	VOLUME	<100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399		
1	8 Fewer Than 25 25 - 49 50 - 99 100 - 149 150 - 199 200 - 249 250 - 299		Sam Road L 2023 J SB Rig	Lee Road at "A"/Narrow eaf Drive Projected AM th Turns = 18			Yes		
	300 - 349 350 - 399		Turr	Lane NOT	Yes	Yes Yes	Yes Yes Ver		
	450 - 499			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	THROUGH VOLUME PLUS LEFT-TURN VOLUME *							
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	Y'es 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		

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

OPPOSING	109 OUGH VOLUME PLUS RIGHT-TURN VOLUME *						
VOLUME	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	350 - 399	
116 100 - 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	Sam Lee Road at	125	105	90	70	
300 - 349	155	Road "E"	110	95	\$0	65	
350 - 399	135		100	85	70	60	
<b>400 - 4</b> 49 450 - 499	120	NB Left Turns $= 6$	90 80	75 70	65 60	55 50	
500 - 549	95	Turn Lane NOT	70	65	55	50	
550 - 599	85	Warranted	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	

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

OPPOSING	THROU	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *							
VOLUME	350 - 399	400 - 449	450 - 499	51%) - 549	550 - 599	= / > 600			
100 - 149	100	80	70	60	55	50			
150 - 199	90	75	65	55	50	45			
200 - 249	80	72	- 460	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			
630 - 699	35	35	35	30	30	30			
700 - 749	30	30	30	30	30	30			
750 or Marc	30	30	30	30	30	30			

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

.

RIGHT-TURN	THRO	ROUG 113 JME PLUS LEFT-TURN VOLUME *-					
VOLUME	<100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399	
 Fewer Than 25 25 - 49 50 - 99		Sam	Lee Road at				
100 - 149 150 - 199		2023	Road "E"				
200 - 249 250 - 299	·	SB Ri	ght Turns = 3			Yes	
300 - 349 350 - 399			Varranted	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 ar More	Yes	Yes	Yes	Yes	Yes	Yes	

RIGHT-TURN	THROUGH VOLUME PLUS LEFT-TURN VOLUME *							
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	Y'es 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		

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

OPPOSING	138 OUGH VOLUME PLUS RIGHT-TURN VOLUME *						
VOLUME	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	350 - 399	
100 - 149	3,0	235	185	145	120	100	
150 150 - 199	245	200	160	130	110	90	
200 - 249	205	170	140	115	100	80	
250 - 299	175	Sam Lee Road at	125	105	90	70	
300 - 349 350 - 399	155 In 135 2	ronside Boulevard	110	95 85	\$0 70	65 60	
<b>400 - 4</b> 49	120 W	B Left Turns = 86	90	75	65	55	
450 - 499	105		80	70	60	50	
500 - 549	95	Turn Lane NOT	70	65	55	50	
550 - 599	85	Warranted	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	

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

OPPOSING	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *						
VOLUME	350 - 399	400 - 449	450 - 499	51%) - 549	550 - 599	= / > 600	
100 - 149	100	80	70	60	55	50	
150 - 199	90	75	65	55	50	45	
200 - 249	80	72	- 460	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	
630 - 699	35	35	35	30	30	30	
700 - 749	30	30	30	30	30	30	
750 or Marc	30	30	30	30	30	30	

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

.

	RIGHT-TURN	THRO	THROUG 137 JME PLUS LEFT-TURN VOLUME *-					
	VOLUME	<100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399	
1	3 Fewer Than 25   25 - 49 50 - 99   100 - 149 150 - 199   200 - 249 250 - 299   300 - 349 350 - 399		Sam Ironsi 2023 I EB Rig Turn W	Lee Road at de Boulevard Projected PM tht Turns = 13 Lane NOT Varranted	Yes	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 ar More	Yes	Yes	Yes	Yes	Yes	Yes	

RIGHT-TURN	THROUGH VOLUME PLUS LEFT-TURN VOLUME *							
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		
309 - 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		

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

OPPOSING	115 OUGH VOLUME PLUS RIGHT-TURN VOLUME *						
VOLUME	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	350 - 399	
144 <b>100 - 149</b>	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	Sam Lee Road at	125	105	90	70	
300 - 349	155	Road "A"/Narrow	110	95	\$0	65	
350 - 399	135	Leaf Drive	100	85	70	60	
<b>400 - 4</b> 49	120	2023 Projected PM	90	75	65	55	
450 - 499	105	NB Left Turns = 2	80	70	60	50	
500 - 549	95	Turn Lane NOT	70	65	55	50	
550 - 399	85	Warranted	65	60	50	45	
600 - 649	75	60	60	55	45	40	
650 - 699	70		55	50	40	35	
700 - 749	65	55	50	45	35	30	
750 or More	60	50	45	40	35	30	

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

OPPOSING	THROU	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
VOLUME	350 - 399	400 - 449	450 - 499	51%) - 549	550 - 599	= / > 600	
100 - 149	100	80	70	60	55	50	
150 - 199	90	75	65	55	50	45	
200 - 249	80	72	- 460	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		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 Marc	30	30	30	30	30	30	

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

.

