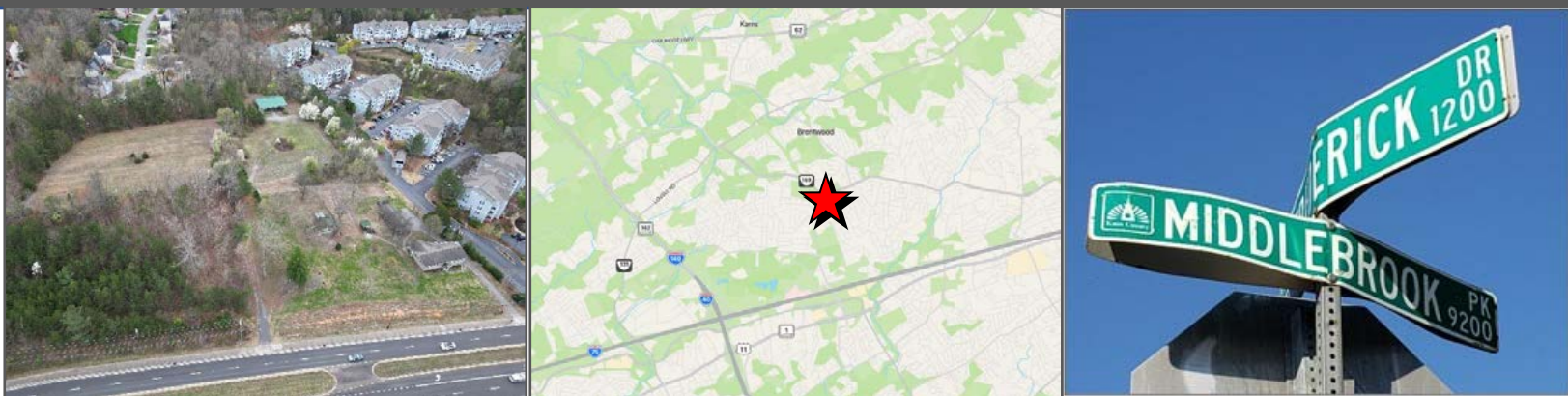


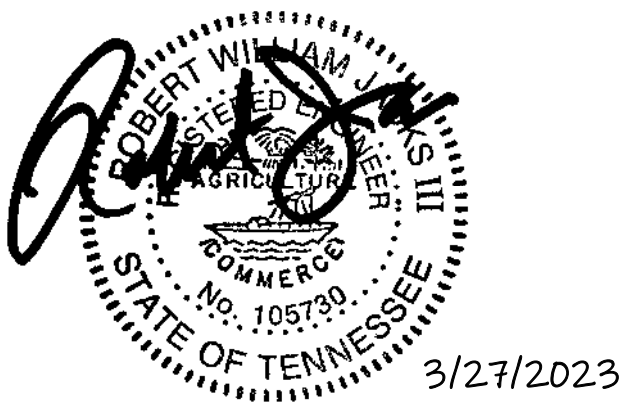


Transportation Impact Study Middlebrook Village Knox County, Tennessee



March 2023

Prepared for:
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Alpharetta, GA 30004



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TIS Version 1
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EXECUTIVE SUMMARY

Preface:

Indus Developers, LLC is proposing a residential development off Middlebrook Pike between Lovell Road/Ball Camp Pike and North Cedar Bluff Road in Northwest Knox County, TN. The proposed development will include 128 multi-family apartments on 10.95 +/- acres, named and referenced in this study as “Middlebrook Village”. The development proposes one entrance on the south side of Middlebrook Pike. The development is anticipated to be fully built and occupied by 2025.

This study’s primary purpose is to determine and evaluate the potential impacts of the development on the adjacent transportation system. The study includes a review of the primary access road and entrance intersection and is a Level 1 study established by Knoxville/Knox County Planning. Recommendations and mitigation measures are offered if transportation operations are projected to be below recognized engineering standards.

Study Results:

The significant findings of this study include the following:

- The Middlebrook Village development, with a total of 128 multi-family apartment units, is estimated to generate 1,191 trips at full build-out and occupancy on an average weekday. Of these daily trips, 67 are estimated to occur during the AM peak hour and 96 in the PM peak hour in 2025.
- The proposed Main Entrance at Middlebrook Pike is expected to operate with reasonable vehicle delays in the projected AM and PM peak hours. The addition of the proposed Main Entrance approach on Middlebrook Pike will operate adequately in 2025 with respect to vehicle capacity.
- The projected 2025 traffic volumes do not warrant the construction of separate entering right-turn lane on Middlebrook Pike at the proposed Main Entrance. A single exiting lane for the development entrance at Middlebrook Pike will be sufficient.

Recommendations:

The following recommendations are offered based on the study analyses to minimize the impacts of the proposed development on the adjacent transportation system while attempting to achieve an acceptable traffic flow and improved safety. More details regarding these recommendations are discussed at the end of the report.

- It is recommended that a Stop Sign (R1-1) be installed, and a 24" white stop bar be applied to the proposed Main Entrance approach at Middlebrook Pike. The stop bar should be applied a minimum of 4 feet away from the edge of Middlebrook Pike and placed at the desired stopping point that maximizes the sight distance.
- Based on a posted speed limit of 40-mph on Middlebrook Pike, the required intersection sight distance is 545 feet for exiting left-turning vehicles at the Main Entrance and 385 feet for exiting right-turning vehicles. The site designer must verify that these distances will be available. Intersection sight distance at the Main Entrance at Middlebrook Pike must not be impacted by future landscaping or signage.
- The construction of the proposed Main Entrance on Middlebrook Pike will require a TDOT Highway Entrance Permit. The developer will need to apply for this permit and coordinate with TDOT regarding their specific requirements for this entrance.
- An existing regulatory sign regarding school bus stops is adjacent to the proposed Main Entrance location at Middlebrook Pike. It is recommended that this sign be removed from this location and placed at the appropriate location, as directed by TDOT, to eliminate potential sight distance interference and intersection operations.
- The site designer should provide the appropriate accommodations for the existing sidewalk on the south side of Middlebrook Pike at the proposed Main Entrance. These accommodations should include a white crosswalk and ADA-compliant ramps with detectable surfaces on the sidewalk approaches.
- It is recommended that a Divided Highway (R6-3) sign be installed below the recommended Stop Sign (R1-1) at the Main Entrance to reduce the potential of a wrong-way entering movement on Middlebrook Pike. In addition, it is recommended that dual Do Not Enter (R5-1) signs be installed on Middlebrook Pike, just west of the proposed Main Entrance and facing toward the east.
- A 15-mph (or lower) Speed Limit Sign (R2-1) is recommended to be posted near the beginning of the development entrance driveway off Middlebrook Pike.

- As shown in the report, Stop Signs (R1-1) and 24" white stop bars are recommended on the new internal drives and parking lot aisleways.
- Sight distance at the new internal intersections must not be impacted by new signage, parked cars, or future landscaping. With a speed limit of 15-mph in the development, the internal intersection sight distance is 170 feet. The required stopping sight distance is 80 feet for a level road grade. The site designer should ensure that internal sight distance lengths are met.
- With long and straight parking lot aisleways proposed internally, it is recommended that speed humps or tables be considered to reduce internal traffic speeds in the development. Alternatively, parking lot islands could be extended toward the aisleways. Extending the parking lot islands a few feet would narrow the aisleway widths and reduce the available driving surface. A narrower aisleway design would reduce driver comfort and internal vehicle speeds.
- All drainage grates and covers for the residential development must be pedestrian and bicycle safe.
- The site designer should include a parking area and a centralized mail delivery center within the development. A specific location with a resident parking area should be designed and provided.
- Internal sidewalks are proposed throughout the development. The internal sidewalk system should connect to the existing external sidewalk system provided on the south side of Middlebrook Pike. Sidewalks should have appropriate ADA-compliant ramps at intersection corners with detectable surfaces, and the internal sidewalks are recommended to be 5 feet minimum in width to meet Knox County regulations. White crosswalks should be applied to the road pavement internally where pedestrians are expected to cross. Internal crosswalks should include Pedestrian Warning (W11-2) signs with a downward arrow plaque (W16-7p) where appropriate.
- All road grade and intersection elements 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 will be located off Middlebrook Pike, between Lovell Road/Ball Camp Pike and North Cedar Bluff Road in Northwest Knox County, TN. The development will be adjacent to and just east of Walden Creek Way, a private roadway for 236 units in the Walden Legacy Apartment Homes development. The proposed access entrance for the development will be located on Middlebrook Pike, where the roadway currently has a center median opening.

As Knoxville/Knox County Planning requested, transportation impacts associated with the proposed development were analyzed at the proposed entrance on Middlebrook Pike, where the proposed development will have road access to and from external destinations.



**View of Development Site along Middlebrook Pike
(Looking South from North Side of Middlebrook Pike)**

The proposed development property is in a suburbanized area of West Knox County, TN. Many single-family residences, established subdivisions, some remaining unused/woodland properties, and commercial businesses are near the proposed development site. The closest commercial properties to this proposed development are approximately 1,500 feet to the west on Middlebrook Pike and consist of a Food City, a restaurant, and a strip mall. The strip mall includes a Subway, Domino's Pizza, a barbershop, spa services, and a tanning salon.

The existing development site has challenging topography, with the southern rear portion of the property sloped towards the north, towards Middlebrook Pike. The development property will consist of two existing parcels, with the easternmost currently undeveloped. A single-family detached house currently occupies the western parcel with an unattached garage and other outbuildings. Most of the land on the two parcels is currently occupied with woodlands, and the property near the existing home consists of a maintained yard and fields.



Figure 1
Location Map

▪ **EXISTING ROADWAYS:**

Table 1 lists the characteristics of the existing primary access roadway adjacent to the development property and included in the study:

TABLE 1
STUDY CORRIDOR CHARACTERISTICS

NAME	CLASSIFICATION ¹	SPEED LIMIT	LANES	ROAD WIDTH ²	TRANSIT ³	PEDESTRIAN FACILITIES	BICYCLE FACILITIES
Middlebrook Pike (SR 169)	Major Arterial	40 mph	4 divided	80 feet	None	8' sidewalk on south side / 5' sidewalk on north side	No bike lanes

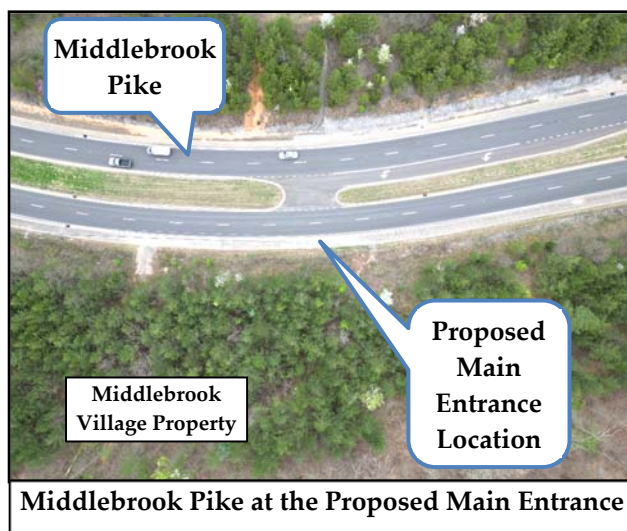
¹ 2018 Major Road Plan by Knoxville/Knox County Planning

² Edge of curb to edge of curb or edge of pavements near project site

³ According to Knoxville Area Transit System Map

Middlebrook Pike (SR 169) is a 4-lane major arterial that traverses in a generally east-west direction. Middlebrook Pike is 11.7 miles long and runs between Lovell Road/Ball Camp Pike on the west side to the Western Avenue (SR 62) at University Avenue intersection on the east side. Closer to the study area, Middlebrook Pike provides convenient access to North Cedar Bluff Road for travel to the south towards Interstate 40. To the west, the Middlebrook Pike roadway transitions to Hardin Valley Road with access to Pellissippi Parkway (SR 162). The posted speed limit on Middlebrook Pike is 40 mph at the project site.

Middlebrook Pike is a divided highway with raised grassed medians adjacent to the proposed development site. The grassed median widths are variable in width, with an average width of 30 feet. Center median openings are numerous along Middlebrook Pike, and an opening is currently available at the proposed entrance location for the Middlebrook Village development. This opening includes an exclusive westbound left-turn lane with 165 feet of vehicle storage. Middlebrook Pike has 6" concrete curbs with 24" gutters. Sidewalks are available on both sides, with a narrower sidewalk on the north side. No utility street lights are provided along Middlebrook Pike in the adjacent study area.



Walden Creek Way intersects Middlebrook Pike just west of the proposed development property. The intersection of Middlebrook Pike at Walden Creek Way is an unsignalized t-intersection. At the Walden Creek Way intersection, the westbound approach of Middlebrook Pike has an exclusive left-turn lane with 150 feet of vehicle storage. Walden Creek Way operates under stop control, but a Stop Sign (R1-1) is not posted on the approach.

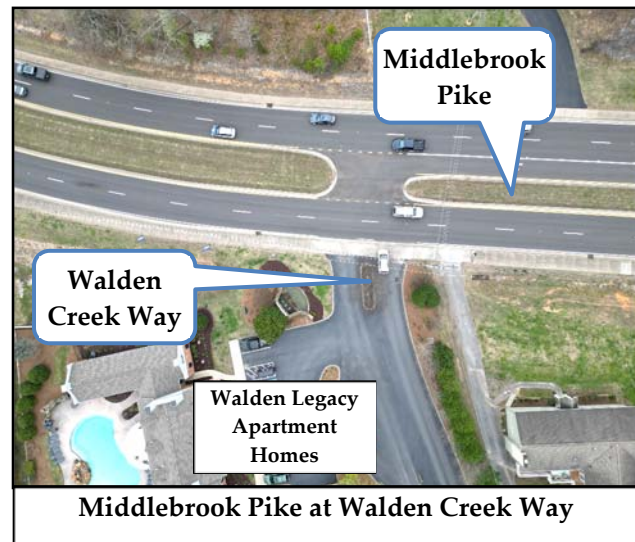
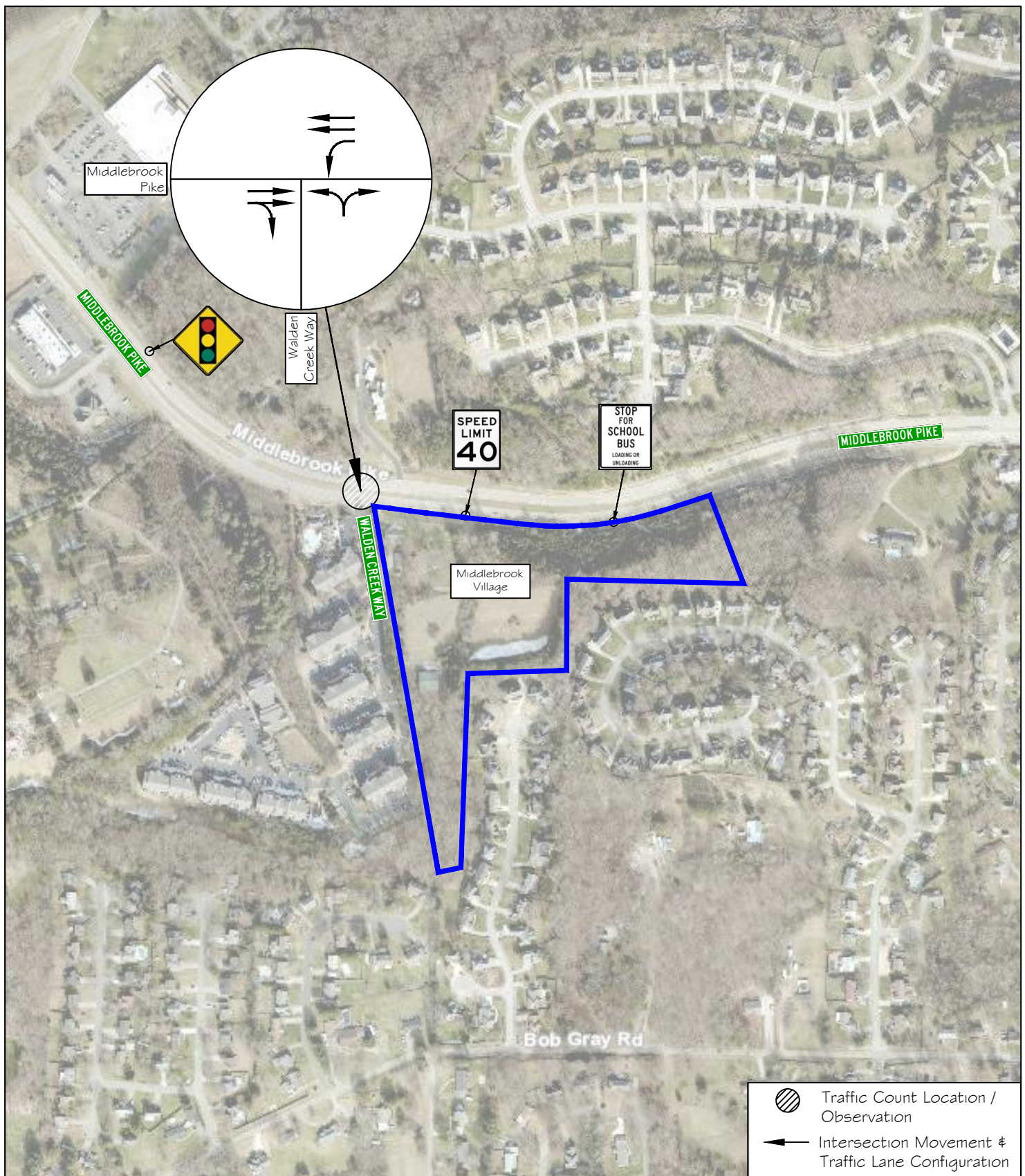


Figure 2 shows the existing lane configurations of the intersection and location where the traffic count was conducted for the study and the current traffic road signage in the study area. The road signage shown in Figure 2 only includes warning and regulatory signage near the development site. The pages following Figure 2 give a further overview of the site study area with photographs.



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

NOT TO SCALE

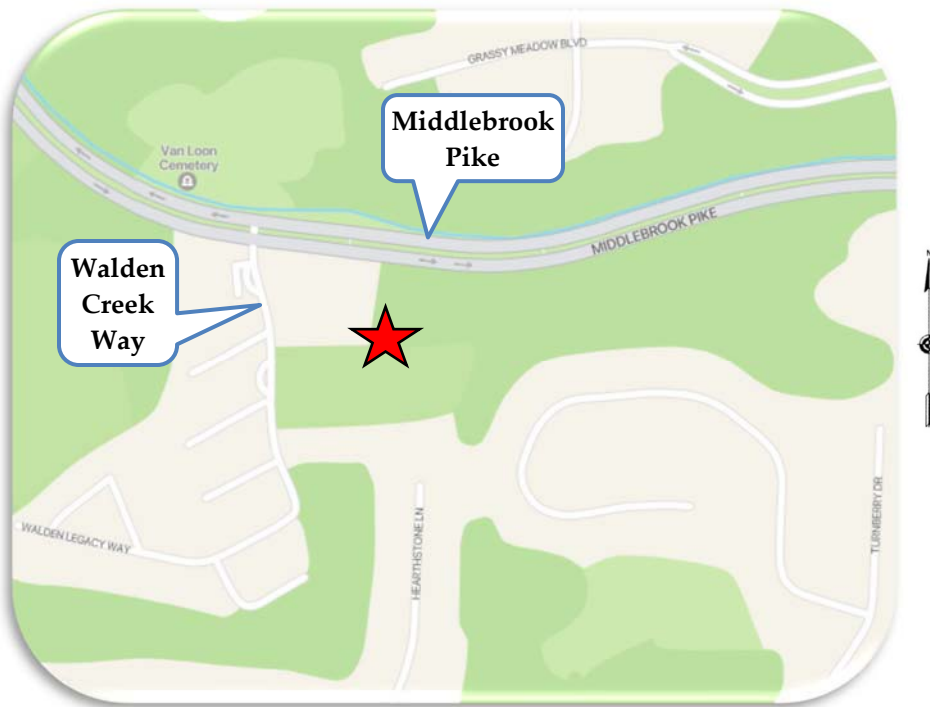


FIGURE 2

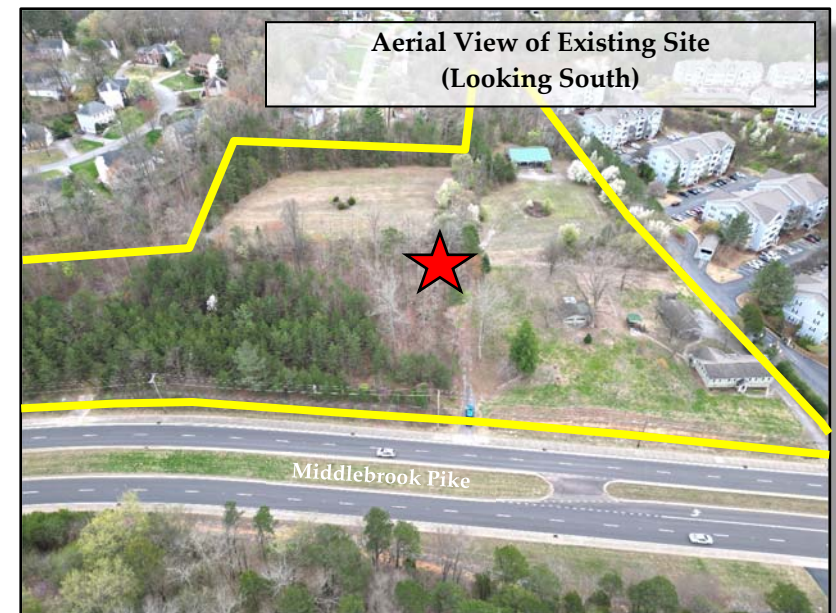
Middlebrook Village

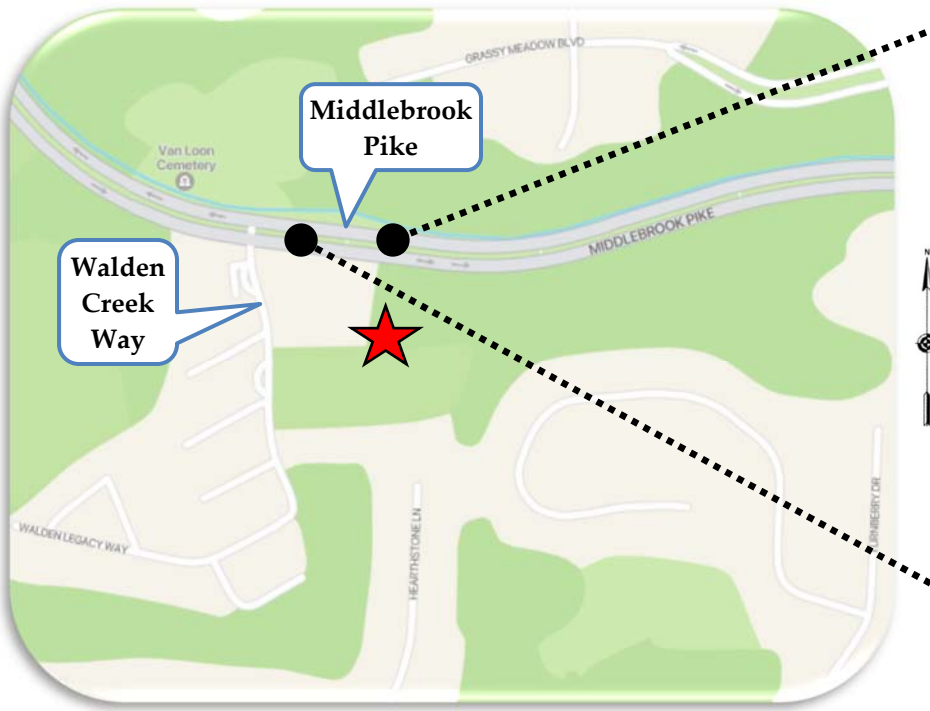
Traffic Count Location, Traffic Signage & Existing Lane Configurations

