POST OAK BEND SUBDIVISION

KNOXVILLE, TENNESSEE

TRAFFIC IMPACT STUDY

Submitted to:

Safe Harbor Development

June 2018

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Submitted by:

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Introduction

Post Oak Bend, LLC. is proposing a residential development, Post Oak Bend Subdivision, off Tooles Bend Road positioned between I-140 (Pellissippi Parkway) and Fort Loudon Lake in southwest Knox County. This study also included analysis of a separate 48-unit single family component on a triangle shaped 16-acre parcel of land along Tooles Bend Road southeast of Tedford Lane. Those 48 lots are not part of the initial development submitted in the conceptual drawing for Use on Review but are included in the analysis to ensure recommended improvements have considered all planned development for the study area. Buildout of the development is anticipated to be 2028 but will ultimately be dictated by the residential market.

Site Plan and Proposed Development

Figure 1 illustrates the site plan for Post Oak Bend Subdivision. Including the 48-single family unit lots on the west side of I-140 (as opposed to the primary development on the east side of I-140), 670 residential units are proposed with 240 being apartments in 15 "Stacked Flats" and 317 being single family units (269 east of I-140 and 48 west of I-140). Another component includes 113 executive townhomes.

Regional Setting and Daily Traffic

Post Oak Bend Subdivision will be located on Tooles Bend Road, a Knox County minor collector road with a 2016 daily traffic volume of 1,670 vehicles per day (VPD) just south of South Northshore Drive (State Route 332). CDM Smith recently collected a 24-hour count on Tooles Bend Road, south of Badgett Road with the detailed results included in the Appendix. This count indicates a daily traffic volume south of Badgett Road of 1,500 VPD. **Figure 2** depicts the vicinity map for the proposed development. Tooles Bend Road intersects and terminates at South Northshore Drive, which is a state route with a daily traffic volume of 13,859 VPD west of Tooles Bend Road (see Appendix for maps of the referenced count locations).

Motorists along Tooles Bend Road can also access South Northshore Drive via a combination of Tedford Lane and Keller Bend Road. This route is circuitous, but it leads to a signalized intersection at South Northshore Drive and Keller Bend Road.


SITE PLAN
Post Oak Bend
Subdivision
Traffic Impact Study
ENTRY FEATURE
FUTURE DEVELOPMENT AREA
HILLVIEW DRIVE
THE DENS
PELLISSIPPI PARKWAY - I-140
FUTURE DEVELOPMENT AREA
COMMUNITY CENTER
Stacked Flat Units: 240 (16 Per Building)
Villas: 71
Executive Townhomes: 113
Estate Lots: 16
Single-Family Lots: 106
Single-Family Lake-Front Lots: 76
Total Homes: 622
Pocket Park Location
Post Oak Bend
MASTER PLAN
Knoxville, Tennessee
GDC
gamble design collaborative
N

Figure 1

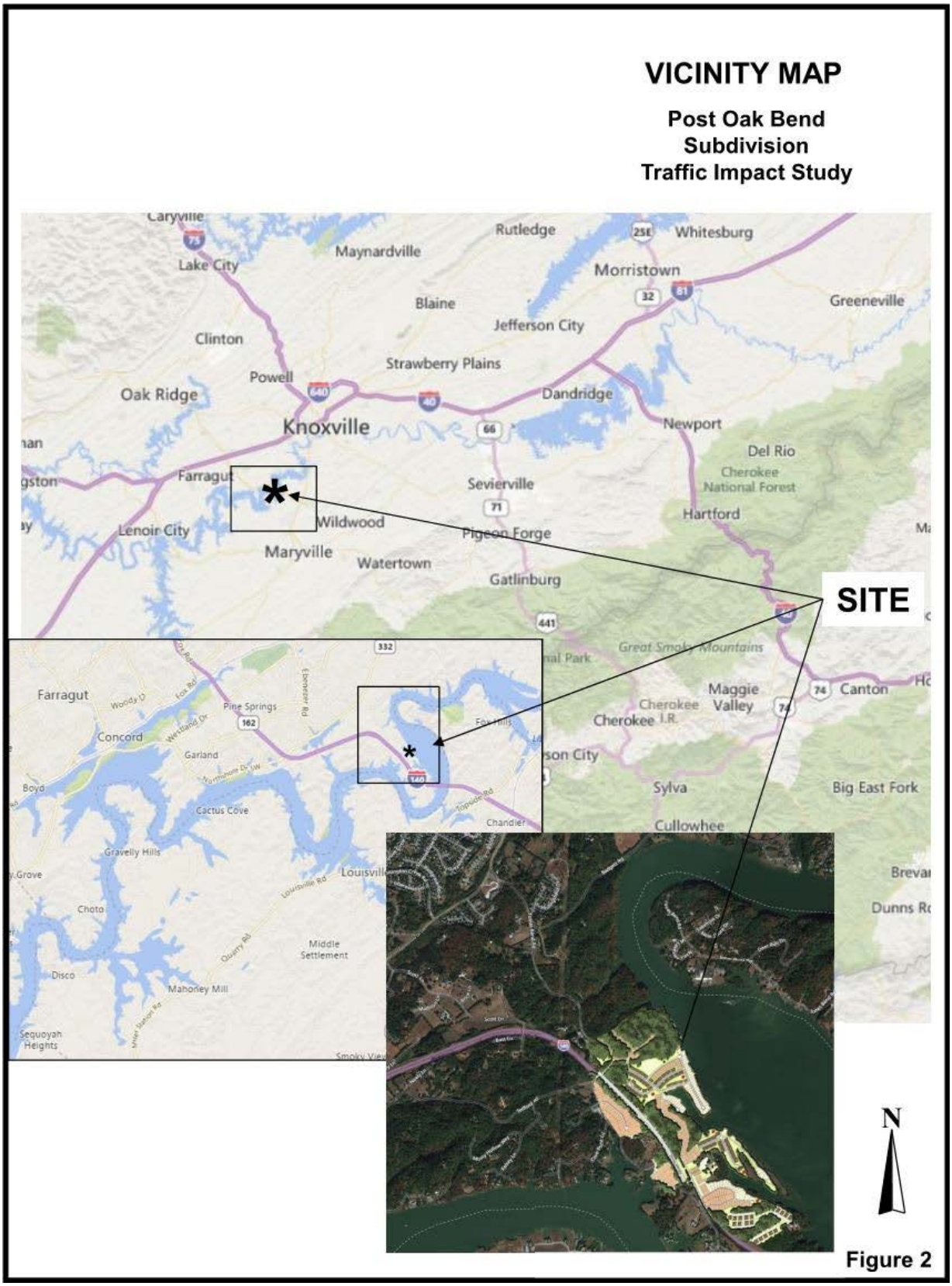

VICINITY MAP
Post Oak Bend
Subdivision
Traffic Impact Study
Caryville
Lake City
Maynardville
Rutledge
Whitesburg
Morristown
Blaine
Jefferson City
Greeneville
Clinton
Strawberry Plains
Powell
Oak Ridge
Knoxville
Dandridge
Newport
Del Rio
Cherokee National Forest
Farragut
Sevierville
Hartford
Lenoir City
Wildwood
Pigeon Forge
Maryville
Watertown
Gatlinburg
SITE
Great Smoky Mountains
Maggie Valley
Canton
Cherokee
Cherokee I.R.
Sylva
Big East Fork
Cullowhee
Pine Springs
Concord
Garland
Boyd
Cactus Cove
Gravelly Hills
Louisville
Choto
Middle Settlement
Disco
Mahoney Mill
Sequoyah Heights
Chandler
N

Figure 2

Data Collection

Intersection turning movement counts were conducted as follows:

- Tooles Bend Road at South Northshore Drive (8 hours on January 25, 2018)
- Tooles Bend Road at Badgett Road (AM and PM peak hours on January 11, 2018)
- Tooles Bend Road at Tedford Lane (AM and PM peak hours on January 11, 2018)

The mechanical 24-hour count on Tooles Bend Road, just south of Badgett Road was conducted on January 24, 2018. All counts were conducted while Knox County Schools and the University of Tennessee were in session. CDM Smith also measured sight distances and conducted an inventory of signs along Tooles Bend Road.

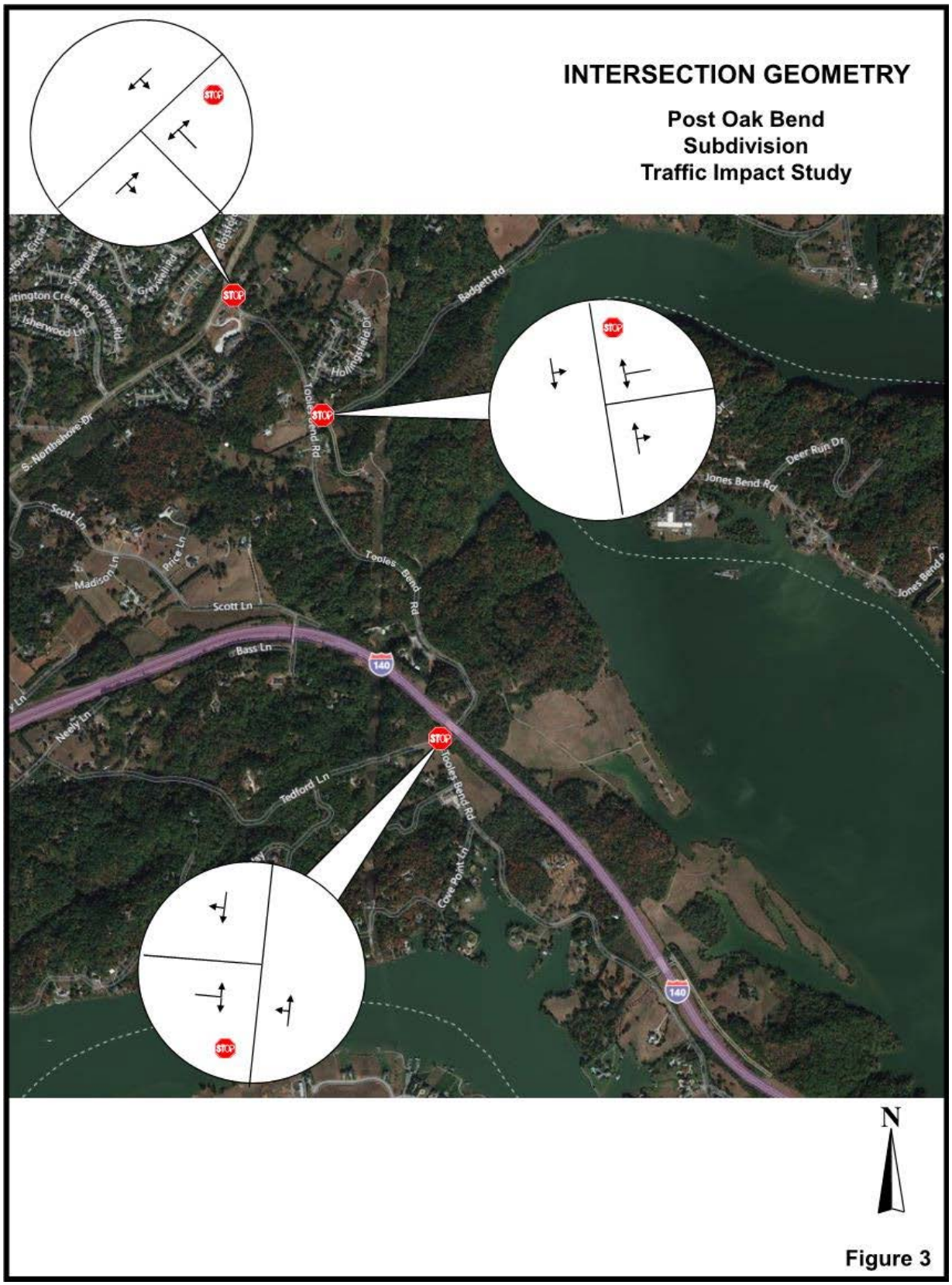
Existing Traffic Conditions

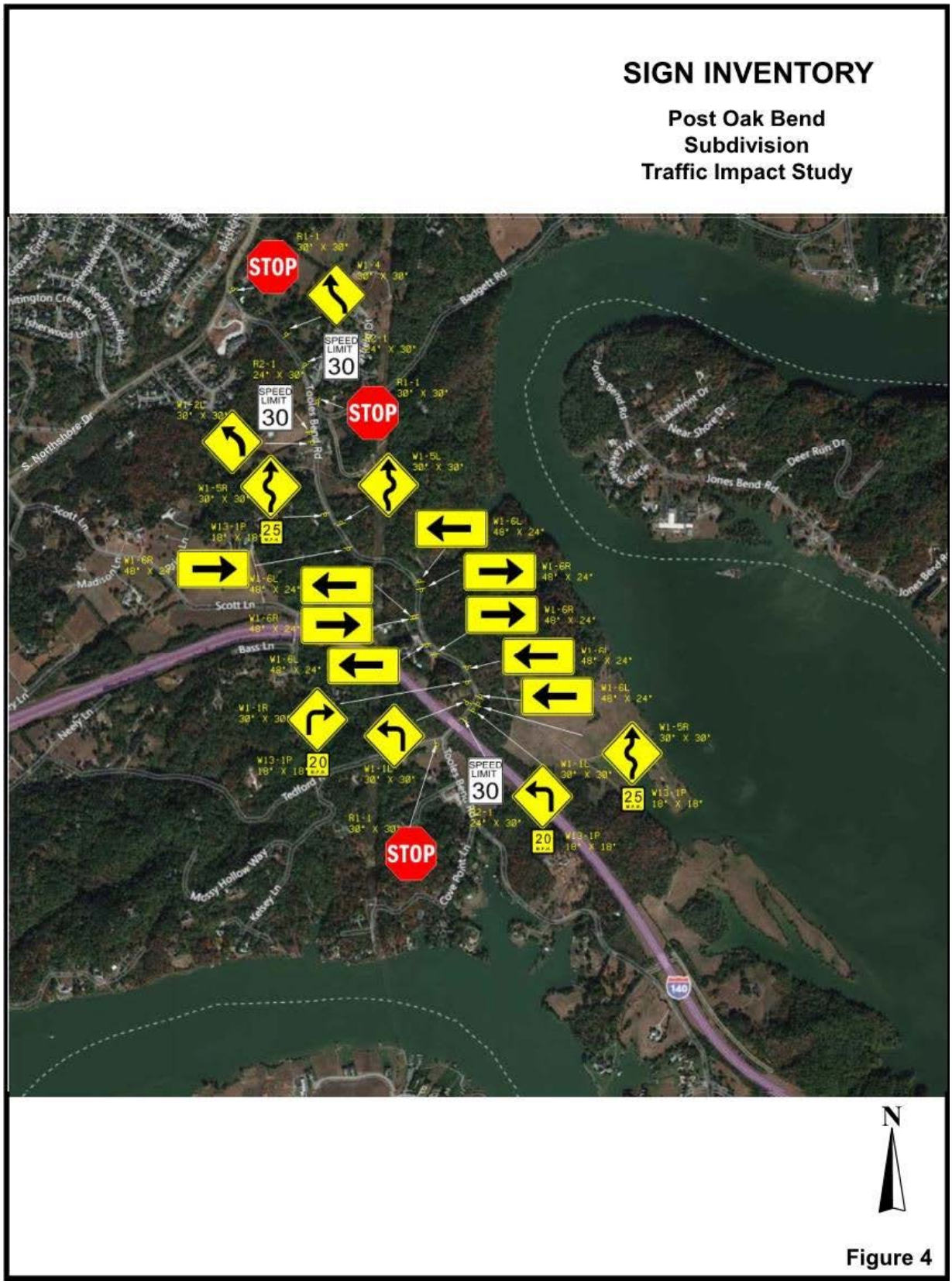
Figures 3 and **4** show existing lane geometry and traffic control devices at the study area intersections and along Tooles Bend Road. Because of horizontal curvature, there are several appropriate curve warning and arrow signs in the south section of Tooles Bend Road. The posted speed limit on Tooles Bend Road is 30 miles per hour (MPH) while the curve warnings signs note advisory speeds of 20 or 25 MPH. Using TDOT's Tennessee Roadway Information Management System Database, or TRIMS, Tooles Bend Road is noted as being 20 feet wide without shoulders. However, field measurements observed a varied road width of 17 to 20 feet along Tooles Bend Road from South Northshore Drive to the proposed southern access. It contains a double-yellow striped centerline and white edge lines on both sides, and rumble strips do not exist. Some sections of Tooles Bend Road contain guardrails, some of which are in poor condition.

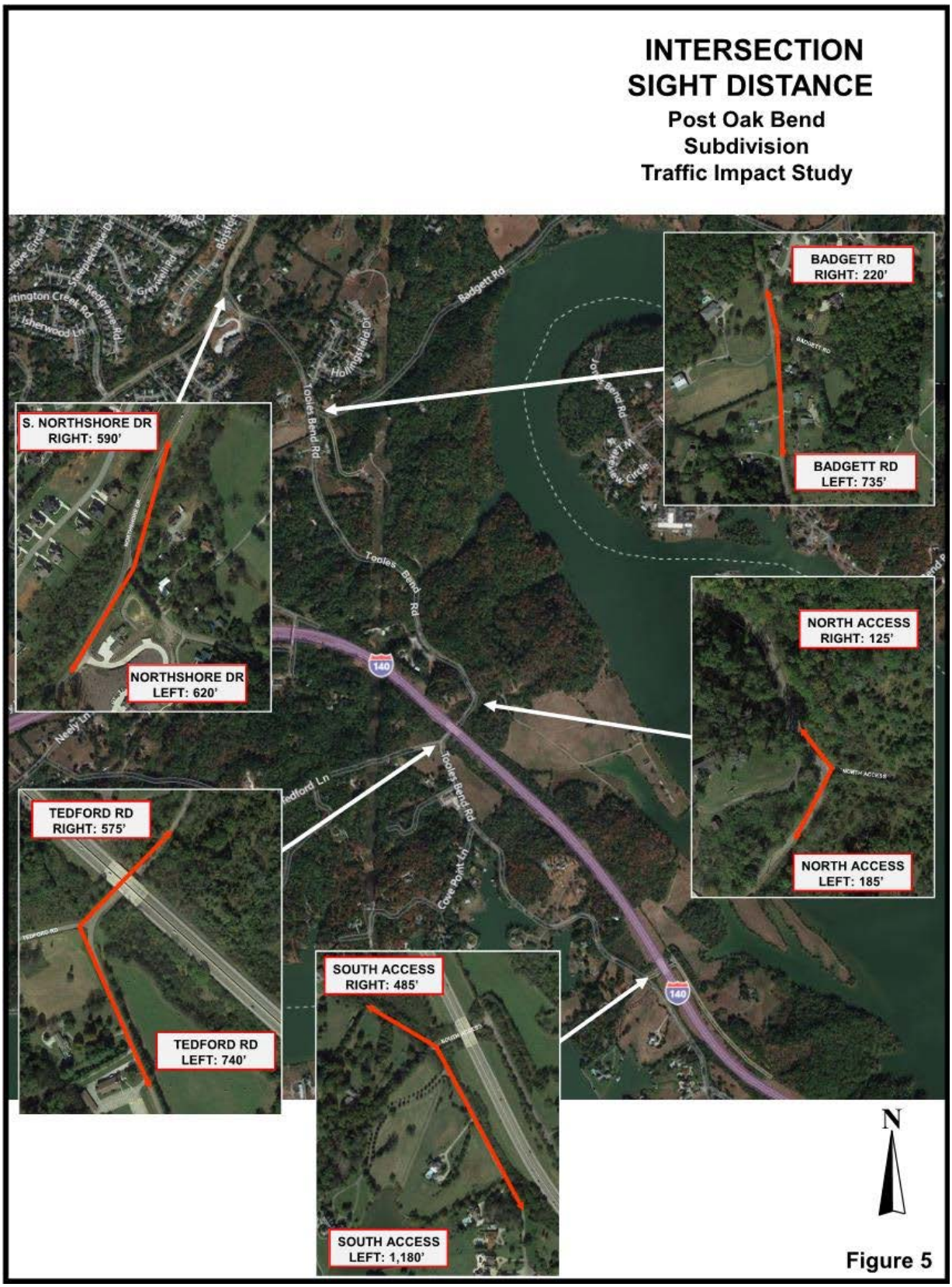
Sight Distance

Sight distance was measured at the study intersections along Tooles Bend Road and the results are depicted in **Figure 5**. With a posted speed limit of 30 MPH, the desirable intersection sight distance is 300 feet. At all existing intersections except Badgett Road, that distance is achieved. Looking right from Badgett Road, the sight distance is 220 feet due to a vertical curve. Very few vehicles were observed making a left turn from Badgett Road onto Tooles Bend Road- none in the morning observation period and three in the evening.

At the proposed north site access on Tooles Bend Road, sight distance is limited looking both left and right. Looking left, a horizontal curve restricts sight distance to 185 feet and looking right, sight distance is restricted to 125 feet due to a vertical curve. There is adequate sight distance at the proposed south site access. The developer is aware of these restrictions and is prepared to make modifications to Tooles Bend Road and the access roads to achieve adequate sight distance.


