

# **BUFFAT MILL ESTATES**

*Knoxville, Tennessee*

## **TRAFFIC IMPACT STUDY**

*Prepared for:*

**BATSON, HIMES, NORVELL, & POE**

*Prepared By:*



**February 2010**

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**KNOXVILLE, TENNESSEE**

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**Prepared for**

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4334 Papermill Drive  
Knoxville, Tennessee 37909**



**February 2010**

**Prepared by**

**WILBUR SMITH ASSOCIATES  
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**Project No. 104200**

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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 Knoxville. The study of this development required 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 resulting traffic conditions, and 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 between Buffat Mill Road and McIntyre Road. The site is approximately 54.7 acres with a RP residential zoning. The development of the property will subdivide the property for 249 single-family units. Figure 1 is the proposed site plan. Access to the site will be from proposed streets intersecting Buffat Mill Road to the north providing access for 118 units and McIntyre. Road to the south serving 131 units. There will not be a connection over the ridge between the 118 and 131 single family units.

### **Site Location**

The site is in the City of Knoxville, northeast of the Knoxville central business district (CBD). The location of the site is south of Buffat Mill Road. Interstate 640 borders the proposed site to the east. Figure 2 illustrates this location relative to local and regional access.

# SITE PLAN

Buffat Mill Estates



Figure 1

# PROJECT VICINITY

## Buffat Mill Estates

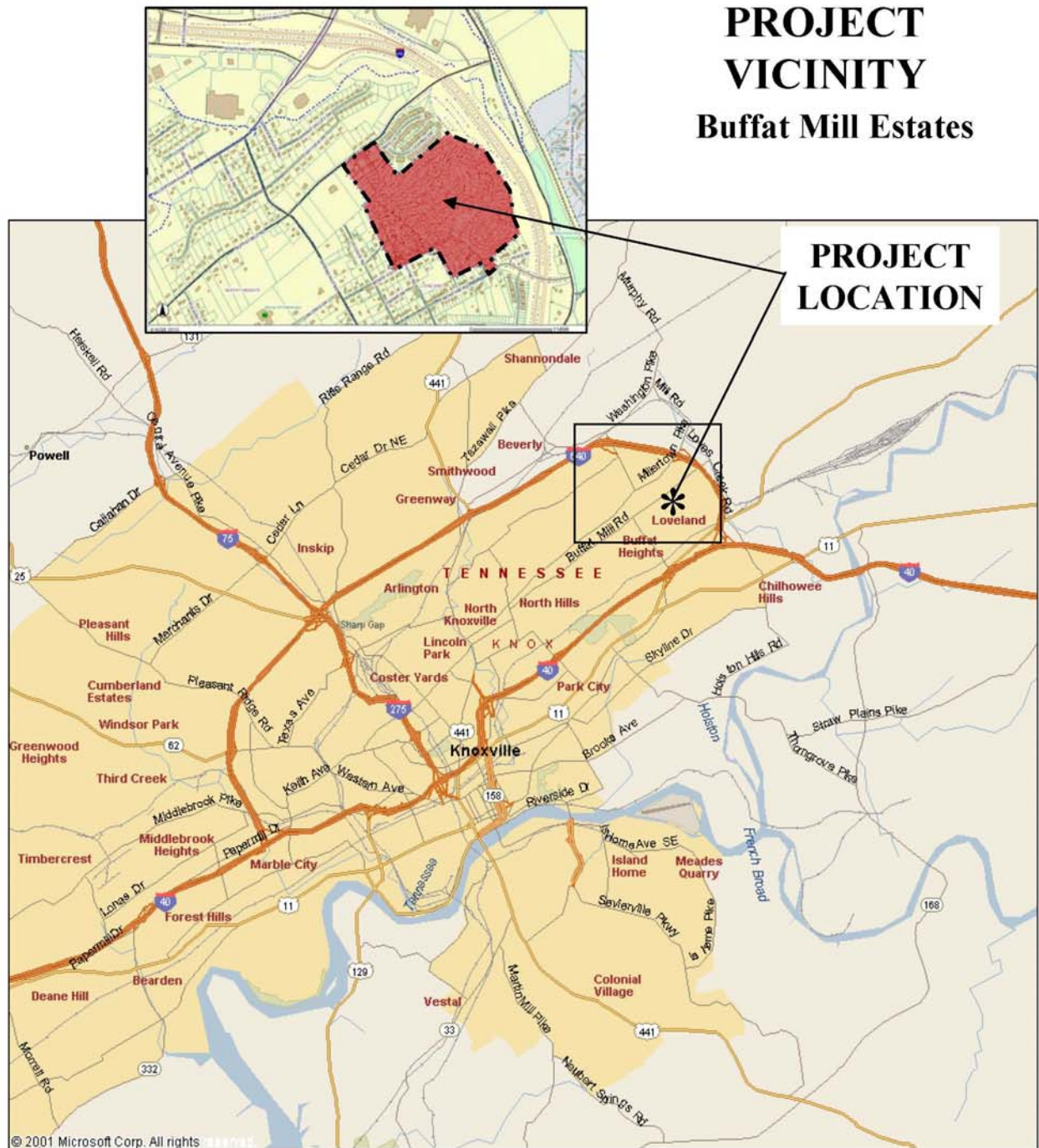


Figure 2



## **LOCAL AND REGIONAL ACCESS**

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### **Local Access**

Local access to this site is proposed street access to Buffat Mill Road and McIntyre Road. Adjacent to the proposed site, Buffat Mill Road is a 19-foot, 2-lane roadway with an east and west orientation extending from Loves Creek Road through Springhill Road. Buffat Mill Road is a classified collector street. The 2007 average daily traffic (ADT) for Buffat Mill Road is approximately 1,580 vehicles per day (vpd). McIntyre Road is a 21-foot, 2-lane roadway with an east and west orientation extending from Loves Creek Road through Springhill Road. The width of McIntyre Road between the site and Loves Creek Road is 45-foot consisting of wide shoulders and two 12-foot lanes. McIntyre Road is a local street.

Loves Creek Road, east of the site, is a north and south collector facility with an ADT of 4,950 and 7,610 in the year 2007 north and south of Buffat Mill Road, respectively, Loves Creek Road extends north through Millertown Pike and south to Rutledge Pike, opposite Chilhowee Drive. Springhill Road is another north and south collector street west of the site. Springhill Road provides a connection between Millertown Pike and Rutledge Pike. Its ADTs are 2,750 and 1,970 north and south of Buffat Mill Road, respectively.

### **Regional Access**

Regional access is by Millertown Pike and Rutledge Pike (S.R. 1), and the interstate system including Interstates 40 and 640. The interstates are accessible from Millertown Pike to I -640, north of the site, and from Rutledge Pike to I-40, south of the site. Millertown Pike is a northeast and southwest two-lane arterial becoming a multiple lanes through the I-640 interchange and adjacent to Knoxville Center. Millertown Pike has an ADT near Springhill Road of 7,760. Rutledge Pike is a multi-lane arterial with a 2007 ADT of approximately 18,015.