PHOTO EXHIBITS

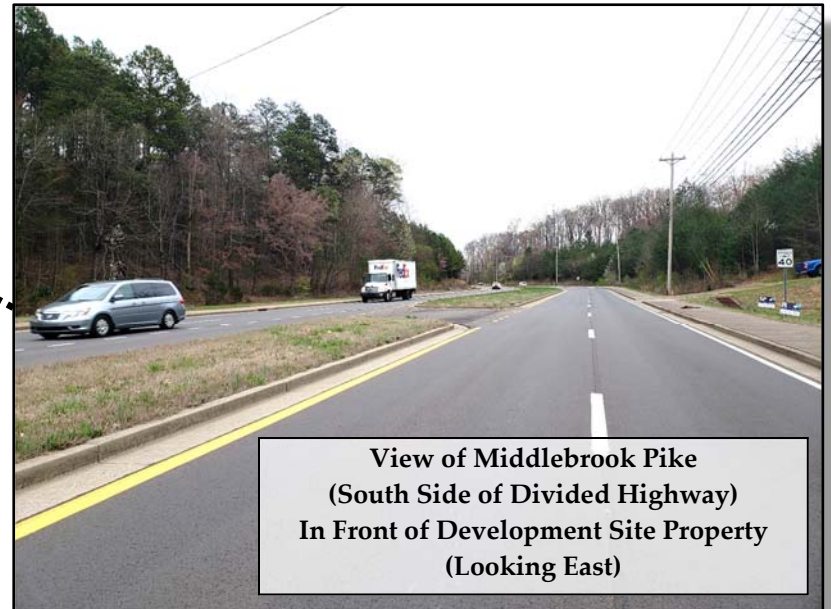
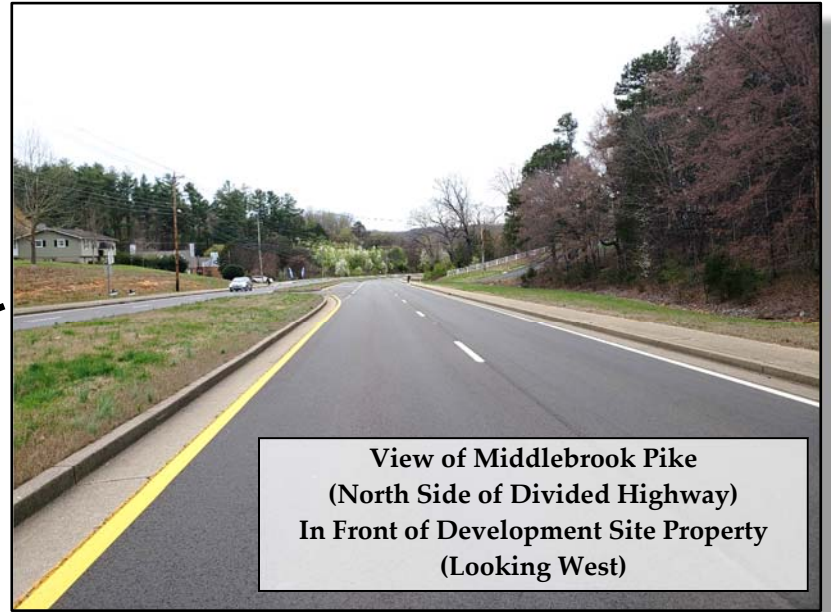


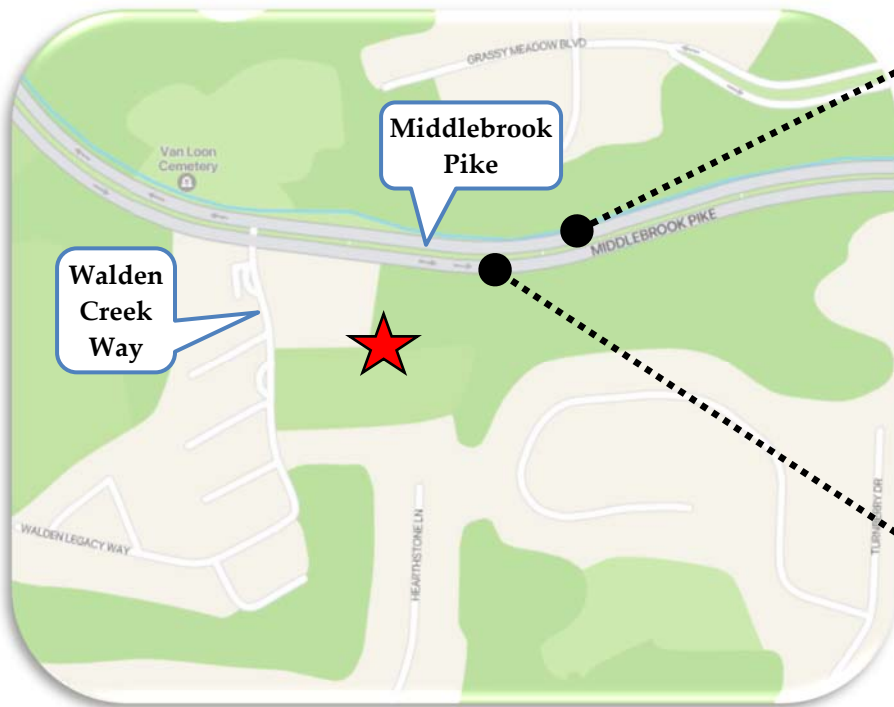
Middlebrook Pike at Proposed Development Site



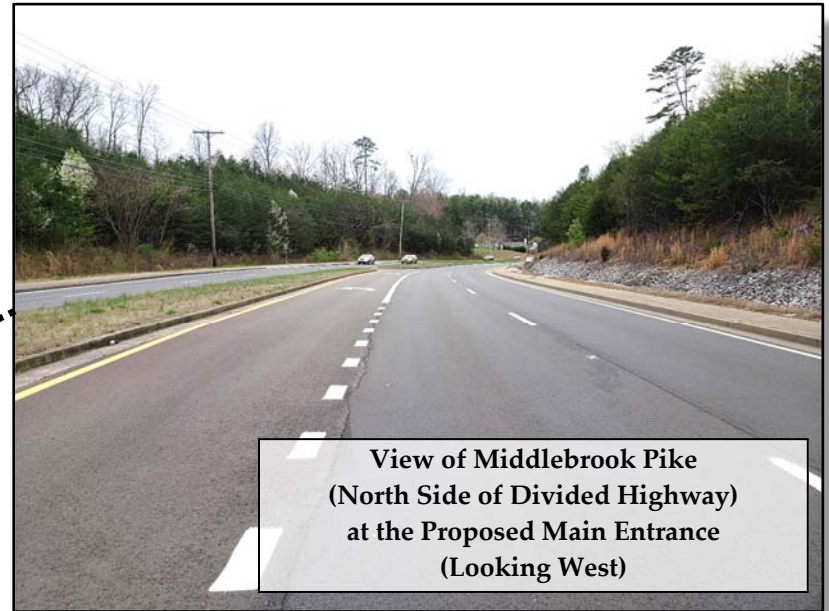


Middlebrook Pike at Proposed Development Site

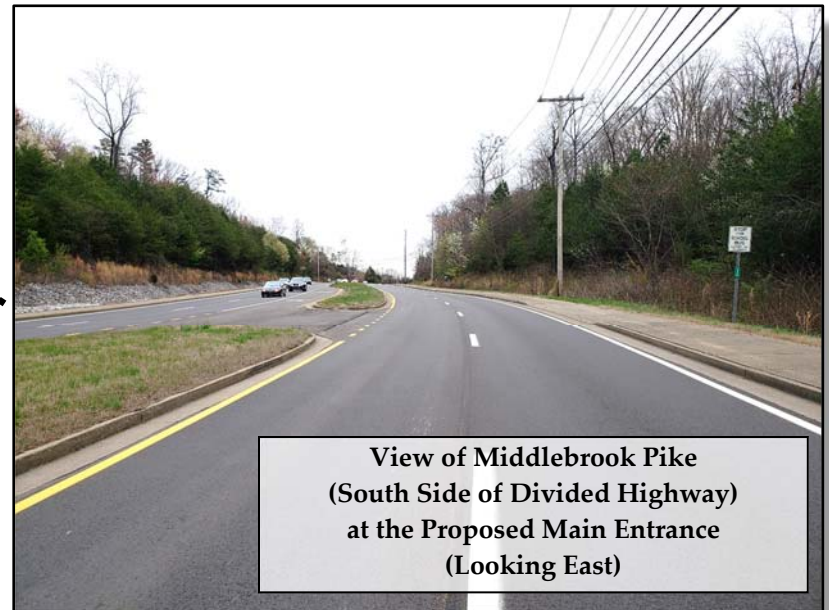




Middlebrook Pike at Proposed Development Site



**View of Middlebrook Pike
(North Side of Divided Highway)
at the Proposed Main Entrance
(Looking West)**



**View of Middlebrook Pike
(South Side of Divided Highway)
at the Proposed Main Entrance
(Looking East)**

▪ **EXISTING TRANSPORTATION VOLUMES PER MODE:**

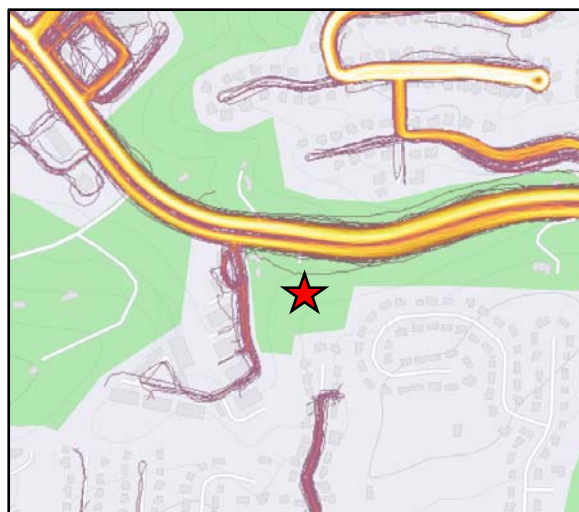
One annual vehicular traffic count location exists near the study area, and the Tennessee Department of Transportation (TDOT) conducts this count. The count location data is the following and can be viewed with further details in Appendix A:

- Existing vehicular roadway traffic:
 - TDOT reported an Average Daily Traffic (ADT) on Middlebrook Pike, east of the intersection with Lovell Road/Ball Camp Pike and west of the development site, at 22,947 vehicles per day in 2021. From 2011 to 2021, this count station has indicated a +2.5% average annual traffic growth rate.

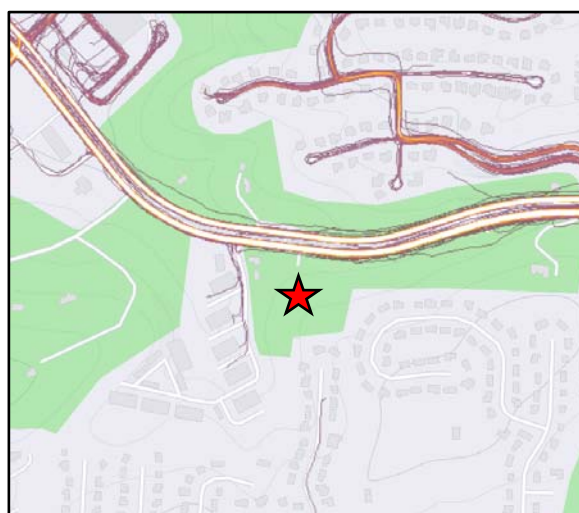
- Existing bicycle and pedestrian volumes:

The average daily pedestrian and bicycle traffic is unknown along Middlebrook Pike. However, with sidewalks on both sides of Middlebrook Pike, this corridor is assumed to have some pedestrian and bicyclist activity. In addition to exercise activities, the relative closeness to the commercial developments could generate some non-motorized traffic. During the 8-hour traffic count for this project, three bicyclists and no pedestrians were observed on Middlebrook Pike. However, on the day of the traffic count for this study, the weather was not particularly conducive to pedestrian and bicyclist activity.

An online website, [strava.com](https://www.strava.com), provides “heat” maps detailing exercise routes taken by pedestrians, joggers, and bicyclists. The provided heat maps show the last two years of data, are



Strava Heat Map for Pedestrian and Joggers



Strava Heat Map for Bicyclists

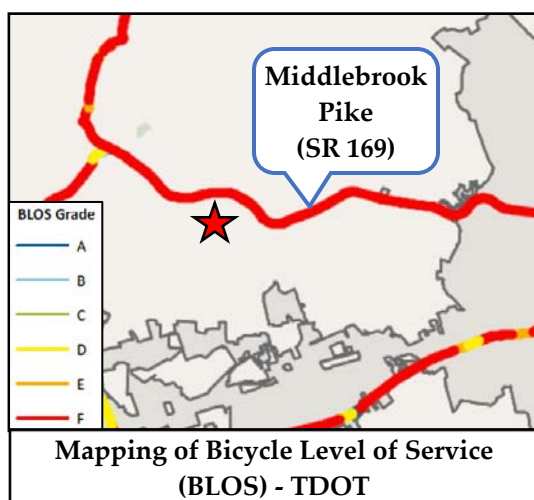
updated monthly, and are gathered from individuals allowing their smart devices to track and compile their routes (millions of users). The activities in the maps are shown on the roads with color intensities with lighter colors signifying higher activity. The Strava heat maps show some bicycle and pedestrian activity in the study area. Higher pedestrian activity is shown along Middlebrook Pike and in the existing adjacent residential developments and the commercial developments to the west. Lower bicycle traffic is shown on Middlebrook Pike and the surrounding roadways. Bicycle traffic is light on Middlebrook Pike, likely due to the lack of bike lanes and the high vehicle volumes on the corridor.

The proposed Middlebrook Village development will be located roughly between commercial developments to the east and west but is not expected to generate measurable amounts of bicycle or pedestrian trips that would significantly reduce vehicle trips. Thus, for the study analyses, these potential reductions are ignored.

▪ **ON-STREET PARKING:**

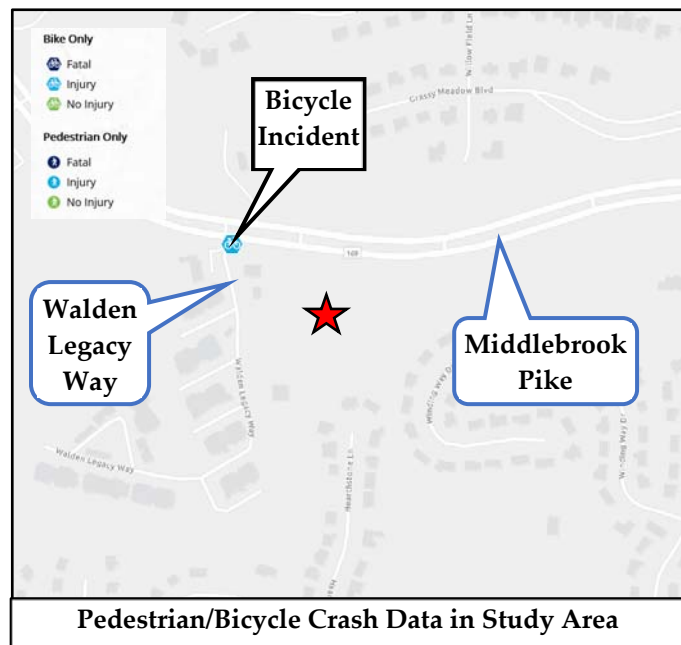
Currently, on-street parking is not allowed or observed on Middlebrook Pike. Off-street parking is provided adjacent to Middlebrook Pike at the Walden Legacy Apartment Homes development and at the other commercial businesses along Middlebrook Pike near the proposed development site.

▪ **PEDESTRIAN AND BICYCLE FACILITIES:**

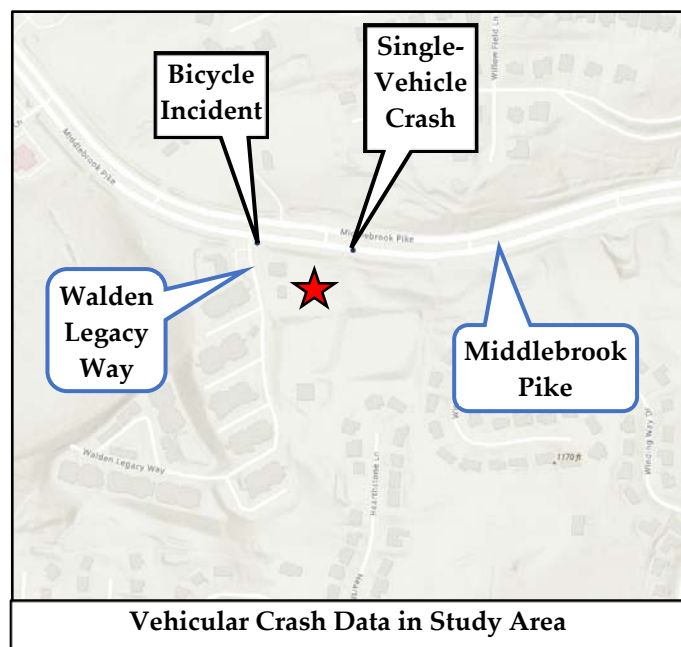


Bicycle facilities (lanes) are not available within the project site study area. Even though bicycle facilities are not provided on Middlebrook Pike (SR 169), TDOT has published mapping illustrating the Bicycle Level of Service (BLOS) for state routes in Knox County. BLOS is a nationally used measure of bicyclist comfort based on a roadway's geometry and traffic conditions. BLOS A designates the route as most suitable for bicyclists and BLOS F as the least suitable. The BLOS for Middlebrook Pike (SR 169) along the development site road frontage shows a grade of F.

■ **CRASH DATA:**



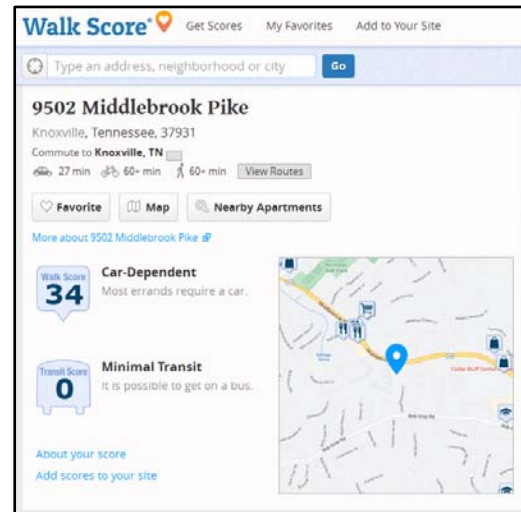
The Knoxville Transportation Planning Organization (TPO) provided a 2020 update to bicycle and pedestrian crash data for Knox County and other surrounding counties. According to the data, one of these incidents occurred in the study area. A bicycle crash was reported in December 2018 adjacent to the project site at the intersection of Middlebrook Pike at Walden Legacy Way. This incident resulted in an injury, and the crash factor was identified as a motorist failing to yield when turning right.



The Knoxville TPO also provides data related to “Life-Altering Traffic Crashes”. This data lists the location of traffic crashes in the Knoxville region that resulted in a fatality or serious injury between October 2016 and September 2021. According to the data, only one of these incidents occurred near the development site in the past couple of years. In addition to the bicycle incident, a single-vehicle crash with a serious injury occurred in front of the proposed development property on January 14th, 2020. No crash factors for this incident are listed as being identified.

▪ **WALK SCORE:**

A private company offers a website at walkscore.com that grades and gives scores to locations within the United States based on “walkability”, “bikeability”, and transit availability based on a patented system. 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.



Appendix B shows maps and other information for the Walk Score, Bike Score, and Transit Score at the development property at 9502 Middlebrook Pike (development property address). The project site location is graded with a Walk Score of 34. This Walk Score indicates that the site is car-dependent and that most errands currently require a vehicle for travel to and from the development property. The site is given a Transit Score of 0 since public transportation is not near the development site. The site is not given a Bike Score.

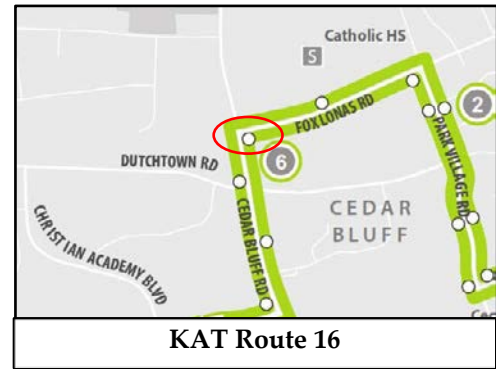
The furthest possible sidewalk travel provided at this location on Middlebrook Pike would allow pedestrians to walk 1.6 miles to the west, just past Ball Camp Pike and Lovell Road at Hardin Valley Road. The existing sidewalk system would allow pedestrians to travel 5.4 miles to the east, just past Dowell Springs Boulevard. The sidewalk system would also allow pedestrians to walk to South Northshore Drive near I-140, over 7 miles to the south.

▪ **TRANSIT SERVICES:**

The City of Knoxville has a network of public transit opportunities offered by Knoxville Area Transit (KAT). Bus service is not available near the development site, and the overall KAT bus system map is provided in Appendix C.

The closest public transit bus service is 1.3 miles away to the southeast at the intersection of North Cedar Bluff Road at Fox Lonas Road and is Route 16, “Cedar Bluff Connector”. It operates on weekdays and weekends, and this route map is also included in Appendix C. KAT had to reduce

its service schedule due to workforce shortages. These changes took place on August 29th, 2022, and the reduced schedule for this route is included in Appendix C. Other transit services in the area include the East Tennessee Human Resource Agency (ETHRA) and the Community Action Committee (CAC), which provides transportation services when requested.



Since the distance to the nearest public bus service is over a mile away, the proposed development is not expected to have reduced vehicle trips due to public transit usage.

PROJECT DESCRIPTION

▪ LOCATION AND SITE PLAN:

The proposed plan layout with 128 multi-family apartments on 10.95 +/- acres is designed by Will Robinson and Associates and is shown in Figure 3. As shown in the figure, one entrance will be constructed for the development at Middlebrook Pike. The Main Entrance will be located at an existing center median opening on Middlebrook Pike that has a westbound exclusive left-turn lane with 165 feet of storage. This existing turn lane was built for future development when Middlebrook Pike was reconstructed approximately 15 years ago, and it will serve the proposed Middlebrook Village development. The proposed Main Entrance will allow full access for all entering and exiting traffic movements to and from the east and west on Middlebrook Pike.