INTERSECTION GEOMETRY
Post Oak Bend
Subdivision
Traffic Impact Study
STOP
Badgett Rd
Toole's Bend Rd
Jones Bend Rd
Deer Run Dr
Scott Ln
Madison Ln
Price Ln
Bass Ln
Neely Ln
Tedford Ln
Cove Point Ln
Holmsfield Dr
S Northshore Dr
Isherwood Ln
Greystell Rd
140
N
Figure 3


SIGN INVENTORY
Post Oak Bend
Subdivision
Traffic Impact Study
STOP
SPEED LIMIT 30
Badgett Rd
Scott Ln
Bass Ln
Tedford
Mossy Hollow Way
Kelsey Ln
Cove Point Ln
Jones Bend Rd
Deer Run Dr
Near Shore Dr
Lakefront Dr
S. Northshire Dr
Madison Ln
N
Figure 4


INTERSECTION
SIGHT DISTANCE
Post Oak Bend
Subdivision
Traffic Impact Study
BADGETT RD
RIGHT: 220'
BADGETT RD
LEFT: 735'
S. NORTHSHORE DR
RIGHT: 590'
NORTHSHORE DR
LEFT: 620'
NORTH ACCESS
RIGHT: 125'
NORTH ACCESS
LEFT: 185'
TEDFORD RD
RIGHT: 575'
TEDFORD RD
LEFT: 740'
SOUTH ACCESS
RIGHT: 485'
SOUTH ACCESS
LEFT: 1,180'
Badgett Rd
Toole's Bend Rd
Holdingfield Dr
Redgrave Rd
Isherwood Ln
Neely Ln
Cove Point Ln
140
N
Figure 5

Level of Service Definition

To express traffic conditions as perceived by drivers, traffic engineering professionals utilize the concept of "level of service" (LOS). Level of service is a qualitative statement of the acceptability of traffic conditions. It reflects the additional travel time, or delay, incurred by drivers at intersections. The LOS index ranges from LOS A, indicating excellent traffic conditions with minimal delay, to LOS F indicating very congested conditions and excessive delay. LOS D is generally considered the minimum acceptable condition in urban areas. The criteria for signalized and unsignalized intersections are presented in **Table 1**.

Table 1: Level of Service Criteria

	Delay in seconds per vehicle	
	Signalized Intersections	Stop-controlled Intersections
A	≤ 10	≤ 10
B	> 10 and ≤ 20	> 10 and ≤ 15
C	> 20 and ≤ 35	> 15 and ≤ 25
D	> 35 and ≤ 55	> 25 and ≤ 35
E	> 55 and ≤ 80	> 35 and ≤ 50
F	> 80	> 50

For stop-controlled intersections, LOS is measured only for those drivers that must yield to other traffic, such as drivers entering or crossing a major road from a side-street, or major-street drivers turning left onto a side-street. For signalized intersections, the most meaningful measure is the intersection-wide LOS reflecting the average of conditions for all drivers entering the signalized intersection.

Traffic Volumes and Level of Service

Figure 6 presents existing AM and PM peak hour intersection traffic volumes and recent average daily traffic (ADT) volumes on Tooles Bend Road and neighboring streets. **Figure 7** shows the resulting existing peak hour LOS analysis using Synchro 9.1. The measured approach peak hour factor (PHF) was used in calculating the existing LOS. Peak hours for the study area intersections are:

- Tooles Bend Road at South Northshore Drive- hours beginning 7:30 AM and 5:00 PM
- Tooles Bend Road at Badgett Road- hours beginning 7:00 AM and 5:00 PM
- Tooles Bend Road at Tedford Lane- hours beginning 7:15 AM and 4:00 PM

The westbound movement from Tooles Bend Road onto South Northshore Drive operates at LOS D in both the AM and PM peak hours. All other unsignalized study area intersection movements operate at LOS A during both peak hours.

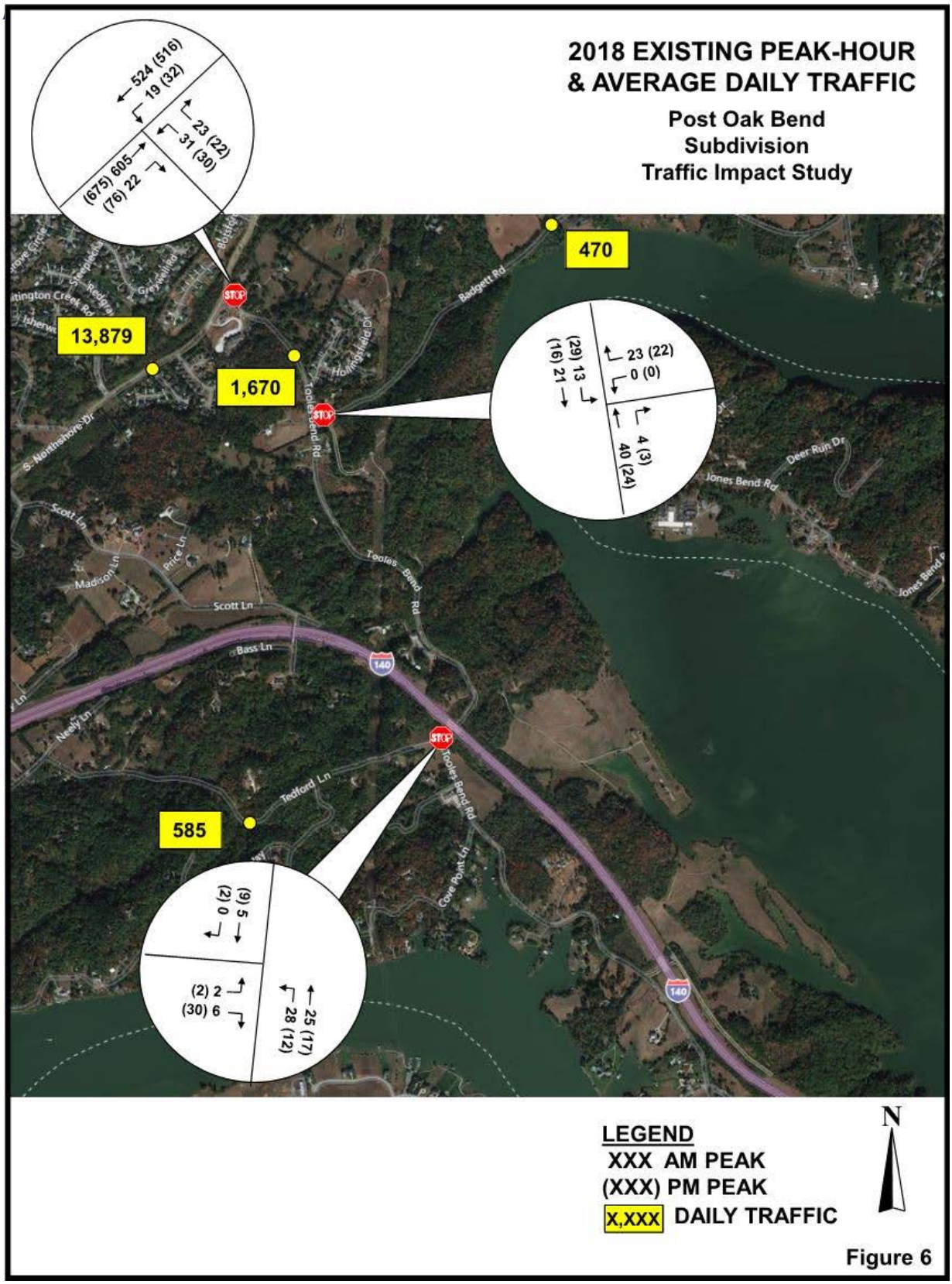

2018 EXISTING PEAK-HOUR
& AVERAGE DAILY TRAFFIC
Post Oak Bend
Subdivision
Traffic Impact Study
524 (516)
19 (32)
23 (22)
31 (30)
(675) 605
(76) 22
13,879
1,670
470
(29) 13
(16) 21
23 (22)
0 (0)
4 (3)
40 (24)
585
(9) 5
(2) 0
(2) 2
(30) 6
25 (17)
28 (12)
Badgett Rd
Toole's Bend Rd
Jones Bend Rd
Deer Run Dr
Scott Ln
Madison Ln
Price Ln
Bass Ln
Neely Ln
Tedford Ln
Cove Point Ln
S. Northshore Dr
Honeysuckle Dr
140
LEGEND
XXX AM PEAK
(XXX) PM PEAK
X,XXX DAILY TRAFFIC
N

Figure 6

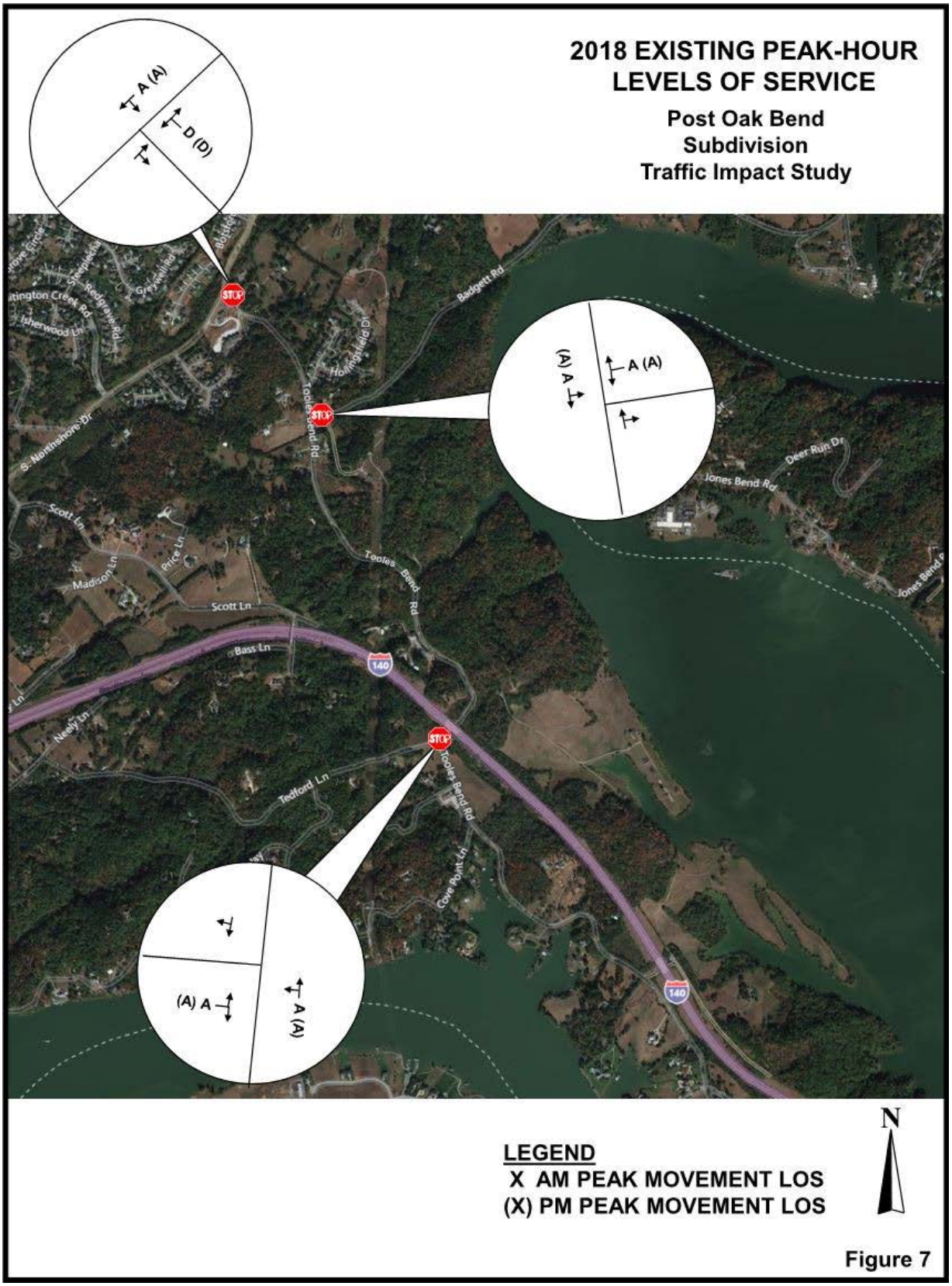

2018 EXISTING PEAK-HOUR
LEVELS OF SERVICE
Post Oak Bend
Subdivision
Traffic Impact Study
A (A)
D (D)
(A) A
A (A)
(A) A
A (A)
STOP
Badgett Rd
Tooles Bend Rd
Jones Bend Rd
Deer Run Dr
Scott Ln
Price Ln
Madison Ln
Bass Ln
Neely Ln
Tedford Ln
Cove Point Ln
S Northshore Dr
Greenfield
Sherwood Ln
140
LEGEND
X AM PEAK MOVEMENT LOS
(X) PM PEAK MOVEMENT LOS
N

Figure 7

Existing Traffic Signal Warrant Analysis- Tooles Bend Road at South Northshore Drive

A traffic signal warrant evaluation was conducted at the intersection of South Northshore Drive and Tooles Bend Road using criteria in Federal Highway Administration's (FHWA) Manual on Uniform Traffic Control Devices (MUTCD). Specifically, three traffic volume warrants were evaluated including:

- Warrant 1- 8- Hour Vehicular Volume; Part A: Minimum Volume and Part B: Interruption
- Warrant 2- 4- Hour Vehicular Volume
- Warrant 3- Peak Hour

Current volumes at the intersection of South Northshore Drive and Tooles Bend Road do not meet the criteria for a traffic signal. The traffic signal warrant assessment table is in the Appendix. The main street volumes on South Northshore Drive are all above the criteria for all warrants but the volumes on Tooles Bend Road fall well below the thresholds.

Crash Data and Knox County Strategic Safety Plan

In three consecutive years from 2014-2016, Knox County undertook a strategic safety plan to evaluate their major and minor collector and minor arterial roads in terms of crashes and daily traffic thresholds. The 2016 study, which was published in 2017, was supplemented with an evaluation of state routes. Tooles Bend Road is a minor collector and South Northshore Drive is a state route, hence both were part of the 2016 study.

The 1.26-mile segment of Tooles Bend Road had 10 crashes reported in the four years between 2012 and 2015 with seven being property damage only and three resulting in non-disabling injuries. The final 2016 crash score was 0.673, which ranked 318th of 554; hence, the segment ranked very low in terms of a safety problem relative to other roads in Knox County. All but 2 of the 10 crashes occurred north of Badgett Road, and most were lane departures.

Segment 9165 on South Northshore Drive (SR 332) is 0.42 miles long and falls between Little Creek Lane and a point east of Tooles Bend Road. This segment of SR 332 experienced 18 crashes in the four-year reporting period with 14 of those being property damage only, 2 resulting in non-disabling injuries, and 2 resulting in disabling injuries. The crash score for this segment of South Northshore Drive was 0.816, which ranked 79th of 198 for the state route segments evaluated. The Appendix includes excerpts from the 2016 safety study related to the Tooles Bend Road and South Northshore Drive assessments.

Chapter 2- Future Conditions without Development

This chapter describes the analysis of 2028 projected conditions without buildout of Post Oak Bend Subdivision, also known as background conditions. It includes a 2028 LOS analysis and a 2028 Tooles Bend Road at South Northshore Drive traffic signal warrant analysis without the proposed development.

Projected 2028 Traffic Growth without Development

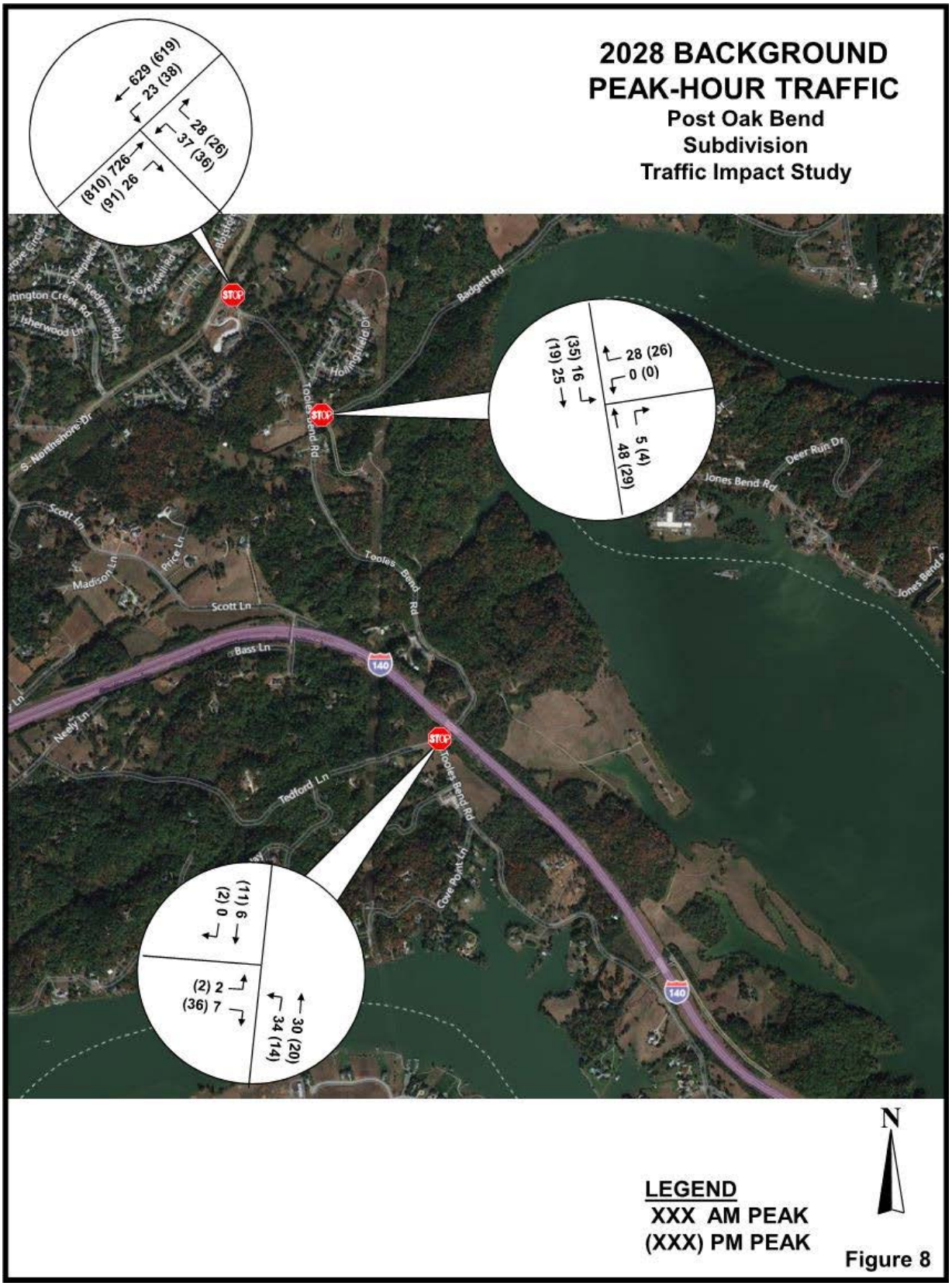
Historic traffic volumes at TDOT Station T287 on South Northshore Drive and MPC Station M264 on Tooles Bend Road were examined to estimate future traffic growth up to 2028. The Appendix includes the location of the two count stations and past daily traffic volumes. Traffic has maintained constant at Station T287 with volumes ranging from 13,161 in 2001 to 13,879 in 2016. Station M264 has sporadic data dating back to 2001, with counts made every other year from 2001 to 2009, but a count was made in 2016 with a recorded volume of 1,670 VPD. Ultimately, a two-percent annual simple growth rate was applied to all movements at all intersections. Thus, for the 2028 traffic projections, a 1.20 growth factor was applied to existing traffic volumes. The argument could be made that Post Oak Bend Subdivision would account for the majority of traffic growth on Tooles Bend Road, and consequently, traffic should not be factored up by 1.20; however, it is more conservative from an analysis standpoint to apply this growth rate to traffic on Tooles Bend Road.

AM and PM Peak Hour 2028 Traffic Volumes and LOS

Figure 8 illustrates projected year 2028 background traffic volumes for the study area intersections. **Figure 9** depicts the projected 2028 LOS's. All movements that now operate at LOS A should continue to operate at LOS A in 2028. Traffic movements from Tooles Bend Road onto South Northshore Drive will worsen from LOS D in both peak hours to LOS E in the AM peak hour and LOS F in the PM peak hour.

2028 Background Traffic Signal Warrant Analysis- Tooles Bend Road at South Northshore Drive

A traffic signal warrant analysis was performed at the Tooles Bend Road and South Northshore Drive intersection using 2028 projected background traffic- the 20-percent rate was applied to all volumes for the 8-hour evaluation period. Traffic on Tooles Bend Road will not meet the criteria to warrant a traffic signal, but the South Northshore Drive traffic continues to exceed the threshold. Even though the LOS's on Tooles Bend Road will worsen to E and F, a traffic signal will not be warranted. The Appendix includes the 2028 background signal warrant analysis assessment table.