Interstate 640 connects to I-40 east and west of the Knoxville CBD and intersects I-75, west of the site. An ADT of 41,370 travels I-640 adjacent to the site. Interstate 40 is an east and west facility extending between Nashville, Tennessee and Asheville, North Carolina. The approximate 2007 ADT for I-40/75 west of I-640 is 166,210. To the east of I-640, I-40 has an ADT of 98,570. Interstate 75 extends north to Lexington, Kentucky, and to the west, I-75 turns south to Chattanooga, Tennessee. Interstate 75 becomes I-275 south of I-640 with a 2007 ADT of 64,390. North of I-640, I-75 has a 2002 ADT of 86,830.



## **EXISTING TRAFFIC CONDITIONS**

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### **Existing Traffic Control**

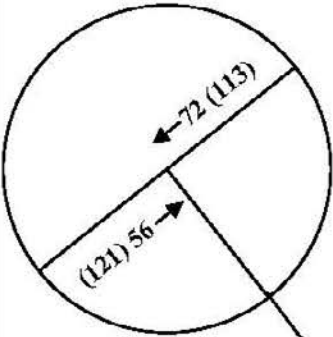
Currently traffic control within the study vicinity is stop control for intersections with Buffat Mill Road. A multi-way STOP is provided for the intersection of Buffat Mill Road and Springhill Road with the southbound approach, the upgrade approach given a free-flow movement. Buffat Mill Road and McIntyre Road have a posted speed limit of 30mph. Signalized intersections are provided for Spring Hill Road at Rutledge Pike and Loves Creek Road at Millertown Pike. The interstate interchanges on Millertown Pike and Rutledge Pike are signalized.

### **Existing Traffic Volumes**

This traffic study conducted 24-hour mechanical counts at proposed subdivision street intersections with Buffat Mill Road and McIntyre Road. The average weekday traffic (AWT) adjacent to the site for Buffat Mill Road is 2,270 and 790 for McIntyre Road. Peak-hour traffic was determined between 7:15-8:15AM for both Buffat Mill Road and McIntyre Road. The PM peak hour is 4:30-5:30PM for Buffat Mill Road and 3:45-4:45PM for McIntyre Road and Figure 3 illustrates the AM and PM peak-hour traffic volumes.

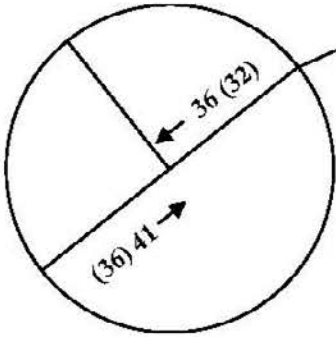
# 2010 EXISTING TRAFFIC

## Buffat Mill Estates



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0 1189ft



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



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. Plans currently include the development of 249 single-family units. Build-out traffic is projected for the horizon year of 2015. Actual build-out will depend largely on market considerations; however, the 2015 horizon year seems reasonable for the build-out conditions.

### **Background Traffic Volumes**

In the vicinity of the proposed site, significant development is occurring. Previous studies conducted by WSA for the Knoxville Center area, which includes this site, utilized a 7-percent annual growth rate. For the purpose of this study, a 3.5-percent rate of growth is used to reflect changes in the growth over the past few years due to market and economic conditions. Therefore, the existing traffic is increased by a total of 18.8-percent for 2015 background traffic and is illustrated in Figure 4.



# 2015 BACKGROUND TRAFFIC

## Buffat Mill Estates

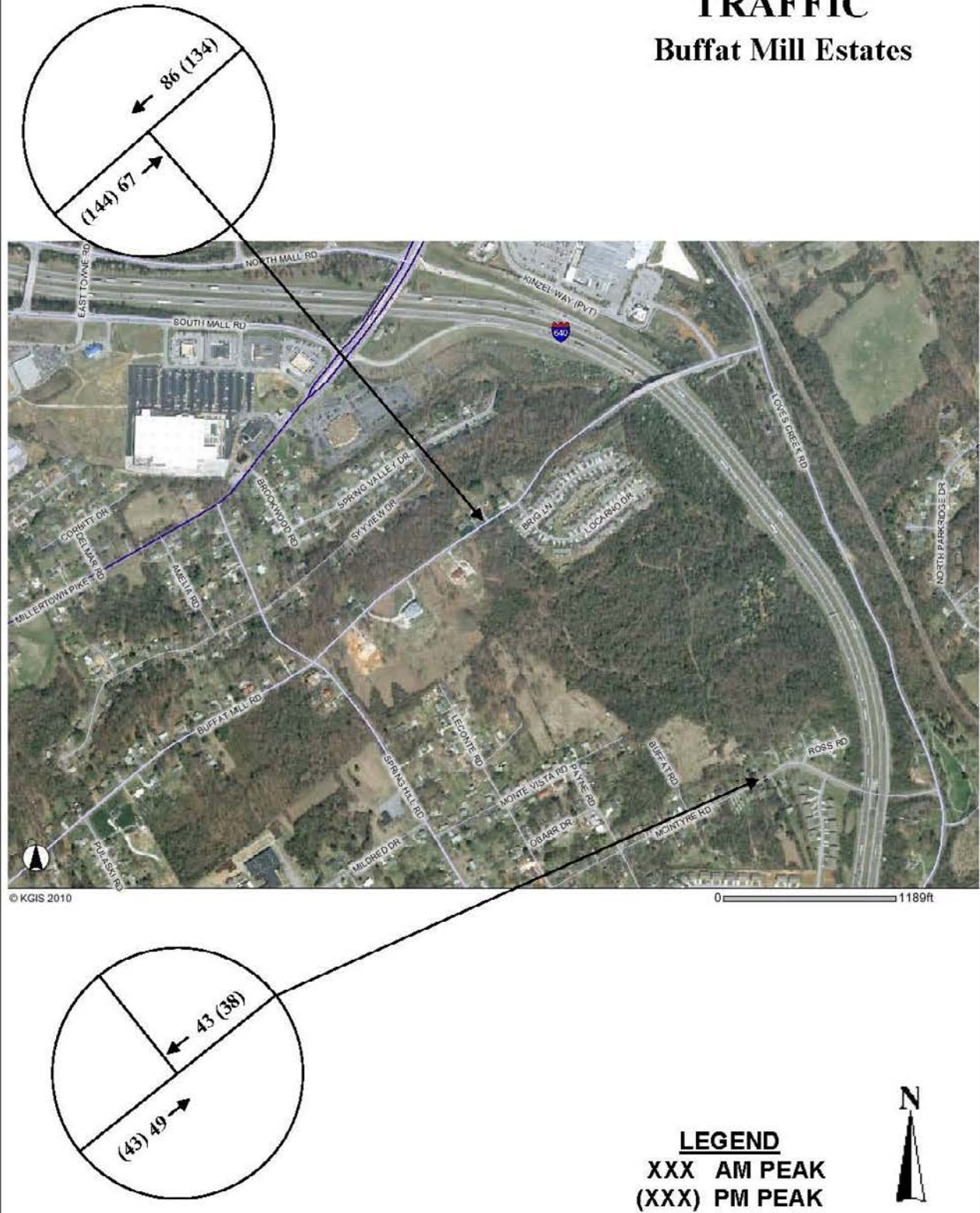


Figure 4

## 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, 8th Edition**. The 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. **Trip Generation** is an essential tool in calculating the traffic, which may be generated by a proposed development. The trip generation of the site was conducted for two subdivisions with 118 units access Buffat Mill Road and 131 units accessing McIntyre Road. From the trip generation calculations, the proposed site, may generate approximately 2,544 daily trips. Table 1 presents the trip generation of this proposed site.

