

***MPM RESIDENTIAL DEVELOPMENT  
City of Knoxville***

***TRAFFIC IMPACT STUDY***

***Prepared For:  
BATSON, HIMES, NORVELL, & POE***

***Prepared By:***



**April 2002**

**MPM RESIDENTIAL DEVELOPMENT**  
**KNOX COUNTY, TENNESSEE**

**TRAFFIC IMPACT STUDY**

**Prepared for**

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**April 2002**

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## **INTRODUCTION**

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This traffic impact study was commissioned to address the impact of a proposed residential development within the city limits of Knoxville in Knox County. The study of this development required the collection of traffic data, generation of anticipated traffic volumes from the proposed site, development of future traffic volumes from both normal growth and the site, analysis of the resulting traffic conditions, and the development of measures necessary to mitigate traffic impacts of normal traffic growth and the proposed development. Methods and procedures utilized in the study are those required for a Level 1 traffic impact study as adopted by the Knoxville/Knox County Metropolitan Planning Commission.

### **Project Description**

The proposed project is a residential development adjacent to Middlebrook Pike. The site is approximately 25 acres with a R-1 zoning. The development will rezone the property to RP (Planned Residential) and subdivide the property for 146 single family unit lots. Access is from a proposed street from Middlebrook Pike at an existing median opening with a left-turn lane. Figure 1 is the proposed site plan.

### **Site Location**

The location of the site is north of Middlebrook Pike west of Vanosdale Road. The site is within the city limits of Knoxville in the western area of Knox County and southwest of the Knoxville central business district (CBD). The adjacent land use is residential in character. Figure 2 illustrates this location relative to local and regional access.

## **LOCAL AND REGIONAL ACCESS**

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### **Local Access**

Local access to this site is Middlebrook Pike (S.R. 169). Adjacent to the proposed site, Middlebrook Pike is a four-lane divided arterial. Site access is a proposed residential street at a median opening. Middlebrook Pike is an east and west facility extending between Pellissippi Parkway (S.R. 162) to the west and Alcoa Highway (U.S. 129) to the east, near the Knoxville CBD. The 2002 average weekday traffic (AWT) for Middlebrook Pike is approximately 25,570.