2028 BACKGROUND
PEAK-HOUR TRAFFIC
Post Oak Bend
Subdivision
Traffic Impact Study
629 (619)
23 (38)
28 (26)
37 (36)
(810) 726
(91) 26
(35) 16
(19) 25
28 (26)
0 (0)
5 (4)
48 (29)
(11) 6
(2) 0
(2) 2
(36) 7
34 (14)
30 (20)
STOP
Badgett Rd
Tooles Bend Rd
Holingsfield Dr
S. Northshore Dr
Scott Ln
Price Ln
Madison Ln
Bass Ln
Neely Ln
Tedford Ln
Cove Point Ln
Deer Run Dr
Jones Bend Rd
140
N
LEGEND
XXX AM PEAK
(XXX) PM PEAK
Figure 8

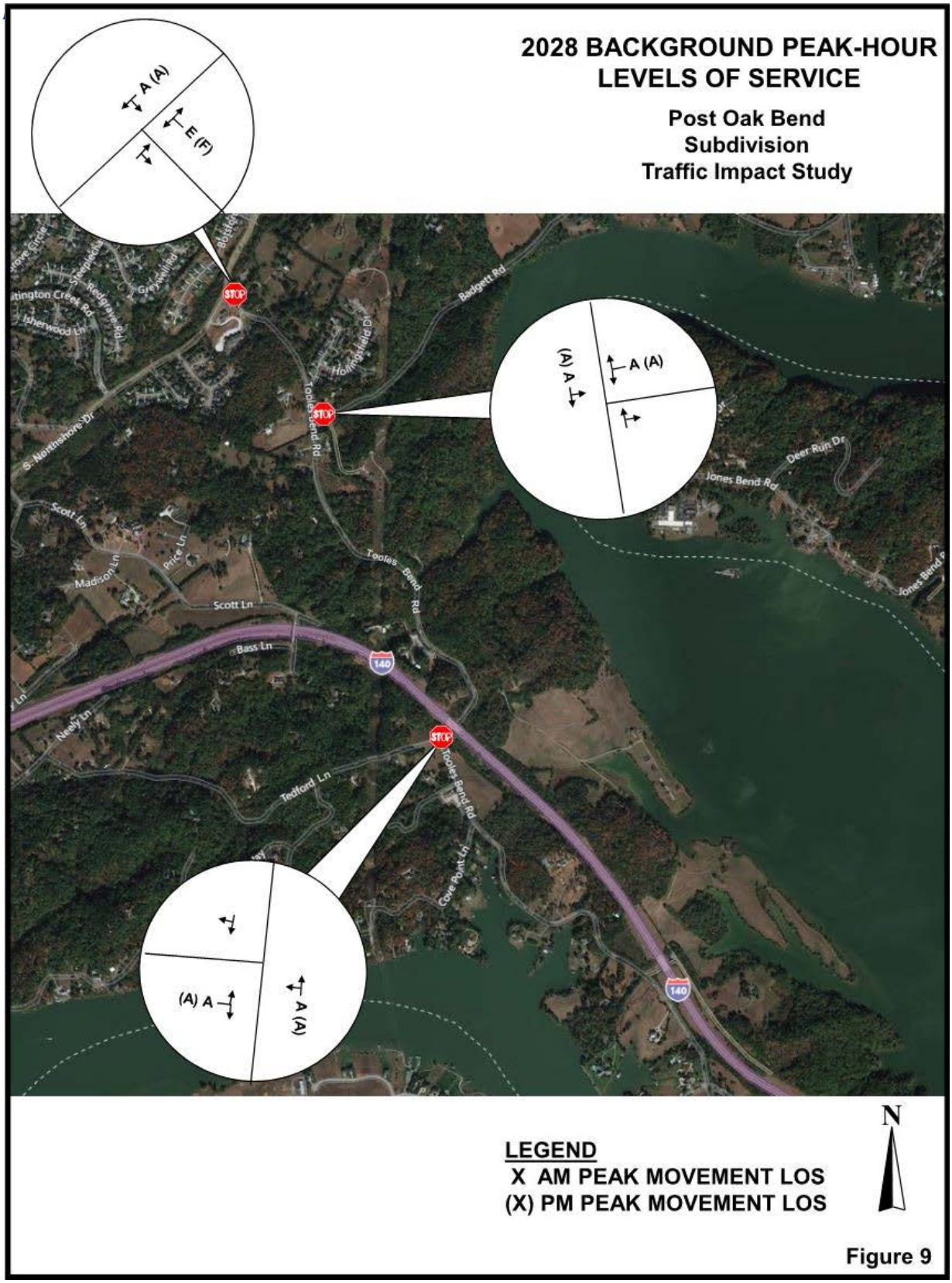

2028 BACKGROUND PEAK-HOUR
LEVELS OF SERVICE
Post Oak Bend
Subdivision
Traffic Impact Study
A (A)
E (F)
(A) A
A (A)
(A) A
A (A)
STOP
Badgett Rd
Tooles Bend Rd
Jones Bend Rd
Deer Run Dr
Scott Ln
Madison Ln
Price Ln
Bass Ln
Neely Ln
Tedford Ln
Cove Point Ln
140
LEGEND
X AM PEAK MOVEMENT LOS
(X) PM PEAK MOVEMENT LOS
N

Figure 9

Chapter 3- Development Impact

This chapter describes the traffic Post Oak Bend Subdivision will generate and its impacts on the street network.

Trip Generation

Table 2 presents the expected trip generation of Post Oak Bend Subdivision. Based on discussions with the developer, CDM Smith took the development descriptions and interpreted the Institute of Transportation Engineers (ITE) Trip Generation Manual category. For example, the single-family lots, villas, and estate lots are classified as single family homes and the executive town homes are classified as residential condominiums or townhomes. Note that 48 single family lots are proposed west of I-140 and would be separate from the primary development and are not part of the conceptual plan submitted for Use on Review. Fifteen "Stacked Flats" are proposed with 16 units per building resulting in 240 total units. Based on the description, CDM Smith categorized these buildings as apartments. For the apartment trips, the MPC trip generation rates were used instead of the ITE Trip Generation Manual rates. The Appendix has copies of the ITE and MPC Trip Generation pages referenced for the applicable residential land uses.

At buildout, Post Oak Bend Subdivision should generate nearly 5,960 daily trips with 418 occurring in the AM peak hour and 547in the PM peak hour. The AM peak hour should realize very directional traffic with 77 percent departing the development. It will be less directional in the PM peak hour with 61 percent oriented towards the development.

Table 2 : Trip Generation

				DAILY			AM PEAK HOUR			PM PEAK HOUR		
LAND USE CODE	RESIDENTIAL TYPE	DEVELOPMENT DESCRIPTION	UNITS	In	Out	Total	In	Out	Total	In	Out	Total
MPC	Apartments	Stacked Flats	240	1,048	1,048	2,096	26	94	120	94	77	171
210	Single Family	Single Family Lots, Villas, & Estate Lots	269	1,305	1,305	2,610	50	149	198	161	95	256
230	Condo/Townhouse	Executive Townhomes	113	358	358	715	10	47	57	45	22	66
Subtotal			**622**	**2,711**	**2,711**	**5,422**	**86**	**289**	**375**	**300**	**193**	**493**
210	Single Family	Off-Site Future Developed Homesites	48	267	267	535	11	33	43	34	20	54
Total			**670**	**2,978**	**2,978**	**5,956**	**96**	**322**	**418**	**334**	**214**	**547**

Sources: ITE Trip Generation, 9th Edition and Knoxville-Knox County MPC

Anticipated Trip Distribution Pattern

Based on current peak hour traffic patterns, the anticipated traffic distribution pattern is illustrated in **Figure 10** and summarized as follows:

- South on South Northshore Drive - 55 percent
- North on South Northshore Drive- 35 percent
- Tedford Lane/Keller Bend Road - 5 percent
- Badgett Road- 5 percent

CDM Smith considered the likelihood of Post Oak Bend Subdivision traffic using Tedford Lane and Keller Bend Road to reach South Northshore Drive. Keller Bend Road at South Northshore Drive is a signalized intersection and this route is being used today by Tooles Bend Road traffic south of Tedford Lane. A travel time survey was performed to support the traffic assignment decision

between using Tooles Bend Road or Tedford Lane and Keller Bend Road to access South Northshore Drive. The results of the travel time survey are:

- Tedford Lane to Keller Bend Road to the intersection of South Northshore Drive and Keller Bend Road: 4 minutes 30 seconds
- Tooles Bend Road to southbound South Northshore Drive to the intersection of South Northshore Drive and Keller Bend Road: 5 minutes 30 seconds

These times exclude any signal delay at the intersection of Keller Bend Road and South Northshore Drive and left turn stop delay at the intersection of Tooles Bend Road at South Northshore Drive.

CDM Smith chose to go against the trend exhibited with today's traffic patterns and assigned five percent of the Post Oak Bend Subdivision trips to Tedford Lane. The reasons are: 1) a left turn is required from the north development access road onto Tooles Bend Road to access Tedford Lane, which is reverse of the intended direction, 2) Tooles Bend Road at South Northshore Drive will need to be improved with either a signal or roundabout upon buildout and should attract traffic, and 3) the travel time difference between Tedford Lane and Tooles Bend is negligible.

The majority of new trips on Tedford Lane was assumed to originate and be destined to the southern site access to avoid left-turn conflicts. Therefore, of the five percent of anticipated trips using Tedford Lane, 75-percent were assumed to use the southern access and the remaining 25-percent to the north access.

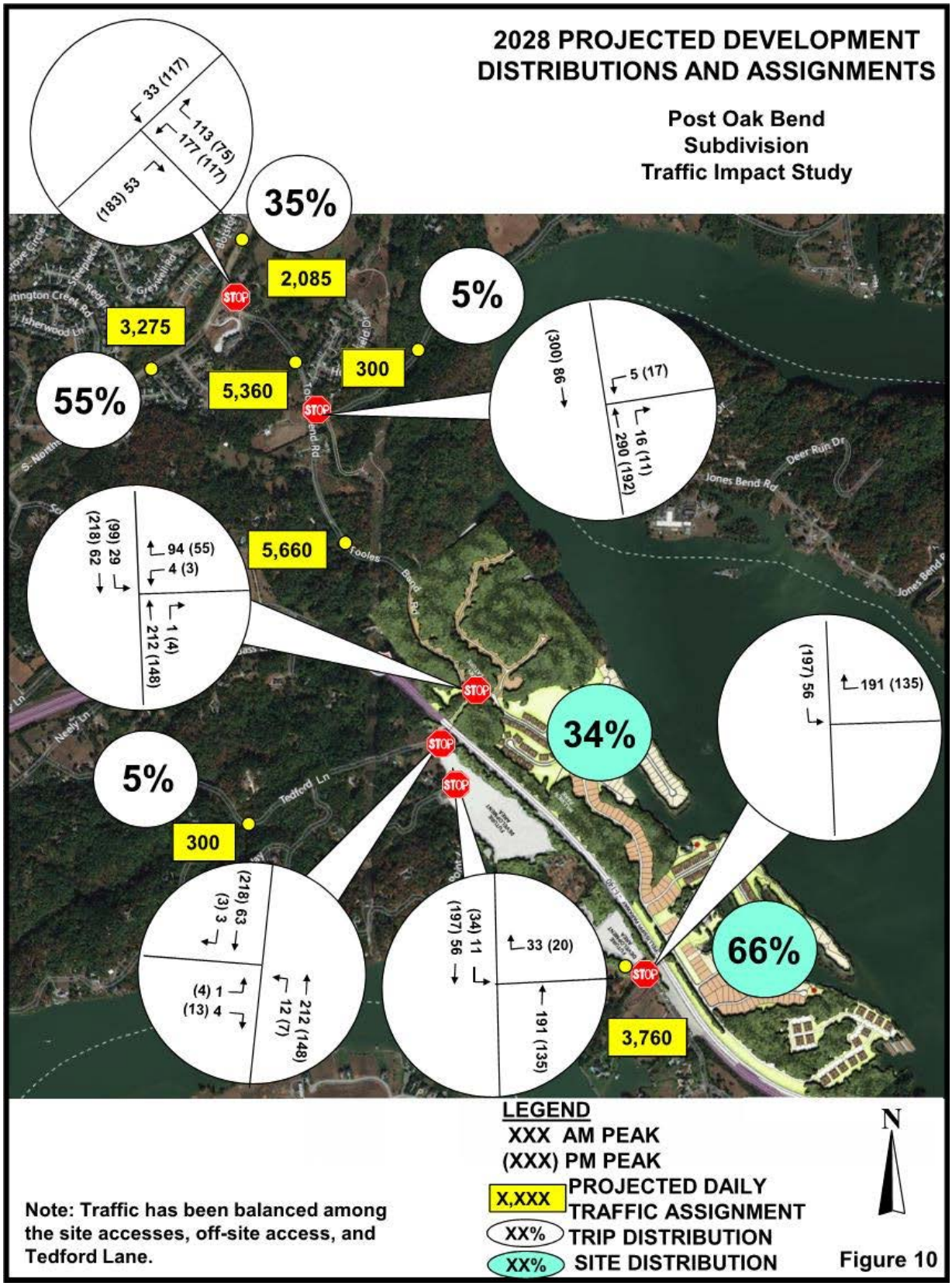
Additionally, the subdivision trips were distributed to either the north or south access based on the location of the residence as shown in the site plan. For example, all of the Stacked Flats are located in the southernmost part of the development; therefore, all trips to and from the Stacked Flats were assigned to use the south access. For the remaining single-family lots and townhome lots that are dispersed throughout the development, a 50-50 split of trips was determined. This results in 34 percent of traffic to the subdivision using the north access and 66 percent using the south access.

Daily Traffic Assignment

A daily traffic assignment of the Post Oak Bend Subdivision trips suggests that Tooles Bend Road will realize a 5,360 to 5,660 daily traffic volume increase. Figure 10 also includes the daily traffic assignment.

Peak Hour Traffic Assignment

The AM and PM peak hour traffic assignments shown in Figure 10 reflect the aforementioned distribution pattern. Today, traffic from Tooles Bend Road favors turning left onto South Northshore Drive versus right by a 60 to 40 ratio. Most of that traffic is probably oriented to I-140 or commercial development near the interchange.


2028 PROJECTED DEVELOPMENT
DISTRIBUTIONS AND ASSIGNMENTS
Post Oak Bend
Subdivision
Traffic Impact Study
35%
2,085
3,275
55%
5,360
5%
300
(300) 86
5 (17)
16 (11)
290 (192)
5,660
(99) 29
(218) 62
94 (55)
4 (3)
1 (4)
212 (148)
34%
(197) 56
191 (135)
5%
300
(218) 63
(3) 3
(4) 1
(13) 4
212 (148)
12 (7)
(34) 11
(197) 56
33 (20)
191 (135)
66%
3,760
LEGEND
XXX AM PEAK
(XXX) PM PEAK
X,XXX PROJECTED DAILY TRAFFIC ASSIGNMENT
XX% TRIP DISTRIBUTION
XX% SITE DISTRIBUTION
N
Note: Traffic has been balanced among the site accesses, off-site access, and Tedford Lane.
Figure 10

2028 Peak Hour Traffic and LOS with Development

Post Oak Bend Subdivision traffic was superimposed on year 2028 background traffic and the results are shown in **Figure 11**. The resulting LOS's are shown in **Figure 12**. All of the study area intersections, except Tooles Bend Road at South Northshore Drive, should continue to operate with acceptable LOS's. This includes the site access road junctions with Tooles Bend Road. At the intersection of Tooles Bend Road and South Northshore Drive, the westbound movement should operate at LOS F in the AM and PM peak hours with several minutes of delay expected. For analysis purposes, separate left and right turn lanes were analyzed to isolate where the delay is worst, and predictably, the right turn would operate at acceptable delays and the left turn would experience excessively long delays (several minutes). The unsignalized movement LOS/ delay values are unreliable when they are excessive, in part because drivers tend to take more risks when they experience long delays.

Tooles Bend Road Segment Assessment

CDM Smith's 24-hour count on Tooles Bend Road, south of Badgett Road, recorded 1,500 VPD on January 24, 2018. At 20-percent growth, the daily traffic should increase to approximately 1,800 VPD by year 2028. Post Oak Bend Subdivision will generate approximately 5,660 trips per day on Tooles Bend Road at buildout, so the total daily traffic on Tooles Bend Road should reach 7,460 VPD. A summary of projected daily traffic on Tooles Bend Road is as follows:

- Existing: 1,500 VPD
- Background traffic growth: 300 VPD
- Post Oak Bend Subdivision traffic: 5,660 VPD
- Total: 7,460 VPD

In Knox County's Strategic Safety Plan, a Minimum Standard Line (MSL) concept was introduced to help evaluate road segments for operation and safety. The MSL is not a LOS or capacity concept, but rather a road segment scoring component associated with the idea that heavily traveled roads should ideally be wider. The line is primarily linear and is a relationship between road width and daily traffic. In the studies for the Safety Plan, two points were added to the overall score of a segment when the segment's ADT was above the listed value for its width and the initial crash score was equal to or greater than 1.5. For a 17-20-foot wide road like Tooles Bend Road, the MSL ADT value ranges from 1,000 to 4,000 VPD.

From a planning level capacity standpoint, it is the opinion of CDM Smith that Tooles Bend Road can accommodate more than 4,000 VPD, with perhaps 9,000 VPD being a good approximation of the operating threshold. The exact value is hard to quantify because little research has been conducted on the capacity of facilities like Tooles Bend Road As reported in Chapter 2, the 2016 Tooles Bend Road crash score was 0.673 and obviously 2 points were not added because the ADT was 1,670 and the crash score was less than 1.5. With the added traffic, it is not appropriate to add 2 points to the current crash score of 0.673 since the crash score is below the 1.5 threshold. Additionally, an increase in daily traffic would change the initial crash score because the exposure rate would increase. It is important to note that Tooles Bend Road will experience more traffic as a result of Post Oak Bend Subdivision, so some safety enhancements are desirable.