**TABLE-1  
TRIP GENERATION**

Land Use	Land-Use Code	Proposed Access	Units	Daily Trips	AM Peak-Hour Trips		PM Peak-Hour Trips	
					Enter	Exit	Enter	Exit
Single-Family Residential	210	Buffat Mill Rd.	118	1,211	23	69	77	45
		McIntyre Rd.	131	1,333	25	76	84	50
Total			249	2,544	48	145	161	95

Reference: Trip Generation, 8th Edition

### Trip Distribution and Assignment

Using the traffic count data in the project vicinity, the trip distribution assumes approximately 55-percent of the residential trips will turn west to Buffat Mill Road towards Springhill Road, and 45-percent to the east towards Loves Creek Road. From the proposed street intersection with McIntyre Road, 55-percent was distributed towards Loves Creek road and 45-percent towards Springhill Road. Figure 5 illustrates this distribution and assignment.

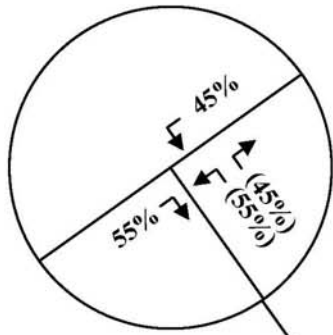
### Project Traffic Volumes

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.

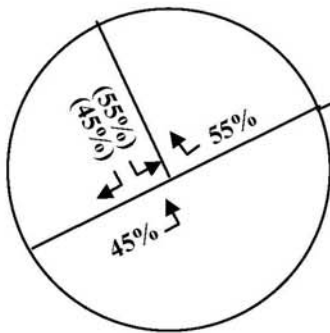


# TRIP DISTRIBUTION

## Buffat Mill Estates



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**LEGEND**  
 XXX ENTERING  
 (XXX) EXITING

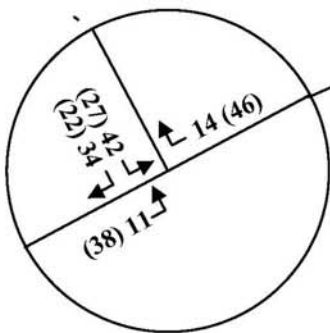
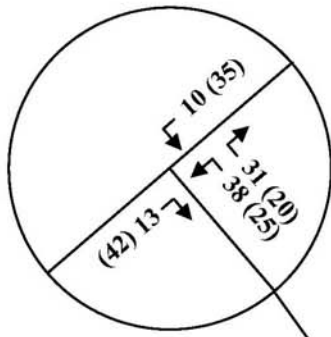


Figure 5



# PROJECT TRIPS

## Buffat Mill Estates



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



Figure 6

### **Total Projected Traffic Volumes**

Background and project traffic volumes were added together to develop post-development traffic volumes for the year 2015. Figure 7 illustrates this 2015 projection. Using these projections, mitigation measures including traffic control devices and geometry of the roadway and intersection can be evaluated. The projected traffic did not indicate the requirement for left- or right-turn lanes on Buffat Mill Road or McIntyre Road.

### **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. LOS A is the best, and LOS F is failing.

Unsignalized intersection has an estimated delay less than 10 seconds for a LOS A. Delays between 15 and 25 seconds result in a LOS C. LOS F exceeds estimated delays of 50 seconds. For urban arterials, minor approaches may frequently experience levels of service E. A LOS C is typically the accepted standard for rural conditions. Levels of service and associated delays for unsignalized intersections are presented in Table 2.

**TABLE-2  
LEVEL-OF-SERVICE (LOS) DESCRIPTION  
FOR TWO-WAY STOP INTERSECTIONS**

Level of Service	Average Control Delay per Vehicle (seconds)
A	$\leq 10.0$
B	$> 10.0$ and $\leq 15.0$
C	$> 15.0$ and $\leq 25.0$
D	$> 25.0$ and $\leq 35.0$
E	$> 35.0$ and $\leq 50.0$
F	$> 50.0$