The total length of the driveway entrance and internal parking lot aisleways will be approximately 1,923 feet (0.36 miles). The driveway entrance and internal aisleways will have a width of 26 feet.

The current plan shown in Figure 3 shows five buildings containing 128 apartment units. Four buildings will contain the apartment units, and the other smaller building will be a clubhouse constructed for numerous uses for future residents. The four buildings containing the apartment units will include one-bedroom, two-bedroom, and three-bedroom apartments. The unit breakdown is the following:

<u>Building</u>	<u>1 BR</u>	<u>2 BR</u>	<u>3 BR</u>
A1	7	14	7
A2	7	14	7
B	-	36	-
C	-	24	12
Totals	14	88	26

A total of 268 parking spaces will be provided in several internal parking lots, including the appropriate number of ADA-accessible parking spaces. Thirty-four of the parking spaces will be constructed with covered storage in garages along the south and east sides of the development. Concrete sidewalks are proposed internally for this development along the buildings and between the buildings.

The southern and easternmost portions of the development property will remain undisturbed for hilltop protection. Due to the topography, retaining walls are proposed along the property's northern, western, and eastern edges.

The schedule for this new residential development's completion depends on economic factors and construction timelines. This project is also contingent on permitting, design, and other regulatory approvals. Currently, the area's real estate and rental market is still experiencing large amounts of activity and growth. This study assumed that the total construction build-out of the development and full occupancy would occur within the next two years (2025).

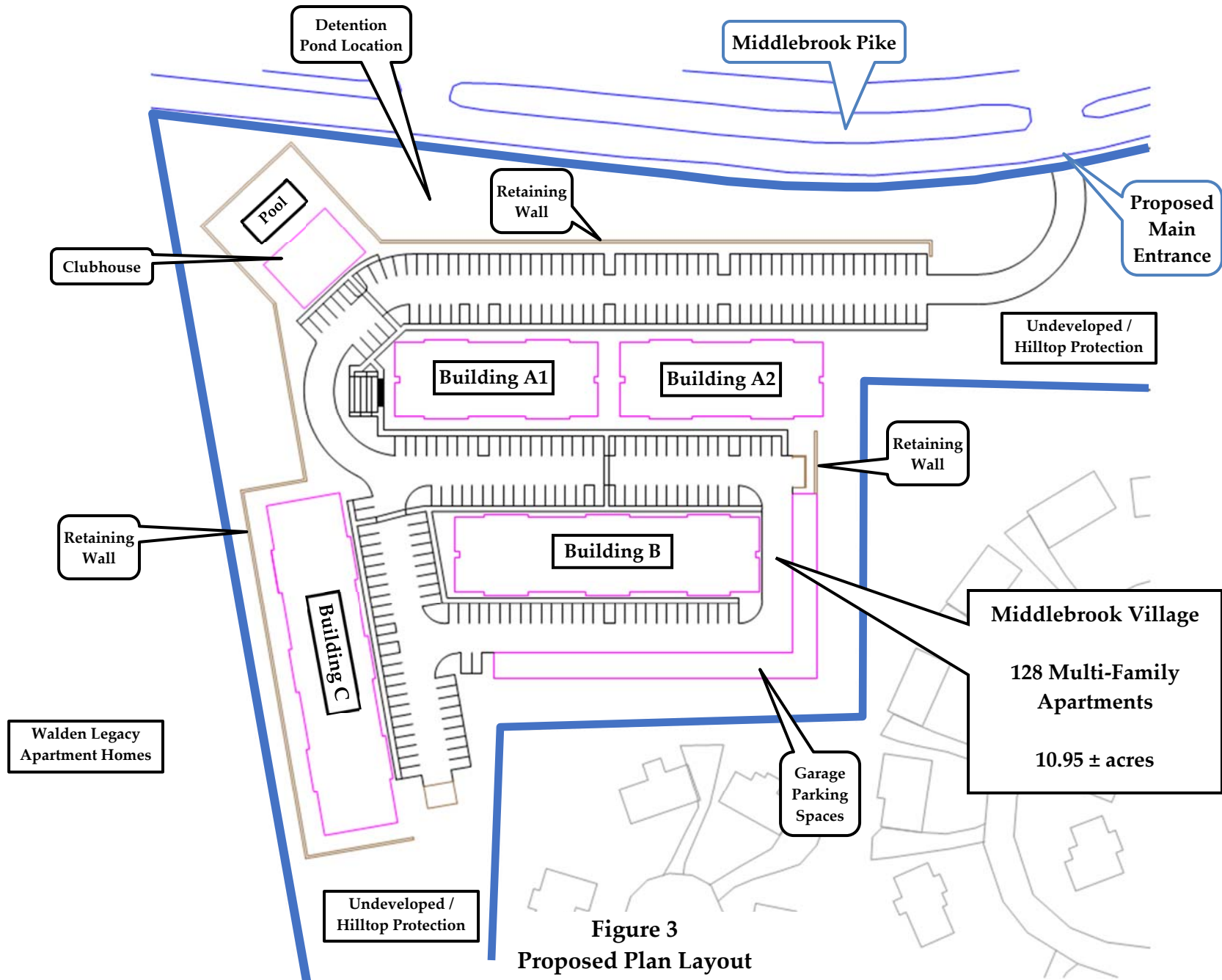


Figure 3
Proposed Plan Layout
Middlebrook Village

Not to Scale

▪ **PROPOSED USES AND ZONING REQUIREMENTS:**

The two existing parcels comprising the Middlebrook Village development property were recently rezoned. The easternmost parcel at 9432 Middlebrook Pike was previously zoned as Planned Residential (PR) with a density of 1 – 4 units per acre. The westernmost parcel at 9502 Middlebrook Village was previously zoned as Agricultural (A). The rezoning allowed both parcels to be zoned as Planned Residential (PR) with a density of less than 12 units per acre. Uses permitted in the Planned Residential (PR) zone include single-family dwellings, duplexes, and multi-dwelling structures and developments. The most recently published online KGIS zoning map is provided in Appendix D. The existing adjacent surrounding zoning and land uses are the following:

- To the northwest of the development site and across Middlebrook Pike, five parcels are zoned as Agricultural (A). These parcels include two undeveloped properties, two parcels occupied by single-family detached houses, and the fifth parcel occupied by a cemetery. This cemetery, the Van Loon Cemetery, has an unknown number of deceased. According to a knoxnewstoday.com article, the cemetery is where a Victorian author, Victoria Van Loon, is buried in an unmarked grave. All these parcels have road access to Middlebrook Pike to the south.
- Atlee Fields Subdivision exists to the north and across Middlebrook Pike from the development property, and all the parcels are zoned as Planned Residential (PR). This subdivision has 165 single-family homes and has been established for many years. Grassy Meadow Boulevard is the only road access for the Atlee Fields Subdivision. This boulevard intersects Middlebrook Pike from the north and is about 1,000 feet east of the proposed development site.
- Immediately east of the development site, the adjacent property is unoccupied, covered in woodlands, and zoned as Agricultural (A). This parcel has direct road access to Middlebrook Pike and has a field entrance off Middlebrook Pike but does not have a center median opening.
- Two residential subdivisions exist south of the development property and consist of the Sanders Crossing and Pine Ridge Crossing Subdivisions. All the parcels in these subdivisions are zoned as Planned Residential (PR) and are fully built out. Both these subdivisions have road access to Bob Gray Road to the south.
- To the west, the development property is adjacent to the Walden Legacy Apartment Homes that is zoned as Planned Residential (PR) with a density of 1 -

12 units per acre. The apartment homes in this development have singular road access to Middlebrook Pike to the north via Walden Legacy Way.



■ **DEVELOPMENT DENSITY:**

The Middlebrook Village development's proposed density is based on a maximum of 128 units on 10.95 acres. One hundred twenty-eight dwelling units on 10.95 acres compute to 11.68 dwelling units per acre, slightly less than allowed for this property with a density of fewer than 12 units per acre in the Planned Residential (PR) zone.

■ **ON-SITE CIRCULATION:**

The total length of the driveway and internal parking lot aiseways will be approximately 1,923 feet (0.36 miles) and will be designed and constructed to Knox County, TN specifications. The internal drives and aiseways will be asphalt paved and include concrete curbs. The lane widths will be 13 feet each for a 26-foot pavement driveway and parking lot aisle width. Concrete sidewalks are being proposed internally along the parking lot aiseways. The driveway entrance and internal aiseways will be private and maintained in the future by the development owner.

■ **SERVICE AND DELIVERY VEHICLE ACCESS AND CIRCULATION:**

Besides residential passenger vehicles, the apartment entrance will also provide access to service, delivery, maintenance, and fire protection/rescue vehicles. None of these other vehicle types will impact roadway operations other than when they occasionally enter and exit the development.

Trash collection areas will be designed on-site for the apartment residents, and private company trash collection trucks are expected to enter and exit this development. The new entrance and parking lot aisleways will be designed and constructed to Knox County specifications and are expected to be adequate for fire protection and rescue vehicles. The development's internal drives are anticipated to accommodate the larger vehicle types and residents' standard passenger vehicles.

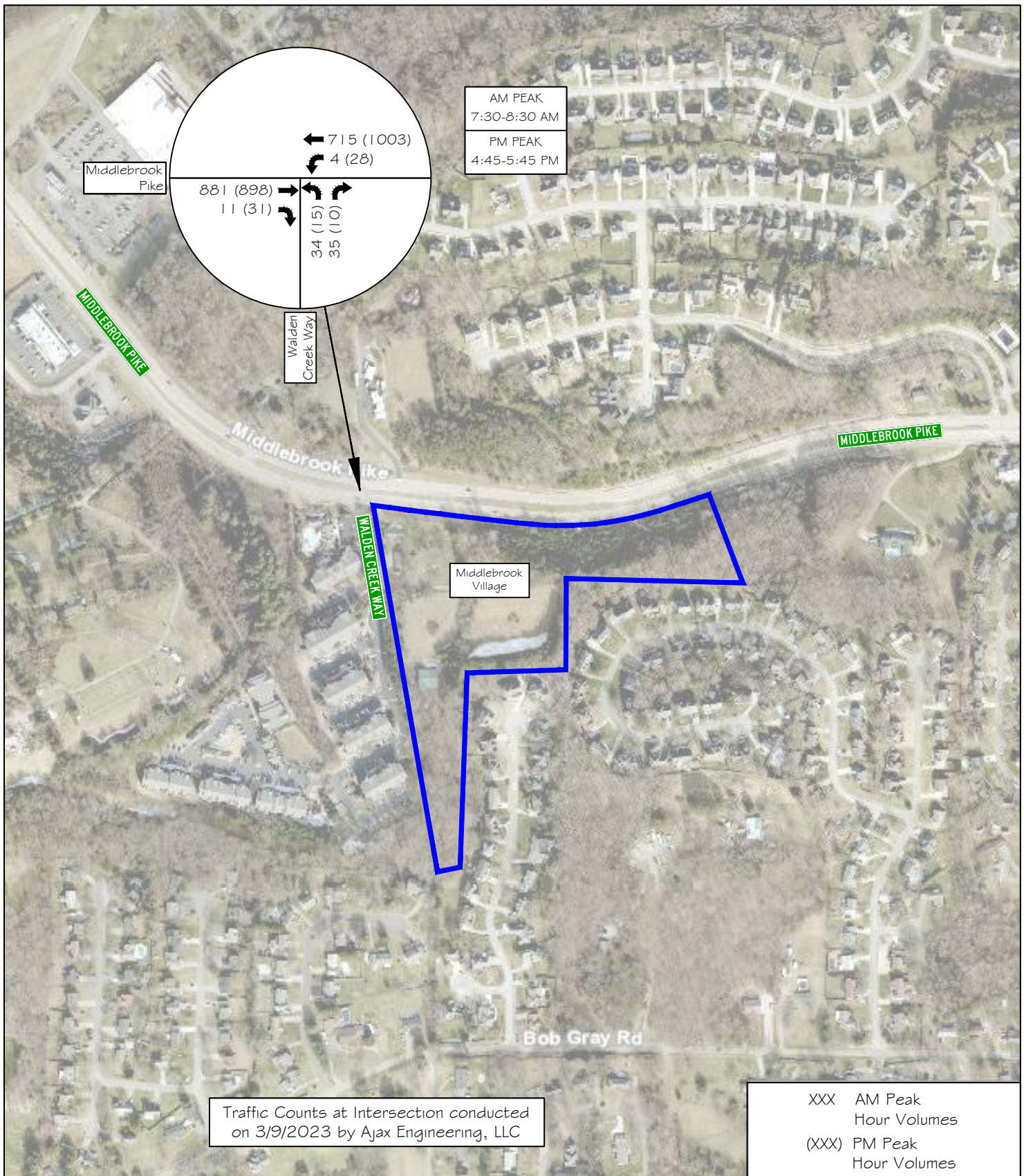
ANALYSIS OF EXISTING AND PROJECTED CONDITIONS

▪ EXISTING TRAFFIC CONDITIONS:

This study conducted an 8-hour traffic count at the unsignalized t-intersection of Middlebrook Pike at Walden Legacy Way, adjacent to the proposed development site, on Thursday, March 9th, 2023. Manual traffic counts were conducted to tabulate the morning and afternoon peak period volumes, travel directions, and patterns near the proposed development site. Based on the traffic volumes collected at the intersection of Middlebrook Pike at Walden Legacy Way, the AM and PM peak hours were observed at 7:30 – 8:30 am and 4:45 – 5:45 pm.

The manual tabulated traffic counts can be reviewed in Figure 4 and Appendix E; some observations from the count are listed below.

- Many Knox County school buses were observed during the traffic counts on Middlebrook Pike. The heavy presence of school buses can be attributed to the nearby schools, including Ball Camp Elementary School and Cedar Bluff Elementary and Middle Schools. During the traffic count, Knox County school bus stops occurred three times (7:07 am, 3:10 pm, and 3:55 pm) just west of the Middlebrook Pike at Walden Legacy intersection for school-age students in the Walden Legacy Apartment Homes development.
- Most traffic observed during the traffic counts were typical passenger vehicles, with some large trucks and heavy vehicles in the thru movements on Middlebrook Pike.
- Three bicyclists were observed during the traffic counts. Two bicyclists were observed on Middlebrook Pike's north sidewalk, one traveling to the east and one to the west. One bicyclist was observed on the south side sidewalk traveling to the east. During the traffic count, no pedestrians were observed on the north or south side sidewalks on Middlebrook Pike.
- A few U-turns were observed at the intersection, with the majority occurring for westbound traffic wanting to return to the east. These westbound U-turn movements were tabulated in the traffic counts as left-turn movements at the intersection with Walden Legacy Way. No U-turns were observed during the AM and PM peak hours, and thus, not included in the peak hour analyses.



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FIGURE 4

Middlebrook Village

2023 Peak Hour Traffic Volumes -
 EXISTING TRAFFIC CONDITIONS

Capacity analyses were undertaken to determine the Level of Service (LOS) for the existing 2023 traffic volumes shown in Figure 4 at the intersection of Middlebrook Pike at Walden Legacy Way. The capacity analyses were calculated following the Highway Capacity Manual (HCM) methods and Synchro Traffic Software (Version 11).

Methodology:

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). LOS designations, which are based on delay, are reported differently for unsignalized and signalized intersections. For example, a delay of 20 seconds at an unsignalized intersection would indicate LOS C, representing 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 it is operating at 75% of its available capacity. This difference is primarily due to motorists' different expectations between the two road facilities. Generally, for most instances, the LOS D / LOS E boundary 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, including 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 two-way stop (or yield) controlled intersection is defined by

the delay for each minor approach and 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 more significant vehicle gap parameters used in the method. 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 more significant gaps sometimes produced by nearby upstream and downstream signalized intersections. For unsignalized intersections, in most instances, the upper limit of acceptable delay during peak hours is the LOS D/E boundary at 35 seconds.

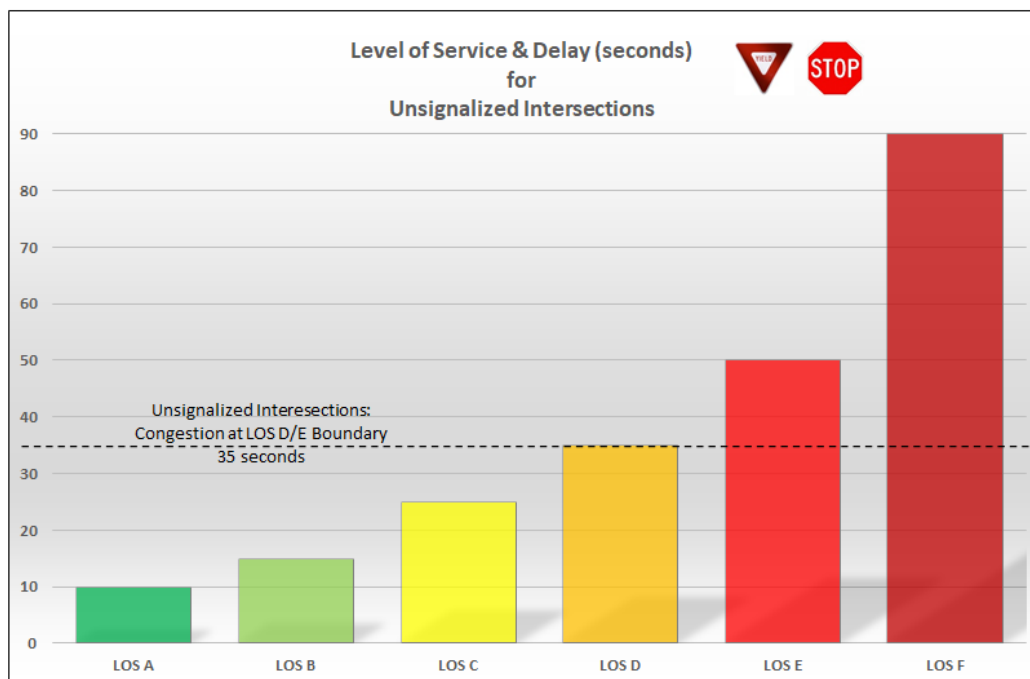
TABLE 2

LEVEL OF SERVICE AND DELAY FOR UNSIGNALIZED INTERSECTIONS



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


Source: Highway Capacity Manual, 6th Edition



Intersection capacity results from the existing 2023 peak hour traffic are shown in Table 3. 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 for the existing 2023 peak hour capacity analyses.

As shown in Table 3, the intersection is calculated to operate with average LOS and reasonable vehicle delays in the existing 2023 conditions. These calculations and results for this intersection are presented in this report as a courtesy and point of reference. This existing intersection is not included in the projected conditions reporting since this intersection was only included in the study for tabulating volumes on Middlebrook Pike and to observe traffic patterns at a similar adjacent land use.

TABLE 3
2023 INTERSECTION CAPACITY ANALYSIS RESULTS -
EXISTING TRAFFIC CONDITIONS

INTERSECTION	TRAFFIC CONTROL	APPROACH/ MOVEMENT	AM PEAK			PM PEAK		
			LOS ^a	DELAY ^b (seconds)	v/c ^c	LOS ^a	DELAY ^b (seconds)	v/c ^c
Middlebrook Pike (EB & WB) at Walden Legacy Way (NB)		Northbound Left/Right	C	17.8	0.308	C	16.1	0.090
		Westbound Left	B	10.4	0.006	B	10.4	0.056

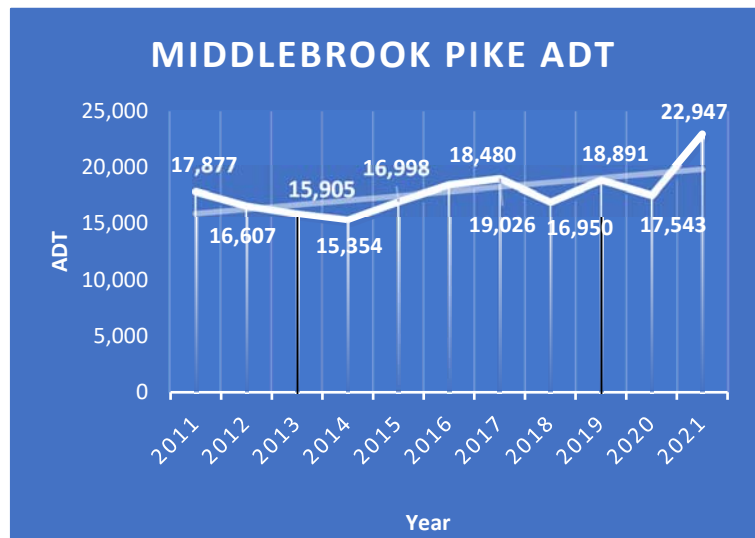
Note: All analyses were calculated in Synchro 11 software and reported using HCM 2010 intersection methodology

^a Level of Service, ^b Average Delay (sec/vehicle), ^c Volume-to-Capacity Ratio

▪ **PROJECTED TRAFFIC CONDITIONS (WITHOUT THE PROJECT):**

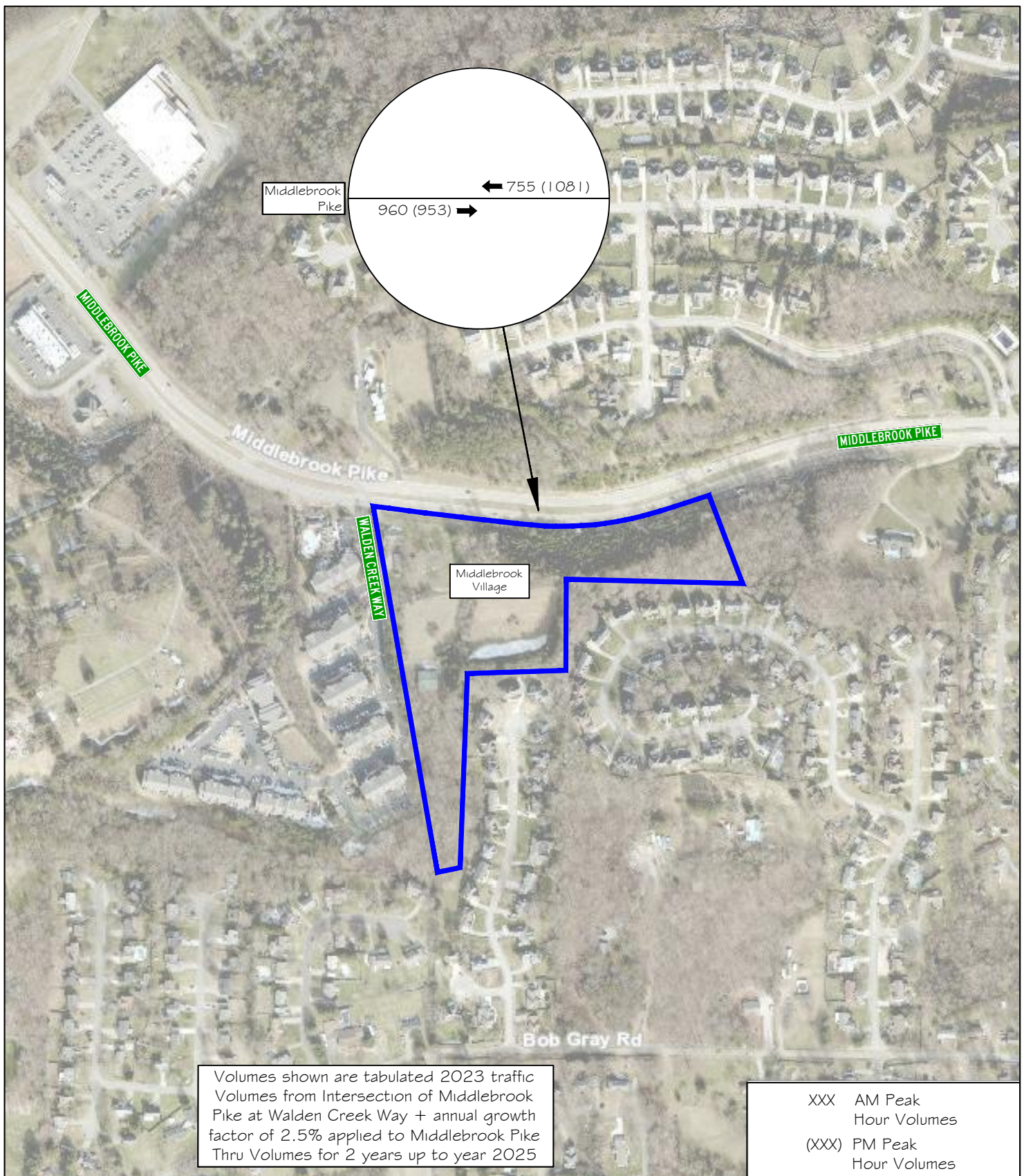
Horizon year traffic conditions represent the projected traffic volumes in the study area without the proposed project being developed (no-build option). The build-out and full occupancy for this proposed development is assumed to occur by 2025.