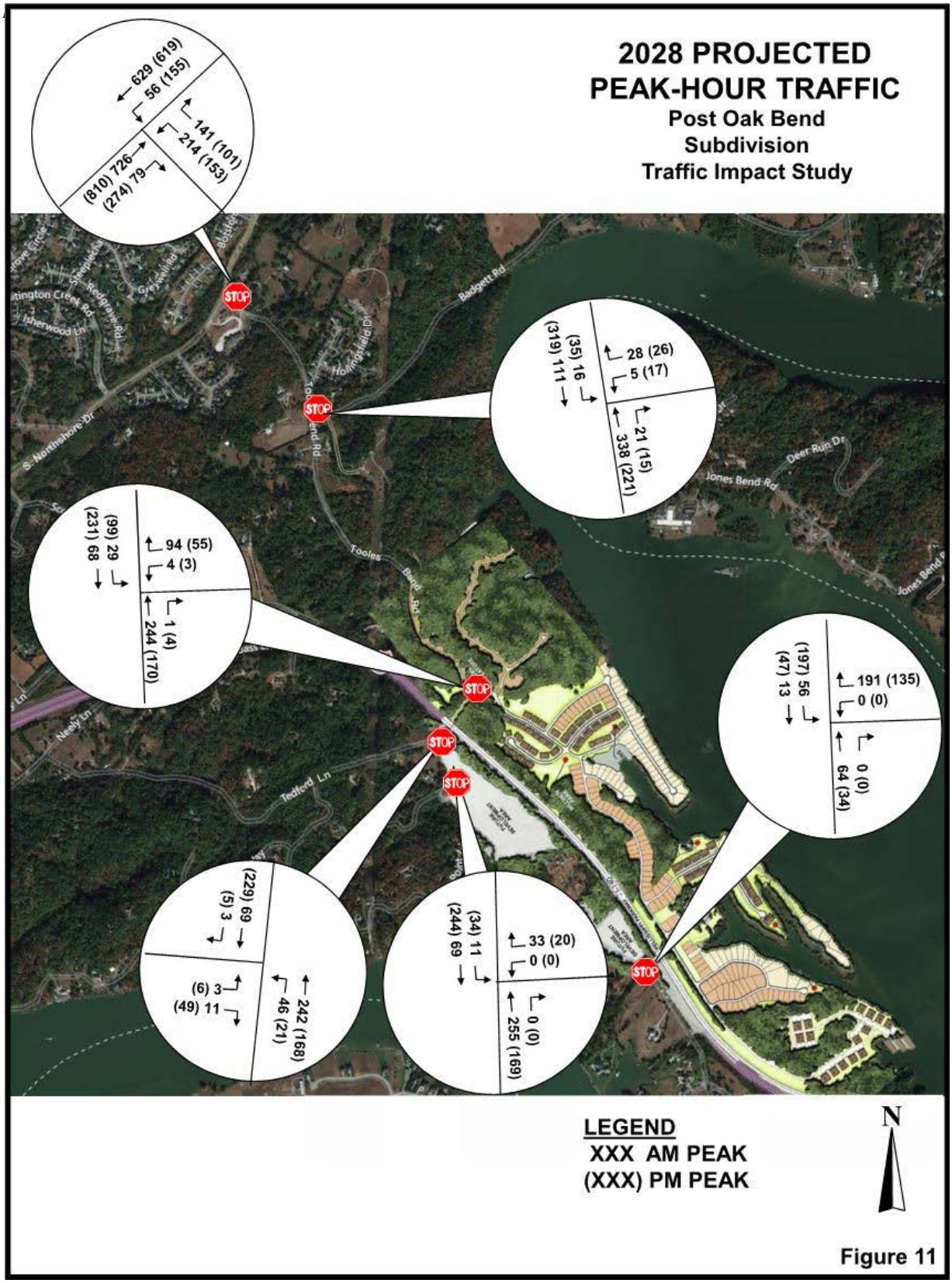
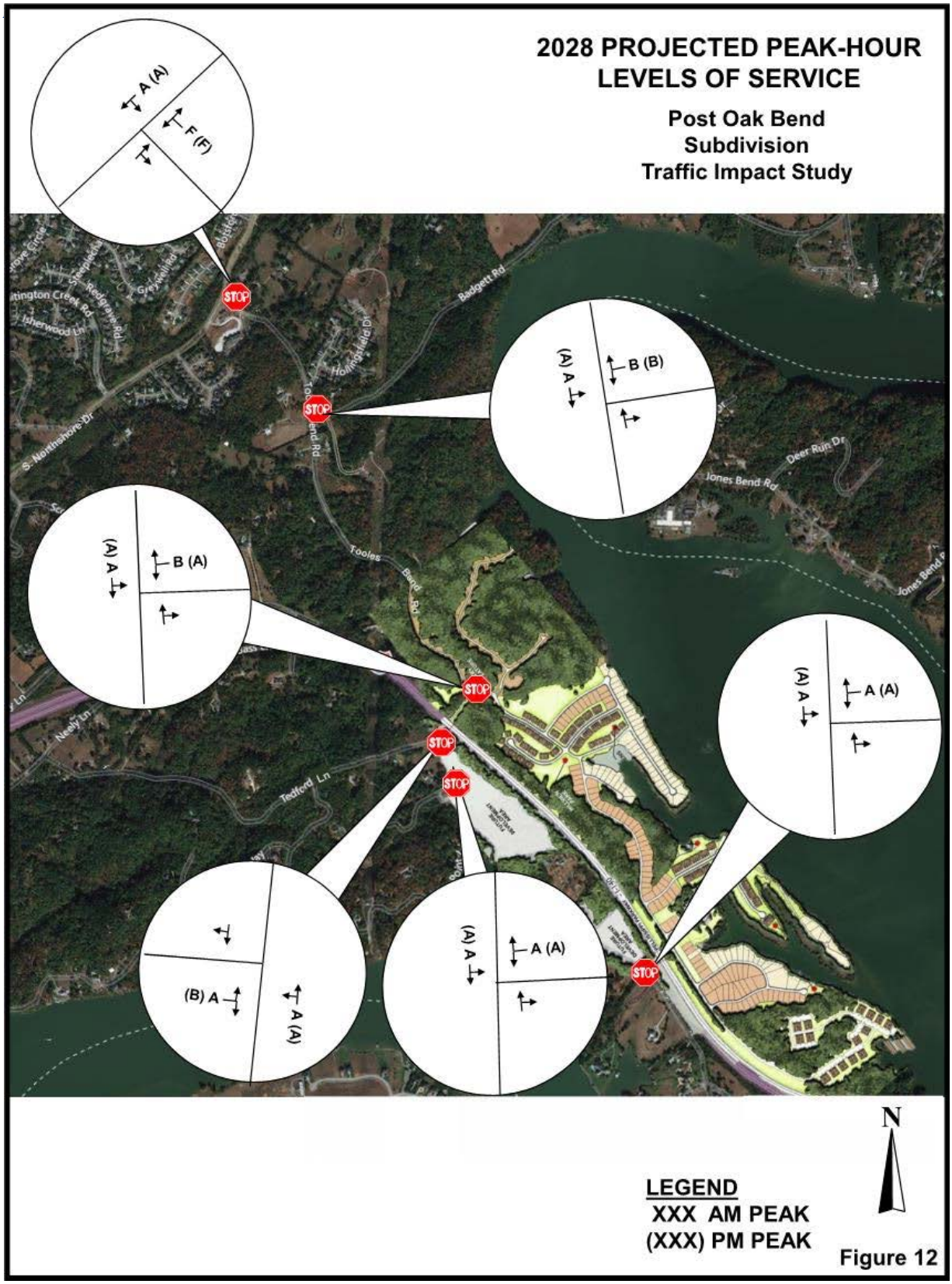

2028 PROJECTED
PEAK-HOUR TRAFFIC
Post Oak Bend
Subdivision
Traffic Impact Study
629 (619)
56 (155)
141 (101)
214 (153)
(810) 726
(274) 79
(35) 16
(319) 111
28 (26)
5 (17)
21 (15)
338 (221)
(99) 29
(231) 68
94 (55)
4 (3)
1 (4)
244 (170)
(197) 56
(47) 13
191 (135)
0 (0)
0 (0)
64 (34)
(229) 69
(5) 3
(6) 3
(49) 11
242 (168)
46 (21)
(34) 11
(244) 69
33 (20)
0 (0)
0 (0)
255 (169)
STOP
Badgett Rd
Jones Bend Rd
Deer Run Dr
Toole Bend Rd
Tooles Bend Rd
Tedford Ln
Neely Ln
Greywall Rd
Sheepfield Dr
Redgrave Rd
Isherwood Ln
S. Northshore Dr
LEGEND
XXX AM PEAK
(XXX) PM PEAK
N

Figure 11


2028 PROJECTED PEAK-HOUR
LEVELS OF SERVICE
Post Oak Bend
Subdivision
Traffic Impact Study
A (A)
F (F)
B (B)
(A) A
B (A)
(A) A
A (A)
(A) A
(B) A
A (A)
(A) A
A (A)
STOP
Badgett Rd
Jones Bend Rd
Deer Run Dr
Tooles Bend Rd
Tedford Ln
Neely Ln
S. Northshore Dr
Greywall Rd
Redgrave Rd
Isherwood Ln
N
LEGEND
XXX AM PEAK
(XXX) PM PEAK
Figure 12

CDM Smith

2028 Projected Traffic Signal Warrant Analysis- Tooles Bend Road at South Northshore Drive

To reevaluate the need for a traffic signal at the intersection of South Northshore Drive at Tooles Bend Road, year 2028 traffic generated by Post Oak Bend Subdivision was projected for the hours of 7:00 to 9:00 AM, 11:00 to 1:00 PM, and 2:00 to 6:00 PM using the trip generation estimates previously discussed and the projected turning movement volumes at South Northshore Drive and Tooles Bend Road. These calculations are included in the Appendix. By year 2028, Warrants 1 (A and B), 2, and 3 should be met.

Figure 13 illustrates the anticipated projected LOS's with the added turn lanes and signalization at South Northshore Drive and Tooles Bend Rd. The overall intersection is expected to improve to LOS B in the AM peak hour and LOS C in the PM peak hour.

CDM Smith conducted additional analysis to determine when the traffic signal would be warranted, or when the development will generate enough traffic to meet the traffic signal warrant criteria. The analysis assumed a linear relationship between project development and buildout years. For example, 50% of the project development was assumed to be completed halfway to the projected completion year. This analysis indicated a traffic signal at the intersection of South Northshore Drive and Tooles Bend Road would be warranted by year 2022, or with 40% of the development constructed, and meets Warrants 1B, 2, and 3. The signal warrant assessment table for this projected condition is located in the Appendix.

2028 Roundabout Analysis- Tooles Bend Road at South Northshore Drive

To mitigate anticipated year 2028 delays and poor LOS's, a roundabout was considered in the second iteration of this study for the Tooles Bend Road at South Northshore Drive intersection. In the initial roundabout analysis contained in the previous version of this study dated June 2018, the SIDRA software produced unexpected results when a northbound right turn bypass lane was contemplated. Adding a northbound right turn bypass lane to South Northshore Drive caused the Tooles Bend Road approach LOS to worsen. This occurred because of the gap acceptance formula in SIDRA that credits right turning traffic in a roundabout to create gaps. Hence, at this intersection, removing the northbound right turn traffic from the roundabout decreased the gaps in the northbound flow that right turn traffic on Tooles Bend Road would use to enter the roundabout.

The unexpected SIDRA results from the previous study prompted CDM Smith to analyze the subject intersection with three different roundabout software packages and eight total versions:

- SIDRA with HCM 6 Methodology
- SIDRA with Standard Capacity Model (SIDRA Standard)
- SIDRA with HCS 2010
- HCS 7.5 with HCM 6 Methodology
- HCS 2010
- Synchro 10 with HCS 2010
- Synchro 10 with HCM 6 Methodology

- SimTraffic 2010

A comparison of the software package results from the previous version of this study is tabulated in the Appendix. Year 2028 AM and PM peak hour volumes at South Northshore Drive and Tooles Bend Road were analyzed as a roundabout intersection without and with a northbound South Northshore Drive right turn bypass lane. As the reader can see from the table, SIDRA with HCM 6 methodology generates some outlying results when analyzing the right turn bypass lane option.

This report includes updated development land use, and the roundabout LOS analysis was rerun with the up-to-date traffic volumes. However, CDM Smith did not rerun the roundabout analysis using all of the software versions mentioned in the preceding paragraph. Instead, and as a result of the extensive examination of the software packages, CDM Smith limited its most recent analysis to SIDRA using the 2010 HCM methodology.

Conclusions that can be reached from the roundabout analysis include:

- Northbound South Northshore Drive will operate at LOS F in the 2028 PM peak hour
- A northbound bypass lane is needed to mitigate the LOS F
- With a northbound bypass lane, the overall intersection LOS is C in the AM and D in the PM using HCS 2010

Figure 14 illustrates the anticipated projected LOS's with a roundabout and northbound bypass right turn lane at South Northshore Drive and Tooles Bend Road with HCS 2010 results.

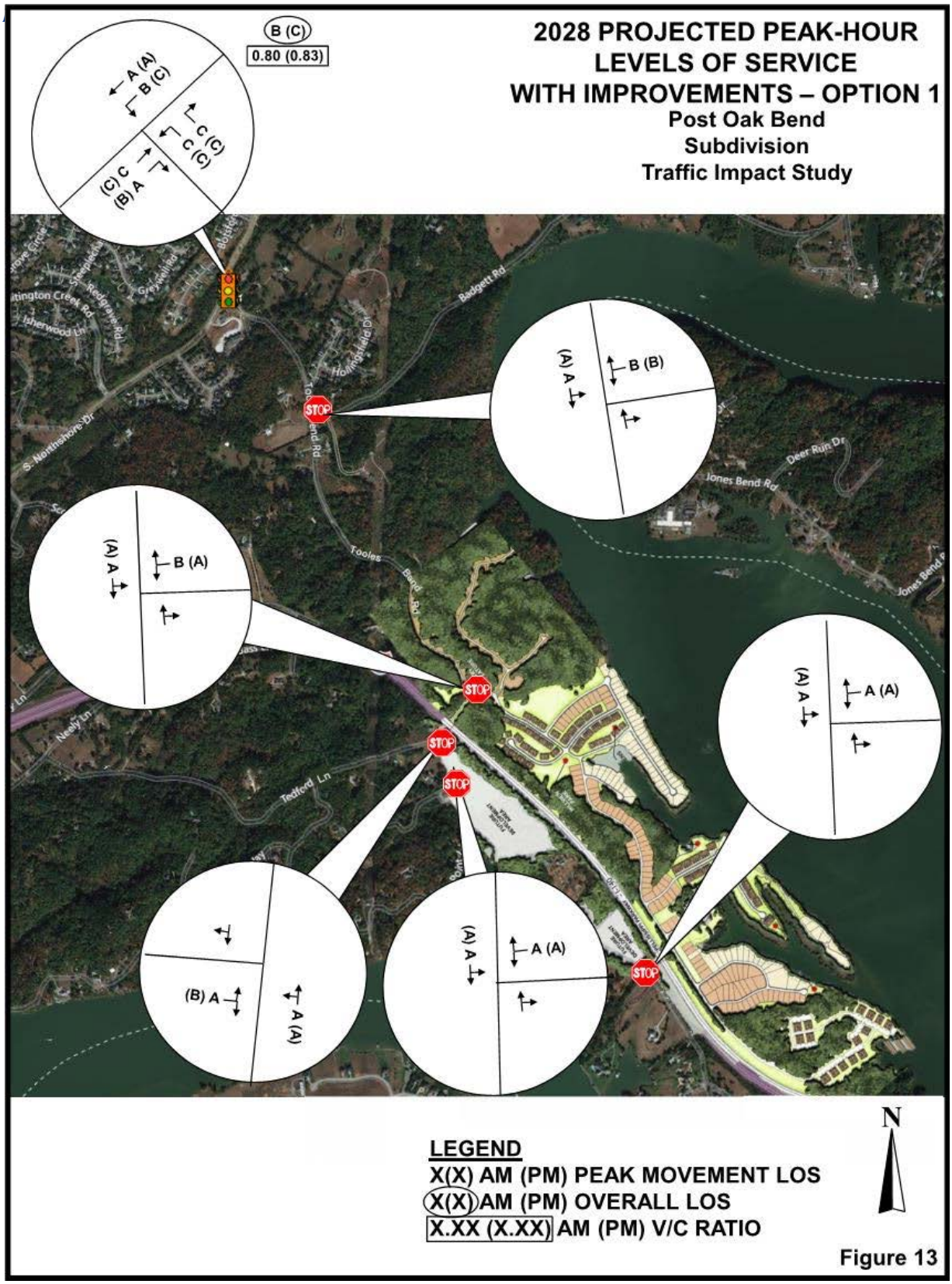

2028 PROJECTED PEAK-HOUR
LEVELS OF SERVICE
WITH IMPROVEMENTS – OPTION 1
Post Oak Bend
Subdivision
Traffic Impact Study
B (C)
0.80 (0.83)
A (A)
B (C)
C (C)
C (C)
(C) C
(B) A
(A) A
B (B)
(A) A
B (A)
(A) A
A (A)
(B) A
A (A)
(A) A
A (A)
STOP
Badgett Rd
Jones Bend Rd
Deer Run Dr
Tooles Bend Rd
Tedford Ln
Neely Ln
S. Northshore Dr
Isherwood Ln
Redgrave Rd
Greydelrid
Hollingsfield Dr
LEGEND
X(X) AM (PM) PEAK MOVEMENT LOS
(X(X)) AM (PM) OVERALL LOS
[X.XX (X.XX)] AM (PM) V/C RATIO
N

Figure 13

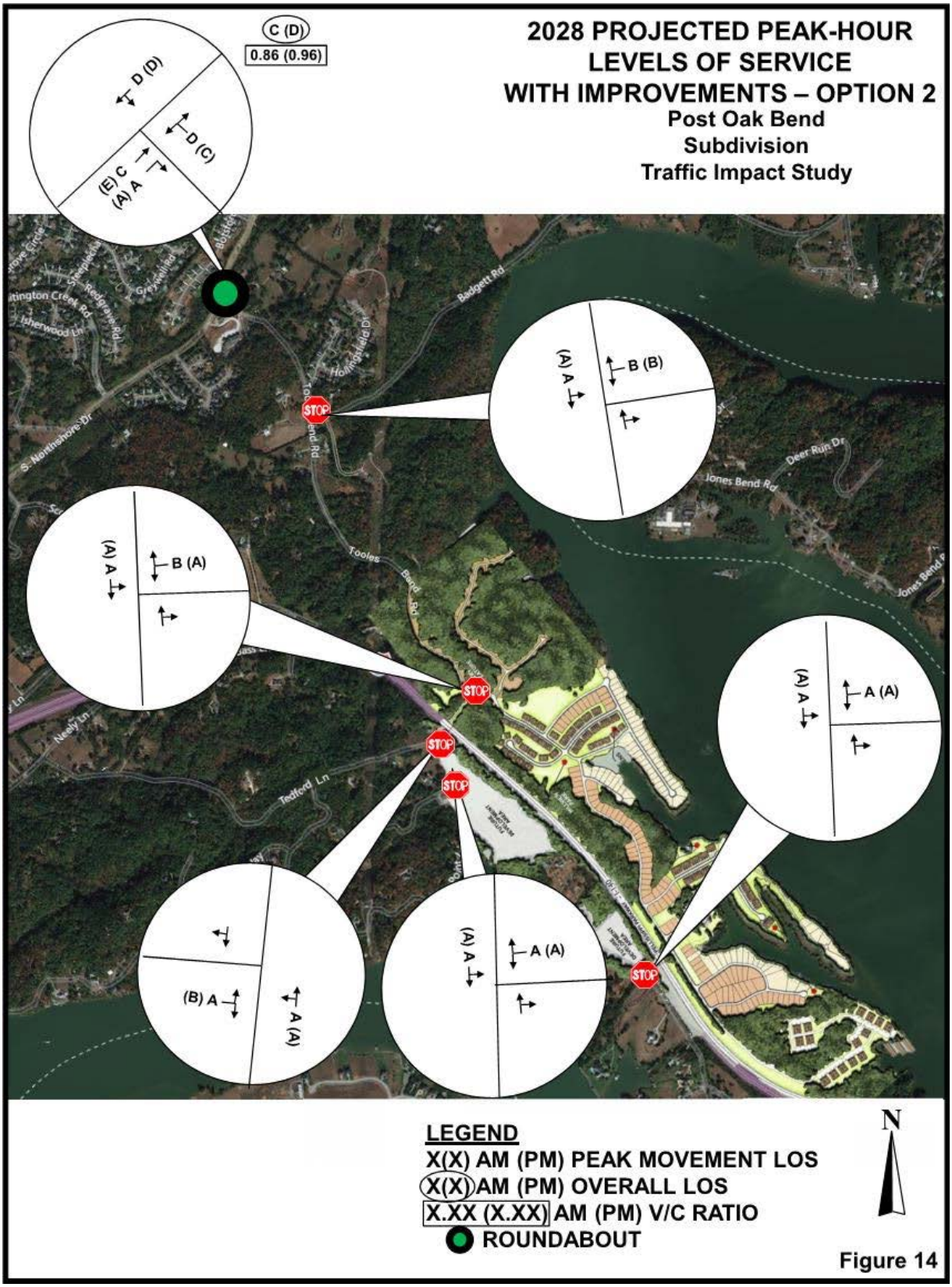

2028 PROJECTED PEAK-HOUR
LEVELS OF SERVICE
WITH IMPROVEMENTS – OPTION 2
Post Oak Bend
Subdivision
Traffic Impact Study
C (D)
0.86 (0.96)
D (D)
D (C)
(E) C
(A) A
(A) A
B (B)
(A) A
B (A)
(A) A
A (A)
(B) A
A (A)
(A) A
A (A)
STOP
Badgett Rd
Tooles Bend Rd
Jones Bend Rd
Deer Run Dr
Tedford Ln
Neely Ln
S. Northshore Dr
Isherwood Ln
LEGEND
X(X) AM (PM) PEAK MOVEMENT LOS
X(X) AM (PM) OVERALL LOS
X.XX (X.XX) AM (PM) V/C RATIO
ROUNDABOUT
N

Figure 14

Chapter 4- Summary and Recommendations

Post Oak Bend Subdivision would be constructed over an approximate 10-year period and ultimately contain 670 total residential units at buildout. A 48-lot single family component is included but would be separated from the main development. Two access roads that intersect Tooles Bend Road are proposed for the primary tract of land. Access to this smaller tract would be on Tooles Bend Road, just south of Tedford Lane. The remainder of this chapter describes the recommendations developed based on the traffic analysis, and **Table 3** details a summary of the capacity and LOS analyses conducted for the study.

South Northshore Drive at Tooles Bend Road

The proposed Post Oak Bend Subdivision will generate enough traffic to justify improvements to the intersection of South Northshore Drive and Tooles Bend Road. A traffic signal and roundabout are both viable options. With both alternatives, Tooles Bend Road needs to be realigned to intersect South Northshore Drive at a 90-degree angle. More discussion on both alternatives is provided in the following paragraphs.

Traffic Signal

Install a 100-foot southbound South Northshore Drive left turn lane with a 320-foot approach taper and 110-foot bay taper. There is a northbound left turn lane on South Northshore Drive at Bickerstaff Boulevard that has a taper ending 220 feet east of Tooles Bend Road. That taper will have to be modified to construct a new left turn lane on South Northshore Drive for Tooles Bend Road. Alternatively, it will be more effective to construct a continuous left turn lane between Bickerstaff Boulevard and Tooles Bend Road.

Install a 150-foot northbound right turn lane on South Northshore Drive at Tooles Bend Road with a 300-foot approach taper.

Widen Tooles Bend Road at South Northshore Drive to allow for two 175-foot turn lanes, one left and one right. This would require a 180-foot approach taper, assuming the taper is directed to the right.

When warranted, in approximately 2022, install a traffic signal.

Improvements to this intersection should come in two phases, with phase one to include building the turn lanes and phase two installing the traffic signal. Phase one construction can include as much of the traffic signal equipment as feasible.

Roundabout

A single lane roundabout is a viable option but would need to include a northbound South Northshore Drive right turn bypass lane. The design details have not been developed for this report. Unlike a traffic signal that should be constructed when warranted, a roundabout could be constructed at any time because it is not tied to warrants.

Traffic Signal and Roundabout Comparison

It is CDM Smith's belief that a roundabout at this intersection will function at an acceptable LOS. In the PM peak hour, the HCS 2010 results project an overall LOS D. By comparison, a traffic signal will operate at LOS B. As drivers get better acquainted with roundabouts, the LOS will likely improve.