**SOURCE:** Highway Capacity Manual, TRB Special Report 209



# 2015 PROJECTED TRAFFIC

## Buffat Mill Estates

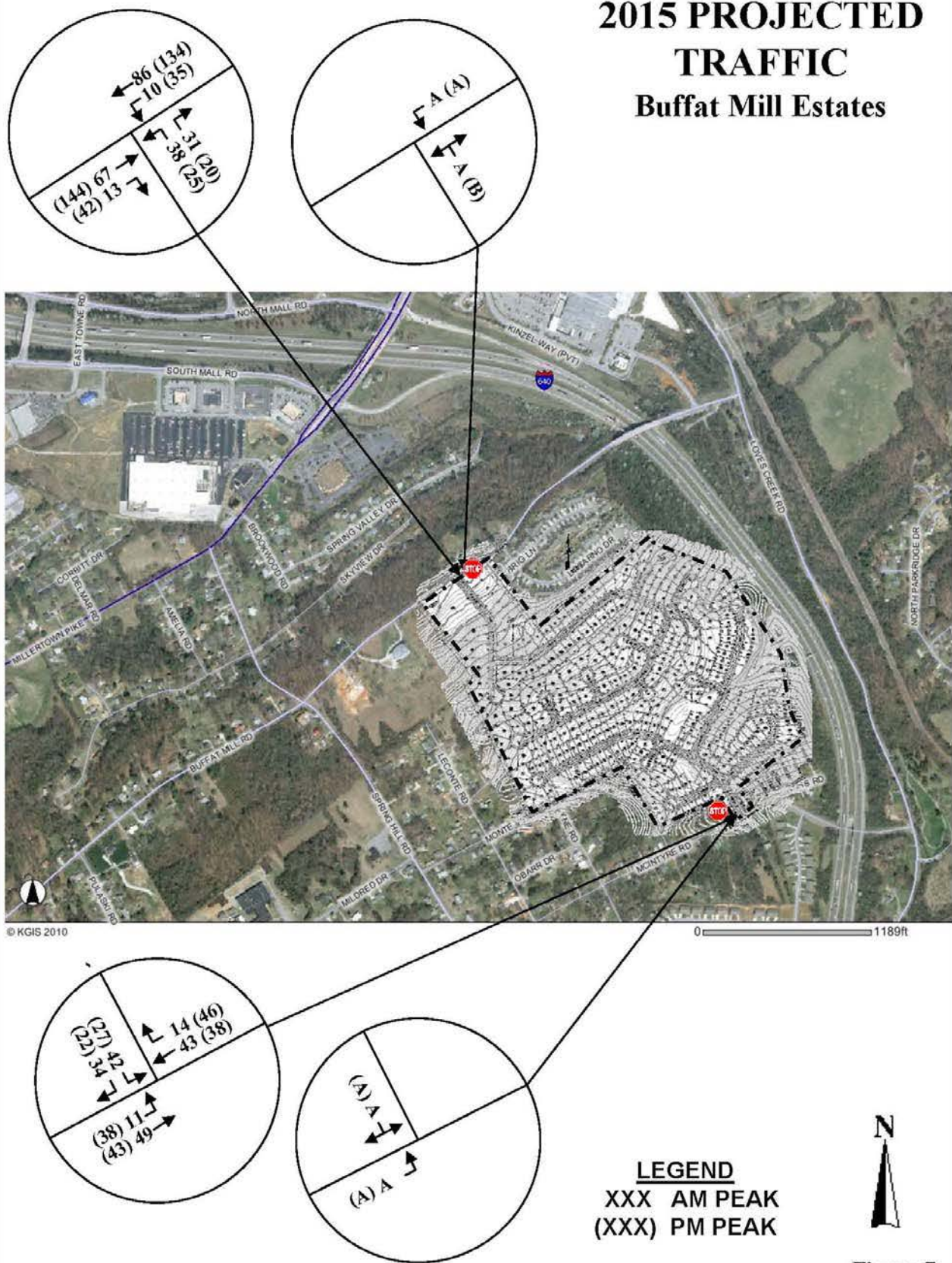


Figure 7



The analyses conducted determined that the site access would operate at acceptable levels of service. The unsignalized subdivision street intersections with Buffat Mill Road and McIntyre Road would experience better than a LOS C. Table 3 presents the projected capacity and LOS.

**TABLE-3  
2015 PROJECTED  
LEVELS OF SERVICE**

INTERSECTION	AM PEAK HOUR			PM PEAK HOUR		
	CAPACITY	DELAY	LOS	CAPACITY	DELAY	LOS
Buffat Mill Road and Site Access	0.09	9.6	A	0.07	10.7	B
McIntyre Road and Site Access	0.09	9.3	A	0.06	9.4	A

Note: Average vehicle delay estimated in seconds. STOP control analyses presented by minor approach.

### **Sight Distance**

The project access proposed to Buffat Mill Road and McIntyre Road. The speed limit for Buffat Mill Road is posted for 30mph. Measured sight distance for the access street to Buffat Mill Road is greater than 600 feet to the west and approximately 350 feet to the east. The required distance for a 30 MPH posted roadway is 200 feet to meet the minimum stopping sight-distance for American Association of State Highway and Transportation Officials (AASHTO) and 300 feet to meet the Knox County minimum corner sight-distance standard. The proposed site access to Buffat Mill Road, therefore, is adequate for the safe egress from the site.

With a posted speed limit, McIntyre Road has a measured sight distance for the access street of approximately 425 feet to the east (left) and 225 feet to the west (right). The restricted sight distance to the right is due to a blind spot created by a wooden utility pole. A vehicle positioned a few feet further than or nearer to the distance of 15 feet from the travelway would have a sight distance of 285 feet at which point the bush located near the roadway blocks the view of oncoming traffic. The required distance for a 30 MPH posted roadway is 200 feet to meet the minimum stopping sight-distance for American Association of State Highway and Transportation Officials (AASHTO) and 300 feet to meet the Knox County minimum corner sight-distance standard. With the limit in sight distance caused by only a blind spot from a pole, minimum stopping sight distance obtained, and the County corner sight-distance nearly achieved, sight-distance is acceptable.

Sight distances for the proposed sight access are illustrated in Figure 8.

# SIGHT DISTANCES

## Buffat Mill Estates



Figure 8



### **Intersection Spacing**

The minimum offset or spacing of intersections serves to separate conflict points and prohibit “corner cutting” between two offset intersections by crossing traffic. T-type intersections are strongly recommended for residential subdivisions. Cross-type intersections are considered less safe than a T-type intersection.

The spacing of the proposed access street for Knox Estates is approximately 280 feet from the intersection of Locarno Drive, both intersecting Buffat Mill Road from the south. The basis of the 300-foot spacing policy of the Knoxville/Knox County Metropolitan Planning Commission, published in their Subdivision Regulations, was not determined, but this same distance is also used by the Metropolitan Government of Nashville and Davidson County Planning Commission. The required minimum may be based on possible traffic queues associated with traffic signals; however, signals installed on collectors are not typical, because the typical collector volumes would not warrant signalization. Signals located on collectors would require much higher than typical collector street traffic volumes and should be limited to the intersection of two collector streets. The distance between these intersections is very near the MPC required minimum and neither intersection would require signalization.

The policy adopted by the MPC exceeds the recommendations the Institute of Transportation Engineers (ITE) and the Transportation Research Board (TRB). Recommended minimum spacing of intersections published by ITE and TRB is 125 feet for a collector street. In the ITE publication, **Transportation and land Development**, the recommended minimum unsignalized intersection spacing is 150 to 200 feet for a major 2-lane collector and the distance of a lot frontage for a minor collector.

It is also important to recognize that the recommended minimum spacing emphasizes offset intersections. This spacing is predicated primarily on the need to offset opposing intersections; however, the intersection spacing between the proposed subdivision street access and Locarno Drive are not offset but are both northbound approaches to Buffat Mill Road. Therefore, the spacing is less critical and does not introduce a concern for corner cutting by though traffic or conflict between left-turning vehicles.

With 278 feet between the proposed development street access and Locarno Drive, the intersection spacing would be considered acceptable based on national standards published by

ITE and TRB. The spacing exceeds the minimum recommended standard of 150 feet. A 300-foot spacing will not be any more safe or less efficient than a 278-foot spacing. The intersections of Buffat Mill Road with the proposed subdivision's street and Locarno Drive will both have an acceptable traffic operation.

## RECOMMENDATIONS

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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 intersections with Buffat mill Road and McIntyre Road to insure that safe sight distance is maintained.
- ◆ Use a minimum intersection radius of 35-foot for the efficient and safe ingress and egress of the site.
- ◆ Post the proposed street approaches to Buffat Mill Road and McIntyre with a STOP sign (R1-1).
- ◆ 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 Engineering Department.

## CONCLUSION

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The study of this proposed residential development evaluated the projected traffic conditions for the intersections of the proposed site access streets with Buffat Mill Road and McIntyre Road. This development currently plans a total of 249 single-family units divided into two separate subdivisions with 118 and 131 units. Background traffic was determined using a 3.5-percent annual compounded growth rate until the year 2015. Traffic associated with the proposed project was then generated and distributed to the proposed site access streets. Using the identified turning movements for the projected traffic conditions, unsignalized capacity and level of service analyses were conducted using the **2000 Highway Capacity Manual**. Unsignalized levels of service were found to be acceptable for the proposed intersections of the site access with Buffat Mill Road and McIntyre Road for the future year studied. The minimum LOS C will be experienced for the proposed street accesses during the peak hours for projected traffic conditions. Street accesses are found to have adequate sight-distances.

The proposed development does not have an unacceptable impact on the adjacent street. With the recommendations of this report, the efficient and safe flow of traffic should be maintained.