# SITE PLAN

## MPM Residential Development



Figure 1

# VICINITY MAP

## MPM Residential Development

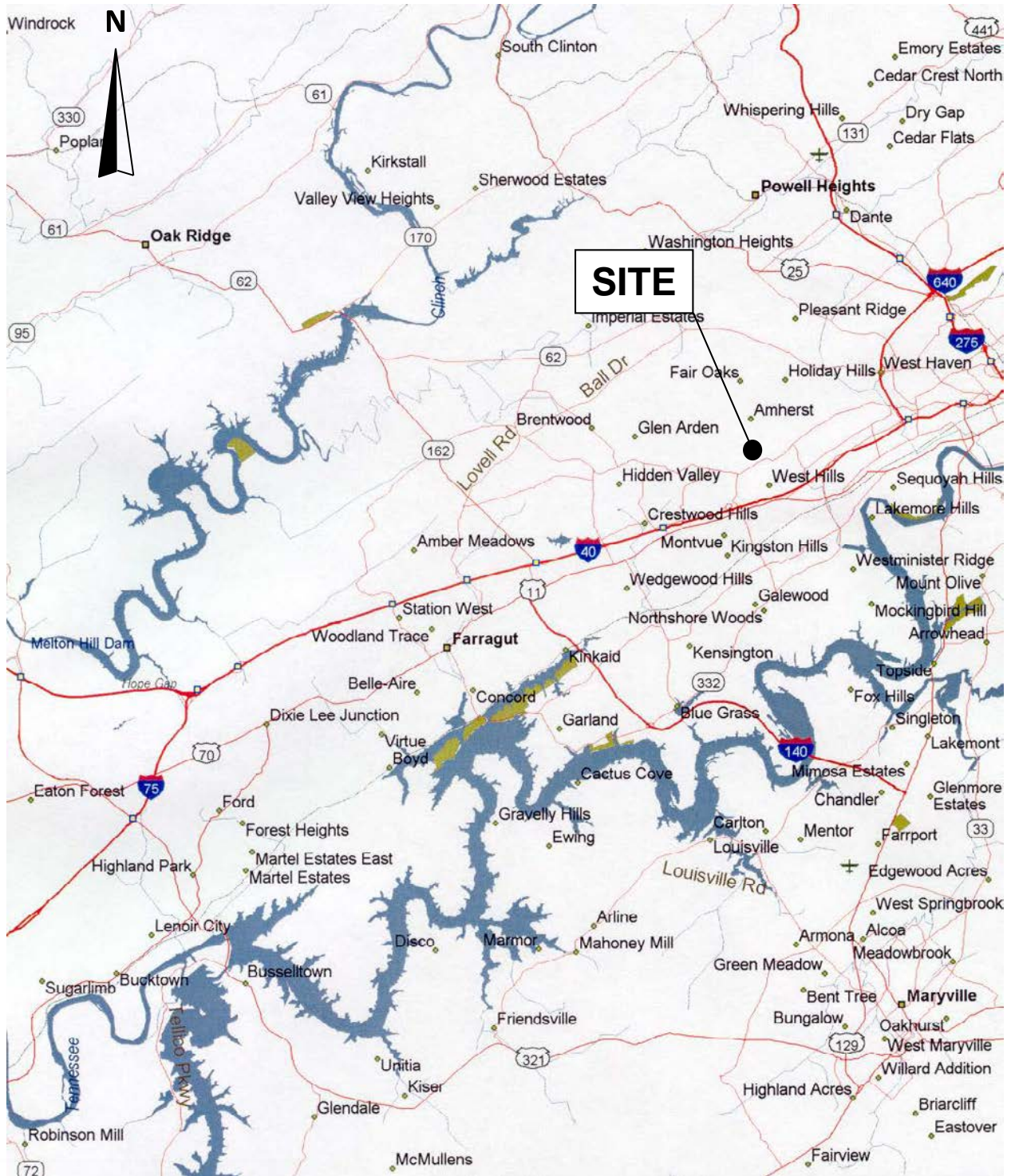


Figure 2

**Regional Access**

To the west is Pellissippi Parkway extending northwest and southeast. Pellissippi Parkway has a 2000 average daily traffic (ADT) of approximately 41,870. This facility becomes Interstate 140 to the south and is designated as part of the federal interstate system. To the south, Pellissippi Parkway intersects Interstate 40/75 and terminates at Alcoa Highway (U.S. 129), providing an essential link to the Knoxville Airport and the Cities of Maryville and Alcoa. Turning north on Alcoa Highway leads back to Knoxville just west of the central business district.

Interstate 40, south of the proposed site, is accessible by Pellissippi Parkway; Cedar Bluff Road; North Gallaher View Road, west of the site; Vanosdale Road to Kingstown Pike (U.S. 11/70) in Westhills to the east; and University Avenue at the terminus of Middlebrook Pike, also to the east. Interstate 40 is an east and west facility extending between Nashville, Tennessee and Asheville, North Carolina. The approximate 2000 ADT for I-40/75 between Pellissippi Parkway (I-140) and the Westhills interchange is 135,940. To the east, I-75 turns north to Lexington, Kentucky, and to the west, I-75 turns south to Chattanooga, Tennessee.

**EXISTING TRAFFIC CONDITIONS**

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**Existing Traffic Control**

Currently traffic control within the study vicinity consists of traffic signals at the intersections of Middlebrook Pike at Vanosdale Road and Piney Grove Church Road to the east. To the west, traffic signals on Middlebrook Pike are located at Robinson Road and North Gallaher View Road. Adjacent intersections are unsignalized at Middlebrook Pike. Middlebrook Pike has a posted speed limit of 45mph.

**Existing Traffic Volumes**

This traffic impact study addresses the intersection of Middlebrook Pike and the proposed site access. A 24-hour directional machine was conducted for Middlebrook Pike adjacent to the site, and a peak-hour turning movement count (TMC) was conducted for the adjacent intersection of Middlebrook Pike and West Forest Boulevard. The AWT was found to be approximately 25,570. Figure 3 illustrates the adjacent street traffic volumes.