In considering whether to select a traffic signal or a roundabout, the following factors will be extremely important:

- Maintenance of traffic
- Drainage impacts
- ROW needs
- Environmental impacts
- Disruptions to driveways
- Cost
- Community acceptance
- Commuter acceptance
- Service life
- Schedule and improvement phasing

In fact, these factors will determine which improvement to select (signal versus roundabout) instead of which provides the better LOS and minimizes delays.

Badgett Road at Tooles Bend Road

Looking right from Badgett Road the intersection sight distance is 220 feet, thus falling 80 feet short of the 300-foot minimum distance established by MPC for a 30 MPH road. The stopping sight distance for a 30 MPH road is 200 feet and is met. An intersection warning sign (W2-2L) should be installed on southbound Tooles Bend Road before the intersection with a 25 MPH Advisory Speed plaque (W13-1P). Improving the vertical curve would be extremely costly and may not be feasible given other transportation needs in Knox County. Additionally, no turn lanes are warranted or recommended from Tooles Bend Road to Badgett Road, and no turn lanes are recommended for the Badgett Road approach.

North Access on Tooles Bend Road

A single approach lane to Tooles Bend Road is recommended; separate left and right turn lanes are not needed. Although it does not meet the Knox County criterion for a left turn lane, a 100-foot southbound left turn lane on Tooles Bend Road with a 150-foot approach taper and 50-foot bay taper is desired.

South Access on Tooles Bend Road

A single approach lane to Tooles Bend Road is recommended; separate left and right turn lanes are not needed. Although it does not meet the Knox County criterion for a left turn lane, a 100-foot southbound left turn lane with a 150-foot approach taper and 50-foot bay taper is desired.

Tedford Road at Tooles Bend Road

No turn lanes are warranted or recommended on Tooles Bend Road to Tedford Lane, and the approach to Tooles Bend Road does not need separate turn lanes.

Tooles Bend Road

Tooles Bend Road is 20 feet wide without shoulders and there are some horizontal curves in the southern section between Badgett Road and the I-140 underpass. There were 10 crashes reported in the 4-year timespan between 2012 and 2015 with most occurring north of Badgett Road. The Knox County safety study ranked the road segment 318th in its crash evaluation, suggesting it is a safe road in comparison to others. Nevertheless, since it will be accommodating more traffic generated by Post Oak Bend Subdivision, certain improvements would enhance safety. In addition, Knox County has recently repaved and restriped the edge lines and center lines along Tooles Bend Road. The following is recommended:

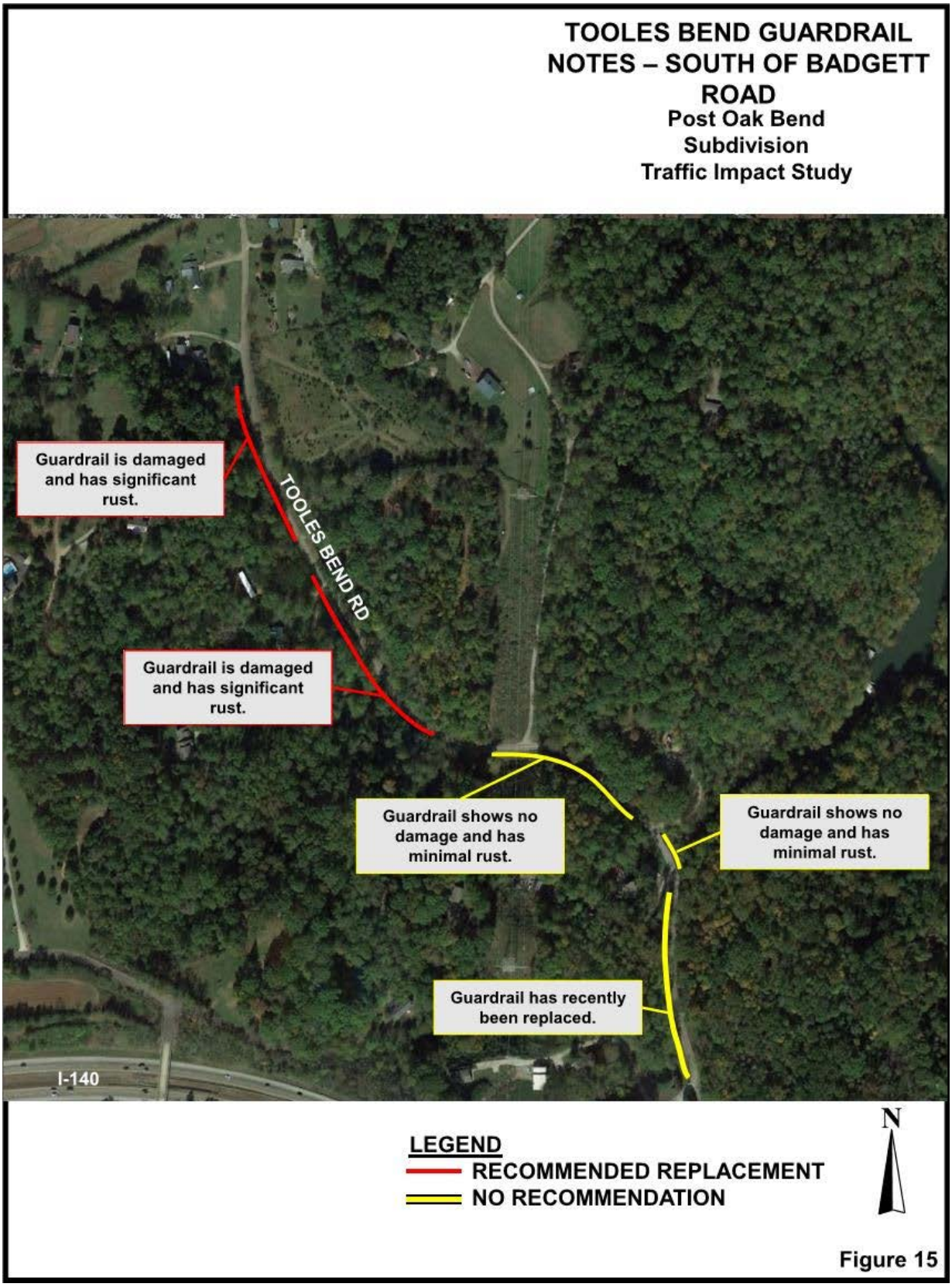
- Replace the existing guardrail in the curved section south of Badgett Road where the guardrail is damaged or lower than 2.5 feet above the roadway. See **Figures 15** and **16** for illustrations of these locations.
- Add centerline raised pavement markings along the corridor.
- Add edge line rumble stripes along the corridor, except where guardrails are located.

48-Lot Off-Site Single Family Tract

This component of the development is not included in the current site plan submitted for Use on Review, but the following recommendations should be carried out when it is constructed:

One access to Tooles Bend Road should be provided. It does not need separate left and right turn lanes on its approach to Tooles Bend Road. A left turn lane from Tooles Bend Road into the development is not warranted according to Knox County criteria and is not recommended.

The intersection sight distance of 300 feet is achievable at almost every point where the access could be provided because this section of Tooles Bend Road is straight and level. The exceptions are potentially at the extreme north or south portions of the property.


TOOLES BEND GUARDRAIL NOTES – SOUTH OF BADGETT ROAD
Post Oak Bend Subdivision
Traffic Impact Study
Guardrail is damaged and has significant rust.
TOOLES BEND RD
Guardrail is damaged and has significant rust.
Guardrail shows no damage and has minimal rust.
Guardrail shows no damage and has minimal rust.
Guardrail has recently been replaced.
I-140
LEGEND
RECOMMENDED REPLACEMENT
NO RECOMMENDATION
N
Figure 15

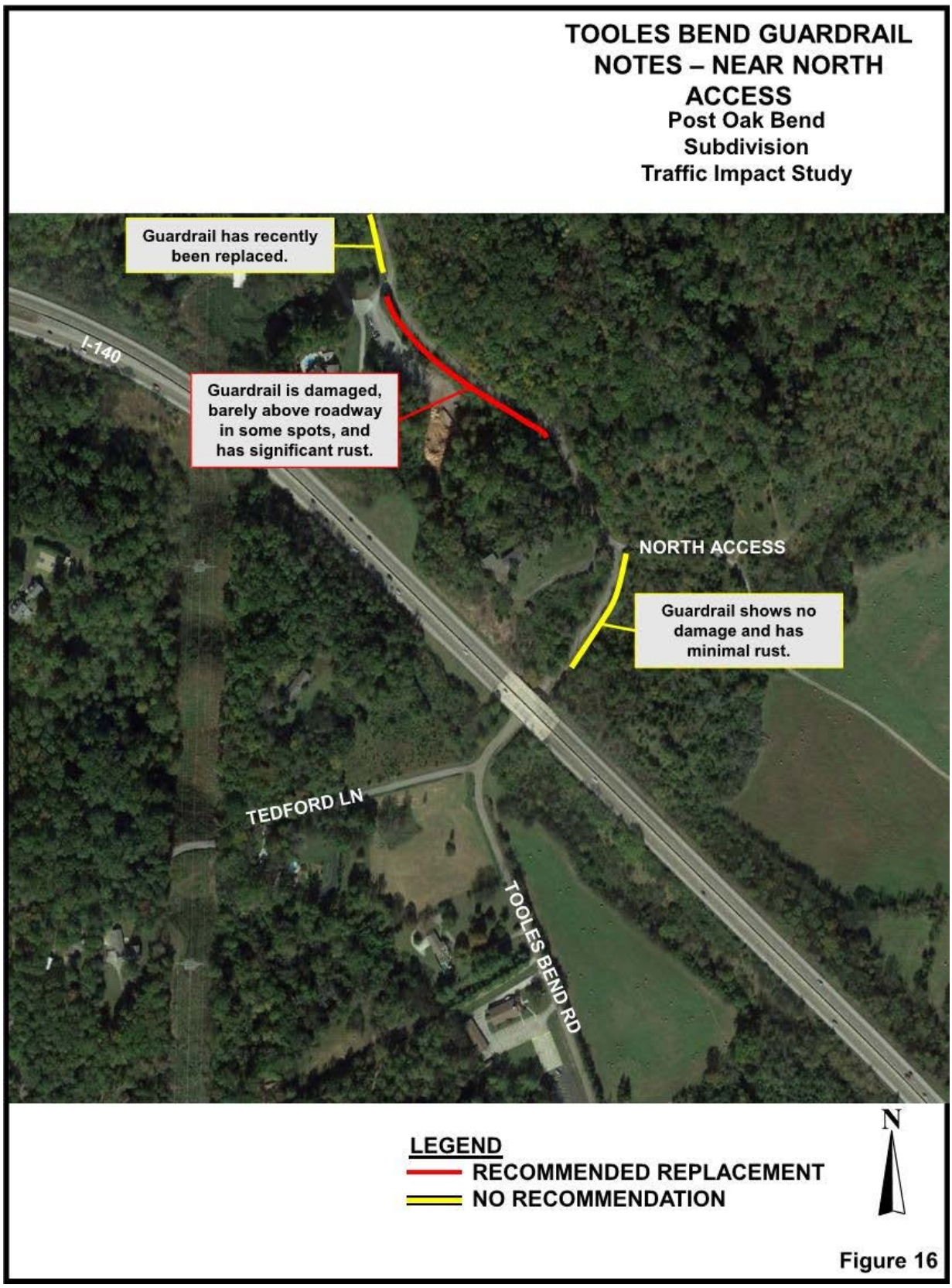

TOOLES BEND GUARDRAIL
NOTES – NEAR NORTH
ACCESS
Post Oak Bend
Subdivision
Traffic Impact Study
Guardrail has recently been replaced.
I-140
Guardrail is damaged, barely above roadway in some spots, and has significant rust.
NORTH ACCESS
Guardrail shows no damage and has minimal rust.
TEDFORD LN
TOOLES BEND RD
LEGEND
RECOMMENDED REPLACEMENT
NO RECOMMENDATION
N

Figure 16

Table 3: Capacity and Level of Service Summary

INTERSECTION	TRAFFIC CONTROL	PEAK PERIOD	2018 EXISTING TRAFFIC			2028 BACKGROUND TRAFFIC			2028 PROJECTED TRAFFIC		
			V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS
Tooles Bend Rd	**STOP**	**AM**	**0.41 / 0.03**	**32.2 / 0.7**	**D / A**	**0.40 / 0.03**	**38.9 / 0.8**	**E / A**	**2.70 / 0.08**	**>500.0 / 2.0**	**F / A**
at Northshore Dr	**NWL/SBL**	**PM**	**0.39 / 0.04**	**34.5 / 1.1**	**D / A**	**0.49 / 0.06**	**53.7 / 1.5**	**F / A**	**4.11 / 0.28**	**>500.0 / 7.7**	**F / A**
Mitigation	*STOP*	*AM*							*2.15 / 0.39*	*>500.0 / 20.0*	*F / C*
Add Exclusive Turn Lanes	*NWL/NWR*	*PM*							*3.00 / 0.32*	*>500.0 / 20.2*	*F / C*
Mitigation	*SIGNAL*	*AM*							*0.80*	*18.0*	*B*
Add Exclusive Turn Lanes & Provide Signalization		*PM*							*0.83*	*20.3*	*C*
Mitigation	*ROUNDABOUT*	*AM*							*0.86*	*24.0*	*C*
Construct Roundabout with Northbound Right Turn Bypass Lane		*PM*							*0.96*	*30.5*	*D*
Tooles Bend Rd	**STOP**	**AM**	**0.03 / 0.01**	**9.0 / 2.8**	**A / A**	**0.03 / 0.01**	**8.7 / 2.9**	**A / A**	**0.05 / 0.01**	**11.0 / 1.1**	**B / A**
at Badgett Rd	**WBL/SBL**	**PM**	**0.04 / 0.02**	**8.6 / 4.8**	**A / A**	**0.03 / 0.02**	**8.6 / 4.8**	**A / A**	**0.08 / 0.03**	**11.8 / 1.0**	**B / A**
Tooles Bend Rd	**STOP**	**AM**	**0.01 / 0.03**	**8.7 / 3.9**	**A / A**	**0.01 / 0.02**	**8.5 / 3.9**	**A / A**	**0.02 / 0.03**	**9.3 / 1.5**	**A / A**
at Tedford Ln	**EBL/NBL**	**PM**	**0.04 / 0.01**	**8.6 / 3.0**	**A / A**	**0.04 / 0.01**	**8.5 / 3.0**	**A / A**	**0.08 / 0.02**	**10.2 / 1.0**	**B / A**
Tooles Bend Rd	**STOP**	**AM**							**0.14 / 0.02**	**10.5 / 2.5**	**B / A**
at North Site Access	**WBL/SBL**	**PM**							**0.08 / 0.08**	**9.8 / 2.9**	**A / A**
Tooles Bend Rd	**STOP**	**AM**							**0.05 / 0.01**	**10.0 / 1.1**	**B / A**
at Apartment Access	**WBL/SBL**	**PM**							**0.03 / 0.03**	**9.3 / 1.2**	**A / A**
Tooles Bend Rd	**STOP**	**AM**							**0.21 / 0.04**	**9.6 / 6.1**	**A / A**
at South Site Access	**WBL/SBL**	**PM**							**0.14 / 0.14**	**9.1 / 6.4**	**A / A**

Note: Average vehicle delay estimated in seconds. STOP control analyses presented by minor approach.
Roundabout analyses reports HCM 2010 results.

Appendix

Traffic Counts

CDM Smith, Inc.

1100 Marion Street, Ste 300
Knoxville, TN 37921
865-963-4300

File Name : Tooles Bend at Badgett
Site Code : 00000111
Start Date : 1/11/2018
Page No : 1

Groups Printed- Unshifted

	TOOLES BEND RD Southbound				BADGETT RD Westbound				TOOLES BEND RD Northbound				BADGETT RD Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	1	8	0	9	0	0	4	4	0	6	0	6	0	0	0	0	19
07:15 AM	2	8	0	10	0	0	5	5	0	4	0	4	0	0	0	0	19
07:30 AM	6	2	0	8	0	0	8	8	0	26	3	29	0	0	0	0	45
07:45 AM	4	3	0	7	0	0	6	6	0	4	1	5	0	0	0	0	18
Total	13	21	0	34	0	0	23	23	0	40	4	44	0	0	0	0	101
08:00 AM	3	2	0	5	0	0	2	2	0	4	1	5	0	0	0	0	12
08:15 AM	5	2	0	7	0	0	4	4	0	0	1	1	0	0	0	0	12
08:30 AM	1	7	0	8	0	0	3	3	0	6	0	6	0	0	0	0	17
08:45 AM	5	4	0	9	0	0	7	7	0	4	0	4	0	0	0	0	20
Total	14	15	0	29	0	0	16	16	0	14	2	16	0	0	0	0	61
*** BREAK ***																	
04:00 PM	6	5	0	11	1	0	3	4	0	4	1	5	0	0	0	0	20
04:15 PM	7	5	0	12	1	0	6	7	0	2	0	2	0	0	0	0	21
04:30 PM	3	6	0	9	0	0	2	2	0	4	0	4	0	0	0	0	15
04:45 PM	7	1	0	8	1	0	2	3	0	6	0	6	0	0	0	0	17
Total	23	17	0	40	3	0	13	16	0	16	1	17	0	0	0	0	73
05:00 PM	6	2	0	8	0	0	6	6	0	6	0	6	0	0	0	0	20
05:15 PM	10	3	0	13	0	0	2	2	0	7	0	7	0	0	0	0	22
05:30 PM	4	6	0	10	0	0	3	3	0	6	2	8	0	0	0	0	21
05:45 PM	9	5	0	14	0	0	11	11	0	5	1	6	0	0	0	0	31
Total	29	16	0	45	0	0	22	22	0	24	3	27	0	0	0	0	94
Grand Total	79	69	0	148	3	0	74	77	0	94	10	104	0	0	0	0	329
Apprch %	53.4	46.6	0		3.9	0	96.1		0	90.4	9.6		0	0	0		
Total %	24	21	0	45	0.9	0	22.5	23.4	0	28.6	3	31.6	0	0	0	0	

	TOOLES BEND RD Southbound				BADGETT RD Westbound				TOOLES BEND RD Northbound				BADGETT RD Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:00 AM																	
07:00 AM	1	**8**	0	9	0	0	4	4	0	6	0	6	0	0	0	0	19
07:15 AM	2	8	0	**10**	0	0	5	5	0	4	0	4	0	0	0	0	19
07:30 AM	**6**	2	0	8	0	0	**8**	**8**	0	**26**	**3**	**29**	0	0	0	0	**45**
07:45 AM	4	3	0	7	0	0	6	6	0	4	1	5	0	0	0	0	18
Total Volume	13	21	0	34	0	0	23	23	0	40	4	44	0	0	0	0	101
% App. Total	38.2	61.8	0		0	0	100		0	90.9	9.1		0	0	0		
PHF	.542	.656	.000	.850	.000	.000	.719	.719	.000	.385	.333	.379	.000	.000	.000	.000	.561
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 05:00 PM																	
05:00 PM	6	2	0	8	0	0	6	6	0	6	0	6	0	0	0	0	20
05:15 PM	**10**	3	0	13	0	0	2	2	0	**7**	0	7	0	0	0	0	22
05:30 PM	4	**6**	0	10	0	0	3	3	0	6	**2**	**8**	0	0	0	0	21
05:45 PM	9	5	0	**14**	0	0	**11**	**11**	0	5	1	6	0	0	0	0	**31**
Total Volume	29	16	0	45	0	0	22	22	0	24	3	27	0	0	0	0	94
% App. Total	64.4	35.6	0		0	0	100		0	88.9	11.1		0	0	0		
PHF	.725	.667	.000	.804	.000	.000	.500	.500	.000	.857	.375	.844	.000	.000	.000	.000	.758

CDM Smith, Inc.