# **APPENDIX**

**TRIP GENERATION  
CAPACITY AND LOS ANALYSES  
TRAFFIC COUNTS  
AUXILIARY LANE EVALUATION**



# HCM Unsignalized Intersection Capacity Analysis

## 9: Buffat Mill Road & Proposed Subdivision Street

2/23/2010



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↻			↻	↻	
Volume (veh/h)	67	13	10	86	38	31
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	73	14	11	93	41	34
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			87		195	80
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			87		195	80
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		95	97
cM capacity (veh/h)			1509		788	980

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	87	104	75
Volume Left	0	11	41
Volume Right	14	0	34
cSH	1700	1509	864
Volume to Capacity	0.05	0.01	0.09
Queue Length 95th (ft)	0	1	7
Control Delay (s)	0.0	0.8	9.6
Lane LOS		A	A
Approach Delay (s)	0.0	0.8	9.6
Approach LOS			A

Intersection Summary			
Average Delay		3.0	
Intersection Capacity Utilization	22.4%		ICU Level of Service A
Analysis Period (min)		15	

# HCM Unsignalized Intersection Capacity Analysis

## 15: McItyre Road & Proposed Road

2/23/2010



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	11	49	43	14	42	34
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	12	53	47	15	46	37
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	62				132	54
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	62				132	54
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				95	96
cM capacity (veh/h)	1541				856	1013

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	65	62	83
Volume Left	12	0	46
Volume Right	0	15	37
cSH	1541	1700	920
Volume to Capacity	0.01	0.04	0.09
Queue Length 95th (ft)	1	0	7
Control Delay (s)	1.4	0.0	9.3
Lane LOS	A		A
Approach Delay (s)	1.4	0.0	9.3
Approach LOS			A

Intersection Summary			
Average Delay		4.1	
Intersection Capacity Utilization	20.9%		ICU Level of Service
Analysis Period (min)		15	A



# HCM Unsignalized Intersection Capacity Analysis

## 9: Buffat Mill Road & Proposed Subdivision Street

2/23/2010



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↻			↻	↻	
Volume (veh/h)	144	42	35	134	25	20
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	157	46	38	146	27	22
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			202		401	179
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			202		401	179
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			97		95	97
cM capacity (veh/h)			1370		588	863

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	202	184	49
Volume Left	0	38	27
Volume Right	46	0	22
cSH	1700	1370	685
Volume to Capacity	0.12	0.03	0.07
Queue Length 95th (ft)	0	2	6
Control Delay (s)	0.0	1.8	10.7
Lane LOS		A	B
Approach Delay (s)	0.0	1.8	10.7
Approach LOS			B

Intersection Summary			
Average Delay		2.0	
Intersection Capacity Utilization		32.5%	ICU Level of Service A
Analysis Period (min)		15	

# HCM Unsignalized Intersection Capacity Analysis

## 15: McItyre Road & Proposed Road

2/23/2010



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔	↔		↔	
Volume (veh/h)	38	43	38	46	22	26
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	41	47	41	50	24	28
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	91				196	66
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	91				196	66
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	97				97	97
cM capacity (veh/h)	1504				771	997

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	88	91	52
Volume Left	41	0	24
Volume Right	0	50	28
cSH	1504	1700	879
Volume to Capacity	0.03	0.05	0.06
Queue Length 95th (ft)	2	0	5
Control Delay (s)	3.6	0.0	9.4
Lane LOS	A		A
Approach Delay (s)	3.6	0.0	9.4
Approach LOS			A

Intersection Summary			
Average Delay		3.5	
Intersection Capacity Utilization		21.0%	ICU Level of Service
Analysis Period (min)		15	A

**Wilbur Smith Associates**  
Knoxville, TN

Site Code: BM  
Station ID:

Latitude: 0' 0.000 South

Start Time	11-Feb-10 Thu	EB		Hour Totals		WB		Hour Totals		Combined Totals	
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
12:00		*	*			*	*				
12:15		*	*			*	*				
12:30		*	*			*	*				
12:45		*	*	0	0	*	*	0	0	0	0
01:00		*	0			*	1				
01:15		*	1			*	1				
01:30		*	5			*	6				
01:45		*	27	0	33	*	23	0	31	0	64
02:00		*	18			*	11				
02:15		*	11			*	23				
02:30		*	21			*	16				
02:45		*	20	0	70	*	18	0	68	0	138
03:00		*	24			*	22				
03:15		*	36			*	29				
03:30		*	19			*	22				
03:45		*	20	0	99	*	23	0	96	0	195
04:00		*	22			*	23				
04:15		*	17			*	22				
04:30		*	21			*	23				
04:45		*	26	0	86	*	21	0	89	0	175
05:00		*	29			*	15				
05:15		*	28			*	22				
05:30		*	16			*	23				
05:45		*	21	0	94	*	20	0	80	0	174
06:00		*	15			*	17				
06:15		*	22			*	24				
06:30		*	16			*	19				
06:45		*	14	0	67	*	14	0	74	0	141
07:00		*	17			*	21				
07:15		*	9			*	17				
07:30		*	13			*	14				
07:45		*	10	0	49	*	19	0	71	0	120
08:00		*	8			*	19				
08:15		*	9			*	25				
08:30		*	8			*	23				
08:45		*	6	0	31	*	23	0	90	0	121
09:00		*	8			*	10				
09:15		*	7			*	13				
09:30		*	5			*	11				
09:45		*	4	0	24	*	8	0	42	0	66
10:00		*	3			*	6				
10:15		*	5			*	6				
10:30		*	1			*	5				
10:45		*	3	0	12	*	6	0	23	0	35
11:00		*	2			*	4				
11:15		*	2			*	3				
11:30		*	3			*	0				
11:45		*	2	0	9	*	3	0	10	0	19
Total		0	574			0	674			0	1248
Percent		0.0%	100.0%			0.0%	100.0%			0.0%	100.0%



**Wilbur Smith Associates**  
Knoxville, TN

Site Code: BM  
Station ID:

Latitude: 0' 0.000 South

Start Time	12-Feb-10 Fri	EB		Hour Totals		WB		Hour Totals		Combined Totals	
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
12:00		0	21			5	15				
12:15		0	10			1	19				
12:30		3	17			2	17				
12:45		3	22	6	70	1	23	9	74	15	144
01:00		0	13			0	24				
01:15		1	20			2	26				
01:30		0	24			1	23				
01:45		0	17	1	74	0	25	3	98	4	172
02:00		2	20			0	19				
02:15		0	28			2	24				
02:30		1	18			0	22				
02:45		0	26	3	92	1	16	3	81	6	173
03:00		1	27			1	25				
03:15		1	27			0	15				
03:30		0	20			0	27				
03:45		0	34	2	108	0	30	1	97	3	205
04:00		0	27			0	21				
04:15		1	16			0	30				
04:30		0	26			0	21				
04:45		2	37	3	106	1	30	1	102	4	208
05:00		1	23			0	28				
05:15		0	34			0	26				
05:30		2	27			0	29				
05:45		0	25	3	109	3	21	3	104	6	213
06:00		4	23			8	22				
06:15		4	20			4	31				
06:30		5	12			9	27				
06:45		7	23	20	78	4	24	25	104	45	182
07:00		8	10			11	20				
07:15		8	9			18	26				
07:30		17	7			21	11				
07:45		22	15	55	41	24	13	74	70	129	111
08:00		9	11			9	13				
08:15		3	10			12	19				
08:30		6	7			11	12				
08:45		5	10	23	38	13	9	45	53	68	91
09:00		15	9			10	17				
09:15		8	8			12	11				
09:30		3	7			12	15				
09:45		7	14	33	38	16	7	50	50	83	88
10:00		9	9			12	10				
10:15		11	6			15	9				
10:30		12	4			11	11				
10:45		18	1	50	20	21	7	59	37	109	57
11:00		19	3			17	7				
11:15		11	5			16	7				
11:30		11	5			13	4				
11:45		13	0	54	13	20	0	66	18	120	31
<b>Total</b>		<b>253</b>	<b>787</b>			<b>339</b>	<b>888</b>			<b>592</b>	<b>1675</b>
<b>Percent</b>		<b>24.3%</b>	<b>75.7%</b>			<b>27.6%</b>	<b>72.4%</b>			<b>26.1%</b>	<b>73.9%</b>
<b>Grand Total</b>		<b>253</b>	<b>1361</b>			<b>339</b>	<b>1562</b>			<b>592</b>	<b>2923</b>
<b>Percent</b>		<b>15.7%</b>	<b>84.3%</b>			<b>17.8%</b>	<b>82.2%</b>			<b>16.8%</b>	<b>83.2%</b>
<b>ADT</b>		<b>ADT 2,267</b>				<b>ADT 2,267</b>					