# 2002 EXISTING TRAFFIC MPM Residential Development

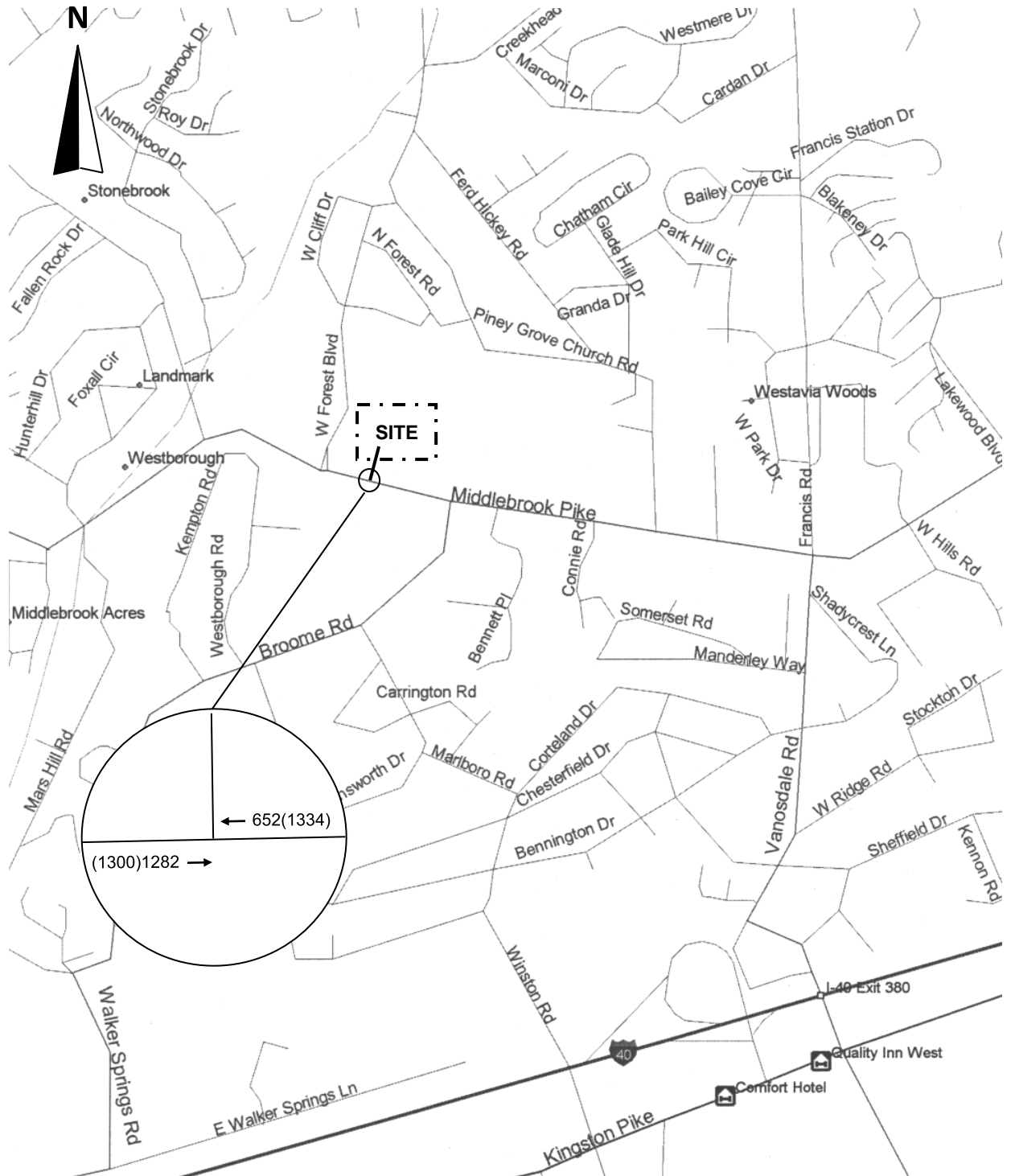


Figure 3

## **BACKGROUND TRAFFIC CONDITIONS**

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Background traffic is traffic that can be anticipated regardless of the proposed development. Traffic within the study area should continue to grow due to other developments and continued growth of Knoxville and Knox County. This traffic must be developed and analyzed for the purpose of establishing a baseline.

### **Background Traffic Volumes**

Using historical TDOT ADT count data, an annual growth rate between 3.5 and 4.5 percent was determined. For the purpose of this study, background traffic was projected for the year 2005 using a 4.0 percent annual compounded growth rate. Completion of this development will depend largely upon market considerations; however, a three-year build-out seems reasonable. Figure 4 illustrates the resulting 2005 background traffic. This traffic is obtained growing existing traffic by a total of 12.5 percent.