Vehicular traffic in the study area has shown modest growth over the past ten years, according to the TDOT count station. As shown in Appendix A, Middlebrook Pike has experienced annual growth of +2.5% over the past ten years.



Annual growth rates were assumed and applied to the existing thru 2023 volumes on Middlebrook Pike obtained at the adjacent intersection to calculate the future volumes in the horizon year of 2025 without the potential development traffic. For this study, an annual growth rate of +2.5% was used to calculate future growth on Middlebrook Pike up to 2025 to account for potential traffic growth in the study area. This growth rate matches the TDOT observed rate over the past ten years.

Capacity analyses were not undertaken to determine the projected LOS in 2025 without the project. These analyses were not conducted since the intersection of Middlebrook Pike at the Main Entrance only exists in the projected conditions with the project. Figure 5 shows the projected 2025 horizon year traffic volumes on Middlebrook Pike at the development site without the project during the AM and PM peak hours. In addition to the growth applied to the thru volumes on Middlebrook Pike, the volumes shown in Figure 5 include the vehicles tabulated in the traffic count entering and exiting the Walden Legacy Apartment Homes development at Walden Legacy Way. These vehicles traveled past the proposed development's site on Middlebrook Pike to the east.



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FIGURE 5

Middlebrook Village

2025 Peak Hour Traffic Volumes -
PROJECTED TRAFFIC CONDITIONS
(WITHOUT THE PROJECT)

▪ **TRIP GENERATION:**

A generated trip is a single or one-direction vehicle movement entering or exiting the study site. The estimated amount of traffic for the 128 multi-family apartments was based on the equations provided by Knoxville-Knox County Planning. These equations were developed from an extensive local study to estimate apartment (and townhouse) trip generation in the surrounding area and were published in December 1999. For Knox County, this is the preferred rate to use for apartments and townhouses. This local rate calculates higher trip rates than the similar land use in the often-referenced Institute of Transportation (ITE) Trip Generation Manual.

The data and calculations from the local study for the proposed land use are shown in Appendix G. A summary of this information is presented in the following table:

TABLE 4
TRIP GENERATION FOR MIDDLEBROOK VILLAGE
128 Multi-Family Apartments

ITE LAND USE CODE	LAND USE DESCRIPTION	# OF UNITS	GENERATED DAILY TRAFFIC	GENERATED TRAFFIC AM PEAK HOUR			GENERATED TRAFFIC PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
Local Trip Rate	Multi-Family Apartments	128	1,191	22%	78%		55%	45%	
				15	52	67	53	43	96
Total New Volume Site Trips			1,191	15	52	67	53	43	96

Data from Local Trip Rates and calculated by using Fitted Curve Equations

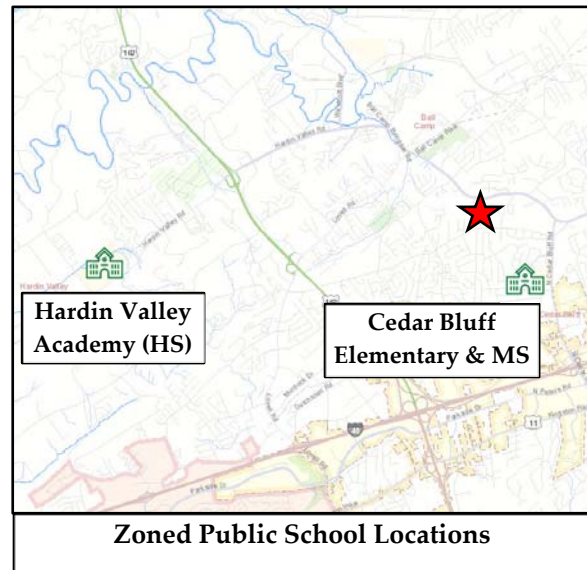
For the proposed residential development, it is estimated that 15 vehicles will enter and 52 will exit, for a total of 67 generated trips during the AM peak hour in the year 2025. Similarly, it is estimated that 53 vehicles will enter and 43 will exit, for a total of 96 generated trips during the PM peak hour in the year 2025. The calculated trips generated for an average weekday are estimated to be 1,191 vehicles for the proposed development. No vehicle trip reductions were included in the calculations or analysis.

The projected trip distribution and assignment for the Middlebrook Village development are based on several sources and engineering judgment. The first source is based on the existing traffic count volumes and the observed travel directions collected at the intersection of Middlebrook Pike at Walden Creek Way adjacent to the proposed development site.

**Top 25 Locations of
2019 Census Bureau Work-Based Trips to
& from Census Tract 46.12**

In addition to employment centers, some generated traffic will travel to and from public and private schools. Schools will be another impetus for external trip-making. The development property is currently zoned for Cedar Bluff Elementary, Cedar Bluff Middle, and Hardin Valley Academy (High School).

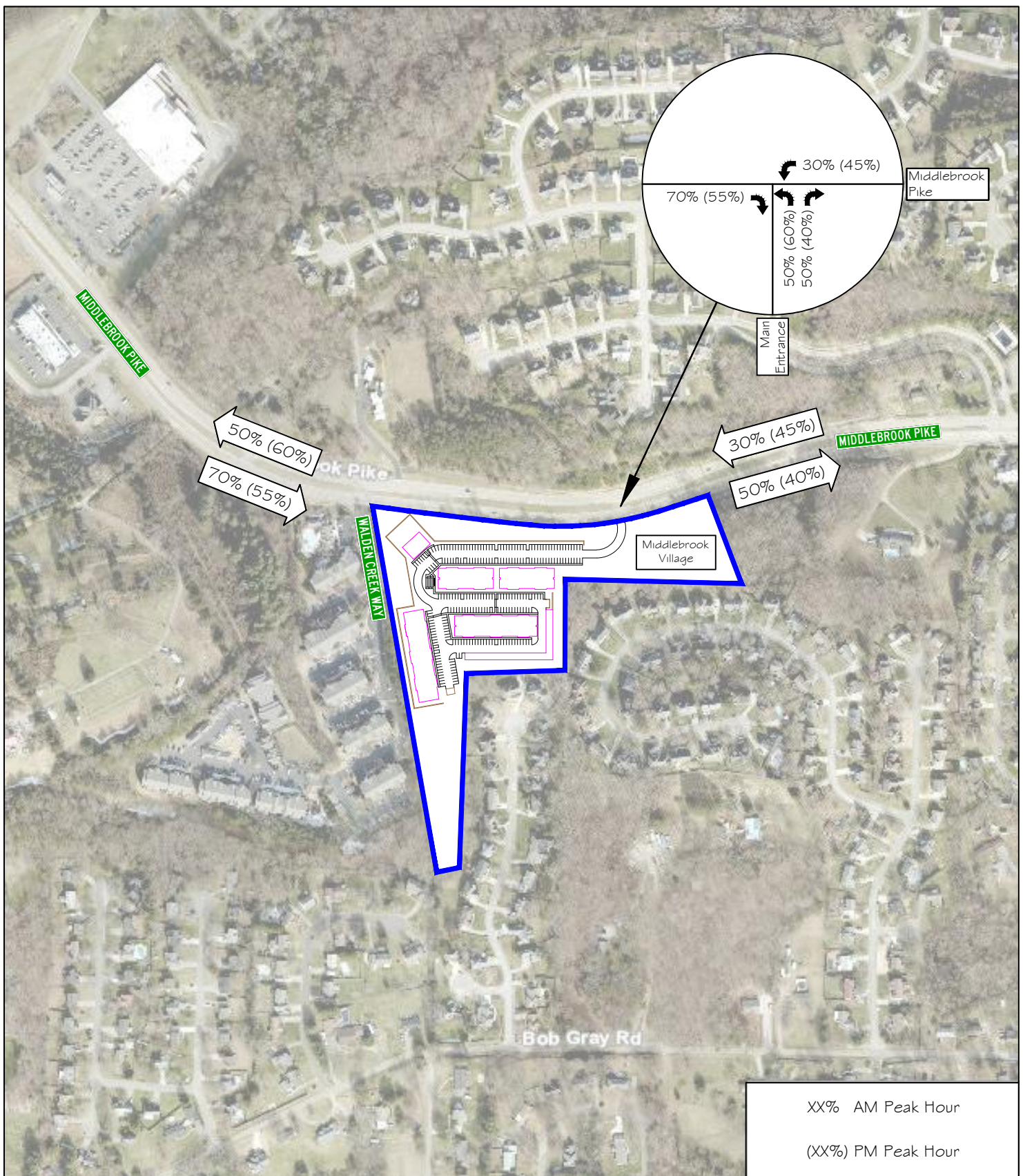
The Cedar Bluff schools are to the southeast on North Cedar Bluff Road and are 1.6 miles away by roadway via Middlebrook Pike. Hardin Valley High School is located to the west, approximately 5.2 miles by roadway via Middlebrook Pike and Hardin Valley Road.



The Knox County Schools Transportation Department has developed Parental Responsibility Zones (PRZ) to determine whether students are offered transportation services to and from school. The PRZ is defined as being 1.5 miles for grades 6 – 12 and 1.0 miles for grades K – 5 from where the students' parcel is accessed to the point where the buses unload at the school. This development will be outside the PRZ for all the zoned schools, and all school-age children attending public schools in the development will be able to utilize this service if desired. Public school buses serving the future Middlebrook Village development are expected to make stops on Middlebrook Pike as currently occurring for the school-age children in the adjacent Walden Legacy Apartment Homes development.

Figure 6 shows the projected distribution of traffic entering and exiting the development at the proposed Main Entrance on Middlebrook Pike. The percentages shown in the figure only pertain to the trips generated by the proposed dwellings in the development calculated from the local trip rates. Ultimately, the projected trip distribution was heavily based on the observed traffic at the intersection of Middlebrook Pike at Walden Legacy Way, and the traffic flows adjacent to the site on Middlebrook Pike. The assumed distribution retained the heavier entering eastbound movements in the AM peak hour observed at Walden Legacy Way and closely retained the observed even split of exiting westbound and eastbound movements.

Figure 7 shows the traffic assignment of the computed trips generated by the development and is based on the assumed distribution of trips shown in Figure 6.



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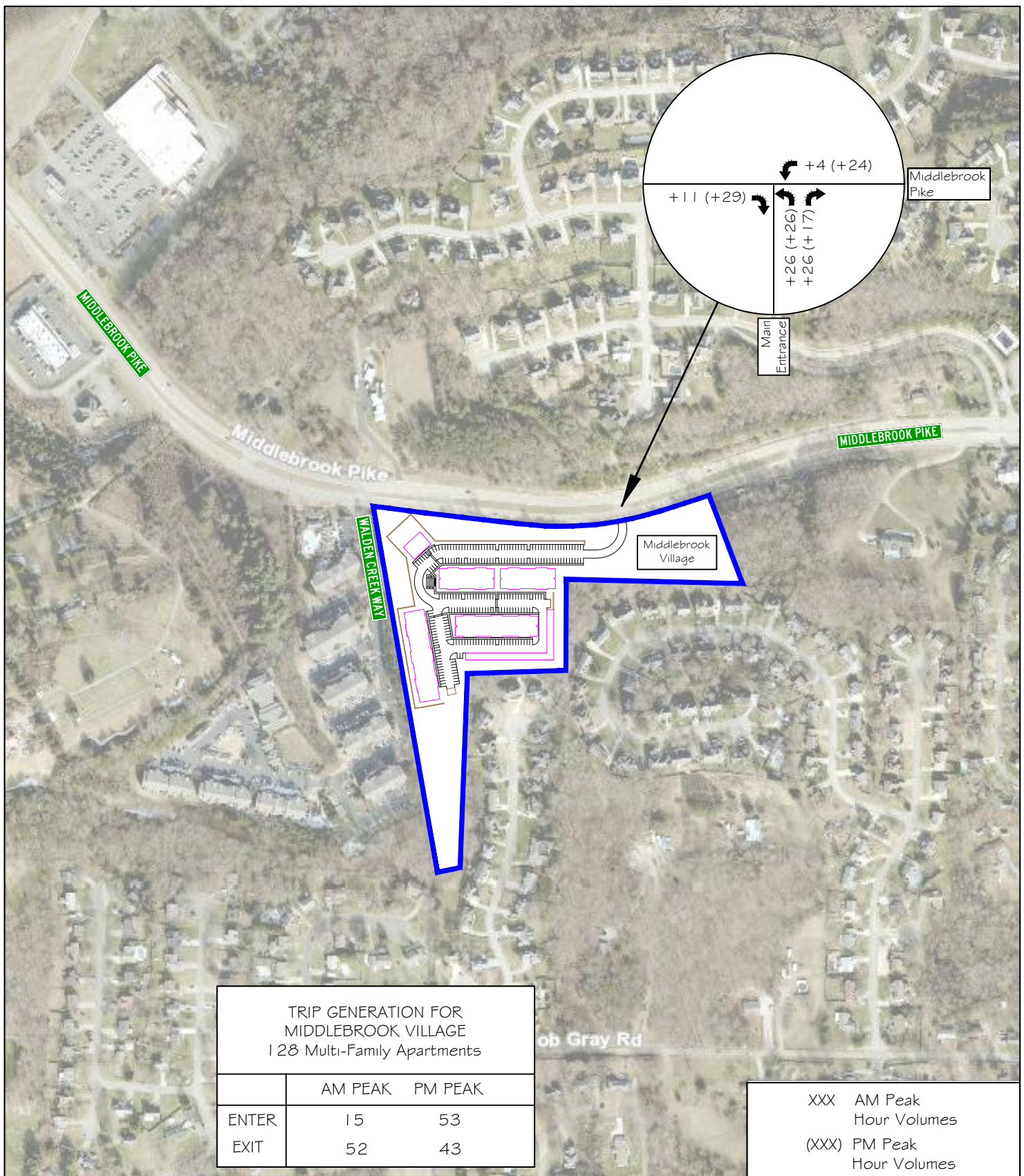
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FIGURE 6

Middlebrook Village

Directional Distribution of Generated Traffic during AM and PM Peak Hour



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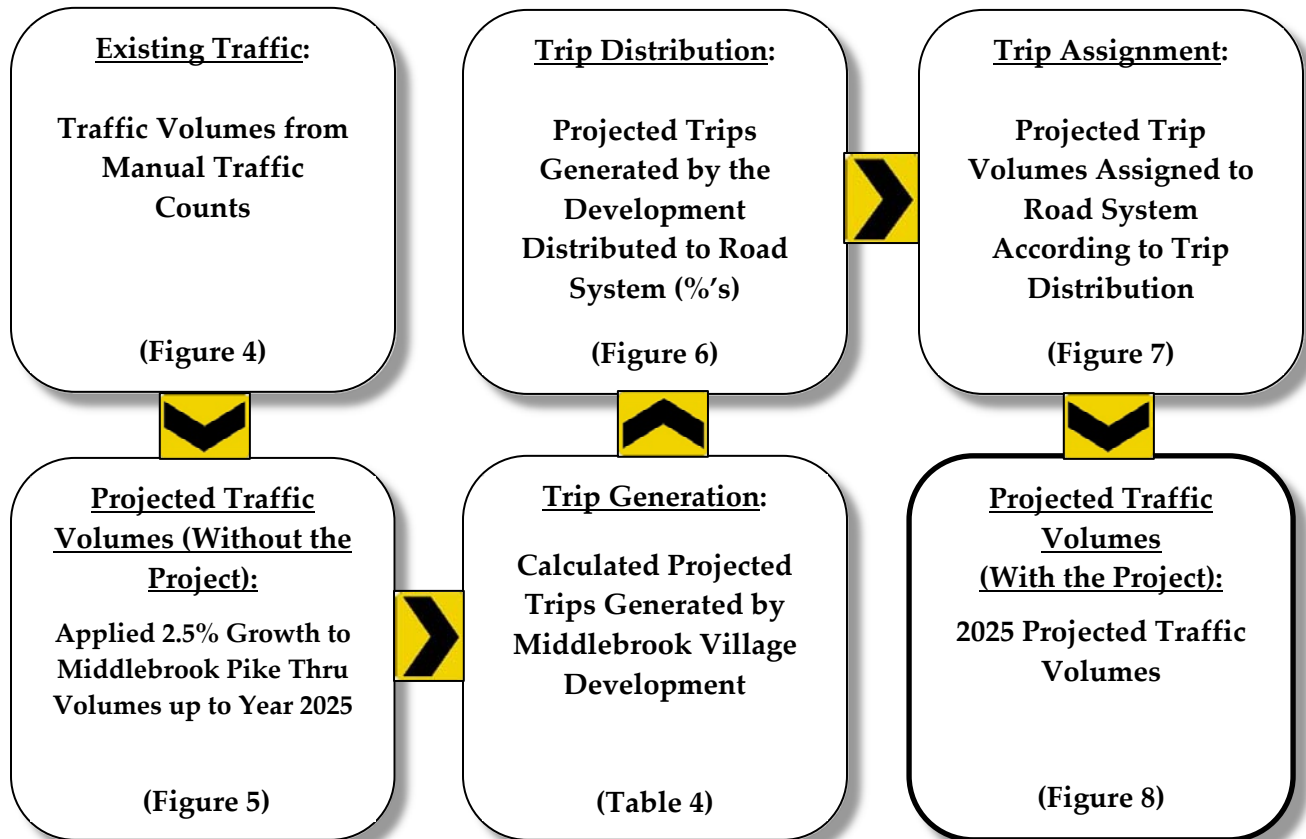
FIGURE 7

Middlebrook Village

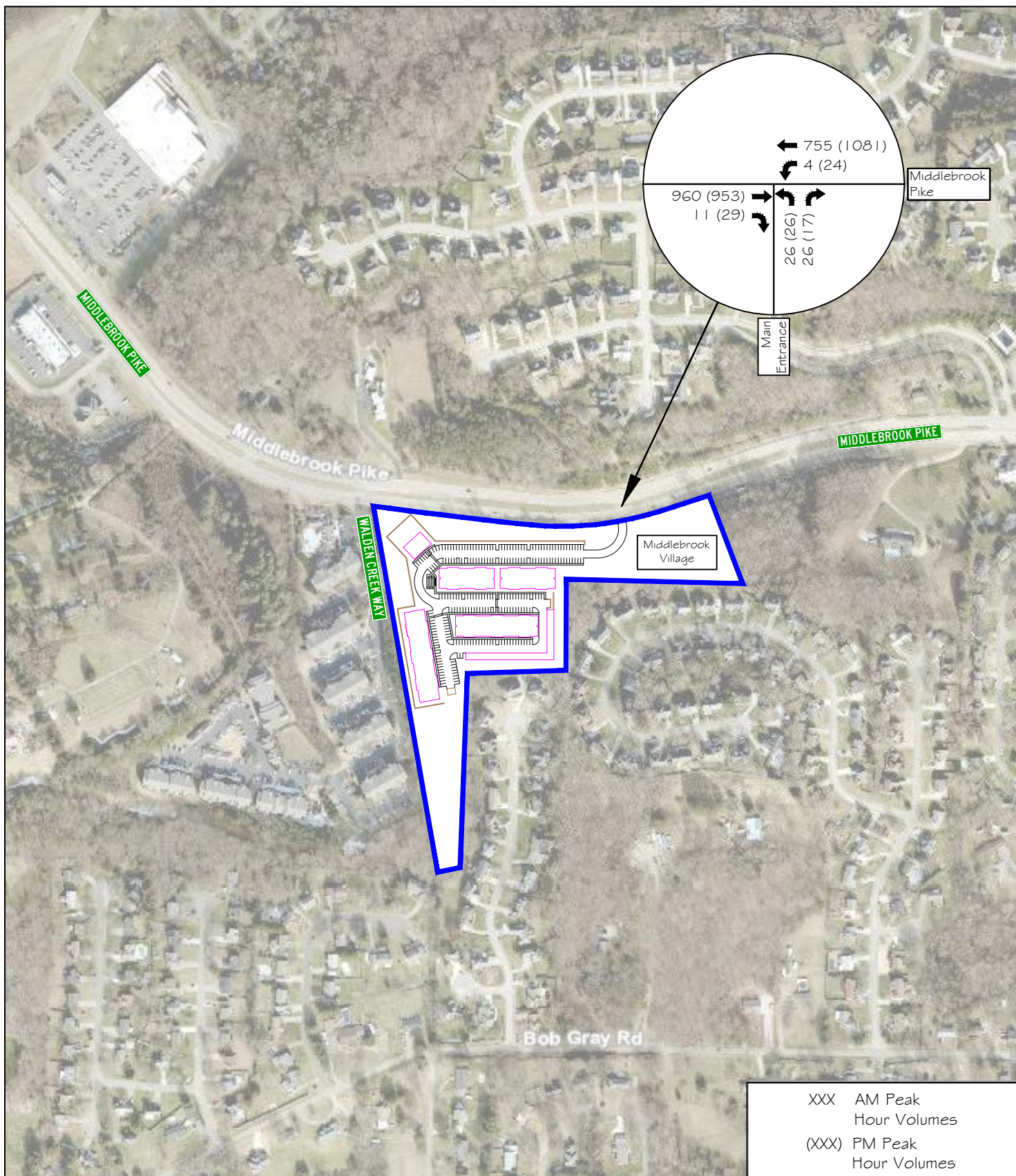
Traffic Assignment of Generated Traffic
during AM and PM Peak Hour

▪ **PROJECTED TRAFFIC CONDITIONS (WITH THE PROJECT):**

Overall, several additive steps were taken to estimate the total projected traffic volumes at the Main Entrance on Middlebrook Pike when the Middlebrook Village development is constructed and fully occupied in 2025. The steps are illustrated below for clarity and review:



The calculated peak hour traffic (Table 4) generated by the Middlebrook Village development was added to the 2025 horizon year traffic (Figure 5) by following the predicted trip distributions and assignments (Figures 6 and 7). This procedure was completed to obtain the total projected traffic volumes at the intersection of Middlebrook Pike at the Main Entrance when the Middlebrook Village development is fully built and occupied in 2025. Figure 8 shows the projected 2025 AM and PM peak hours with the generated development traffic at the proposed Main Entrance.