Latitude: 0' 0.000 South

Start Time	03-Feb-10 Wed	EB		Hour Totals		WB		Hour Totals		Combined Totals	
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
12:00		*	*			*	*				
12:15		*	*			*	*				
12:30		*	*			*	*				
12:45		*	*	0	0	*	*	0	0	0	0
01:00		*	*			*	*				
01:15		*	*			*	*				
01:30		*	*			*	*				
01:45		*	*	0	0	*	*	0	0	0	0
02:00		*	*			*	*				
02:15		*	*			*	*				
02:30		*	*			*	*				
02:45		*	*	0	0	*	*	0	0	0	0
03:00		*	*			*	*				
03:15		*	*			*	*				
03:30		*	*			*	*				
03:45		*	*	0	0	*	*	0	0	0	0
04:00		*	*			*	*				
04:15		*	*			*	*				
04:30		*	*			*	*				
04:45		*	*	0	0	*	*	0	0	0	0
05:00		*	*			*	*				
05:15		*	*			*	*				
05:30		*	*			*	*				
05:45		*	*	0	0	*	*	0	0	0	0
06:00		*	*			*	*				
06:15		*	11			*	11				
06:30		*	6			*	7				
06:45		*	9	0	26	*	15	0	33	0	59
07:00		*	10			*	5				
07:15		*	4			*	3				
07:30		*	4			*	3				
07:45		*	5	0	23	*	7	0	18	0	41
08:00		*	10			*	3				
08:15		*	4			*	6				
08:30		*	5			*	4				
08:45		*	4	0	23	*	0	0	13	0	36
09:00		*	4			*	2				
09:15		*	6			*	6				
09:30		*	2			*	2				
09:45		*	3	0	15	*	2	0	12	0	27
10:00		*	1			*	3				
10:15		*	3			*	3				
10:30		*	3			*	1				
10:45		*	1	0	8	*	1	0	8	0	16
11:00		*	1			*	3				
11:15		*	1			*	3				
11:30		*	1			*	0				
11:45		*	1	0	4	*	1	0	7	0	11
Total		0	99			0	91			0	190
Percent		0.0%	100.0%			0.0%	100.0%			0.0%	100.0%

Latitude: 0' 0.000 South

Start Time	04-Feb-10 Thu	EB		Hour Totals		WB		Hour Totals		Combined Totals	
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
12:00		2	2			1	3				
12:15		1	9			2	4				
12:30		1	7			0	9				
12:45		0	4	4	22	0	6	3	22	7	44
01:00		0	8			3	5				
01:15		0	1			1	3				
01:30		0	4			0	4				
01:45		0	3	0	16	0	3	4	15	4	31
02:00		0	6			0	6				
02:15		2	4			0	5				
02:30		2	8			0	6				
02:45		1	8	5	26	1	8	1	25	6	51
03:00		0	9			1	9				
03:15		0	3			0	6				
03:30		0	9			0	5				
03:45		0	4	0	25	0	13	1	33	1	58
04:00		3	12			0	10				
04:15		0	9			0	8				
04:30		0	9			0	6				
04:45		1	6	4	36	1	8	1	32	5	68
05:00		0	3			1	3				
05:15		0	13			0	9				
05:30		2	10			3	8				
05:45		3	3	5	29	2	6	6	26	11	55
06:00		2	6			1	5				
06:15		2	*			2	*				
06:30		1	*			3	*				
06:45		7	*	12	6	3	*	9	5	21	11
07:00		10	*			10	*				
07:15		9	*			7	*				
07:30		13	*			7	*				
07:45		9	*	41	0	12	*	36	0	77	0
08:00		12	*			11	*				
08:15		7	*			8	*				
08:30		2	*			4	*				
08:45		2	*	23	0	2	*	25	0	48	0
09:00		2	*			2	*				
09:15		2	*			4	*				
09:30		5	*			5	*				
09:45		3	*	12	0	3	*	14	0	26	0
10:00		5	*			9	*				
10:15		5	*			5	*				
10:30		6	*			2	*				
10:45		1	*	17	0	5	*	21	0	38	0
11:00		4	*			4	*				
11:15		7	*			3	*				
11:30		6	*			7	*				
11:45		5	*	22	0	2	*	16	0	38	0
Total		145	160			137	158			282	318
Percent		47.5%	52.5%			46.4%	53.6%			47.0%	53.0%
Grand Total		145	259			137	249			282	508
Percent		35.9%	64.1%			35.5%	64.5%			35.7%	64.3%
ADT		ADT 790		AADT 790							