## **DEVELOPMENT IMPACTS**

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Project conditions are developed by generating traffic based on the proposed land uses, distributing the trips to the transportation network, and conducting analyses for capacity and LOS.

### **Trip Generation**

Project traffic for the single-family units was determined using the publication, **Trip Generation, 6th Edition**. The **Trip Generation** reference is published by the Institute of Transportation Engineers (ITE) and represents national data collected for many different land uses including industrial, residential, and commercial uses. Rates adopted by the County were developed in conformance with the requirements of ITE. **Trip Generation** is an essential tool in calculating the traffic, which may be generated by a proposed development. From the trip generation calculations, the proposed site may generate approximately 1,470 daily trips. Table 1 presents the trip generation of this proposed site.



TABLE-1

## TRIP GENERATION

LAND USE	L.U.C.	Units	DAILY TRIPS	AM PEAK		PM PEAK	
				ENTER	EXIT	ENTER	EXIT
Single Family	210	146	1,468	28	84	97	54

**Trip Distribution and Assignment**

Using the turning-movement count conducted for Middlebrook Pike and West Forest Boulevard, the trip assignment assumes approximately 40 percent of the residential trips will turn to the east and 60 percent to the west. Traffic turning west will probably turn south on North Gallaher View Road to access the interstate and Kingston Pike. Figures 5 illustrate this distribution and assignment.

**Project Traffic Volumes**

By multiplying the trips generated by the distribution percentages, the project traffic volumes were determined. Figure 6 illustrates the resulting project traffic volumes associated with the proposed project.