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FIGURE 8

Middlebrook Village

2025 Peak Hour Traffic Volumes -
PROJECTED TRAFFIC CONDITIONS
(WITH THE PROJECT)

Capacity analyses were conducted to determine the projected LOS at the Main Entrance with the development traffic in 2025. Appendix F includes the worksheets for these capacity analyses. The projected 2025 peak hour calculations with the project resulted in average LOS with reasonable vehicle delays, as shown in Table 5.

TABLE 5
2025 INTERSECTION CAPACITY ANALYSIS RESULTS -
PROJECTED TRAFFIC CONDITIONS (WITH THE PROJECT)

INTERSECTION	TRAFFIC CONTROL	APPROACH/ MOVEMENT	AM PEAK			PM PEAK		
			LOS ^a	DELAY ^b (seconds)	v/c ^c	LOS ^a	DELAY ^b (seconds)	v/c ^c
Middlebrook Pike (EB & WB) at Main Entrance (NB)	 Unsignalized	Northbound Left/Right	C	20.5	0.199	C	20.9	0.174
		Westbound Left	B	10.8	0.007	B	10.5	0.039

Note: All analyses were calculated in Synchro 11 software and reported using HCM 2010 intersection methodology

^a Level of Service, ^b Average Delay (sec/vehicle), ^c Volume-to-Capacity Ratio

▪ **POTENTIAL TRANSPORTATION SAFETY ISSUES:**

The study area was investigated for potential existing and future safety issues when the development is constructed. These adjacent transportation system features are discussed in the following pages.

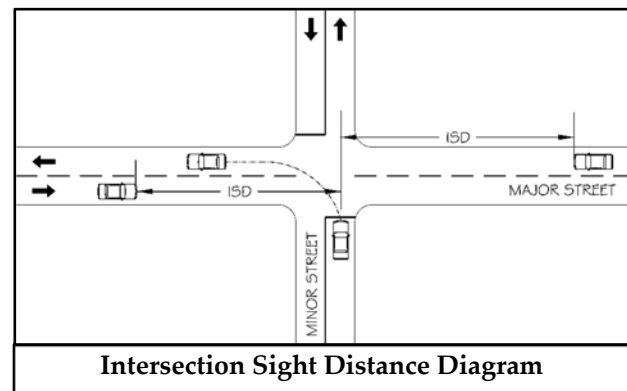
○ **EVALUATION OF SIGHT DISTANCE**

For intersections, sight distance evaluations have two categories: Stopping Sight Distance (SSD) and Intersection Sight Distance (ISD).

Methodology:

SSD is the distance required for a motorist on a major street to perceive, react, and the vehicle to come to a complete stop before colliding with an object on the road. For evaluating intersections, this object would be another vehicle entering the intersection from a minor street. SSD can be considered the minimum visibility distance standard for evaluating the safety of an intersection.

ISD is the required visibility distance standard for evaluating the safety of an intersection per section 3.04.J.5 in the Knoxville-Knox County Subdivision Regulations. 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.

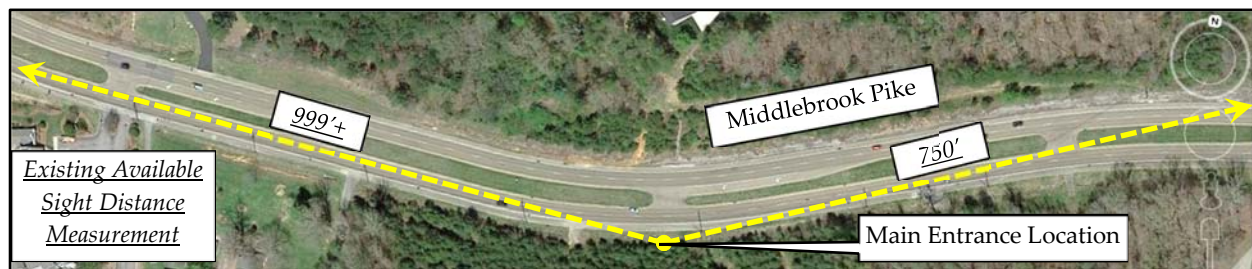


Three traffic maneuvers are available for vehicles stopped on a minor street at a 4-way intersection: (1) left-turn, (2) right-turn, (3) or a crossing maneuver across the major street. For turns from the minor street, ISD is needed to allow a stopped motorist to turn onto a major street without being overtaken by an approaching vehicle. The most critical ISD is for left turns from the minor street. The ISD for this maneuver includes the time to turn left and clear half of the intersection without conflicting with the oncoming traffic from the left and accelerating to the road's operating speed without causing the approaching vehicles from the right to reduce their speed substantially.

With a posted speed limit of 40-mph on Middlebrook Pike at the Main Entrance, the ISD is 385 feet for exiting right-turn movements and is calculated based on AASHTO's (American Association of State Highway Transportation Officials) guidance. For exiting left-turn movements at the Main Entrance, the ISD is calculated to be 545 feet.

Visual observations of the sight distances at the proposed entrance location on Middlebrook Pike were undertaken. Using a Nikon Laser Rangefinder at the proposed Main Entrance, the available sight distance was visually estimated to be 999'+ feet to the west and 750' feet to the east. The available sight distances from the proposed Main Entrance on Middlebrook Pike will be adequate based on visual observations.

Images of the existing sight distances at the proposed Main Entrance location are labeled below with the ISD and rangefinder-measured sight distances.



**View of Sight Distance on Middlebrook Pike
at the Proposed Main Entrance Location
(Looking West)**



**View of Sight Distance on Middlebrook Pike
at the Proposed Main Entrance Location
(Looking East)**

- **EVALUATION OF TURN LANE THRESHOLDS**

The need for a separate turn lane was evaluated in the projected 2025 conditions for Middlebrook Pike at the proposed Main Entrance. The evaluation did not include left turns on Middlebrook Pike since a westbound left-turn lane is already provided in the center of the road for this movement.

The criteria used for this turn lane evaluation were based on Knox County's "Access Control and Driveway Design Policy" and TDOT's "Highway System Access Manual". These design policies relate vehicle volume thresholds based on prevailing speeds for two-lane and four-lane roadways. The location of the proposed entrance on Middlebrook Pike is within a 40-mph speed zone and, thus, was evaluated based on this speed.

According to Knox County's and TDOT's guidelines, a separate eastbound right-turn lane on Middlebrook Pike at the proposed Main Entrance is not warranted based on the projected 2025 peak hour traffic volumes. The worksheets for these evaluations are provided in Appendix I.

- **PROJECTED VEHICLE QUEUES**

An additional software program was used to calculate the 2025 AM and PM peak hour projected vehicle queues at the proposed Main Entrance. The previously mentioned Synchro Traffic Software includes SimTraffic. The Synchro portion of the software performs the macroscopic calculations for intersections, and SimTraffic performs micro-simulation and animation of vehicular traffic. SimTraffic (Version 11) software was utilized to estimate the projected vehicle queues.

The 95th percentile vehicle queue is the recognized measurement in the traffic engineering profession as the design standard used when considering vehicle queue lengths. A 95th percentile vehicle queue length means 95% certainty that the vehicle queue will not extend beyond that point. The calculated vehicle queue results were based on averaging the outcome obtained during ten traffic simulations. The 95th percentile vehicle queue lengths at the proposed Main Entrance on Middlebrook Pike are shown in Table 6 for the projected 2025 conditions with the project. The vehicle queue worksheet results from the SimTraffic software are in Appendix J.

TABLE 6
TURN LANE STORAGE & VEHICLE QUEUE SUMMARY -
2025 PROJECTED PEAK HOUR TRAFFIC (WITH THE PROJECT)

INTERSECTION	APPROACH/ MOVEMENT	STORAGE LENGTH (ft)	SIMTRAFFIC 95 th PERCENTILE QUEUE LENGTH (ft)		ADEQUATE LENGTH?
			AM PEAK HOUR	PM PEAK HOUR	
Middlebrook Pike (EB & WB) at Main Entrance (NB)	Westbound Left	165	16	39	YES
	Northbound Left/Right	n/a	86	61	n/a

Note: 95th percentile queues were calculated in SimTraffic 11 software

Table 7 shows that the westbound left-turn entering motorists on Middlebrook Pike at the Main Entrance will adequately be contained in the existing westbound left-turn lane on Middlebrook Pike, which provides 165 feet of vehicle storage. The projected vehicle queues for the exiting traffic in the 2025 AM and PM peak hours at the proposed Main Entrance are calculated to be reasonable. The maximum calculated vehicle queue at the Main Entrance occurs during the AM peak hour with a distance of 86 feet, just over three passenger cars, assuming a length of 25 feet per vehicle.

CONCLUSIONS & RECOMMENDATIONS

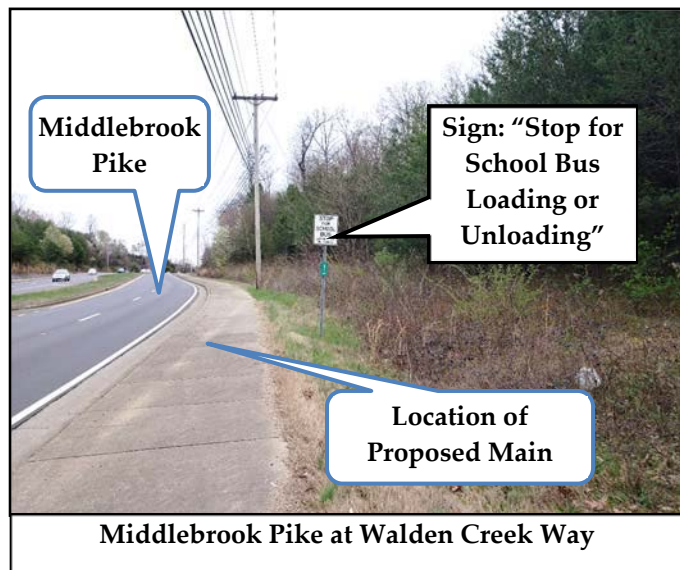
The following is an overview of recommendations to minimize the transportation impacts of the Middlbroom Village development on the adjacent transportation system while attempting to achieve an acceptable traffic flow and safety level.



Middlebrook Pike at the Main Entrance: The 2025 projected level of service calculations for this proposed intersection resulted in average vehicle delays and LOS.

- 1a) The construction of an eastbound right-turn lane on Middlebrook Pike for entering traffic is not warranted at the proposed Main Entrance based on the projected 2025 traffic volumes.
- 1b) It is recommended that a Stop Sign (R1-1) be installed, and a 24" white stop bar be applied to the proposed Main Entrance approach at Middlebrook Pike. The stop bar should be applied a minimum of 4 feet away from the edge of Middlebrook Pike and placed at the desired stopping point that maximizes the sight distance.
- 1c) A single exiting lane for the development entrance at Middlebrook Pike will be sufficient. The northbound exiting lane at Middlebrook Pike is proposed as a shared left/right turn lane. The 95th percentile vehicle queue lengths were calculated at this intersection for the 2025 projected conditions with the project, and the calculated vehicle queues are reasonable. The longest queue in the projected 2025 conditions is calculated to be 86 feet in the AM peak hour and 61 feet in the PM peak hour. These queue lengths translate to just over three passenger cars, assuming a length of 25 feet per vehicle.
- 1d) Intersection sight distance at the Main Entrance at Middlebrook Pike must not be impacted by future landscaping or signage. Based on a posted speed limit of 40-mph on Middlebrook Pike, the required ISD is 545 feet for exiting left-turning vehicles at the Main Entrance and 385 feet for exiting right-turning vehicles. The site designer must verify that these distances will be available.
- 1e) The construction of the proposed Main Entrance on Middlebrook Pike will require a TDOT Highway Entrance Permit. The developer will need to apply for this permit and coordinate with TDOT regarding their specific requirements for this entrance.

- 1f) An existing regulatory sign regarding school bus stops is adjacent to the proposed Main Entrance location at Middlebrook Pike. It is recommended that this sign be removed from this location and placed at the appropriate location, as directed by TDOT, to eliminate potential sight distance interference and intersection operations. This



signage may be more appropriate to be installed west of the existing Walden Creek Way intersection since bus stops were observed occurring at this adjacent intersection.

- 1g) The site designer should provide the appropriate accommodations for the existing sidewalk on the south side of Middlebrook Pike at the proposed Main Entrance. These accommodations should include a white crosswalk and ADA-compliant ramps with detectable surfaces on the sidewalk approaches.

- 1h) It is recommended that a Divided Highway (R6-3) sign be installed below the recommended Stop Sign (R1-1) at the Main Entrance to reduce the potential of a wrong-way entering movement on Middlebrook Pike. In addition, it is recommended that dual Do Not Enter (R5-1) signs be installed on Middlebrook Pike, just west of the proposed Main Entrance and facing toward the east.



R6-3

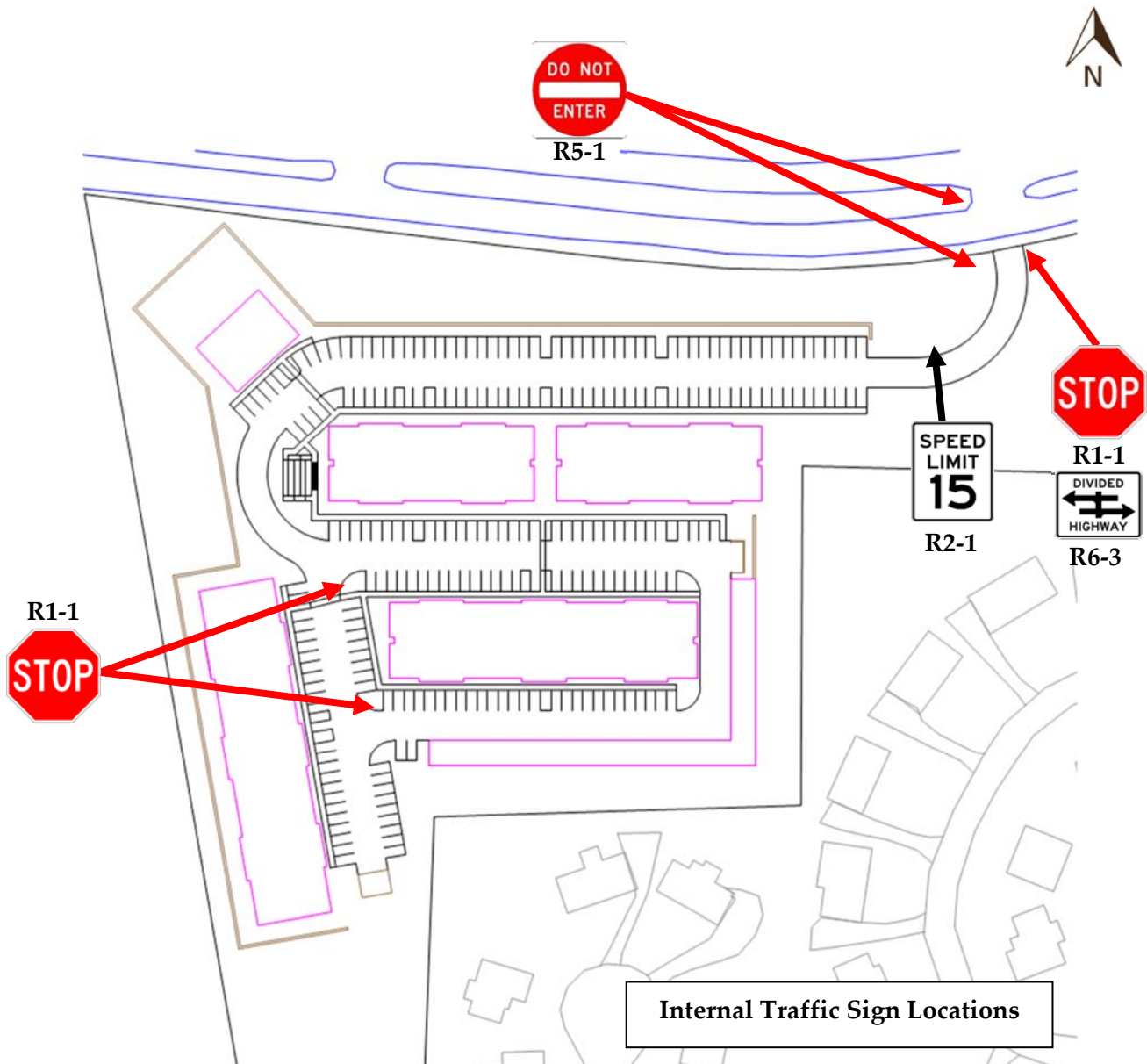


R5-1



Middlebrook Village Development Internal Drives/Parking Lot Aisleways: The layout plan shows one entrance on Middlebrook Pike constructed for the development, as shown in Figure 3.

- 2a) A 15-mph (or lower) Speed Limit Sign (R2-1) is recommended to be posted near the beginning of the development entrance driveway off Middlebrook Pike. Since the entrance driveway will not be a public road, a posted speed limit of less than 25-mph is acceptable.
- 2b) Stop Signs (R1-1) with 24" white stop bars and other traffic signage are recommended to be installed at the internal drives and parking lot aisleways, as shown below:



- 2c) Sight distance at the new internal intersections must not be impacted by new signage, parked cars, or future landscaping. With a speed limit of 15-mph in the development, the internal intersection sight distance is 170 feet. The required stopping sight distance is 80 feet for a level road grade. The site designer should ensure that internal sight distance lengths are met.
- 2d) With long and straight parking lot aiseways proposed internally, it is recommended that speed humps or tables be considered to reduce internal traffic speeds in the development. Alternatively, parking lot islands could be extended toward the aiseways. Extending the parking lot islands a few feet would narrow the aisleway widths and reduce the available driving surface. A narrower aisleway design would reduce driver comfort and internal vehicle speeds.
- 2e) All drainage grates and covers for the residential development must be pedestrian and bicycle safe.
- 2f) The site designer should include a parking area and a centralized mail delivery center within the development. A specific location with a resident parking area should be designed and provided.
- 2g) Internal sidewalks are proposed throughout the development. The internal sidewalk system should connect to the existing external sidewalk system provided on the south side of Middlebrook Pike. Sidewalks should have appropriate ADA-compliant ramps at intersection corners with detectable surfaces, and the internal sidewalks are recommended to be 5 feet minimum in width to meet Knox County regulations. White crosswalks should be applied to the road pavement internally where pedestrians are expected to cross. Internal crosswalks should include Pedestrian Warning (W11-2) signs with a downward arrow plaque (W16-7p) where appropriate.
- 2h) All road grade and intersection elements should be designed to AASHTO, TDOT, and Knox County specifications and guidelines to ensure proper operation.



APPENDIX A

HISTORICAL TRAFFIC COUNT DATA

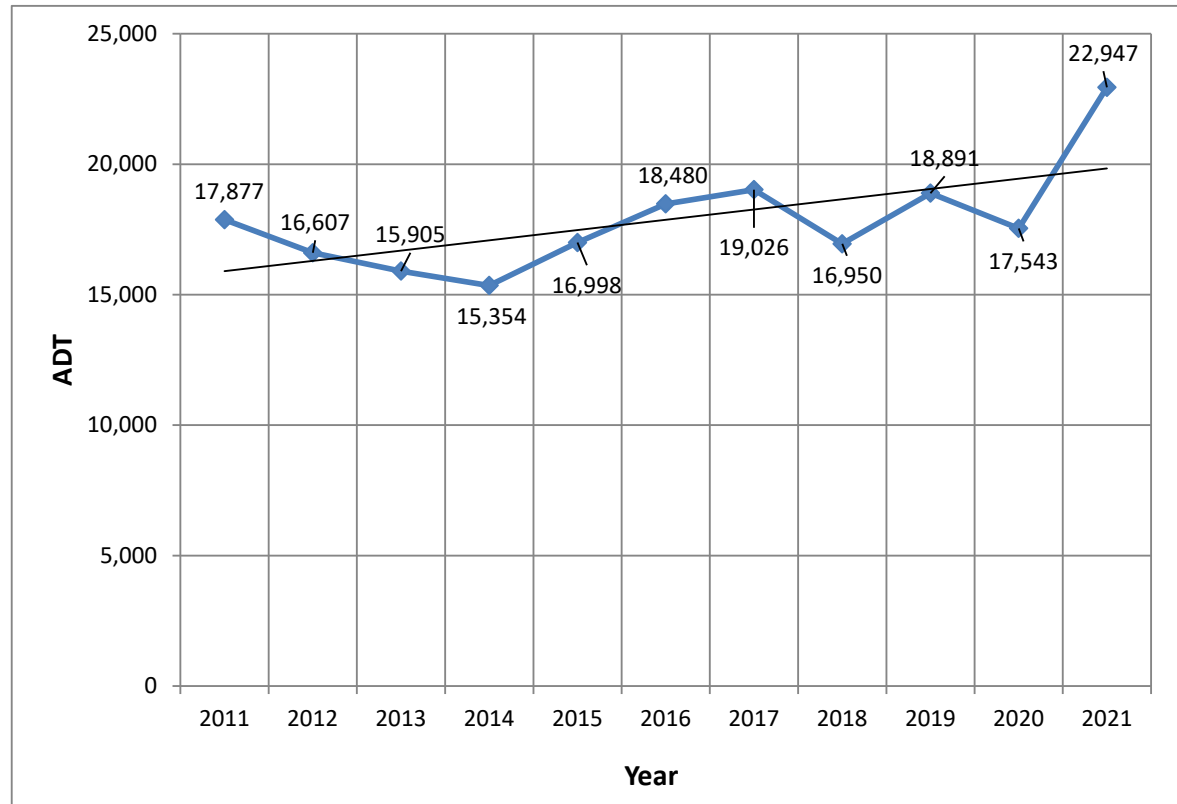
Historical Traffic Counts

Organization: TDOT

Station ID #: 47000088

Location: Middlebrook Pike, east of Ball Camp Pike / Lovell Road

YEAR	ADT	
2011	17,877	Trendline ↓
2012	16,607	
2013	15,905	
2014	15,354	
2015	16,998	
2016	18,480	
2017	19,026	
2018	16,950	
2019	18,891	
2020	17,543	
2021	22,947	



2011 - 2021 Growth Rate = 28.4%

Average Annual Growth Rate = 2.5%

TDOT
 Department of Transportation

MS2
 Transportation Data Management System

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[Audio Update OFF](#)

[List View](#)
[All Data](#)

Record
 15616
 of 15616
 Goto Record

 Go

Location ID	47000088	MPO ID	
Type	SPOT	HPMS ID	
On NHS		On HPMS	Yes
IRS ID	47SR169001	IRS Loc Pl	0 199
SF Group	Urban	Route Type	
AF Group	Urban Minor Arterial	Active	Yes
GC Group	Knox	Category	CC
Class Dist Grp	Urban Minor Arterial	Milepost	
Seas Class Grp			
WIM Group			
QC Group	Default		
Funct Class	Minor Arterial		
Located On	SR109		
Loc On Alias	MIDDLEBROOK PK		
	BALL CAMP		

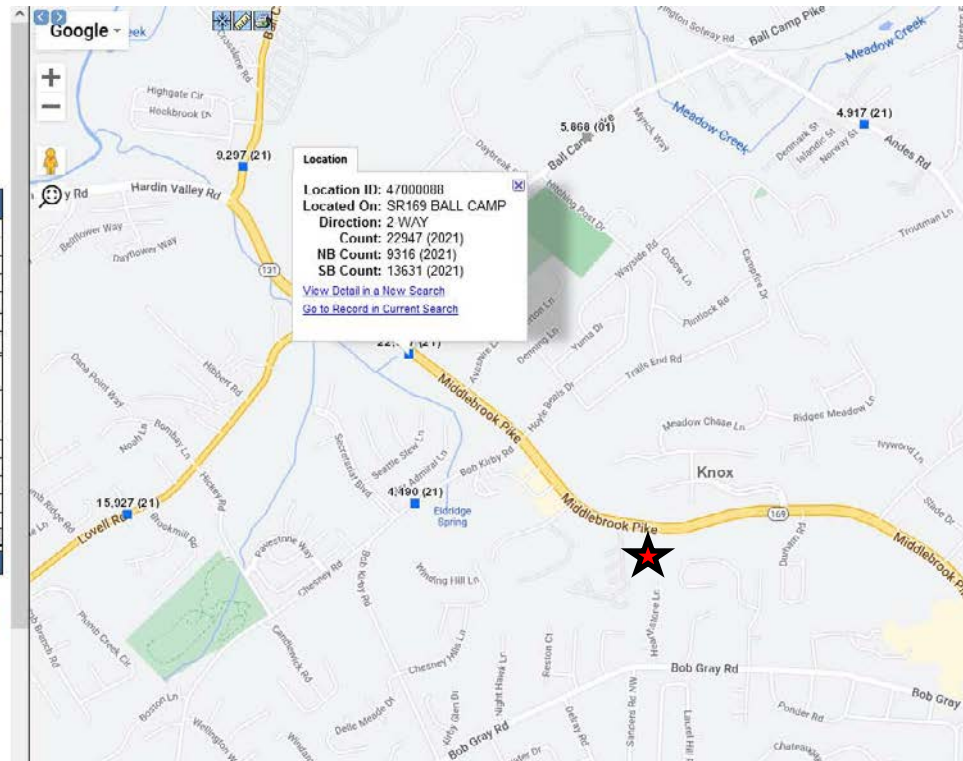
More Detail

STATION DATA

Directions: 2 WAY NB SB

Year	AAADT	DHV 30	K %	D %	PA	BC	Src
2021	22,947	1,877	8	57	22,188 (97%)	759 (3%)	
2020	17,543 ⁷		13	51	16,876 (96%)	667 (4%)	
2019	18,891 ²		13	51			
2018	16,950		11	51			
2017	19,028 ²						

1 of 38





APPENDIX B

WALK SCORE

WALKSCORE

(from walkscore.com)




Walk Score  [Get Scores](#) [My Favorites](#) [Add to Your Site](#)

 [Go](#)


9502 Middlebrook Pike

Knoxville, Tennessee, 37931

Commute to **Knoxville, TN**

 27 min  60+ min  60+ min [View Routes](#)

[Favorite](#) [Map](#) [Nearby Apartments](#)

[More about 9502 Middlebrook Pike](#) 

Walk Score

34

Car-Dependent
Most errands require a car.