1100 Marion Street, Ste 300
Knoxville, TN 37921
865-963-4300

File Name : Tooles Bend at Northshore
Site Code : 00000000
Start Date : 1/25/2018
Page No : 1

Groups Printed- Unshifted

	TOOLES BEND RD Southbound				NORTHSHORE DR Westbound				TOOLES BEND RD Northbound				NORTHSHORE DR Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	0	0	0	0	2	79	0	81	11	0	5	16	0	72	7	79	176
07:15 AM	0	0	0	0	5	102	0	107	11	0	13	24	0	102	3	105	236
07:30 AM	0	0	0	0	5	149	0	154	9	0	13	22	0	112	3	115	291
07:45 AM	0	0	0	0	2	127	0	129	8	0	3	11	0	173	10	183	323
Total	0	0	0	0	14	457	0	471	39	0	34	73	0	459	23	482	1026
08:00 AM	0	0	0	0	6	130	0	136	6	0	4	10	0	150	3	153	299
08:15 AM	0	0	0	0	6	118	0	124	8	0	3	11	0	170	6	176	311
08:30 AM	0	0	0	0	11	110	0	121	4	0	9	13	0	132	3	135	269
08:45 AM	0	0	0	0	3	126	0	129	0	0	3	3	0	131	6	137	269
Total	0	0	0	0	26	484	0	510	18	0	19	37	0	583	18	601	1148
*** BREAK ***																	
11:00 AM	0	0	0	0	4	72	0	76	2	0	8	10	0	84	3	87	173
11:15 AM	0	0	0	0	3	82	0	85	3	0	6	9	0	93	5	98	192
11:30 AM	0	0	0	0	3	94	0	97	4	0	9	13	0	103	6	109	219
11:45 AM	0	0	0	0	5	91	0	96	9	0	3	12	0	101	6	107	215
Total	0	0	0	0	15	339	0	354	18	0	26	44	0	381	20	401	799
12:00 PM	0	0	0	0	3	95	0	98	8	0	3	11	0	86	7	93	202
12:15 PM	0	0	0	0	6	130	0	136	4	0	14	18	0	98	1	99	253
12:30 PM	0	0	0	0	6	109	0	115	3	0	4	7	0	122	6	128	250
12:45 PM	0	0	0	0	1	119	0	120	5	0	4	9	0	126	3	129	258
Total	0	0	0	0	16	453	0	469	20	0	25	45	0	432	17	449	963
*** BREAK ***																	
02:00 PM	0	0	0	0	1	105	0	106	4	0	5	9	0	112	2	114	229
02:15 PM	0	0	0	0	2	113	0	115	6	0	4	10	0	118	6	124	249
02:30 PM	0	0	0	0	9	117	0	126	3	0	8	11	0	117	10	127	264
02:45 PM	0	0	0	0	5	106	0	111	9	0	6	15	0	93	5	98	224
Total	0	0	0	0	17	441	0	458	22	0	23	45	0	440	23	463	966
03:00 PM	0	0	0	0	7	117	0	124	3	0	7	10	0	107	5	112	246
03:15 PM	0	0	0	0	4	139	0	143	8	0	7	15	0	130	8	138	296
03:30 PM	0	0	0	0	8	107	0	115	2	0	5	7	0	137	6	143	265
03:45 PM	0	0	0	0	11	109	0	120	8	0	8	16	0	142	18	160	296
Total	0	0	0	0	30	472	0	502	21	0	27	48	0	516	37	553	1103
04:00 PM	0	0	0	0	6	86	0	92	9	0	7	16	0	157	15	172	280
04:15 PM	0	0	0	0	3	117	0	120	3	0	5	8	0	144	13	157	285
04:30 PM	0	0	0	0	7	129	0	136	7	0	4	11	0	164	11	175	322
04:45 PM	0	0	0	0	5	130	0	135	2	0	14	16	0	122	6	128	279
Total	0	0	0	0	21	462	0	483	21	0	30	51	0	587	45	632	1166
05:00 PM	0	0	0	0	6	125	0	131	9	0	3	12	0	138	15	153	296
05:15 PM	0	0	0	0	9	126	0	135	12	0	7	19	0	190	21	211	365
05:30 PM	0	0	0	0	7	138	0	145	5	0	8	13	0	157	20	177	335
05:45 PM	0	0	0	0	10	127	0	137	4	0	4	8	0	190	20	210	355
Total	0	0	0	0	32	516	0	548	30	0	22	52	0	675	76	751	1351
Grand Total	0	0	0	0	171	3624	0	3795	189	0	206	395	0	4073	259	4332	8522
Apprch %	0	0	0		4.5	95.5	0		47.8	0	52.2		0	94	6		
Total %	0	0	0	0	2	42.5	0	44.5	2.2	0	2.4	4.6	0	47.8	3	50.8	

CDM Smith, Inc.

1100 Marion Street, Ste 300
Knoxville, TN 37921
865-963-4300

File Name : Tooles Bend at Northshore
Site Code : 00000000
Start Date : 1/25/2018
Page No : 2

	TOOLES BEND RD Southbound				NORTHSHORE DR Westbound				TOOLES BEND RD Northbound				NORTHSHORE DR Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 09:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:30 AM																	
07:30 AM	0	0	0	0	5	**149**	0	**154**	**9**	0	**13**	**22**	0	112	3	115	291
07:45 AM	0	0	0	0	2	127	0	129	8	0	3	11	0	**173**	**10**	**183**	**323**
08:00 AM	0	0	0	0	**6**	130	0	136	6	0	4	10	0	150	3	153	299
08:15 AM	0	0	0	0	6	118	0	124	8	0	3	11	0	170	6	176	311
Total Volume	0	0	0	0	19	524	0	543	31	0	23	54	0	605	22	627	1224
% App. Total	0	0	0		3.5	96.5	0		57.4	0	42.6		0	96.5	3.5		
PHF	.000	.000	.000	.000	.792	.879	.000	.881	.861	.000	.442	.614	.000	.874	.550	.857	.947
Peak Hour Analysis From 10:00 AM to 01:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 12:00 PM																	
12:00 PM	0	0	0	0	3	95	0	98	**8**	0	3	11	0	86	**7**	93	202
12:15 PM	0	0	0	0	**6**	**130**	0	**136**	4	0	**14**	**18**	0	98	1	99	253
12:30 PM	0	0	0	0	6	109	0	115	3	0	4	7	0	122	6	128	250
12:45 PM	0	0	0	0	1	119	0	120	5	0	4	9	0	**126**	3	**129**	**258**
Total Volume	0	0	0	0	16	453	0	469	20	0	25	45	0	432	17	449	963
% App. Total	0	0	0		3.4	96.6	0		44.4	0	55.6		0	96.2	3.8		
PHF	.000	.000	.000	.000	.667	.871	.000	.862	.625	.000	.446	.625	.000	.857	.607	.870	.933
Peak Hour Analysis From 02:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 05:00 PM																	
05:00 PM	0	0	0	0	6	125	0	131	9	0	3	12	0	138	15	153	296
05:15 PM	0	0	0	0	9	126	0	135	**12**	0	7	**19**	0	**190**	**21**	**211**	**365**
05:30 PM	0	0	0	0	7	**138**	0	**145**	5	0	**8**	13	0	157	20	177	335
05:45 PM	0	0	0	0	**10**	127	0	137	4	0	4	8	0	190	20	210	355
Total Volume	0	0	0	0	32	516	0	548	30	0	22	52	0	675	76	751	1351
% App. Total	0	0	0		5.8	94.2	0		57.7	0	42.3		0	89.9	10.1		
PHF	.000	.000	.000	.000	.800	.935	.000	.945	.625	.000	.688	.684	.000	.888	.905	.890	.925

CDM Smith, Inc.

1100 Marion Street, Ste 300
Knoxville, TN 37921
865-963-4300

File Name : Tooles Bend at Tedford
Site Code : 00003333
Start Date : 1/11/2018
Page No : 1

Groups Printed- Unshifted

	TOOLES BEND RD Southbound				TEDFORD LN Westbound				TOOLES BEND RD Northbound				TEDFORD LN Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	5	4	0	9	0	0	0	0	9
07:15 AM	0	0	0	0	0	0	0	0	7	4	0	11	1	0	0	1	12
07:30 AM	0	1	0	1	0	0	0	0	9	12	0	21	0	0	2	2	24
07:45 AM	0	3	0	3	0	0	0	0	8	3	0	11	1	0	1	2	16
Total	0	4	0	4	0	0	0	0	29	23	0	52	2	0	3	5	61
08:00 AM	0	1	0	1	0	0	0	0	4	6	0	10	0	0	3	3	14
08:15 AM	0	0	0	0	0	0	0	0	2	2	0	4	0	0	5	5	9
08:30 AM	0	4	1	5	0	0	0	0	3	2	0	5	1	0	1	2	12
08:45 AM	0	4	2	6	0	0	0	0	6	2	0	8	0	0	4	4	18
Total	0	9	3	12	0	0	0	0	15	12	0	27	1	0	13	14	53
*** BREAK ***																	
04:00 PM	0	5	1	6	0	0	0	0	1	6	0	7	2	0	5	7	20
04:15 PM	0	2	0	2	0	0	0	0	2	1	0	3	0	0	10	10	15
04:30 PM	0	1	1	2	0	0	0	0	3	5	0	8	0	0	7	7	17
04:45 PM	0	1	0	1	0	0	0	0	6	5	0	11	0	0	8	8	20
Total	0	9	2	11	0	0	0	0	12	17	0	29	2	0	30	32	72
05:00 PM	0	1	1	2	0	0	0	0	0	10	0	10	2	0	2	4	16
05:15 PM	0	4	0	4	0	0	0	0	1	3	0	4	2	0	5	7	15
05:30 PM	0	3	0	3	0	0	0	0	5	2	0	7	3	0	7	10	20
05:45 PM	0	3	0	3	0	0	0	0	1	3	0	4	0	0	2	2	9
Total	0	11	1	12	0	0	0	0	7	18	0	25	7	0	16	23	60
Grand Total	0	33	6	39	0	0	0	0	63	70	0	133	12	0	62	74	246
Apprch %	0	84.6	15.4		0	0	0		47.4	52.6	0		16.2	0	83.8		
Total %	0	13.4	2.4	15.9	0	0	0	0	25.6	28.5	0	54.1	4.9	0	25.2	30.1	

	TOOLES BEND RD Southbound				TEDFORD LN Westbound				TOOLES BEND RD Northbound				TEDFORD LN Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:15 AM																	
07:15 AM	0	0	0	0	0	0	0	0	7	4	0	11	**1**	0	0	1	12
07:30 AM	0	1	0	1	0	0	0	0	**9**	**12**	0	**21**	0	0	2	2	**24**
07:45 AM	0	**3**	0	**3**	0	0	0	0	8	3	0	11	1	0	1	2	16
08:00 AM	0	1	0	1	0	0	0	0	4	6	0	10	0	0	**3**	**3**	14
Total Volume	0	5	0	5	0	0	0	0	28	25	0	53	2	0	6	8	66
% App. Total	0	100	0		0	0	0		52.8	47.2	0		25	0	75		
PHF	.000	.417	.000	.417	.000	.000	.000	.000	.778	.521	.000	.631	.500	.000	.500	.667	.688
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:00 PM																	
04:00 PM	0	**5**	**1**	**6**	0	0	0	0	1	**6**	0	7	**2**	0	5	7	**20**
04:15 PM	0	2	0	2	0	0	0	0	2	1	0	3	0	0	**10**	**10**	15
04:30 PM	0	1	1	2	0	0	0	0	3	5	0	8	0	0	7	7	17
04:45 PM	0	1	0	1	0	0	0	0	**6**	5	0	**11**	0	0	8	8	20
Total Volume	0	9	2	11	0	0	0	0	12	17	0	29	2	0	30	32	72
% App. Total	0	81.8	18.2		0	0	0		41.4	58.6	0		6.2	0	93.8		
PHF	.000	.450	.500	.458	.000	.000	.000	.000	.500	.708	.000	.659	.250	.000	.750	.800	.900

Greater Traffic Company

TOOLES BEND RD S OF NORTHSHORE DR

M264

Start Time	10/17/2016 Mon	NB AM	NB PM	Hour Totals AM	Hour Totals PM	SB AM	SB PM	Hour Totals AM	Hour Totals PM	
12:00		2	18			1	19			
12:15		0	14			0	17			
12:30		0	7			0	8			
12:45		0	14	2	53	0	18	1	62	
01:00		0	15			3	10			
01:15		0	16			0	11			
01:30		0	10			0	10			
01:45		0	6	0	47	0	15	3	46	
02:00		0	21			0	6			
02:15		0	9			1	10			
02:30		2	14			0	21			
02:45		0	6	2	50	0	9	1	46	
03:00		0	5			0	11			
03:15		0	12			0	11			
03:30		0	20			0	19			
03:45		0	21	0	58	0	20	0	61	
04:00		0	17			0	18			
04:15		0	18			0	14			
04:30		0	19			1	20			
04:45		1	13	1	67	0	23	1	75	
05:00		1	19			2	16			
05:15		1	18			1	23			
05:30		5	9			0	22			
05:45		4	17	11	63	2	29	5	90	
06:00		1	10			3	14			
06:15		6	12			3	21			
06:30		12	12			6	21			
06:45		9	9	28	43	14	31	26	87	
07:00		32	6			11	8			
07:15		19	13			11	12			
07:30		30	3			7	10			
07:45		22	7	103	29	11	11	40	41	
08:00		18	9			10	9			
08:15		17	9			9	9			
08:30		10	8			6	7			
08:45		17	10	62	36	9	8	34	33	
09:00		8	7			14	7			
09:15		28	2			18	2			
09:30		16	1			5	9			
09:45		9	2	61	12	15	4	52	22	
10:00		21	1			9	4			
10:15		11	0			10	1			
10:30		8	1			13	3			
10:45		11	1	51	3	9	0	41	8	
11:00		13	2			6	0			
11:15		18	0			9	2			
11:30		22	0			17	0			
11:45		9	0	62	2	10	0	42	2	
Peak	-	07:00	03:30	-	-	09:00	05:00	-	-	-
Vol.	-	103	76	-	-	52	90	-	-	-
P.H.F.		0.805	0.905			0.722	0.776			
Lane Total		846				819				

CDM SMITH, INC.
1100 Marion Street, Ste 300
Knoxville, TN 37921
865-963-4300

Site Code: TOOLES BEND
Station ID:

Latitude: 0' 0.0000 Undefined

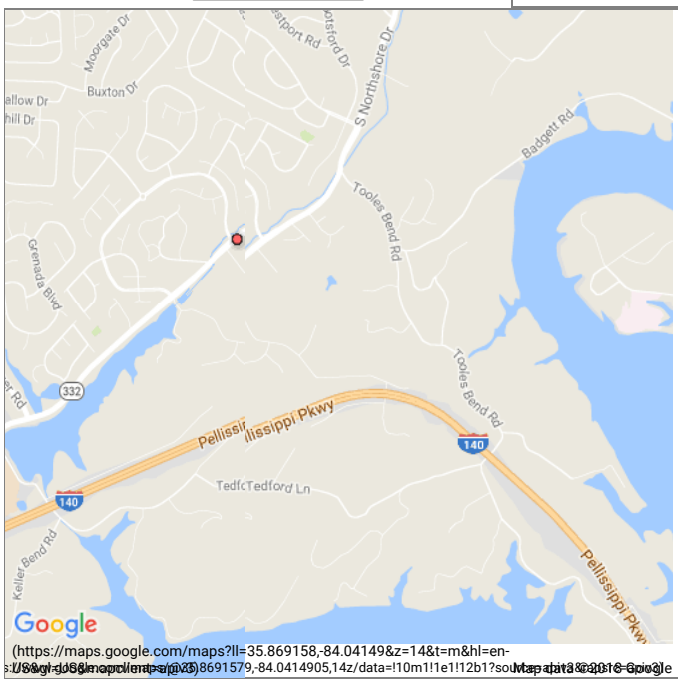
Start Time	24-Jan-18 Wed	NB	SB							Total
12:00 AM		2	1							3
01:00		0	3							3
02:00		2	1							3
03:00		0	0							0
04:00		1	1							2
05:00		11	5							16
06:00		28	26							54
07:00		**103**	40							**143**
08:00		62	34							96
09:00		61	**52**							113
10:00		45	30							75
11:00		44	29							73
12:00 PM		48	39							87
01:00		47	**64**							111
02:00		30	47							77
03:00		64	60							**124**
04:00		**71**	48							119
05:00		56	62							118
06:00		41	61							102
07:00		29	41							70
08:00		36	33							69
09:00		12	22							34
10:00		3	8							11
11:00		2	2							4
Total		798	709							1507
Percent		53.0%	47.0%							
AM Peak	-	07:00	09:00	-	-	-	-	-	-	07:00
Vol.	-	103	52	-	-	-	-	-	-	143
PM Peak	-	16:00	13:00	-	-	-	-	-	-	15:00
Vol.	-	71	64	-	-	-	-	-	-	124
Grand Total		798	709							1507
Percent		53.0%	47.0%							
ADT		ADT 1,507		AADT 1,507						

Traffic History

Traffic History reflects the Annual Average Daily Traffic (AADT) count along specific locations on Tennessee's road network

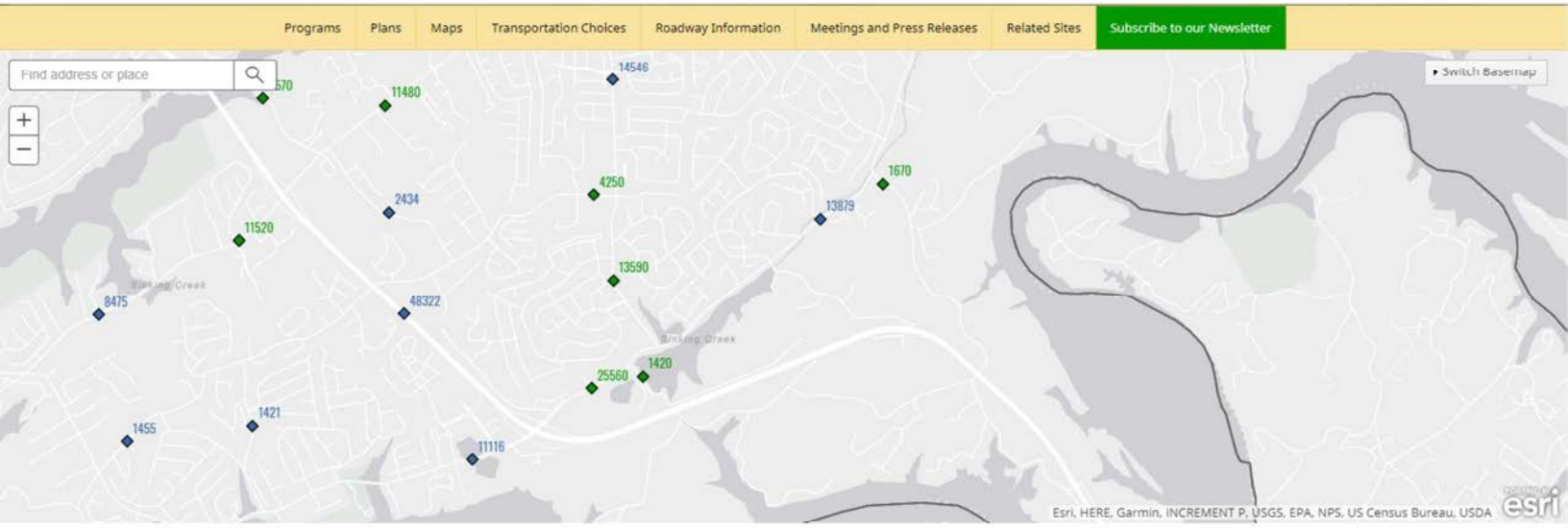
View stations on map: Select a county... ▾

Non-Map Record Search: Anderson ▾ Station Number: 287 Search



Station Information	
Station	000287
Route	SR332
Location	SOUTHWEST KNOXVILL
County	Knox
2016	13879
2015	13133
2014	14108
2013	14516
2012	13611
2011	12898
2010	13984
2009	13148
2008	12603
2007	14005
2006	14294
2005	13141
2004	14731
2003	13325
2002	14099
2001	13161
2000	11981
1999	11292
1998	10737
1997	12515

Download File:	KML (/Applications/Files/TrfcHist.kmz)	ESRI Geodatabase (/Applications/Files/TrfcHistFGDB.zip)	ESRI Shapefile (/Applications/Files/TrfcHistSHP.zip)	Database Table (/Applications/Files/TrfcHis
Open With:	Google Earth (https://earth.google.com/)	ArcGIS Explorer (http://www.esri.com/software/arcgis/explorer/index.html)		MS Access or Exce


Programs
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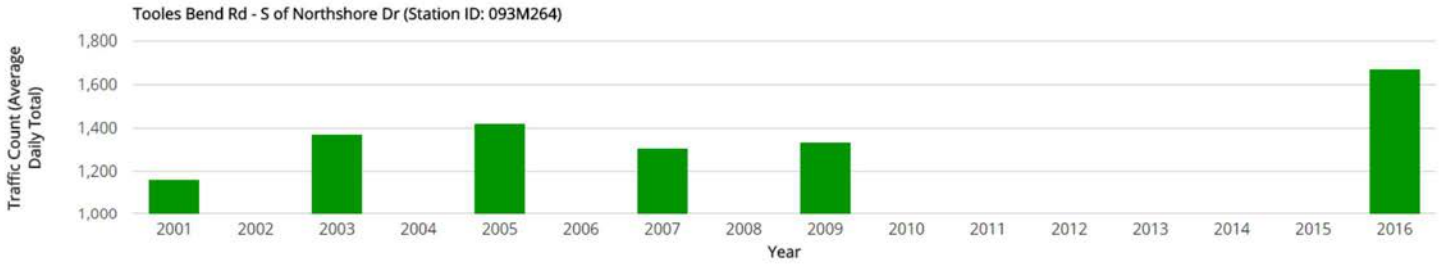
14546
11480
4250
1670
2434
13879
11520
13590
8475
48322
25560
1420
1455
1421
11116
Esri, HERE, Garmin, INCREMENT P, USGS, EPA, NPS, US Census Bureau, USDA
esri


Tooles Bend Rd - S of Northshore Dr (Station ID: 093M264)
Traffic Count (Average Daily Total)
1,800
1,600
1,400
1,200
1,000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Year