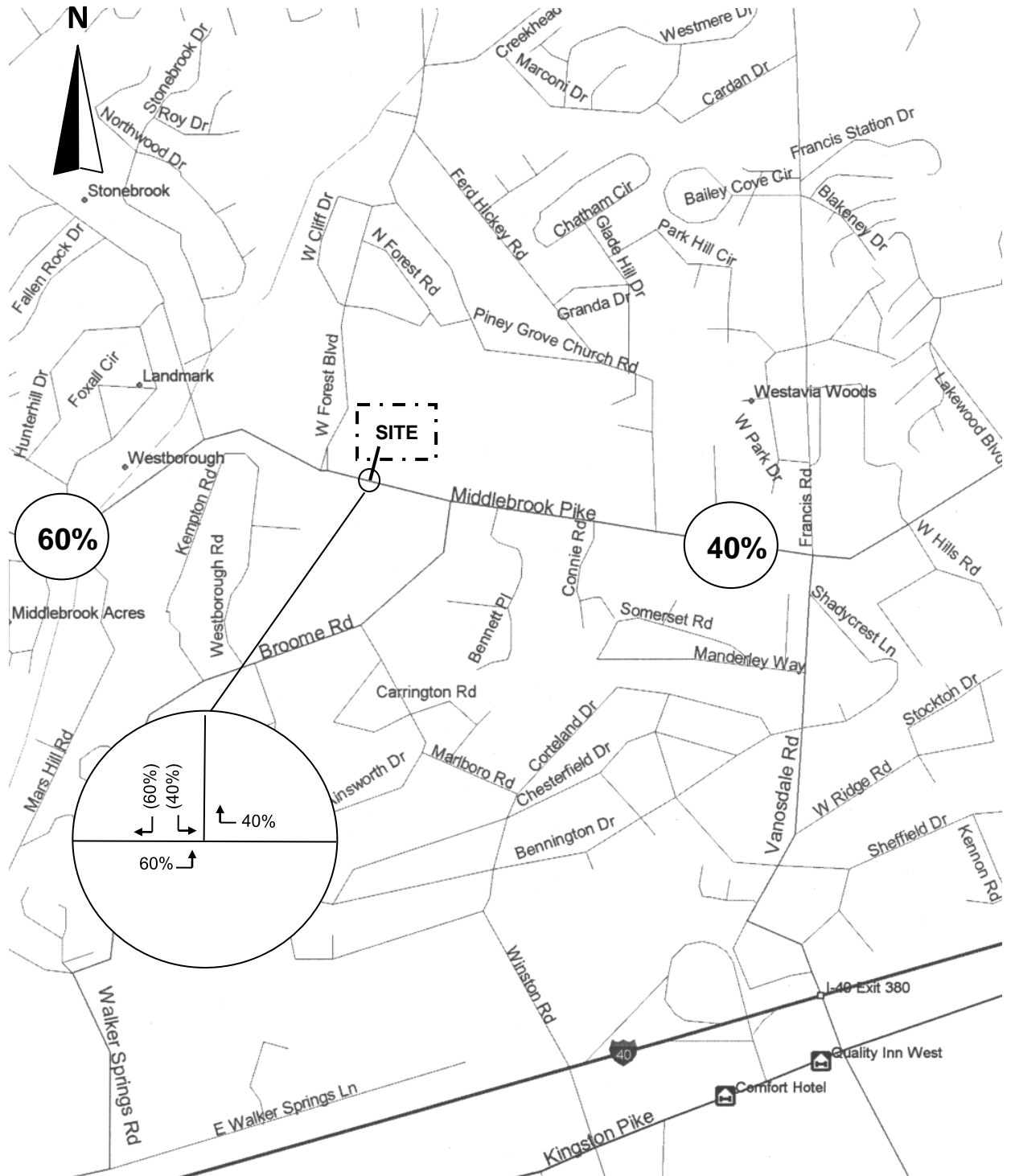
**Total Projected Traffic Volumes**

Background and project traffic volumes were added together to develop post-development traffic volumes for the year 2005. Figure 7 illustrates this 2005 projection. Using this projection, mitigation measures including traffic control devices and roadway and intersection geometry can be evaluated. The projected AWT on Middlebrook Pike may become approximately 26,160 to the east and 26,450 to the west.

**Signal Warrant Analysis**

Traffic signal warrants were evaluated for the proposed site access and Middlebrook Pike. There are eight warrants published in the **Manual on Uniform Traffic Control Devices, 2000 Edition**. For prevailing speeds greater than 40mph, signal warrants were evaluated. Three traffic volume warrants were examined with the first having three