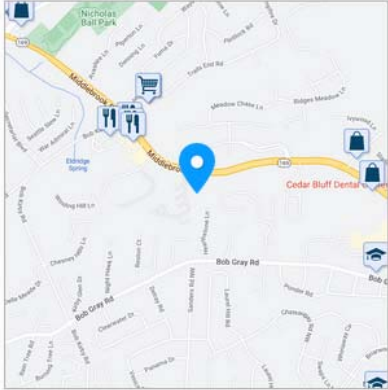
Transit Score

0

Minimal Transit
It is possible to get on a bus.

[About your score](#)

[Add scores to your site](#)



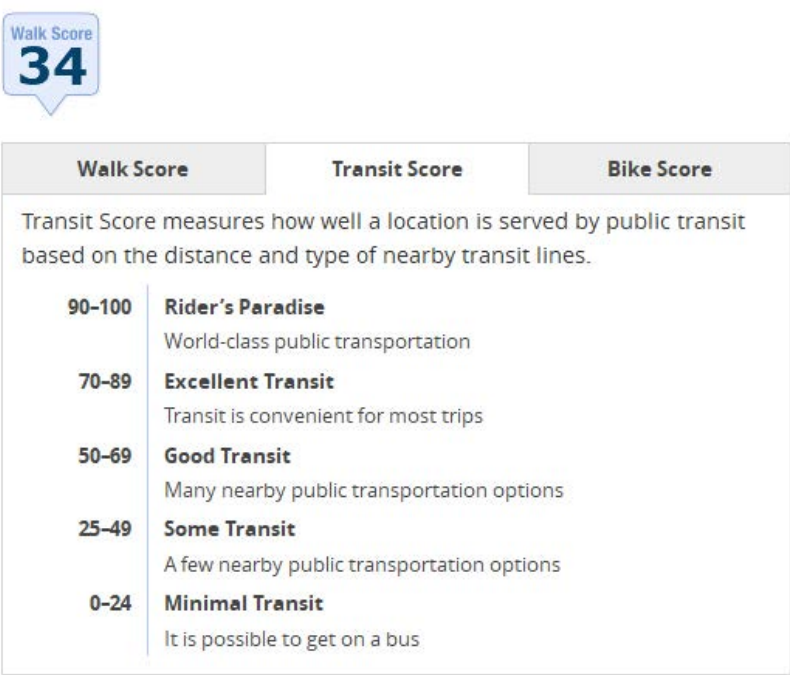
Scores for 9502 Middlebrook Pike

x



Scores for 9502 Middlebrook Pike

x



Scores for 9502 Middlebrook Pike



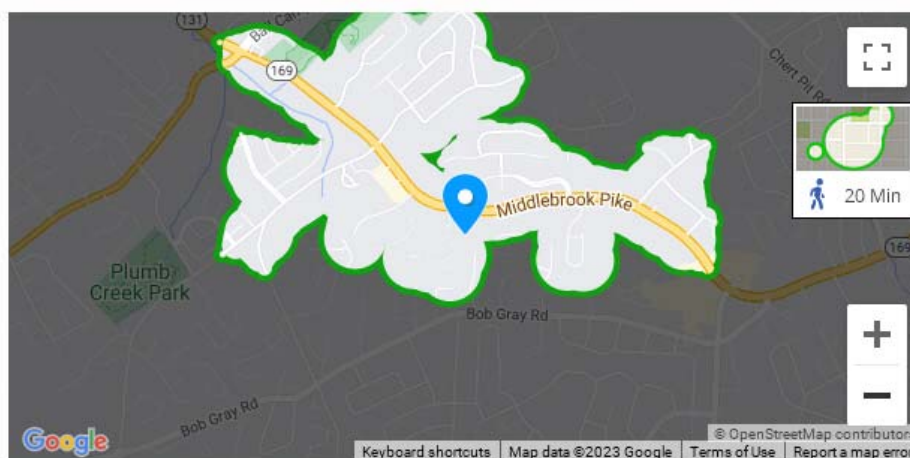
Walk Score
34

Walk Score	Transit Score	Bike Score
Bike Score measures whether an area is good for biking based on bike lanes and trails, hills, road connectivity, and destinations.		
90-100	Biker's Paradise	Daily errands can be accomplished on a bike
70-89	Very Bikeable	Biking is convenient for most trips
50-69	Bikeable	Some bike infrastructure
0-49	Somewhat Bikeable	Minimal bike infrastructure

Travel Time Map

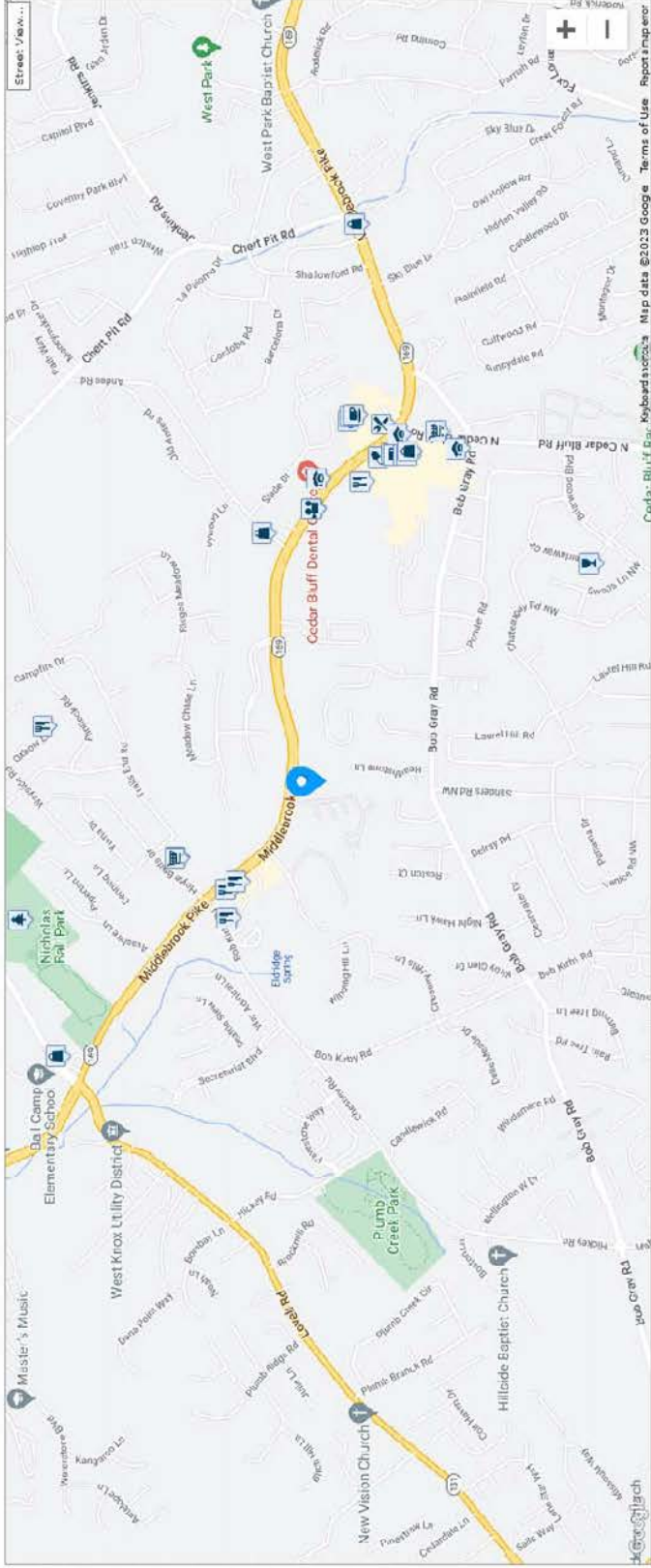
[Add to your site](#)

Explore how far you can travel by car, bus, bike and foot from 9502 Middlebrook Pike.



What's Nearby

- Restaurants:**
 - Dominio's Pizzeria .3m
- Coffee:**
 - El Estero Bros Bagels .8m
- Bars:**
 - Illegor .9m
- Groceries:**
 - Food City .3m
- Parks:**
 - Bell Camp Park .7m
- Schools:**
 - River's Edge Christian Acad... .7m
- Shopping:**
 - Insight Eyecare .6m
- Entertainment:**
 - RedLuxe .7m
- Errands:**
 - Rita K. Moore, PharmD .3m
- Search Nearby:**



APPENDIX C

KNOXVILLE AREA TRANSIT MAP AND INFORMATION

Knoxville City Center



Legend

Transfer Point

Lift Service Area Boundary

Points of Interest

Hospital

School

Library

Point of Interest

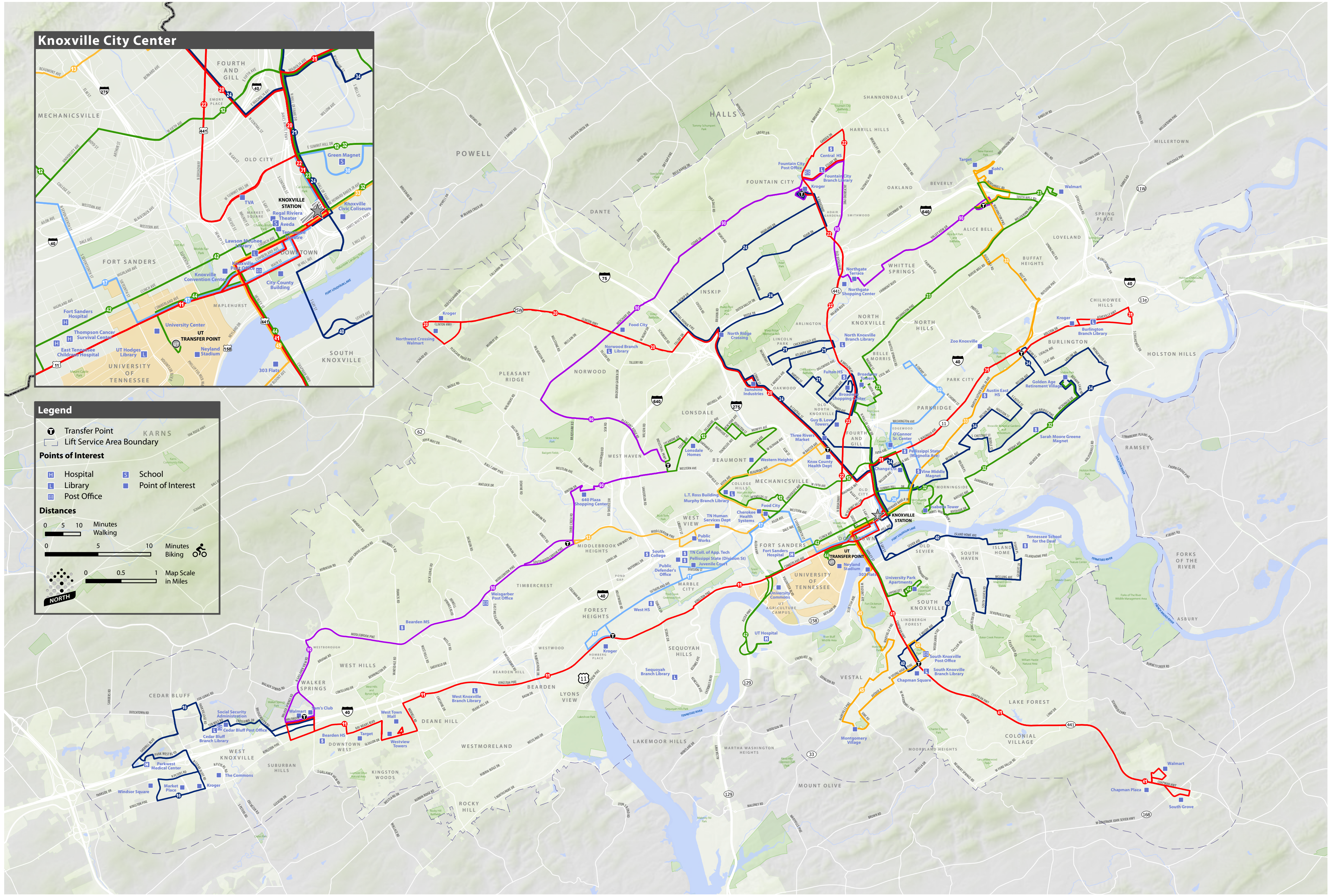
Post Office

Distances

0 5 10 Minutes Walking

0 5 10 Minutes Biking

0 0.5 1 Map Scale in Miles



16

CEDAR BLUFF

CONNECTOR

(Weekdays and Saturdays)



Route 16 - Cedar Bluff: Weekdays

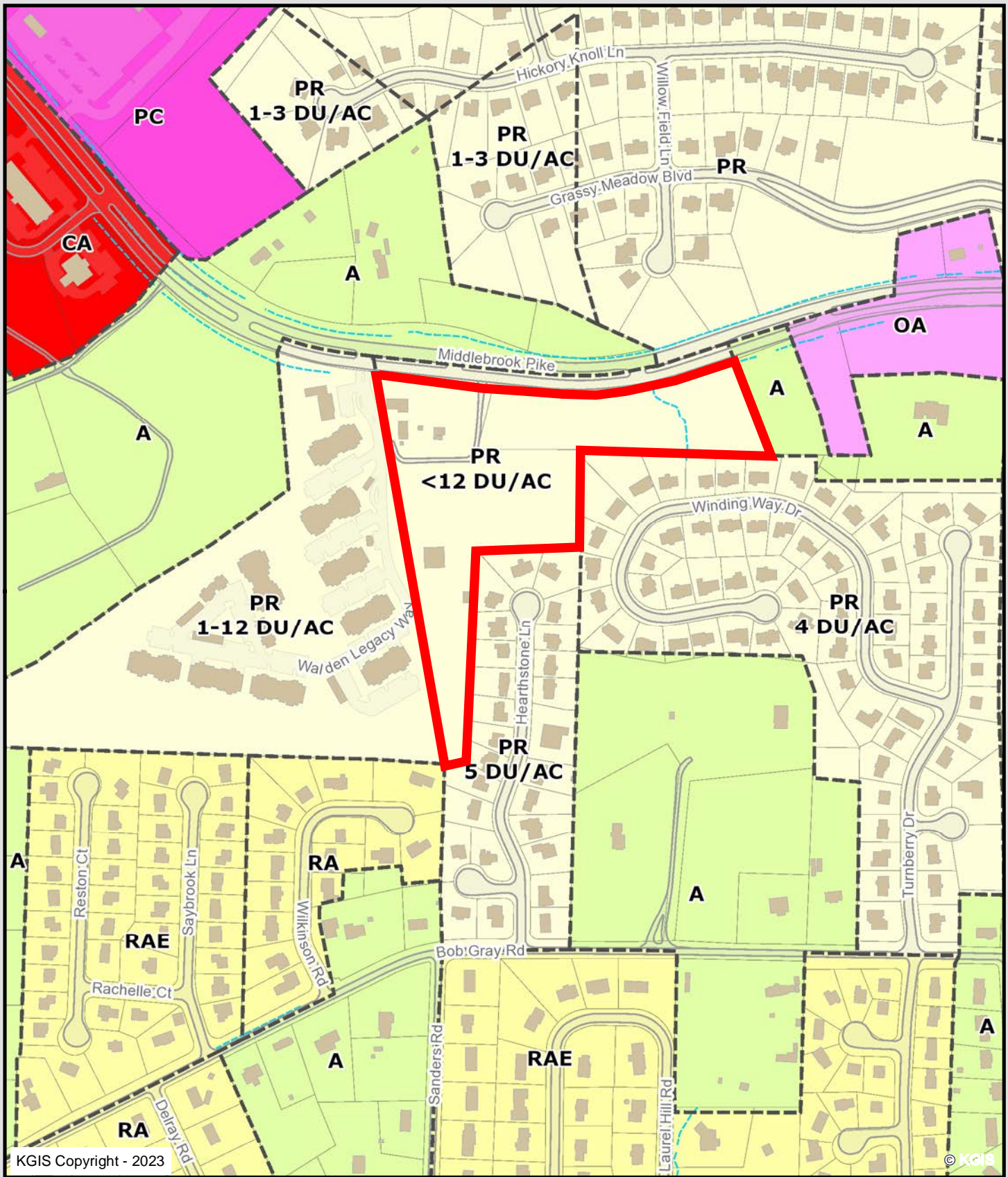
Going away from Walmart				Going to Walmart		
Walmart	Park Village @ Woodpark	Parkwest Hospital	Windsor Square	Parkwest Hospital	Cedar Bluff @ Fox Lonas	Walmart
1	2	3	4	5	6	7
6:15 AM	6:27 AM	6:32 AM	6:42 AM	6:50 AM	6:54 AM	7:10 AM
7:15 AM	7:27 AM	7:32 AM	7:42 AM	7:50 AM	7:54 AM	8:10 AM
8:15 AM	8:27 AM	8:32 AM	8:42 AM	8:50 AM	8:54 AM	9:10 AM
9:15 AM	9:27 AM	9:32 AM	9:42 AM	9:50 AM	9:54 AM	10:10 AM
10:15 AM	10:27 AM	10:32 AM	10:42 AM	10:50 AM	10:54 AM	11:10 AM
11:15 AM	11:27 AM	11:32 AM	11:42 AM	11:50 AM	11:54 AM	12:10 PM
12:15 PM	12:27 PM	12:32 PM	12:42 PM	12:50 PM	12:54 PM	1:10 PM
1:15 PM	1:27 PM	1:32 PM	1:42 PM	1:50 PM	1:54 PM	2:10 PM
2:15 PM	2:27 PM	2:32 PM	2:42 PM	2:50 PM	2:54 PM	3:10 PM
3:15 PM	3:27 PM	3:32 PM	3:42 PM	3:50 PM	3:54 PM	4:10 PM
4:15 PM	4:27 PM	4:32 PM	4:42 PM	4:50 PM	4:54 PM	5:10 PM
5:15 PM	5:27 PM	5:32 PM	5:42 PM	5:50 PM	5:54 PM	6:10 PM
6:15 PM	6:27 PM	6:32 PM	6:42 PM	6:50 PM	6:54 PM	7:10 PM
7:15 PM	7:27 PM	7:32 PM	7:42 PM	7:50 PM	7:54 PM	8:10 PM
8:15 PM	8:27 PM	8:32 PM	8:42 PM	8:50 PM	8:54 PM	9:10 PM
9:15 PM	9:27 PM	9:32 PM	9:42 PM	9:50 PM	9:54 PM	10:10 PM

Route 16 - Cedar Bluff: SATURDAYS

Going away from Walmart				Going to Walmart		
Walmart	Park Village @ Woodpark	Parkwest Hospital	Windsor Square	Parkwest Hospital	Cedar Bluff @ Fox Lonas	Walmart
1	2	3	4	5	6	7
7:15 AM	7:27 AM	7:32 AM	7:42 AM	7:50 AM	7:54 AM	8:10 AM
8:15 AM	8:27 AM	8:32 AM	8:42 AM	8:50 AM	8:54 AM	9:10 AM
9:15 AM	9:27 AM	9:32 AM	9:42 AM	9:50 AM	9:54 AM	10:10 AM
10:15 AM	10:27 AM	10:32 AM	10:42 AM	10:50 AM	10:54 AM	11:10 AM
11:15 AM	11:27 AM	11:32 AM	11:42 AM	11:50 AM	11:54 AM	12:10 PM
12:15 PM	12:27 PM	12:32 PM	12:42 PM	12:50 PM	12:54 PM	1:10 PM
1:15 PM	1:27 PM	1:32 PM	1:42 PM	1:50 PM	1:54 PM	2:10 PM
2:15 PM	2:27 PM	2:32 PM	2:42 PM	2:50 PM	2:54 PM	3:10 PM
3:15 PM	3:27 PM	3:32 PM	3:42 PM	3:50 PM	3:54 PM	4:10 PM
4:15 PM	4:27 PM	4:32 PM	4:42 PM	4:50 PM	4:54 PM	5:10 PM
5:15 PM	5:27 PM	5:32 PM	5:42 PM	5:50 PM	5:54 PM	6:10 PM
6:15 PM	6:27 PM	6:32 PM	6:42 PM	6:50 PM	6:54 PM	7:10 PM
7:15 PM	7:27 PM	7:32 PM	7:42 PM	7:50 PM	7:54 PM	8:10 PM
8:15 PM	8:27 PM	8:32 PM	8:42 PM	8:50 PM	8:54 PM	9:10 PM
9:15 PM	9:27 PM	9:32 PM	9:42 PM	9:50 PM	9:54 PM	10:10 PM