TABLE 4A

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

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

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

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

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



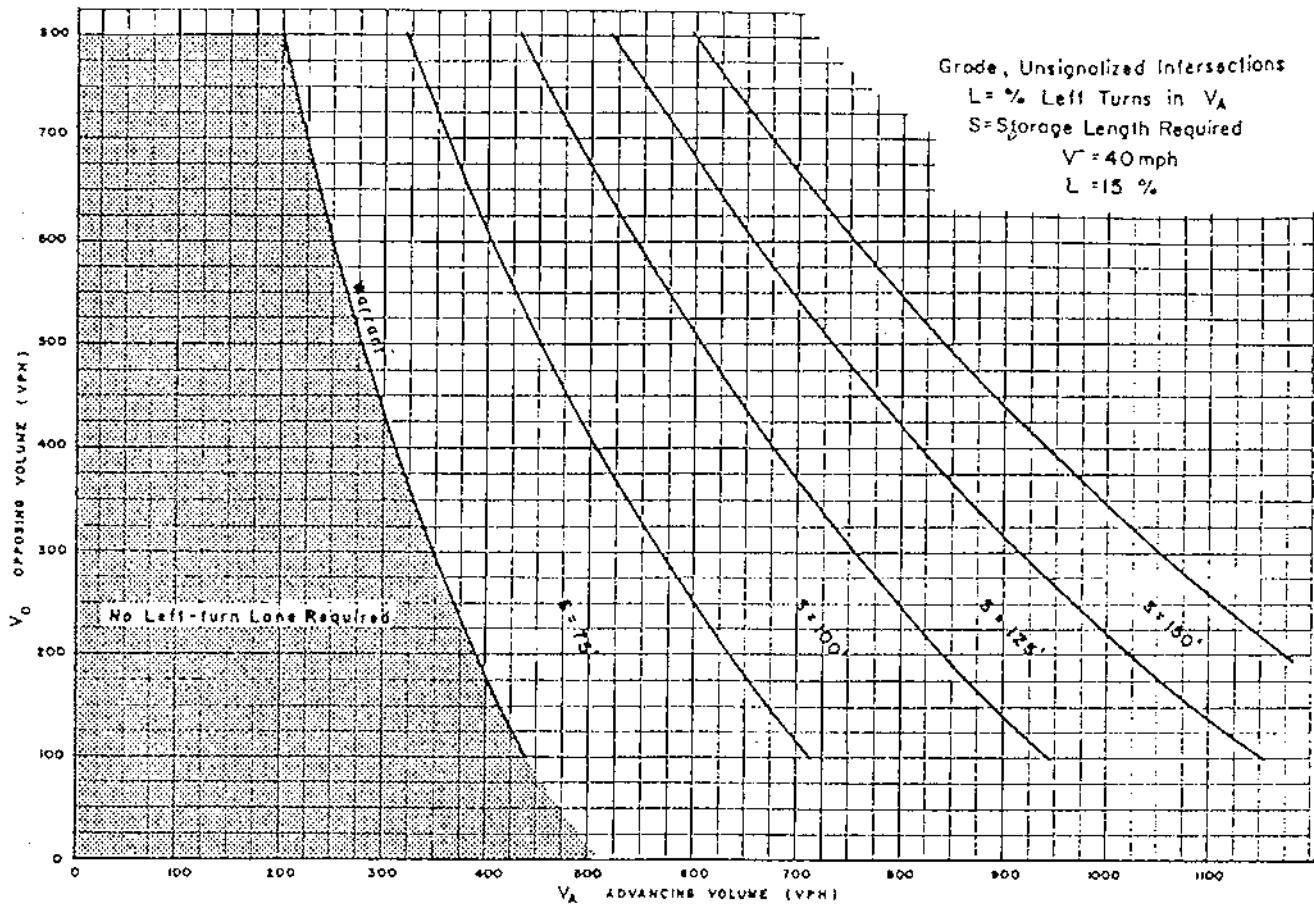


Figure 4. Warrant for left-turn storage lanes on two-lane highways.

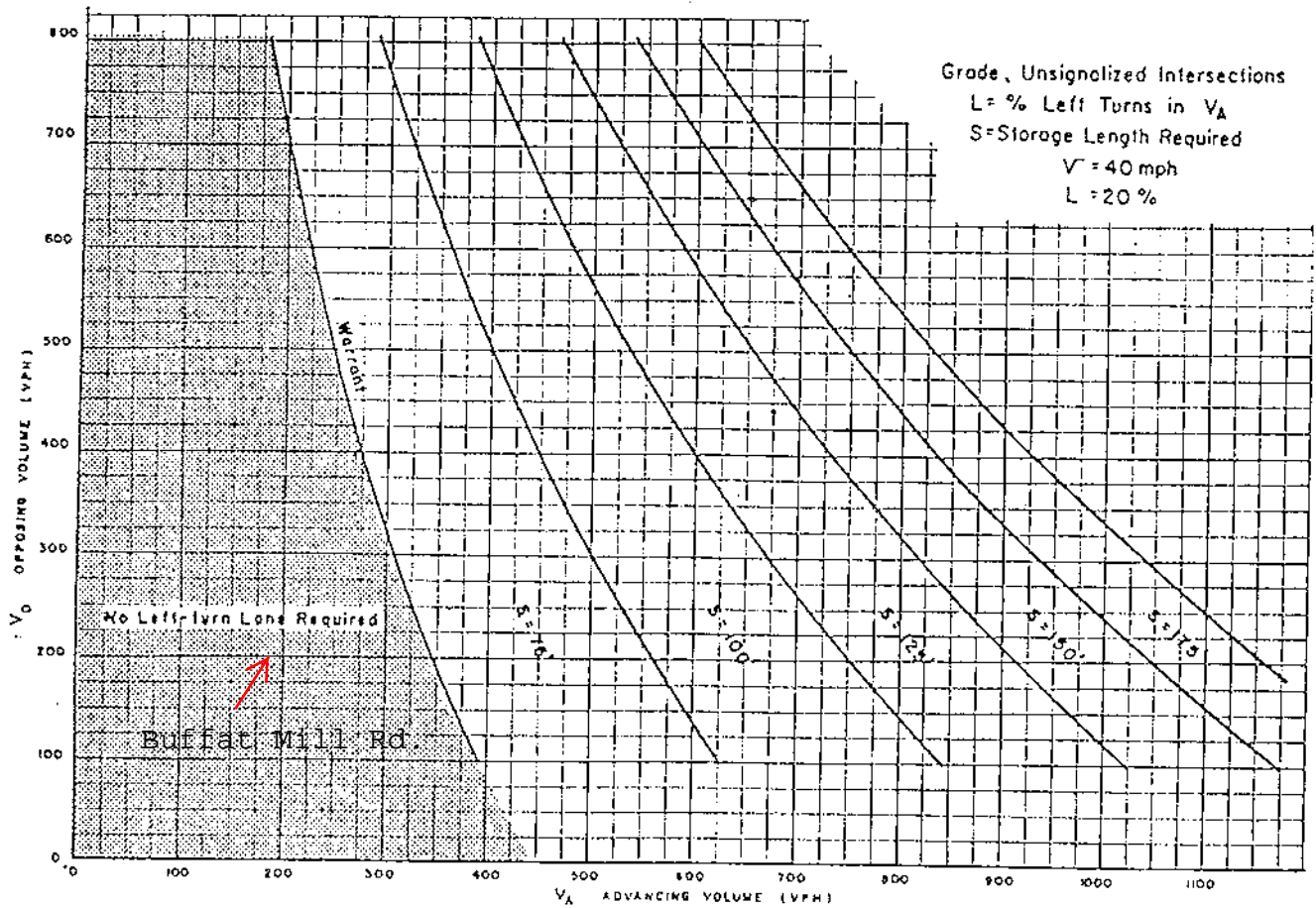


Figure 5. Warrant for left-turn storage lanes on two-lane highways.