# DISTRIBUTION AND ASSIGNMENT MPM Residential Development



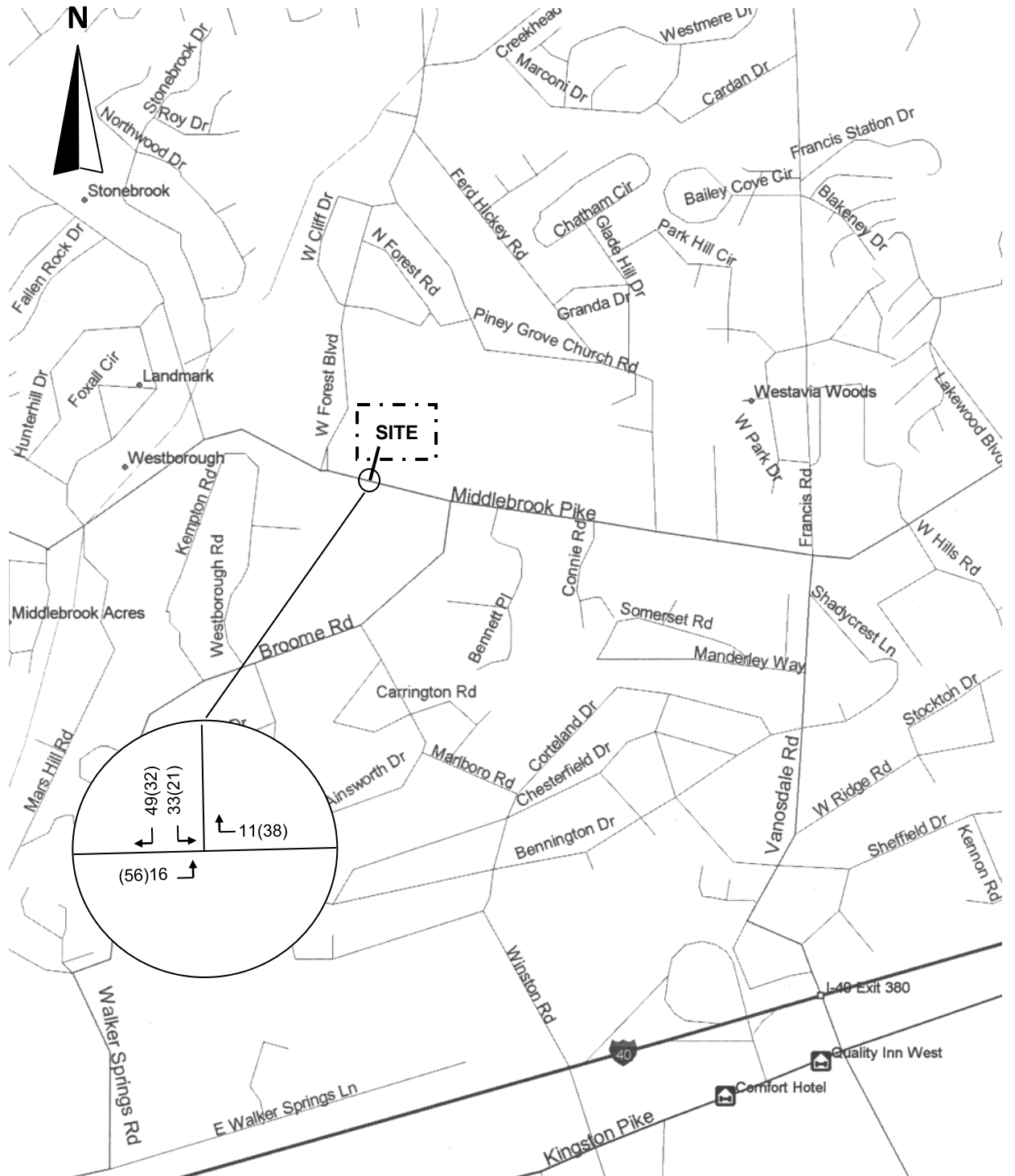
**LEGEND**  
**XXX** ENTERING TRIPS  
**(XXX)** EXITING TRIPS



Figure 5

# PROJECT TRIPS

## MPM Residential Development

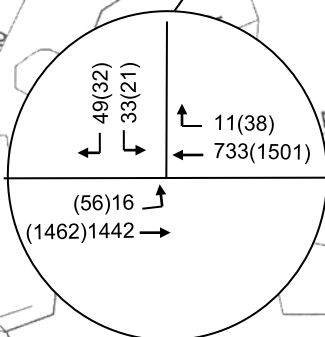
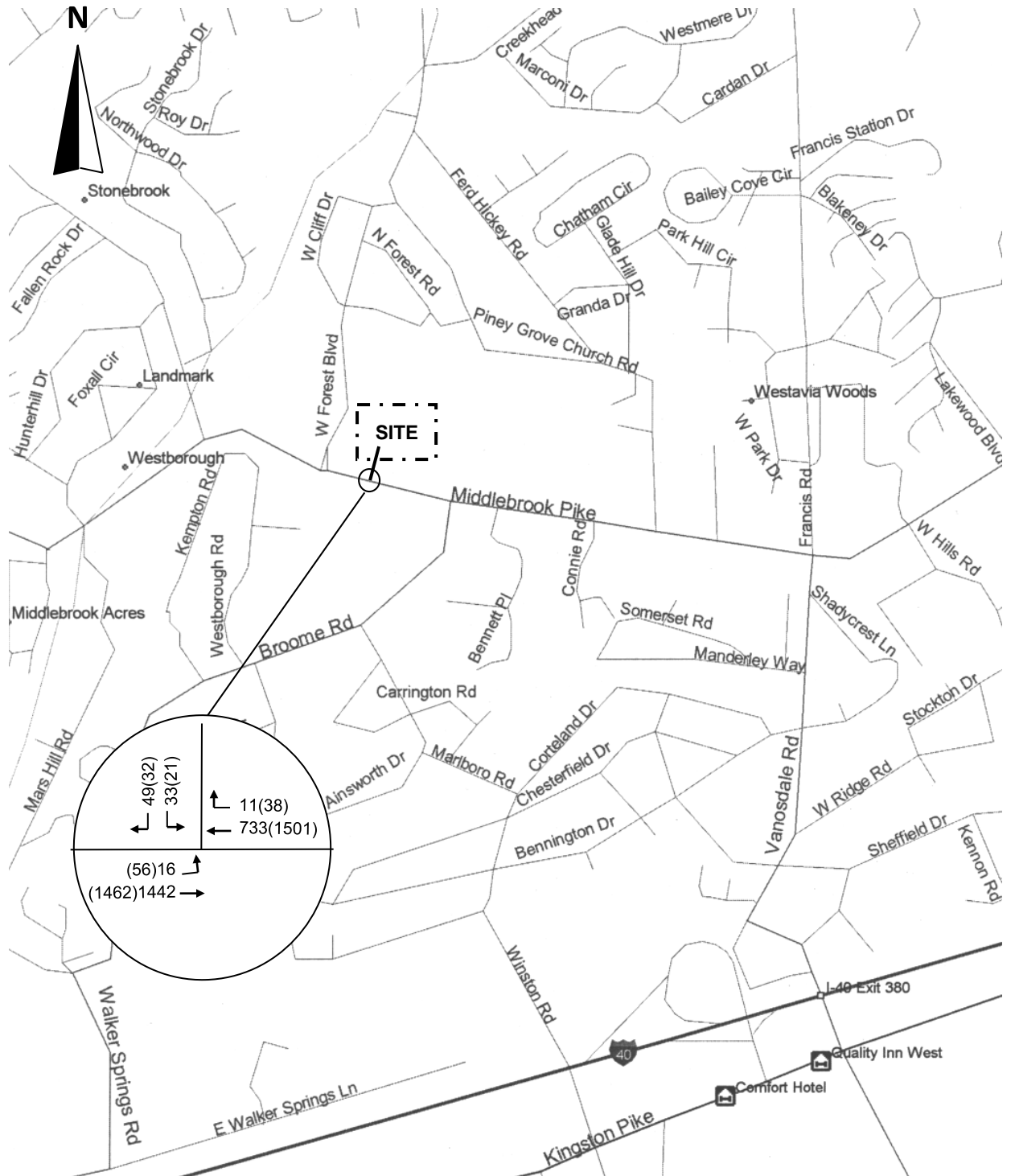