	RIGHT-TURN	<u>96</u> RO	96 ROUGH VOLUME PLUS LEFT-TURN VOLUME *-					
	VOLUME	<100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399	
2	Fewer Than 25 25 - 49 50 - 99 100 - 149 150 - 199 200 - 249 200 - 249		Sam Road 2023 I NB Rig	Lee Road at "A"/Narrow eaf Drive Projected PM				
	300 - 349 350 - 399 400 - 449 450 - 499		Turn	Lane NOT arranted 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	
	600 ar More	Yes	Yes	Yes	Yes	Yes	Yes	

RIGHT-TURN	THRO	UGH VOLUM	E PLUS LEI	T-TURN	VOLUMI	LUME *				
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				
309 - 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				

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

OPPOSING	113 OU	113 OUGH VOLUME PLUS RIGHT-TURN VOLUME *					
VOLUME	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	350 - 399	
117 <b>100 - 149</b>	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	Sam Lee Road at	125	105	90	70	
300 - 349	155 I	Road "A"/Narrow	110	95	\$0	65	
350 - 399	135	Leaf Drive	100	85	70	60	
<b>400 - 44</b> 9	120 22	2023 Projected PM	90	75	65	55	
450 - 499	105 S	SB Left Turns = 31	80	70	60	50	
500 - 549	95	Turn Lane NOT	70	65	55	50	
550 - 599	85	Warranted	65	60	50	45	
600 - 649	75 Lu	60	60	55	45	40	
650 - 699	70		55	50	40	35	
700 - 749	65	55	50	45	35	30	
750 or More	60	50	45	40	35	30	

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

OPPOSING	THROU	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
VOLUME	350 - 399	400 - 449	450 - 499	51%) - 549	550 - 599	= / > 600	
100 - 149	100	80	70	60	55	50	
150 - 199	90	75	65	55	50	45	
200 - 249	80	72	- 460	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		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 Marc	30	30	30	30	30	30	

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

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Γ

	RIGHT-TURN	83 ROU	ROUGH VOLUME PLUS LEFT-TURN VOLUME *-				
	VOLUME	<100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399
61	Fewer Than 25 25 - 49 50 - 99		Sam Lee Road "A"	Road at //			
	100 - 149 150 - 199		Leaf I 2023 Proje	Orive			
	200 - 249 250 - 299		SB Right T	urns = 61			Yes
	300 - 349 350 - 399		Warra	nted	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 ar More	Yes	Yes	Yes	Yes	Yes	Yes

RIGHT-TURN	THRO	UGH VOLUM	E PLUS LEI	LEFT-TURN VOLUME *				
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	Y'es 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		

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

	OPPOSING	111 OUGH VOLUME PLUS RIGHT-TURN VOLUME *						
6		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	Sam Lee Road at	125	105	90	70	
	300 - 349 350 - 399	155 135	Road "A"	110	95 85	\$0 70	65 60	
	400 - 449 450 - 499	120 N	B Left Turns = 22	90 80	75 70	65 60	55 50	
	500 - 549	95	Turn Lane NOT	70	65	55	50	
	550 - 599	85	Warranted	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	

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

OPPOSING	THROU	GH VOLUME	VOLUME PLUS RIGHT-TURN VOLUME *					
VOLUME	350 - 399	400 - 449	450 - 499	51%) - 549	550 - 599	= / > 600		
100 - 149	100	80	70	60	55	50		
150 - 199	90	75	65	55	50	45		
200 - 249	80	72	- 460	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		
630 - 699	35	35	35	30	30	30		
700 - 749	30	30	30	30	30	30		
750 or Marc	30	30	30	30	30	30		

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

.