TABLE 4A

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

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

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

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

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



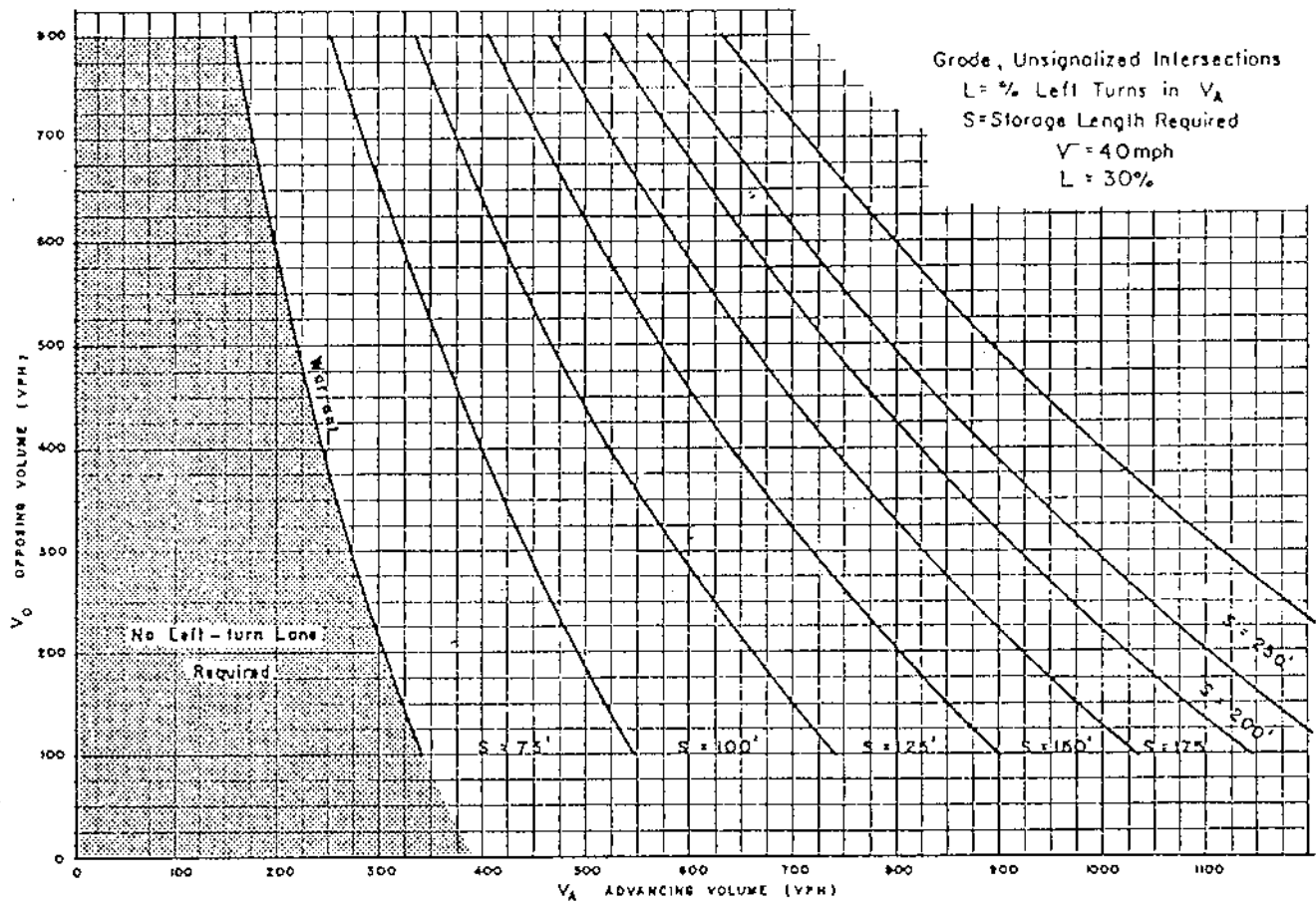


Figure 6. Warrant for left-turn storage lanes on two-lane highways.

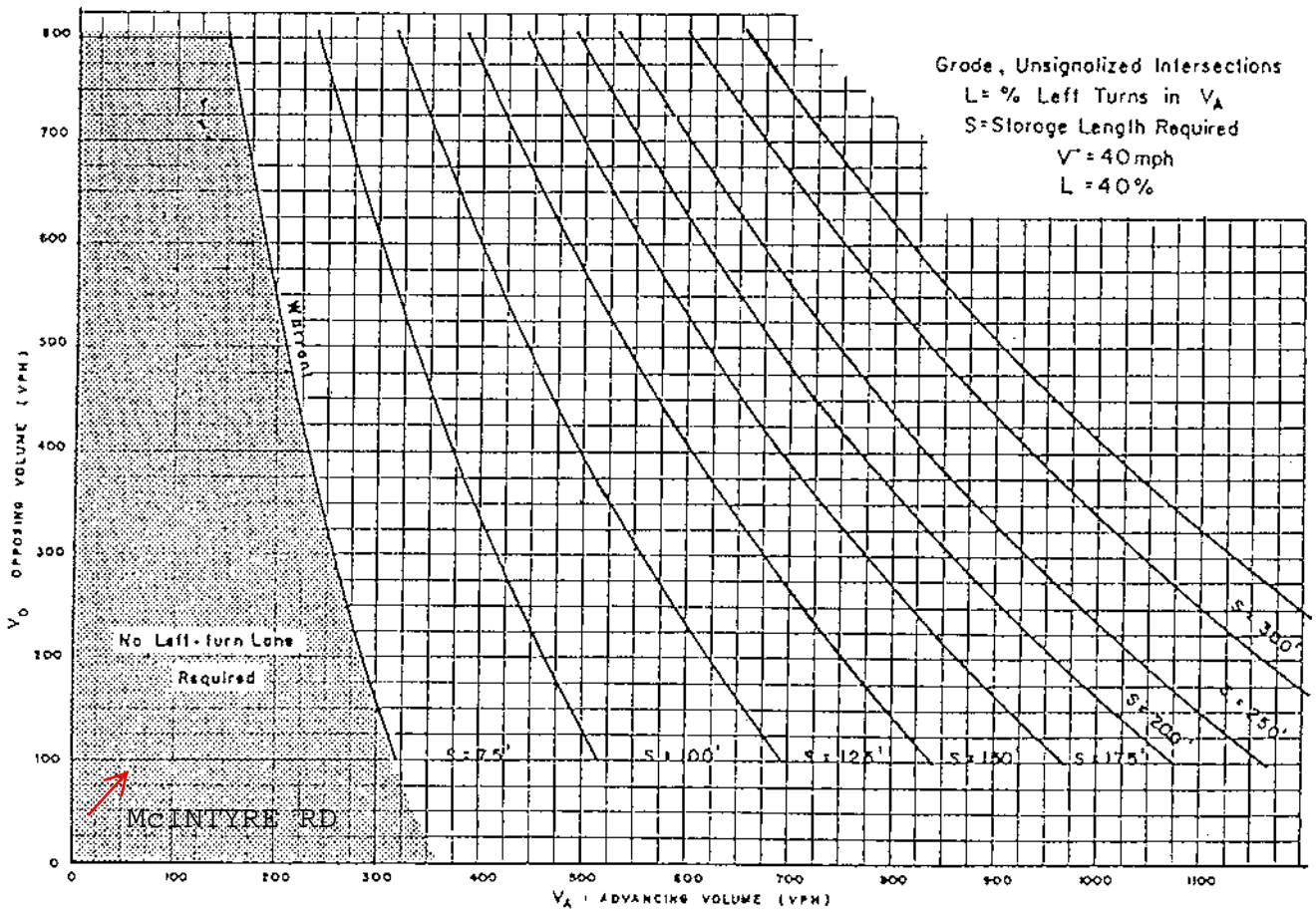


Figure 7. Warrant for left-turn storage lanes on two-lane highways.

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

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

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

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