**LEGEND**  
**XXX AM PEAK**  
**(XXX) PM PEAK**



Figure 6

# 2005 PROJECTED TRAFFIC MPM Residential Development



**LEGEND**  
**XXX AM PEAK**  
**(XXX) PM PEAK**



Figure 7

separate criteria. Warrants include the Minimum Volume (Warrant 1A), Interruption to Continuous Traffic Flow (Warrant 1B), Combination (Warrant 1A & B), Four-hour (Warrant 2), and Peak-hour Volume (Warrant 3B). Each of these warrants examines the varying traffic volume for major and minor approaches. Any part of Warrant 1 must be met for a minimum of eight hours. Warrant 2 must be met for four hours, and one hour must be met for the Peak-Hour Warrant (Warrant 3B).

With a single lane approach from the proposed development, the Minimum Volume Warrant is nearly met for one hour; the Interruption Warrant is nearly met for four hours; the Four-hour Warrant is met for 2 hours; and the Peak-hour Warrant is met for the AM peak hour. The separation of left and right turns from the proposed street access would result in the Minimum Volume Warrant not being met for any hour. Hours met for the Interruption Warrant would be reduced to nearly two hours, and the Four-hour Warrant would be met for only one hour. The Peak-hour Warrant would be mitigated with the addition of an additional minor approach lane. Traffic volumes, therefore, would be insufficient to warrant signalization of the proposed intersection.

### **Projected Capacity and Level of Service**

In order to evaluate the operations of the traffic control devices, capacity and level of service were calculated using the **2000 Highway Capacity Manual, Special Report 209** published by the Transportation Research Board. Signalized and unsignalized intersections are evaluated based on estimated intersection delays, which may be related to level of service (LOS). Level of service and capacity are the measurements of an intersection's ability to accommodate traffic volumes. Levels of service for intersections range from A to F. A LOS of A is the best, and LOS F is failing.

For signalized intersections, a LOS of A has an average estimated intersection delay of less than 10 seconds, and LOS F has estimated delay of greater than 80 seconds. A LOS of C and D are typical design values. Within urban areas, a LOS D, delay between 35 and 55 seconds, is considered acceptable by the Institute of Transportation Engineers (ITE) for signalized intersections.

Unsignalized intersection levels of service have lower thresholds of delays. A LOS of F exceeds estimated delays of 45 seconds. For urban arterials, minor approaches may frequently experience levels of service E. A full level of service description for unsignalized and signalized intersections is presented in Tables 2 and 3, respectively.