APPENDIX D

ZONING MAP



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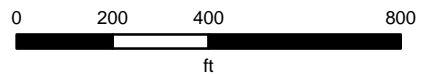
Middlebrook Village

Zoning Map - 3.14.23

Knoxville - Knox County - KUB Geographic Information System



Printed: 3/14/2023 at 3:29:16 PM



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APPENDIX E

MANUAL TRAFFIC COUNT DATA

TRAFFIC COUNT DATA

Major Street: Middlebrook Pike (EB and WB)

Minor Street: Walden Legacy Way (NB)

Traffic Control: Stop Conditions on Walden Legacy Way

3/9/2023 (Thursday)

Partly Sunny to Cloudy/Misty

Conducted by: Ajax Engineering

	Middlebrook Pike		Walden Legacy Way		Middlebrook Pike			
TIME	WESTBOUND		NORTHBOUND		EASTBOUND		VEHICLE	PEAK
BEGIN	LT	THRU	LT	RT	THRU	RT	TOTAL	HOUR
7:00 AM	0	126	4	11	107	0	248	
7:15 AM	2	156	8	7	181	0	354	
7:30 AM	1	195	9	17	195	2	419	7:30 AM - 8:30 AM
7:45 AM	1	205	14	7	258	5	490	
8:00 AM	1	170	8	7	222	3	411	
8:15 AM	1	145	3	4	206	1	360	
8:30 AM	3	116	4	4	195	0	322	
8:45 AM	2	134	6	3	171	1	317	
TOTAL	11	1247	56	60	1535	12	2921	
11:00 AM	3	113	3	1	125	1	246	
11:15 AM	5	115	6	8	132	3	269	
11:30 AM	1	137	4	2	144	2	290	
11:45 AM	1	144	2	1	127	2	277	
12:00 PM	1	120	4	1	127	1	254	12:00 PM - 1:00 PM
12:15 PM	3	137	1	4	160	1	306	
12:30 PM	1	140	3	3	156	1	304	
12:45 PM	4	153	2	2	149	3	313	
TOTAL	19	1059	25	22	1120	14	2259	
2:00 PM	0	142	2	2	163	5	314	
2:15 PM	3	168	2	3	132	2	310	
2:30 PM	4	146	2	2	169	8	331	
2:45 PM	5	161	3	1	140	3	313	
3:00 PM	9	188	6	4	179	6	392	
3:15 PM	4	187	4	2	157	5	359	
3:30 PM	5	176	1	7	200	3	392	
3:45 PM	7	175	2	0	208	4	396	
4:00 PM	2	181	2	5	252	4	446	
4:15 PM	4	235	7	4	215	6	471	
4:30 PM	5	197	4	4	258	2	470	
4:45 PM	5	268	5	2	215	9	504	4:45 PM - 5:45 PM
5:00 PM	9	243	5	3	230	6	496	
5:15 PM	10	250	3	3	217	10	493	
5:30 PM	4	242	2	2	236	6	492	
5:45 PM	2	263	4	9	190	13	481	
TOTAL	78	3222	54	53	3161	92	6660	

2023 AM Peak Hour

7:30 AM - 8:30 AM

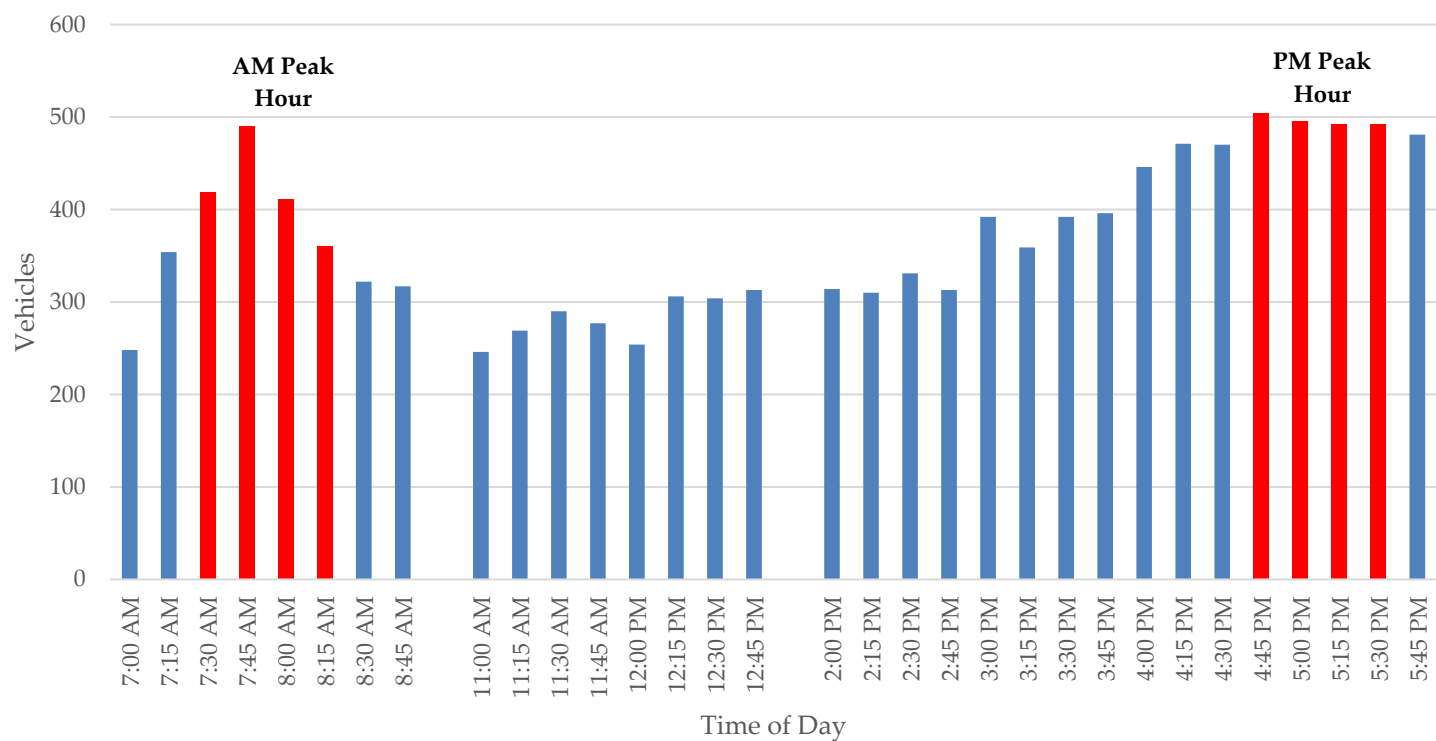
	Middlebrook Pike		Walden Legacy Way		Middlebrook Pike	
TIME	WESTBOUND		NORTHBOUND		EASTBOUND	
BEGIN	LT	THRU	LT	RT	THRU	RT
7:30 AM	1	195	9	17	195	2
7:45 AM	1	205	14	7	258	5
8:00 AM	1	170	8	7	222	3
8:15 AM	1	145	3	4	206	1
TOTAL	4	715	34	35	881	11
PHF	1.00	0.87	0.61	0.51	0.85	0.55
Truck %	0.0%	2.2%	0.0%	0.0%	1.9%	0.0%

2023 PM Peak Hour

4:45 PM - 5:45 PM

	Middlebrook Pike		Walden Legacy Way		Middlebrook Pike	
TIME	WESTBOUND		NORTHBOUND		EASTBOUND	
BEGIN	LT	THRU	LT	RT	THRU	RT
4:45 PM	5	268	5	2	215	9
5:00 PM	9	243	5	3	230	6
5:15 PM	10	250	3	3	217	10
5:30 PM	4	242	2	2	236	6
TOTAL	28	1003	15	10	898	31
PHF	0.70	0.94	0.75	0.83	0.95	0.78
Truck %	0.0%	0.4%	0.0%	0.0%	0.2%	0.0%

**Middlebrook Pike at Walden Legacy Way
Intersection Traffic Count Totals
3/9/2023**



APPENDIX F

CAPACITY ANALYSES – HCM WORKSHEETS (SYNCHRO 11)

EXISTING CONDITIONS

HCM 2010 TWSC

2: Walden Legacy Way & Middlebrook Pike

03/15/2023

Intersection						
Int Delay, s/veh	1.1					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑		↓	↑↑	↑↓	
Traffic Vol, veh/h	881	11	4	715	34	35
Future Vol, veh/h	881	11	4	715	34	35
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	150	-	0	-
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	4	-	-	-4	-5	-
Peak Hour Factor	85	55	100	87	61	51
Heavy Vehicles, %	2	0	0	2	0	0
Mvmt Flow	1036	20	4	822	56	69
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1056	0	1465	528
Stage 1	-	-	-	-	1046	-
Stage 2	-	-	-	-	419	-
Critical Hdwy	-	-	4.1	-	5.8	6.4
Critical Hdwy Stg 1	-	-	-	-	4.8	-
Critical Hdwy Stg 2	-	-	-	-	4.8	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	667	-	182	538
Stage 1	-	-	-	-	406	-
Stage 2	-	-	-	-	716	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	667	-	181	538
Mov Cap-2 Maneuver	-	-	-	-	309	-
Stage 1	-	-	-	-	406	-
Stage 2	-	-	-	-	712	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		0.1		17.8	
HCM LOS	C					
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	404	-	-	667	-	
HCM Lane V/C Ratio	0.308	-	-	0.006	-	
HCM Control Delay (s)	17.8	-	-	10.4	-	
HCM Lane LOS	C	-	-	B	-	
HCM 95th %tile Q(veh)	1.3	-	-	0	-	

HCM 2010 TWSC

2: Walden Legacy Way & Middlebrook Pike

03/15/2023

Intersection						
Int Delay, s/veh	0.5					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑		↑	↑↑	↑	
Traffic Vol, veh/h	898	31	28	1003	15	10
Future Vol, veh/h	898	31	28	1003	15	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	150	-	0	-
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	4	-	-	-4	-5	-
Peak Hour Factor	95	78	70	94	75	83
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	945	40	40	1067	20	12

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	985	0	1579
Stage 1	-	-	-	-	965
Stage 2	-	-	-	-	614
Critical Hdwy	-	-	4.1	-	5.8
Critical Hdwy Stg 1	-	-	-	-	4.8
Critical Hdwy Stg 2	-	-	-	-	4.8
Follow-up Hdwy	-	-	2.2	-	3.5
Pot Cap-1 Maneuver	-	-	709	-	158
Stage 1	-	-	-	-	438
Stage 2	-	-	-	-	602
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	709	-	149
Mov Cap-2 Maneuver	-	-	-	-	292
Stage 1	-	-	-	-	438
Stage 2	-	-	-	-	568

Approach	EB	WB	NB
HCM Control Delay, s	0	0.4	16.1
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	357	-	-	709	-
HCM Lane V/C Ratio	0.09	-	-	0.056	-
HCM Control Delay (s)	16.1	-	-	10.4	-
HCM Lane LOS	C	-	-	B	-
HCM 95th %tile Q(veh)	0.3	-	-	0.2	-

PROJECTED CONDITIONS (WITH THE PROJECT)

HCM 2010 TWSC
6: Main Entrance & Middlebrook Pike

03/16/2023

Intersection						
Int Delay, s/veh	0.6					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑		↑	↑↑	↑	
Traffic Vol, veh/h	960	11	4	755	26	26
Future Vol, veh/h	960	11	4	755	26	26
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	165	-	0	-
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	4	-	-	-4	0	-
Peak Hour Factor	85	90	90	87	90	90
Heavy Vehicles, %	2	0	0	2	0	0
Mvmt Flow	1129	12	4	868	29	29

Major/Minor	Major1	Major2	Minor1
Conflicting Flow All	0	0	1141
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	-	-	4.1
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	-	-	2.2
Pot Cap-1 Maneuver	-	-	620
Stage 1	-	-	-
Stage 2	-	-	-
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	-	-	620
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.1	20.5
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	290	-	-	620	-
HCM Lane V/C Ratio	0.199	-	-	0.007	-
HCM Control Delay (s)	20.5	-	-	10.8	-
HCM Lane LOS	C	-	-	B	-
HCM 95th %tile Q(veh)	0.7	-	-	0	-

HCM 2010 TWSC

6: Main Entrance & Middlebrook Pike

03/16/2023

Intersection						
Int Delay, s/veh	0.5					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑		↓	↑↑	↓	
Traffic Vol, veh/h	953	29	24	1081	26	17
Future Vol, veh/h	953	29	24	1081	26	17
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	165	-	0	-
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	4	-	-	-4	0	-
Peak Hour Factor	95	90	90	94	90	90
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	1003	32	27	1150	29	19
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1035	0	1648	518
Stage 1	-	-	-	-	1019	-
Stage 2	-	-	-	-	629	-
Critical Hdwy	-	-	4.1	-	6.8	6.9
Critical Hdwy Stg 1	-	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	679	-	92	508
Stage 1	-	-	-	-	314	-
Stage 2	-	-	-	-	499	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	679	-	88	508
Mov Cap-2 Maneuver	-	-	-	-	211	-
Stage 1	-	-	-	-	314	-
Stage 2	-	-	-	-	479	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		0.2		20.9	
HCM LOS	C					
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	274	-	-	679	-	
HCM Lane V/C Ratio	0.174	-	-	0.039	-	
HCM Control Delay (s)	20.9	-	-	10.5	-	
HCM Lane LOS	C	-	-	B	-	
HCM 95th %tile Q(veh)	0.6	-	-	0.1	-	

APPENDIX G

LOCAL TRIP GENERATION RATES

Local Apartment Trip Generation Study

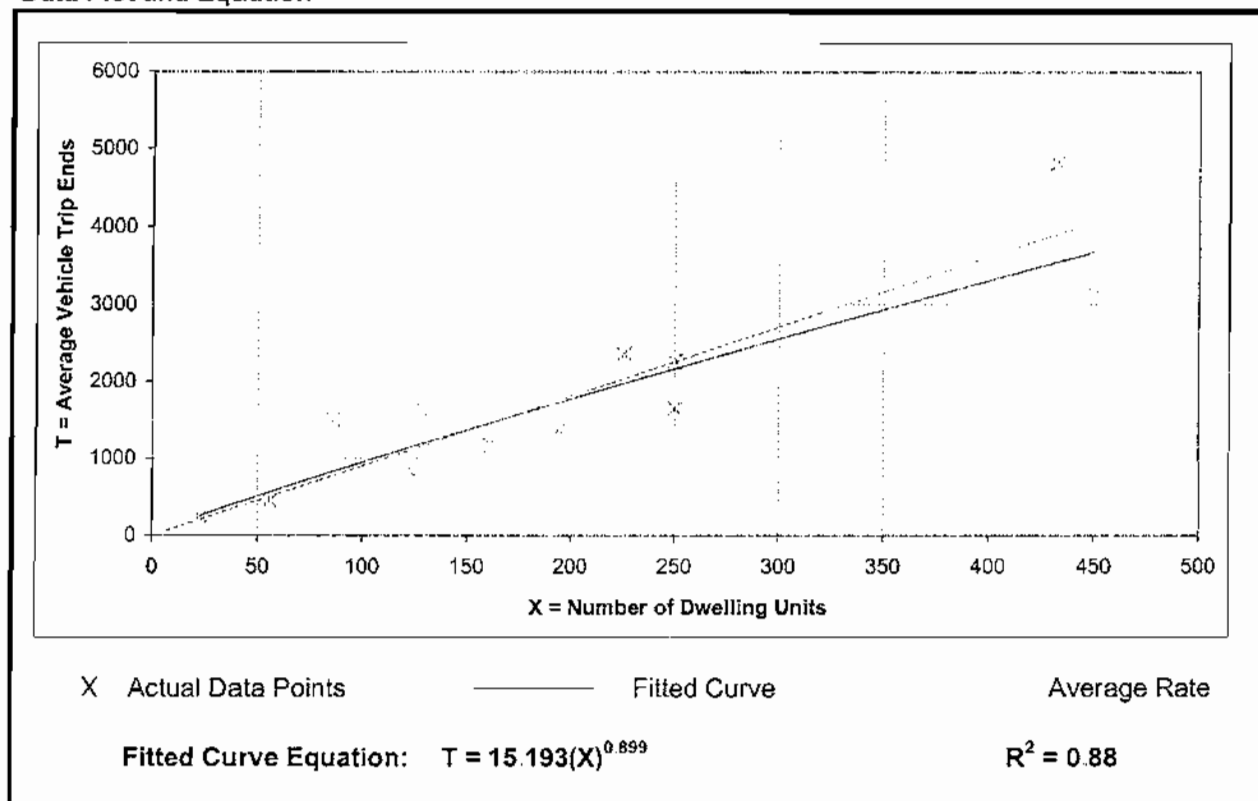
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

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

Trip Generation Per Dwelling Unit

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

Data Plot and Equation



Local Apartment Trip Generation Study

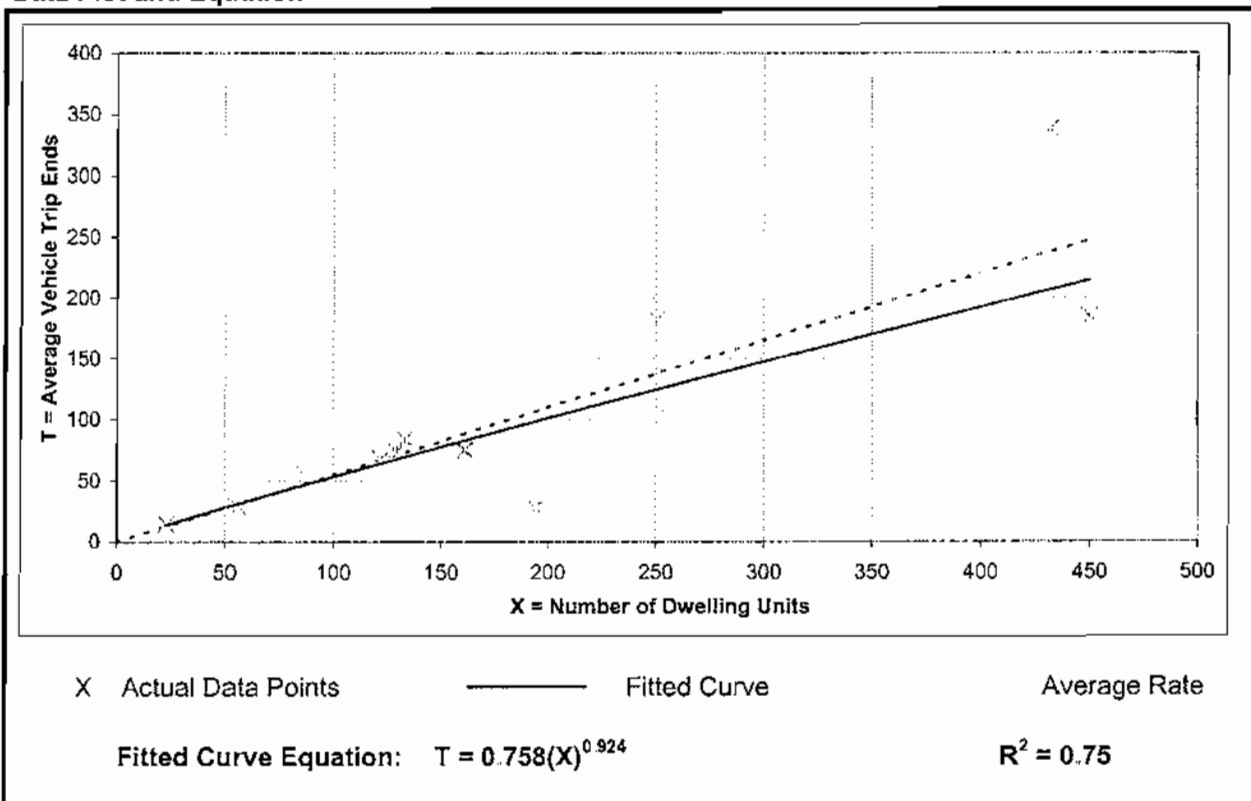
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Number of Studies: 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

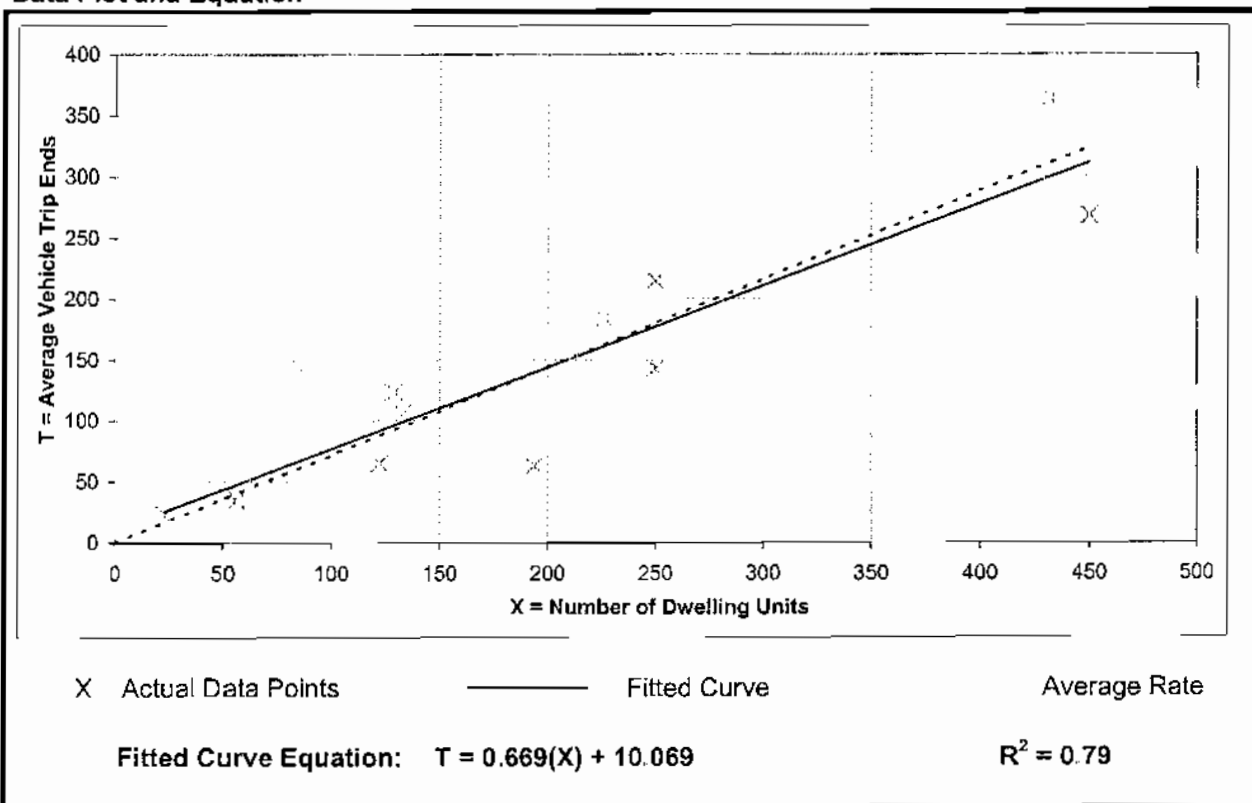
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