Knox County Engineering & Public Works
205 W. Baxter Ave.
Knoxville, TN 37917
865-215-5800

Site: #485 TEDFORD RD
4/29/2015
Wednesday

24 Hour Volume, per Channel

#485 TEDFORD RD

Interval Start	
11:00 AM	42
12:00 PM	25
1:00 PM	42
2:00 PM	44
3:00 PM	52
4:00 PM	47
5:00 PM	49
6:00 PM	55
7:00 PM	21
8:00 PM	30
9:00 PM	16
10:00 PM	4
11:00 PM	2
4/30/2015 12:00 AM	1
1:00 AM	0
2:00 AM	1
3:00 AM	2
4:00 AM	2
5:00 AM	4
6:00 AM	8
7:00 AM	40
8:00 AM	46
9:00 AM	40
10:00 AM	12
Total	585

Peak Hours

12:00 AM - 12:00 PM	
Started	8:00 AM
Peak Volume	46
Factor	-

12:00 PM - 12:00 AM	
Started	6:00 PM
Peak Volume	55
Factor	-

Greater Traffic Company

BADGETT RD W OF WRIGHTS FERRY RD

M263

Start Time	10/17/2016 Mon	EB AM	EB PM	Hour Totals AM	Hour Totals PM	WB AM	WB PM	Hour Totals AM	Hour Totals PM	
12:00		0	4			1	2			
12:15		0	4			0	0			
12:30		0	4			0	3			
12:45		0	2	0	14	0	4	1	9	
01:00		0	3			0	2			
01:15		0	3			0	4			
01:30		0	1			0	2			
01:45		0	2	0	9	0	4	0	12	
02:00		0	4			0	5			
02:15		0	2			0	0			
02:30		0	6			0	4			
02:45		0	2	0	14	0	4	0	13	
03:00		0	5			0	2			
03:15		0	2			0	4			
03:30		0	4			0	7			
03:45		0	7	0	18	0	6	0	19	
04:00		0	7			0	3			
04:15		0	3			0	9			
04:30		0	8			0	7			
04:45		1	5	1	23	0	4	0	23	
05:00		0	5			1	5			
05:15		1	8			2	7			
05:30		0	18			2	7			
05:45		0	9	1	40	0	5	5	24	
06:00		1	14			0	2			
06:15		1	3			0	3			
06:30		2	3			2	4			
06:45		2	8	6	28	3	3	5	12	
07:00		2	1			6	3			
07:15		3	4			6	3			
07:30		6	2			4	3			
07:45		4	1	15	8	8	2	24	11	
08:00		3	5			5	0			
08:15		3	1			3	2			
08:30		2	1			9	0			
08:45		3	0	11	7	5	1	22	3	
09:00		3	0			4	0			
09:15		4	0			8	1			
09:30		2	1			4	0			
09:45		1	1	10	2	1	1	17	2	
10:00		3	0			6	0			
10:15		1	0			1	1			
10:30		3	1			1	0			
10:45		5	0	12	1	7	0	15	1	
11:00		5	0			5	1			
11:15		2	1			2	0			
11:30		2	0			4	0			
11:45		3	0	12	1	5	0	16	1	
Peak	-	07:15	05:15	-	-	08:30	03:30	-	-	-
Vol.	-	16	49	-	-	26	25	-	-	-
P.H.F.		0.667	0.681			0.722	0.694			
Lane Total		233				235				

Trip Generation

Single-Family Detached Housing
(210)

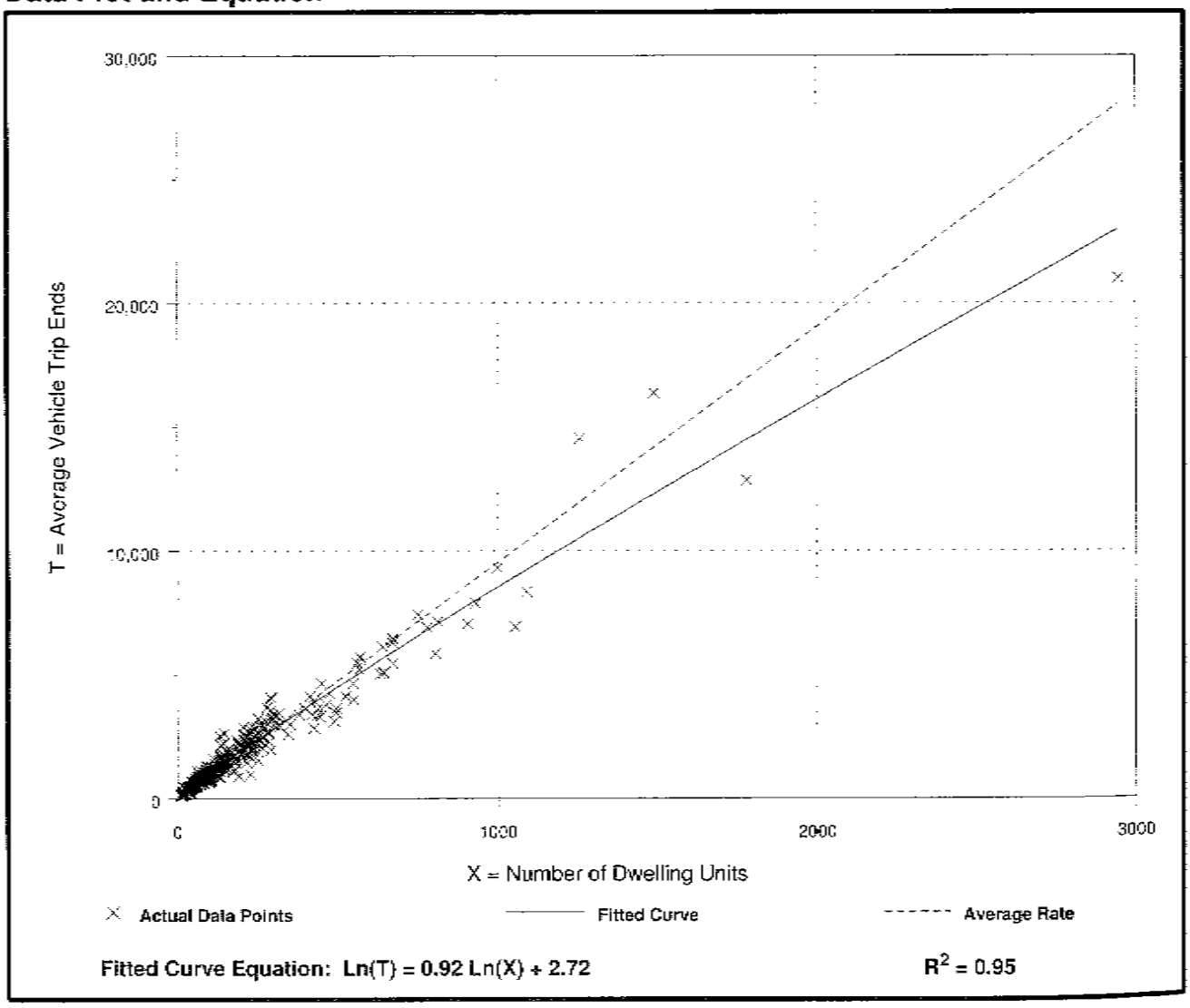
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

Number of Studies: 355
Avg. Number of Dwelling Units: 198
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
9.52	4.31 - 21.85	3.70

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.92 Ln(X) + 2.72

R^2 = 0.95

Single-Family Detached Housing
(210)

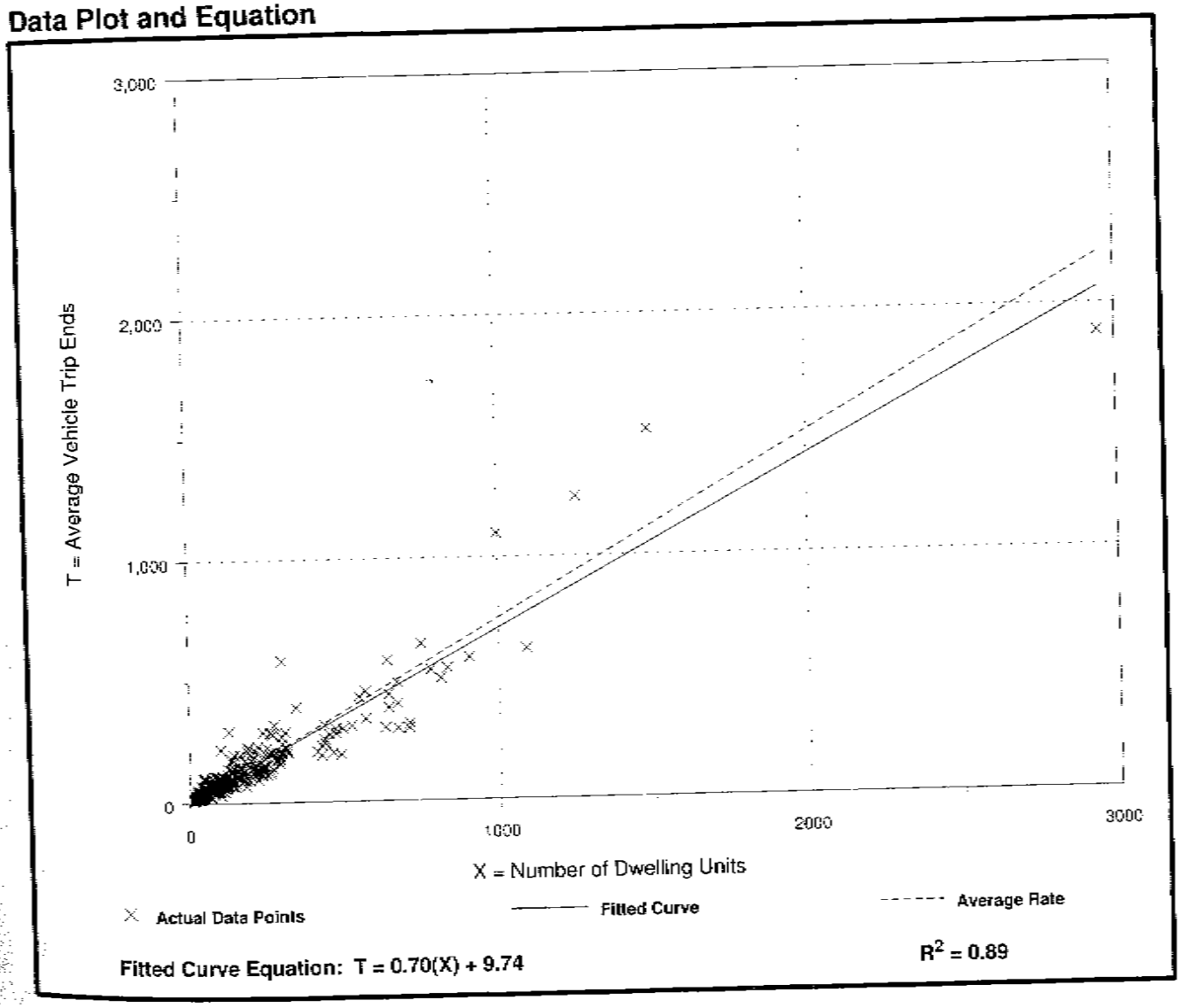
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Number of Studies: 292
Avg. Number of Dwelling Units: 194
Directional Distribution: 25% entering, 75% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.75	0.33 - 2.27	0.90

Data Plot and Equation



Fitted Curve Equation: $T = 0.70(X) + 9.74$

$R^2 = 0.89$

Single-Family Detached Housing
(210)

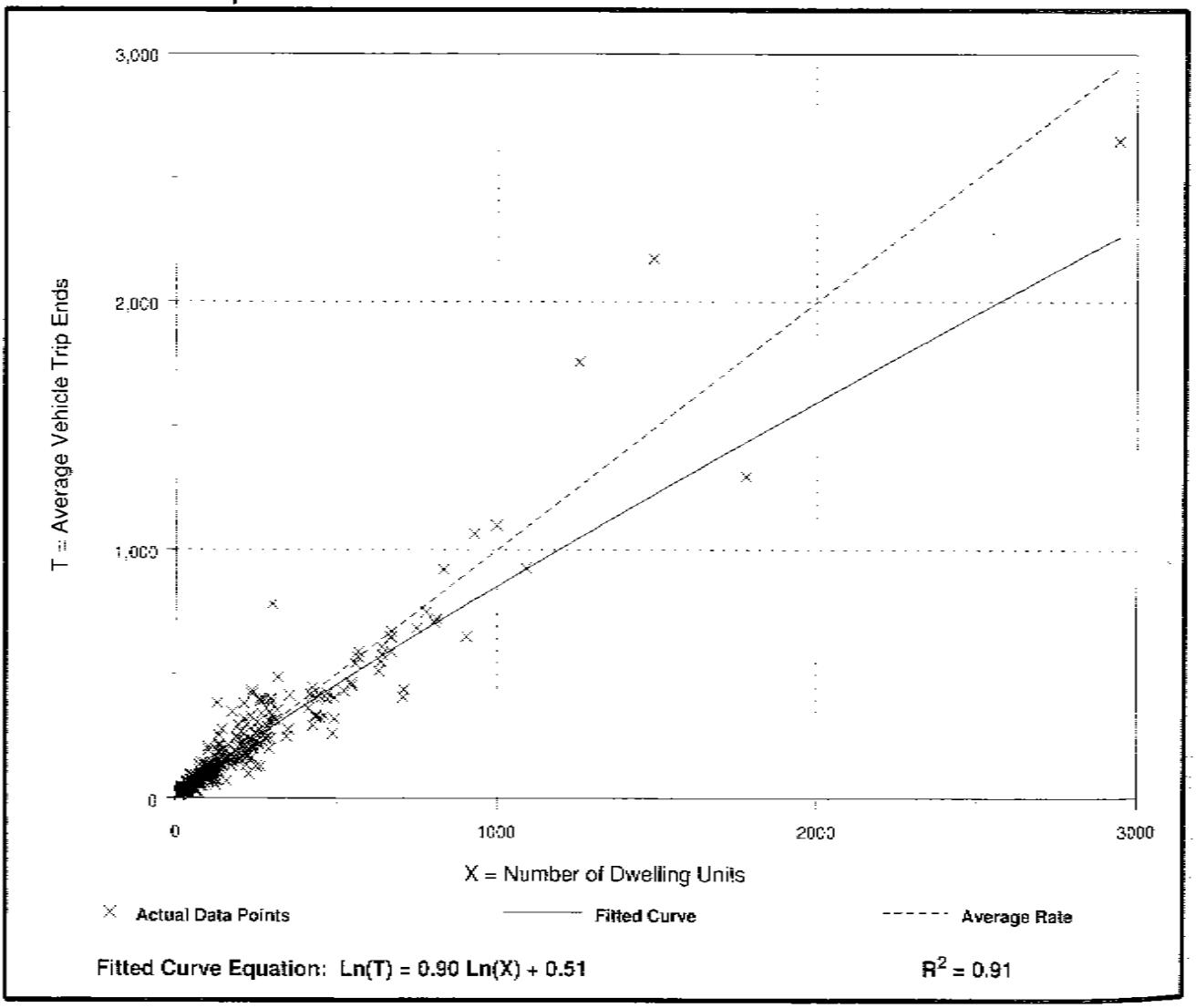
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

Number of Studies: 321
Avg. Number of Dwelling Units: 207
Directional Distribution: 63% entering, 37% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
1.00	0.42 - 2.98	1.05

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.90 Ln(X) + 0.51

R^2 = 0.91

Residential Condominium/Townhouse
(230)

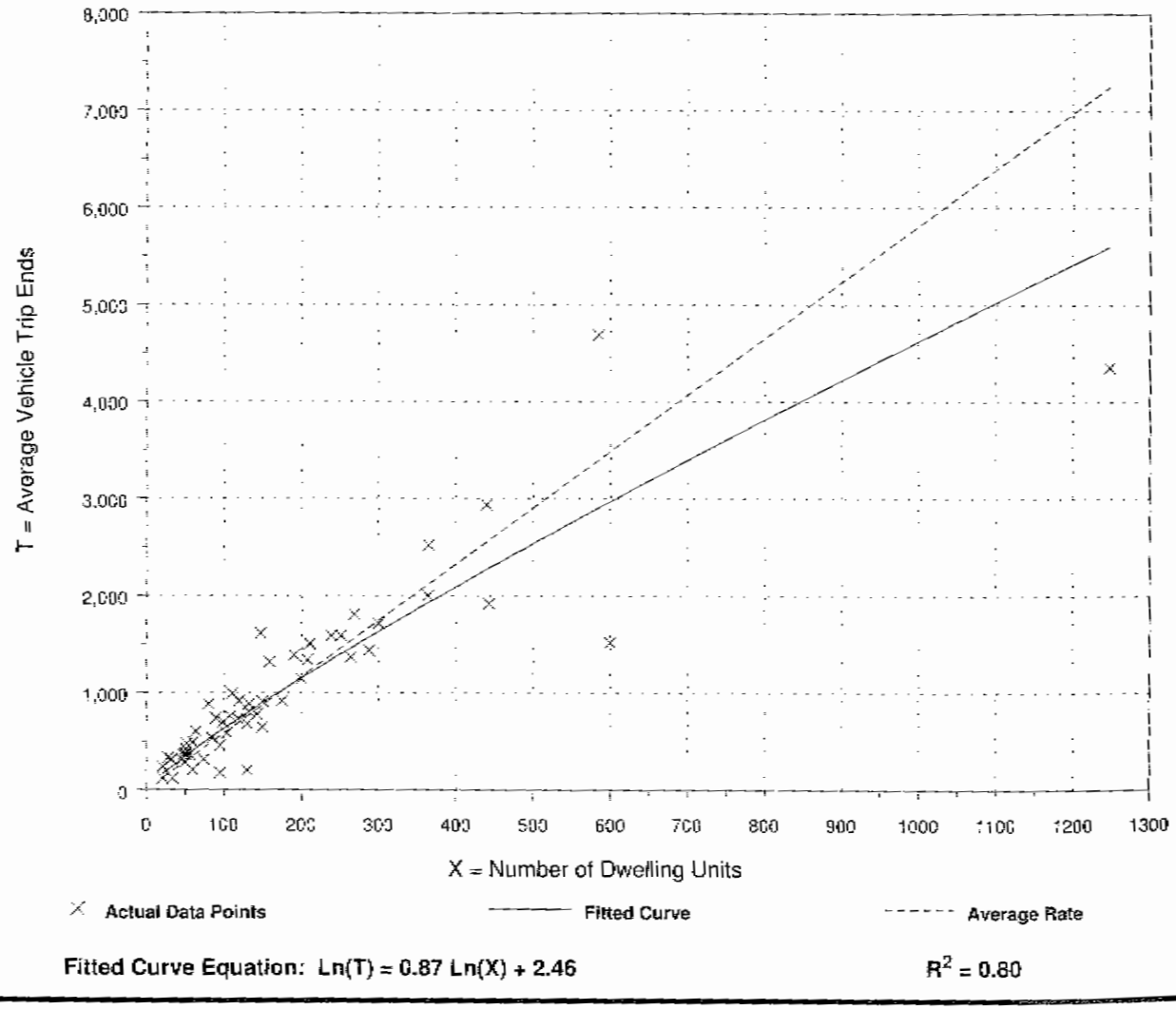
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

Number of Studies: 56
Avg. Number of Dwelling Units: 179
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
5.81	1.53 - 11.79	3.11

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.87 Ln(X) + 2.46

R^2 = 0.80

Residential Condominium/Townhouse
(230)