**TABLE-2**

**LEVEL-OF-SERVICE (LOS) DESCRIPTION  
FOR TWO-WAY STOP INTERSECTIONS**

LOS	AVERAGE CONTROL DELAY PER VEHICLE (seconds)
A	≤10.0
B	>10.0 and ≤15.0
C	>15.0 and ≤25.0
D	>25.0 and ≤35.0
E	>35.0 and ≤50.0
F	>50.0

SOURCE: 2000 Highway Capacity Manual, TRB Special Report 209

**TABLE-3**

**LEVEL-OF-SERVICE (LOS) DESCRIPTION  
FOR SIGNALIZED INTERSECTIONS**

LOS	AVERAGE CONTROL DELAY PER VEHICLE (seconds)	DESCRIPTION
A	≤10.0	Very low delay with extremely favorable progression. Most vehicles don't stop.
B	>10.0 and ≤20.0	Generally good progression. Increase number of stops from that described for LOS "A" resulting in higher delays
C	>20.0 and ≤35.0	Fair progression with increased delay. Number of stopping vehicles become significant; however, many still pass through the intersection without stopping. Stable flow.
D	>35.0 and ≤55.0	The influence of congestion becomes more noticeable. Longer delays resulting from unfavorable progression, longer cycles, or high V/C ratios. Approaching unstable flow.
E	>55.0 and ≤80.0	Limit of acceptable delay. Long delays associated with poor progression, long cycles, or high V/C ratios.
F	>80.0	Unacceptable operation resulting from oversaturation (flow rates exceed capacity). Poor progression, long cycles, and high V/C ratios.

SOURCE: 2000 Highway Capacity Manual, TRB Special Report 209

Analyses were conducted using the Synchro Software, developed by Trafficware. Table 4 presents the unsignalized and signalized analyses of the projected traffic conditions. For unsignalized traffic control of the proposed access street, a LOS of E may be experienced during the PM peak hour for the left-turn egress. Signalization of the proposed street would result in an intersection LOS of B. Signalization, however, would not be warranted for the

proposed intersection. The unsignalized levels of service are considered acceptable for an urban arterial. The LOS E should be limited to the PM peak hour.

**TABLE-4**  
**2005 PROJECTED**  
**LEVELS OF SERVICE**

INTERSECTION	AM PEAK			PM PEAK		
	V/C	DELAY	LOS	V/C	DELAY	LOS
Middlebrook Pike & Proposed Site Access	0.83	19.4/11.6 9.7	C/B A	0.90	40.7/18.1 14.2	E/B B

Note: Average vehicle control delay estimated in seconds. Unsignalized analyses (SBL/SBR). *Signalized analyses*

**Sight Distance**

The project access is proposed to Middlebrook Pike, a four-lane divided roadway. The road’s speed limit is currently posted for 45mph. Measured sight distance to the west is approximately 590 feet and 570 feet to the east. The required distance is 360 feet to meet the minimum stopping sight-distance for American Association of State Highway and Transportation Officials (AASHTO) and 450 feet to meet the Knox County minimum corner sight-distance standard. The proposed site access, therefore, meets both criteria and is acceptable for safe operations.

**RECOMMENDATIONS**

The analyses conducted and the review of the traffic volumes identified the following recommendations:

- Minimize landscaping, using low growing vegetation, and signing at the street access to insure that safe sight distance is maintained.
- Use a minimum intersection radius of 30-foot for the efficient and safe ingress and egress of the site.
- Provide separate left- and right-turn lanes for the site access.
- Post the proposed street with a STOP sign (R1-1) at Middlebrook Pike.

- Intersection design should conform to the recommended standards and practices of the American Association of State Highway and Transportation Officials, the Institute of Transportation Engineers, and the City of Knoxville Public Works Department.

## CONCLUSION

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The study of this proposed residential development evaluated the projected traffic conditions. Background traffic was determined using a 4.0 percent annual compounded growth rate until the year 2005. Traffic associated with the proposed project was then generated and distributed to the proposed site access. Using the identified turning movements for the projected traffic conditions, unsignalized and signalized capacity and level of service analyses were conducted using the **2000 Highway Capacity Manual**. Unsignalized levels of service were found to be acceptable. A LOS E may be experienced for the left-turn egress during the PM peak hour. Capacities and delays with installation of a traffic signal were found to be very good, resulting in acceptable levels of service with the proposed development; however, a signal is not warranted with the projected traffic and with separate left- and right-turn lanes for the proposed street approach.

The proposed development was identified has having a minimal impact on the adjacent street and intersections. With the recommendations of this report, the efficient and safe flow of traffic should be maintained.

## **APPENDIX**

**TRIP GENERATION  
CAPACITY AND LOS ANALYSES  
SIGNAL WARRANT ANALYSES  
TRAFFIC COUNTS**