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

Data Plot and Equation



TRIP GENERATION FOR MIDDLEBROOK VILLAGE
128 Multi-Family Apartments

ITE LAND USE CODE	LAND USE DESCRIPTION	# OF UNITS	GENERATED DAILY TRAFFIC	GENERATED TRAFFIC AM PEAK HOUR			GENERATED TRAFFIC PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
Local Trip Rate	Multi-Family Apartments	128	1,191	22%	78%		55%	45%	
				15	52	67	53	43	96
Total New Volume Site Trips			1,191	15	52	67	53	43	96

Data from Local Trip Rates and calculated by using Fitted Curve Equations

TRIP GENERATION FOR MIDDLEBROOK VILLAGE

128 Multi-Family Apartments

$$128 \text{ Units} = X$$

Weekday:

Fitted Curve Equation: $T = 15.193(X)^{0.899}$

$$T = 15 * 78.41$$

$$T = \underline{\underline{1,191 \text{ trips}}}$$

Peak Hour of Adjacent Traffic between 7 and 9 am:

Fitted Curve Equation: $T = 0.758(X)^{0.924}$

$$T = 0.758 * 89$$

$$T = \underline{\underline{67 \text{ trips}}}$$

Peak Hour of Adjacent Traffic between 4 and 6 pm:

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

$$T = 0.669 * 128 + 10.07$$

$$T = \underline{\underline{96 \text{ trips}}}$$

APPENDIX H

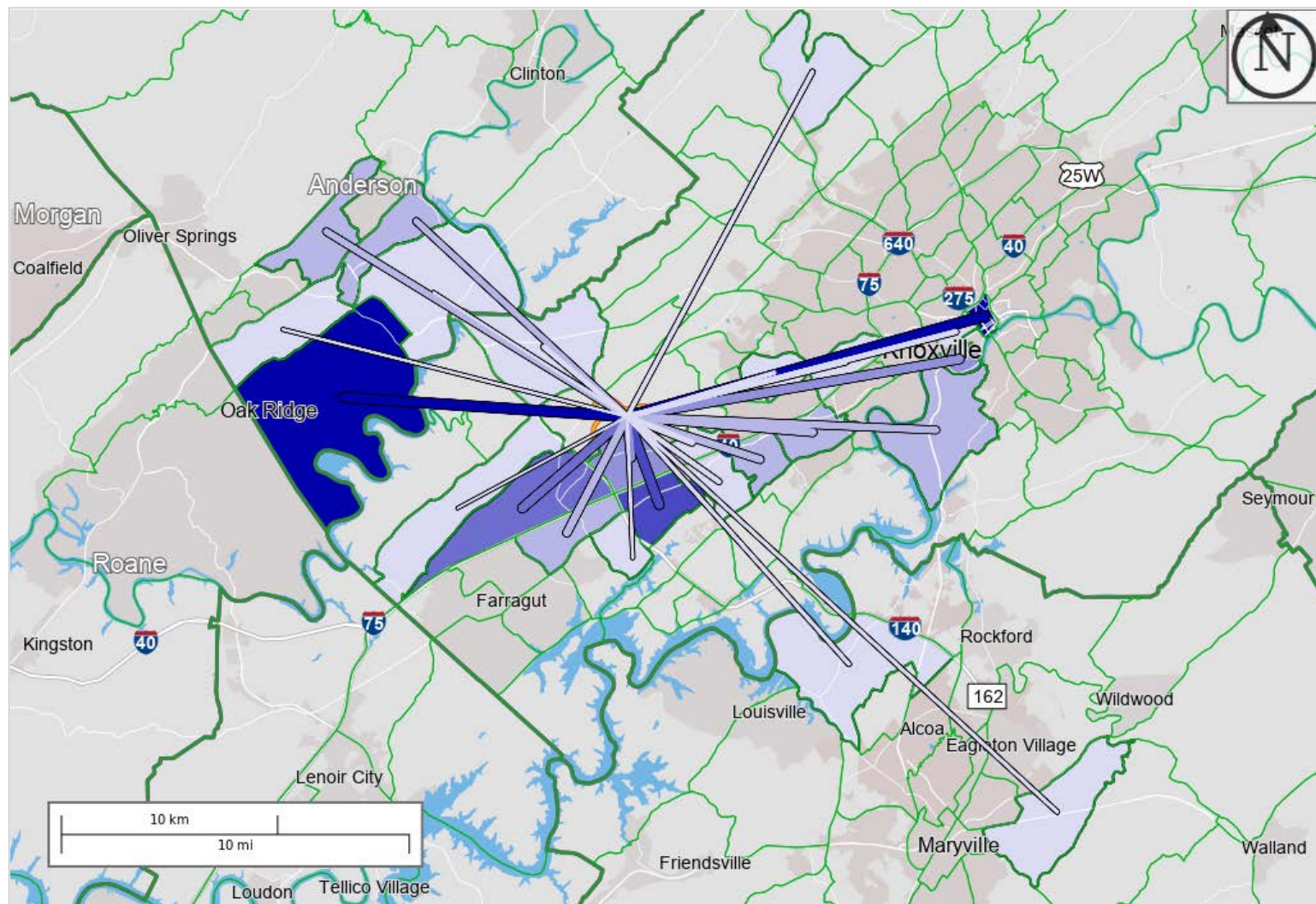
2019 CENSUS BUREAU DATA

Work Destination Report - Home Selection Area to Work Census Tracts All Jobs for All Workers in 2019

Created by the U.S. Census Bureau's OnTheMap <https://onthemap.ces.census.gov> on 03/14/2023

Counts of All Jobs from Home Selection Area to Work Census Tracts in 2019

All Workers



Map Legend

Job Count

- 87 - 99
- 74 - 86
- 62 - 73
- 49 - 61
- 37 - 48
- 24 - 36
- 11 - 23

Selection Areas

- 📍 Analysis Selection

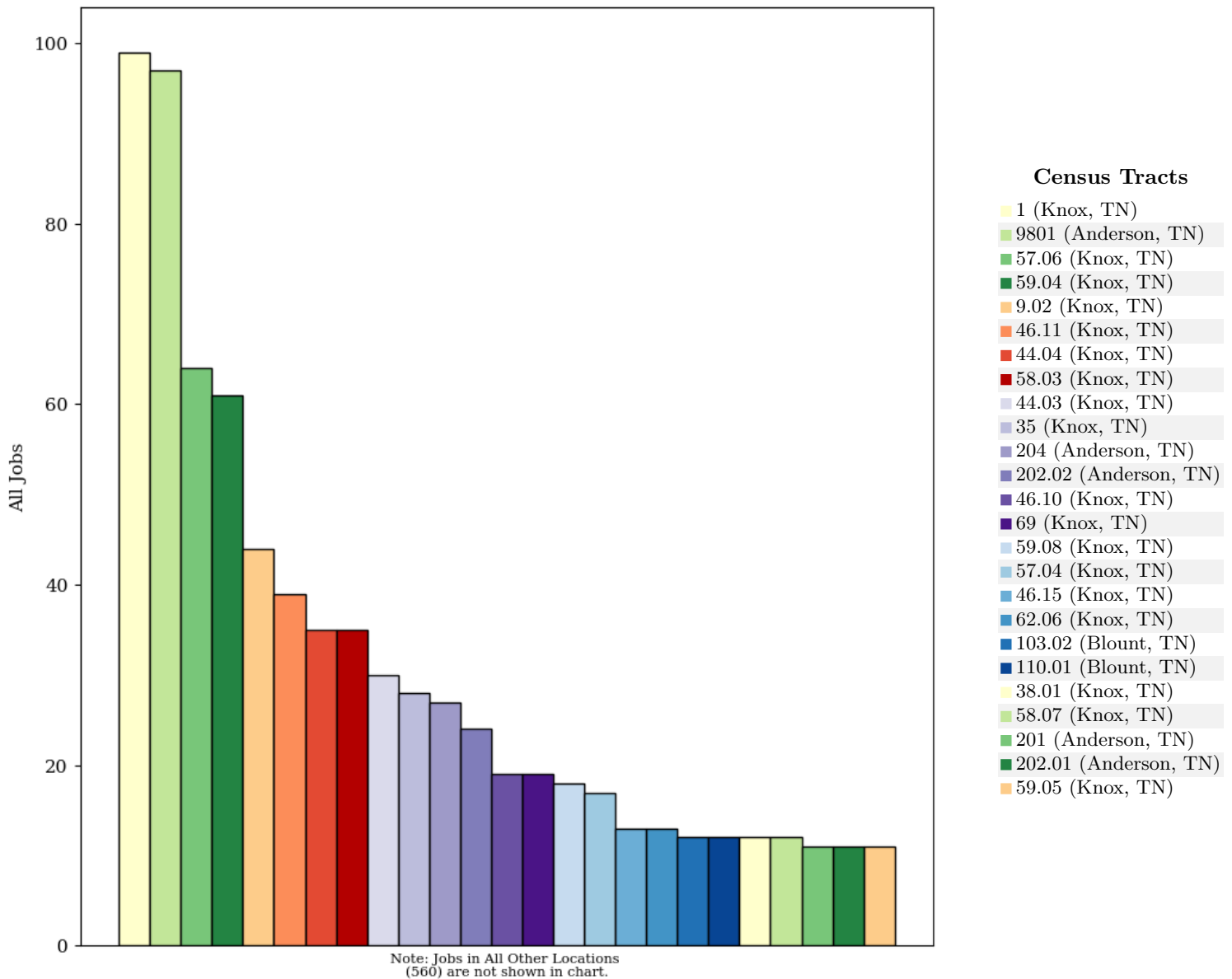
Job Count

- 📍 87 - 99
- 📍 74 - 86
- 📍 62 - 73
- 📍 49 - 61
- 📍 37 - 48
- 📍 24 - 36
- 📍 11 - 23



All Jobs from Home Selection Area to Work Census Tracts in 2019

All Workers



All Jobs from Home Selection Area to Work Census Tracts in 2019

All Workers

Census Tracts as Work Destination Area	2019	
	Count	Share
All Census Tracts	1,323	100.0
1 (Knox, TN)	99	7.5
9801 (Anderson, TN)	97	7.3
57.06 (Knox, TN)	64	4.8
59.04 (Knox, TN)	61	4.6
9.02 (Knox, TN)	44	3.3
46.11 (Knox, TN)	39	2.9
44.04 (Knox, TN)	35	2.6
58.03 (Knox, TN)	35	2.6
44.03 (Knox, TN)	30	2.3
35 (Knox, TN)	28	2.1

Census Tracts as Work Destination Area	2019	
	Count	Share
204 (Anderson, TN)	27	2.0
202.02 (Anderson, TN)	24	1.8
46.10 (Knox, TN)	19	1.4
69 (Knox, TN)	19	1.4
59.08 (Knox, TN)	18	1.4
57.04 (Knox, TN)	17	1.3
46.15 (Knox, TN)	13	1.0
62.06 (Knox, TN)	13	1.0
103.02 (Blount, TN)	12	0.9
110.01 (Blount, TN)	12	0.9
38.01 (Knox, TN)	12	0.9
58.07 (Knox, TN)	12	0.9
201 (Anderson, TN)	11	0.8
202.01 (Anderson, TN)	11	0.8
59.05 (Knox, TN)	11	0.8
All Other Locations	560	42.3

Additional Information

Analysis Settings

Analysis Type	Destination
Destination Type	Census Tracts
Selection area as	Home
Year(s)	2019
Job Type	All Jobs
Selection Area	46.12 (Knox, TN) from Census Tracts
Selected Census Blocks	16
Analysis Generation Date	03/14/2023 15:54 - OnTheMap 6.8.1
Code Revision	f9358819d46a60bb89052036516a1c8fe8bbbbeac
LODES Data Version	20211018_1647

Data Sources

Source: U.S. Census Bureau, OnTheMap Application and LEHD Origin-Destination Employment Statistics (Beginning of Quarter Employment, 2nd Quarter of 2002-2019).

Notes

1. Race, Ethnicity, Educational Attainment, and Sex statistics are beta release results and are not available before 2009.
2. Educational Attainment is only produced for workers aged 30 and over.
3. Firm Age and Firm Size statistics are beta release results for All Private jobs and are not available before 2011.

APPENDIX I

KNOX COUNTY AND TDOT TURN LANE VOLUME THRESHOLD WORKSHEETS

TABLE 5B

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

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

$$960 / 2 = 480 * 1.05 = 504$$

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 600	+ / > 600
Fewer Than 25 25 - 49 50 - 99				Yes	Yes Yes	Yes Yes
100 - 149 150 - 199		Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
200 - 249 250 - 299	Yes Yes	Yes Yes	<div> <p align="center">Middlebrook Pike at Main Entrance</p> <p align="center">2025 Projected AM EB Right Turns = 11</p> <p align="center">Right Turn Lane NOT Warranted</p> </div>	Yes Yes	Yes Yes	Yes Yes
300 - 349 350 - 399	Yes Yes	Yes Yes		Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499	Yes Yes	Yes Yes		Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes Yes	Yes Yes		Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

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

TABLE 5B

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

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

$$953 / 2 = 476.5 * 1.05 = 501$$

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

Middlebrook Pike at
Main Entrance

2025 Projected PM
EB Right Turns = 29

Right Turn Lane NOT
Warranted

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

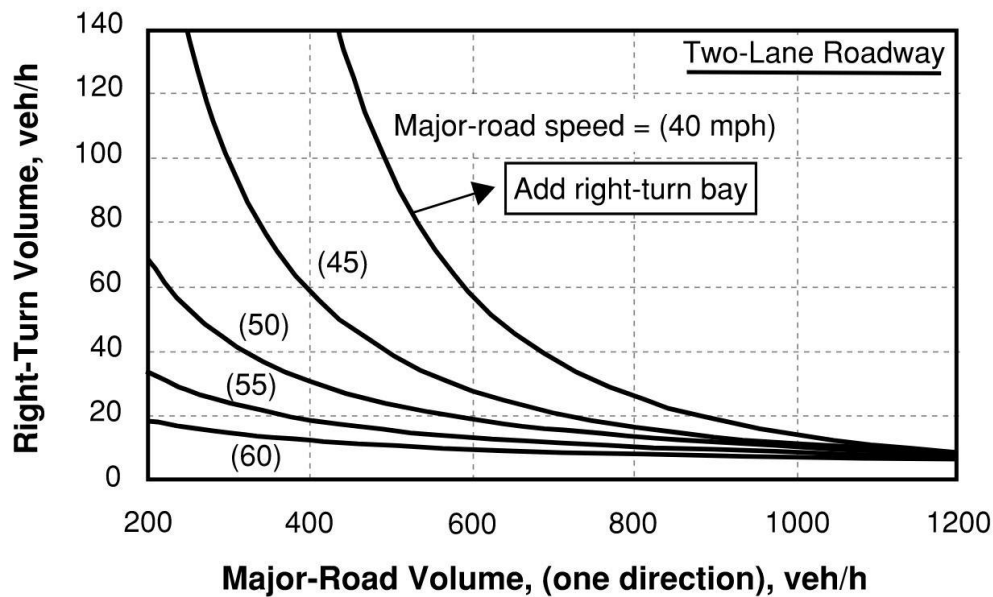
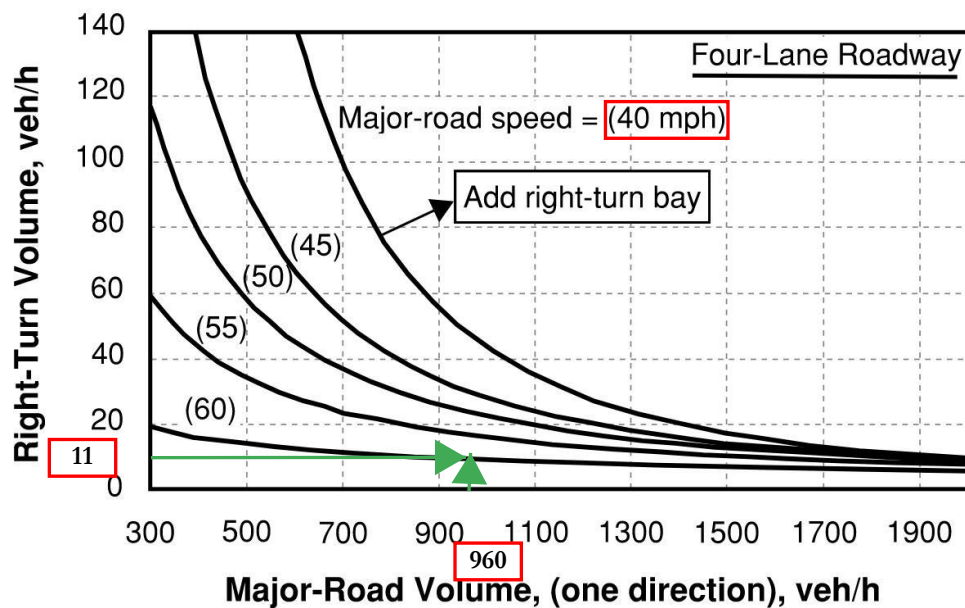


Figure 3-18: Right-Turn Lane Warrant along Two-Lane Roadway (Unsignalized Intersection with Two-Way Stop-Control)²⁴



Middlebrook Pike at
Main Entrance

2025 Projected AM
EB Right Turns = 11

Right Turn Lane NOT
Warranted

Figure 3-19: Right-Turn Lane Warrant along Four-Lane Roadway (Unsignalized Intersection with Two-Way Stop-Control)²⁵

²⁴ TRB, NCHRP 457, Evaluating Intersection Improvements (2001)

²⁵ TRB, NCHRP 457, Evaluating Intersection Improvements (2001)

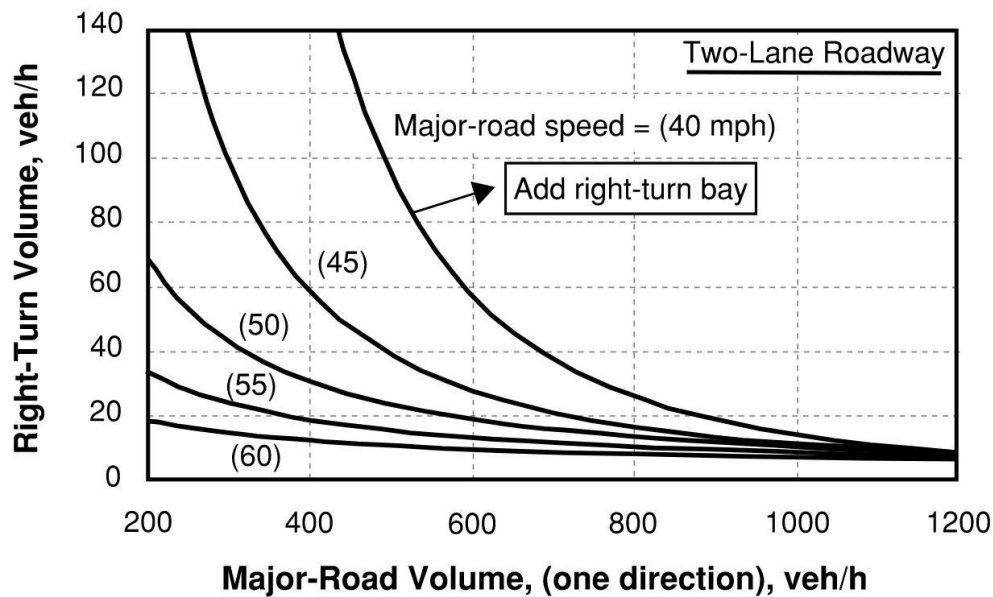
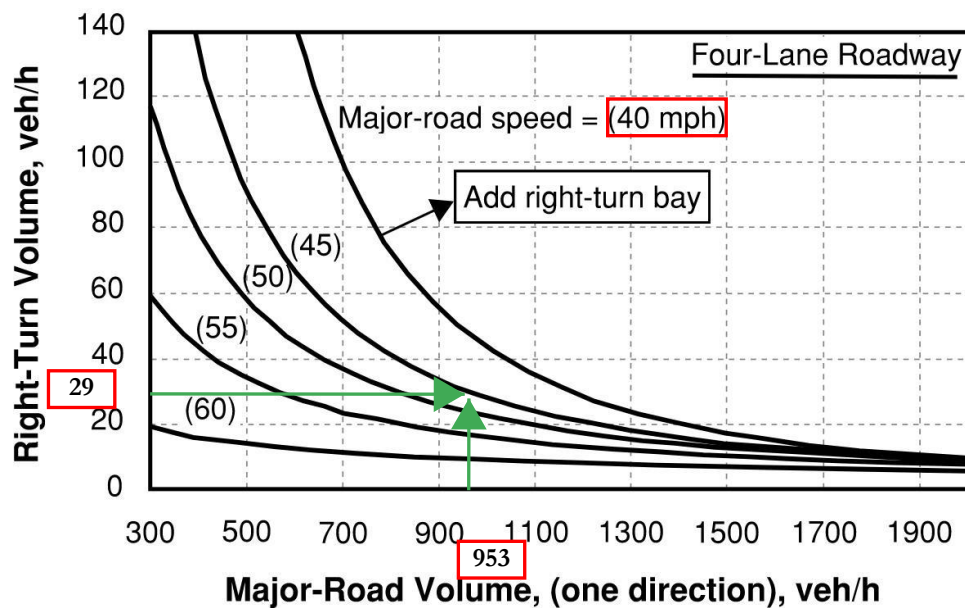


Figure 3-18: Right-Turn Lane Warrant along Two-Lane Roadway (Unsignalized Intersection with Two-Way Stop-Control)²⁴



Middlebrook Pike at
Main Entrance

2025 Projected PM
EB Right Turns = 29

Right Turn Lane NOT
Warranted

Figure 3-19: Right-Turn Lane Warrant along Four-Lane Roadway (Unsignalized Intersection with Two-Way Stop-Control)²⁵

²⁴ TRB, NCHRP 457, Evaluating Intersection Improvements (2001)

²⁵ TRB, NCHRP 457, Evaluating Intersection Improvements (2001)

APPENDIX J

SIMTRAFFIC VEHICLE QUEUE WORKSHEETS

Intersection: 6: Main Entrance & Middlebrook Pike

Movement	WB	NB
Directions Served	L	LR
Maximum Queue (ft)	25	118
Average Queue (ft)	3	37
95th Queue (ft)	16	86
Link Distance (ft)		124
Upstream Blk Time (%)		2
Queuing Penalty (veh)		0
Storage Bay Dist (ft)	165	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 0

Intersection: 6: Main Entrance & Middlebrook Pike

Movement	EB	WB	NB
Directions Served	T	L	LR
Maximum Queue (ft)	2	40	81
Average Queue (ft)	0	13	27
95th Queue (ft)	2	39	61
Link Distance (ft)	361		124
Upstream Blk Time (%)			0
Queuing Penalty (veh)			0
Storage Bay Dist (ft)		165	
Storage Blk Time (%)			
Queuing Penalty (veh)			

Network Summary

Network wide Queuing Penalty: 0

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