RIGHT-TURN	57 <b>RO</b>	57 ROUGH VOLUME PLUS LEFT-TURN VOLUME *-					
VOLUME	<100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399	
11 Fewer Than 25   25 - 49 50 - 99   100 - 149 150 - 199   200 - 249 250 - 299   300 - 349 350 - 399		Sam Lee Road Road "A" 2023 Projected SB Right Turns Turn Lane NC Warranted	at PM = 11 DT	Yes	Yes Yes	Yes Yes Yes	
400 - 449 450 - 499 500 - 549		Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	
550 - 599 600 ar More	Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	

RIGHT-TURN	THRO	UGH VOLUM	E PLUS LEI	T-TURN	VOLUMI	<u>}</u> *
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

**APPENDIX I** 

**RESPONSE LETTER TO ADDRESS REVIEW COMMENTS** 



11812 Black Road Knoxville, Tennessee 37932 Phone (865) 556-0042 ajaxengineering@gmail.com

March 16, 2020

PROJECT NAME: Hayden Hill Phase 4

TO: Knoxville-Knox County Planning

# SUBJECT:TIS Comment Response Document for Hayden Hill Phase 4 (4-SB-20-C & 4-D-<br/>20-UR) - Review Comments dated March 13, 2020

Dear Knoxville-Knox County Planning Staff:

The following comment response document is submitted to address comments dated March 13, 2020.

- 1. <u>Reviewer Comment</u>: 1 Please modify the "MPC Trip Generation Rates" to "Knoxville-Knox County Planning Trip Generation Rates" throughout the study.
- <u>Response</u>: This modification was made to last paragraph on page 42 and in the footnotes for Table 6 on page 31.
- 2. <u>Reviewer Comment</u>: 2 In Figure 5 (pg 22), it is not clear how the traffic count near Road E was used. Please explain, or if not used please delete it from the study discussion and data.
- <u>Response</u>: To eliminate confusion, the traffic count that was conducted near the proposed Road "E" intersection was deleted from the study. This deletion resulted in removal of the traffic count location in Figure 3 on page 8, changes to the discussion on page 21, removal from Figure 5 on page 22, and the count removal from Appendix E.

# 3. <u>Reviewer Comment</u>: 3 In Table 6 (page 31), the townhouses should be in Phase 2 not Phase 3.

- <u>Response</u>: Table 6 on page 31 was revised to change the townhouses from Phase 3 to Phase 2. This change was also made in Appendix G.
- 4. <u>Reviewer Comment</u>: In Figure 10 (page 43), there are a few errors.
  - a. The PM westbound left-turn volume at Ironside Blvd should be 86 instead of 66 to match the totals of the movement in Figures 6, 9a, 9b, and 9c.
- <u>Response</u>: The PM westbound left-turn volume at Ironside Boulevard has been changed in Figure 10 (page 43) from 66 to 86.
  - b. The AM southbound left-turn volume at Road A/Narrow Leaf Drive should be 9 instead of 8 to match the totals of the movement in Figures 9a and 9b.
- <u>Response</u>: The AM southbound left-turn volume at Road "A"/Narrow Leaf Drive has been changed in Figure 10 (page 43) from 8 to 9.
  - c. These corrections should be made in all associated sheets such as capacity analyses and turn lane warrant analyses. Also, please add a note to explain that the through volumes on Sam Lee Road at Road A/Narrow Leaf Drive and at Road E were calculated by balancing with the volumes at Ironside Blvd. The manual count near Road E does not appear to have been used.
- Response: The changes that were made to the PM westbound left-turn volume at Ironside Boulevard resulted in small changes to Tables 7a and 7b. It also resulted in minor changes to the Synchro results shown in Appendix F and the numbers shown in the turn lane warrant analysis in Appendix H. It did not affect the final conclusions.

The changes that were made to the AM southbound left-turn volume at Road "A"/Narrow Leaf Drive did not result in changes to any tables since it had the correct value of 9 vehicles in the Synchro analysis. However, it did result in changes to the numbers shown in the turn lane warrant analysis in Appendix H. It did not affect the final conclusions.

Finally, a note was added to the end of the discussion on page 35 stating that the thru volumes on Sam Lee Road at Road "A"/Narrow Leaf Drive and at Road "E" were calculated by balancing with the volumes at Ironside Boulevard.

In addition to the requested revisions, other changes in the report include the following:

- Updated Title Page
- Updated Table of Contents
- Updated Page Footers
- Added Appendix I to include this response letter

If you have any questions or further comments, please feel free to contact me at any time. I look forward to your review and approval.

Sincerely,

Ajax Engineering, LLC Robert W. Jacks, P.E.





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