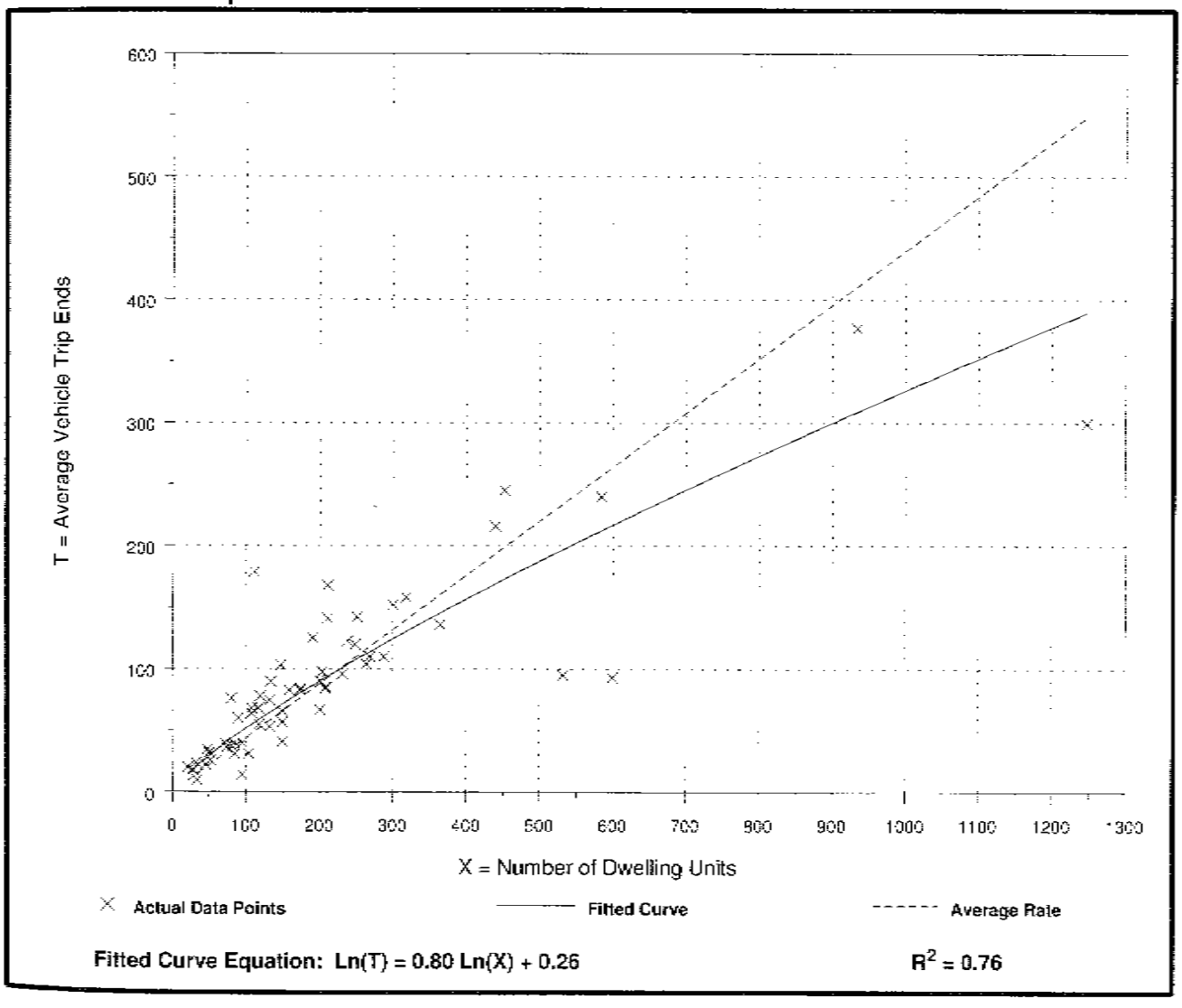
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Number of Studies: 59
Avg. Number of Dwelling Units: 213
Directional Distribution: 17% entering, 83% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.44	0.15 - 1.61	0.69

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.80 Ln(X) + 0.26

R^2 = 0.76

Residential Condominium/Townhouse
(230)

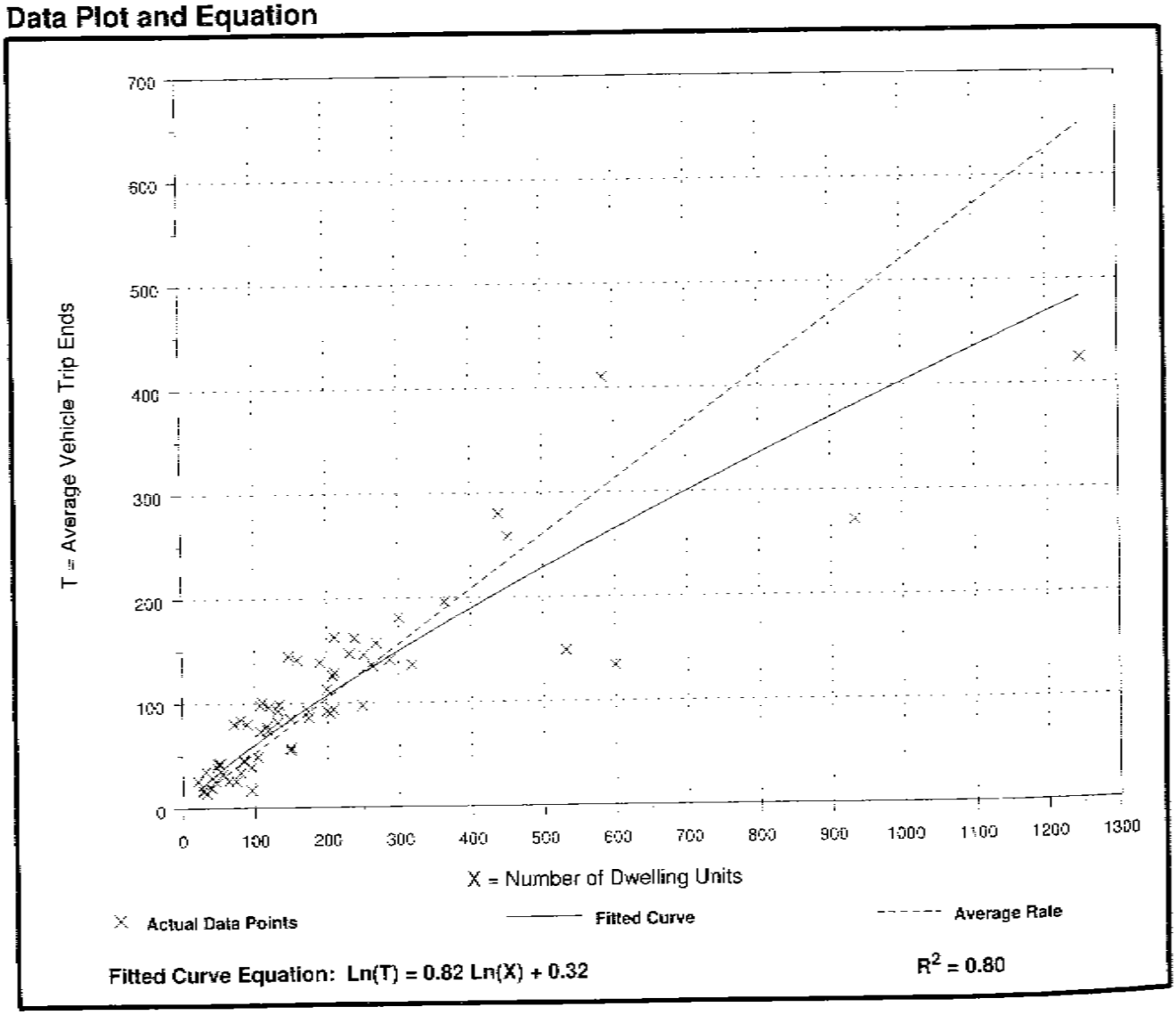
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

Number of Studies: 62
Avg. Number of Dwelling Units: 205
Directional Distribution: 67% entering, 33% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.52	0.18 - 1.24	0.75

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.82 Ln(X) + 0.32

R^2 = 0.80

Local Apartment
Trip Generation Study

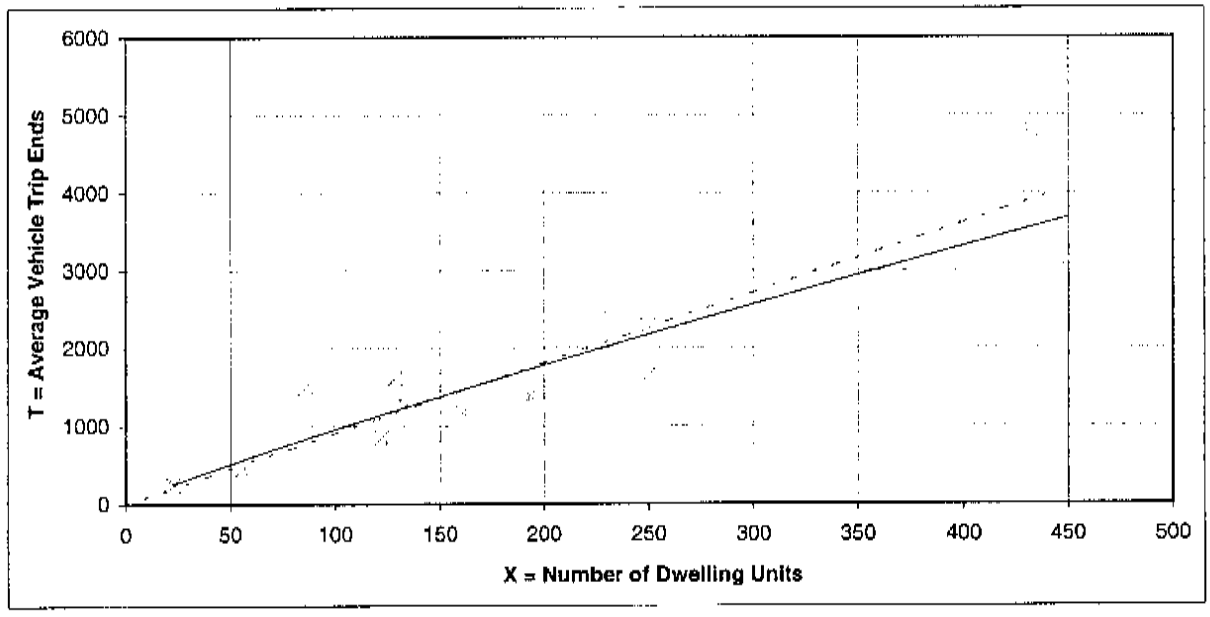
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday**

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



X Actual Data Points ——— Fitted Curve ····· Average Rate

Fitted Curve Equation: $T = 15.193(X)^{0.899}$ $R^2 = 0.88$

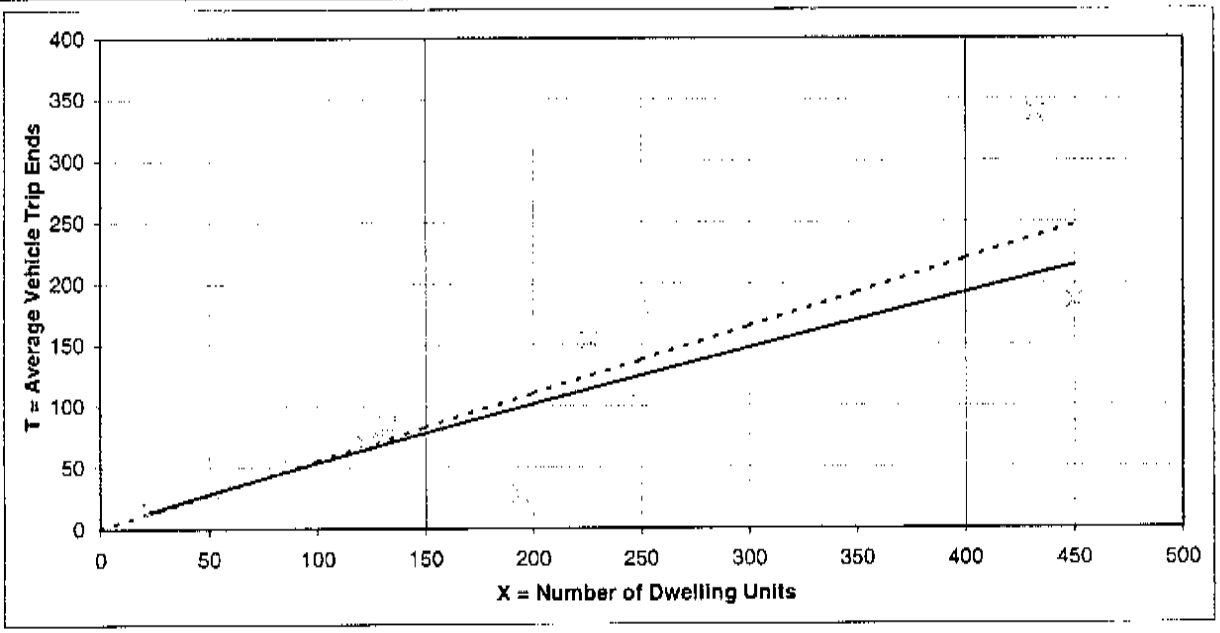
Local Apartment
Trip Generation Study

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



X Actual Data Points ——— Fitted Curve ····· Average Rate

Fitted Curve Equation: $T = 0.758(X)^{0.924}$ $R^2 = 0.75$

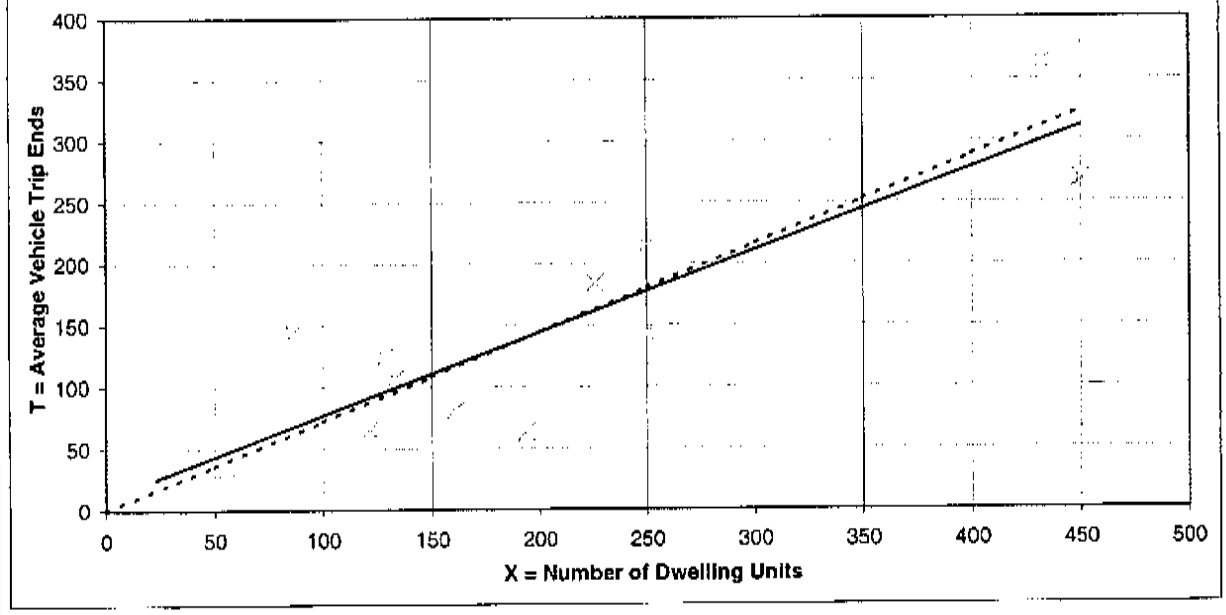
Local Apartment
Trip Generation Study

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



X Actual Data Points ——— Fitted Curve ····· Average Rate

Fitted Curve Equation: $T = 0.669(X) + 10.069$ $R^2 = 0.79$

Synchro Analysis

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations						
Traffic Volume (veh/h)	605	22	19	524	31	23
Future Volume (Veh/h)	605	22	19	524	31	23
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.86	0.86	0.88	0.88	0.61	0.61
Hourly flow rate (vph)	703	26	22	595	51	38
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			729		1355	716
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			729		1355	716
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		68	91
cM capacity (veh/h)			875		161	430

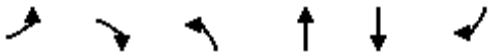
Direction, Lane #	NB 1	SB 1	NW 1
Volume Total	729	617	89
Volume Left	0	22	51
Volume Right	26	0	38
cSH	1700	875	219
Volume to Capacity	0.43	0.03	0.41
Queue Length 95th (ft)	0	2	46
Control Delay (s)	0.0	0.7	32.2
Lane LOS		A	D
Approach Delay (s)	0.0	0.7	32.2
Approach LOS			D

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	52.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	0	23	40	4	13	21
Future Volume (Veh/h)	0	23	40	4	13	21
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.72	0.72	0.38	0.38	0.85	0.85
Hourly flow rate (vph)	0	32	105	11	15	25
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	166	110			116	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	166	110			116	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	97			99	
cM capacity (veh/h)	817	943			1473	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	32	116	40
Volume Left	0	0	15
Volume Right	32	11	0
cSH	943	1700	1473
Volume to Capacity	0.03	0.07	0.01
Queue Length 95th (ft)	3	0	1
Control Delay (s)	9.0	0.0	2.8
Lane LOS	A		A
Approach Delay (s)	9.0	0.0	2.8
Approach LOS	A		

Intersection Summary			
Average Delay		2.1	
Intersection Capacity Utilization		18.5%	ICU Level of Service A
Analysis Period (min)		15	



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	2	6	28	25	5	0
Future Volume (Veh/h)	2	6	28	25	5	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.67	0.67	0.63	0.63	0.42	0.42
Hourly flow rate (vph)	3	9	44	40	12	0
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	140	12	12			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	140	12	12			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	99	97			
cM capacity (veh/h)	830	1069	1607			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	12	84	12
Volume Left	3	44	0
Volume Right	9	0	0
cSH	997	1607	1700
Volume to Capacity	0.01	0.03	0.01
Queue Length 95th (ft)	1	2	0
Control Delay (s)	8.7	3.9	0.0
Lane LOS	A	A	
Approach Delay (s)	8.7	3.9	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	4.0		
Intersection Capacity Utilization	19.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations						
Traffic Volume (veh/h)	675	76	32	516	30	22
Future Volume (Veh/h)	675	76	32	516	30	22
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.89	0.89	0.94	0.94	0.68	0.68
Hourly flow rate (vph)	758	85	34	549	44	32
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			843		1418	800
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			843		1418	800
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			96		70	92
cM capacity (veh/h)			793		144	385

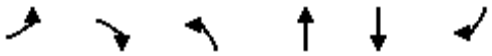
Direction, Lane #	NB 1	SB 1	NW 1
Volume Total	843	583	76
Volume Left	0	34	44
Volume Right	85	0	32
cSH	1700	793	196
Volume to Capacity	0.50	0.04	0.39
Queue Length 95th (ft)	0	3	43
Control Delay (s)	0.0	1.1	34.5
Lane LOS		A	D
Approach Delay (s)	0.0	1.1	34.5
Approach LOS			D

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	63.4%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	0	22	24	3	29	16
Future Volume (Veh/h)	0	22	24	3	29	16
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.50	0.50	0.84	0.84	0.80	0.80
Hourly flow rate (vph)	0	44	29	4	36	20
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	123	31			33	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	123	31			33	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	96			98	
cM capacity (veh/h)	852	1043			1579	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	44	33	56
Volume Left	0	0	36
Volume Right	44	4	0
cSH	1043	1700	1579
Volume to Capacity	0.04	0.02	0.02
Queue Length 95th (ft)	3	0	2
Control Delay (s)	8.6	0.0	4.8
Lane LOS	A		A
Approach Delay (s)	8.6	0.0	4.8
Approach LOS	A		

Intersection Summary			
Average Delay	4.9		
Intersection Capacity Utilization	19.1%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	2	30	12	17	9	2
Future Volume (Veh/h)	2	30	12	17	9	2
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.80	0.80	0.66	0.66	0.46	0.46
Hourly flow rate (vph)	3	38	18	26	20	4
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	84	22	24			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	84	22	24			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	96	99			
cM capacity (veh/h)	907	1055	1591			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	41	44	24
Volume Left	3	18	0
Volume Right	38	0	4
cSH	1043	1591	1700
Volume to Capacity	0.04	0.01	0.01
Queue Length 95th (ft)	3	1	0
Control Delay (s)	8.6	3.0	0.0
Lane LOS	A	A	
Approach Delay (s)	8.6	3.0	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	4.5		
Intersection Capacity Utilization	18.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations						
Traffic Volume (veh/h)	726	26	23	629	37	28
Future Volume (Veh/h)	726	26	23	629	37	28
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)	789	28	25	684	40	30
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			817		1537	803
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			817		1537	803
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		68	92
cM capacity (veh/h)			811		124	383

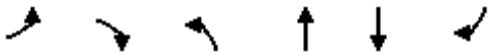
Direction, Lane #	NB 1	SB 1	NW 1
Volume Total	817	709	70
Volume Left	0	25	40
Volume Right	28	0	30
cSH	1700	811	174
Volume to Capacity	0.48	0.03	0.40
Queue Length 95th (ft)	0	2	44
Control Delay (s)	0.0	0.8	38.9
Lane LOS		A	E
Approach Delay (s)	0.0	0.8	38.9
Approach LOS			E

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	62.1%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	0	28	48	5	16	25
Future Volume (Veh/h)	0	28	48	5	16	25
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	30	52	5	17	27
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	116	54			57	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	116	54			57	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	97			99	
cM capacity (veh/h)	871	1012			1547	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	30	57	44
Volume Left	0	0	17
Volume Right	30	5	0
cSH	1012	1700	1547
Volume to Capacity	0.03	0.03	0.01
Queue Length 95th (ft)	2	0	1
Control Delay (s)	8.7	0.0	2.9
Lane LOS	A		A
Approach Delay (s)	8.7	0.0	2.9
Approach LOS	A		

Intersection Summary			
Average Delay		3.0	
Intersection Capacity Utilization		18.9%	ICU Level of Service
Analysis Period (min)		15	



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	2	7	34	30	6	0
Future Volume (Veh/h)	2	7	34	30	6	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	8	37	33	7	0
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	114	7	7			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	114	7	7			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	99	98			
cM capacity (veh/h)	862	1075	1614			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	10	70	7
Volume Left	2	37	0
Volume Right	8	0	0
cSH	1025	1614	1700
Volume to Capacity	0.01	0.02	0.00
Queue Length 95th (ft)	1	2	0
Control Delay (s)	8.5	3.9	0.0
Lane LOS	A	A	
Approach Delay (s)	8.5	3.9	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	4.1		
Intersection Capacity Utilization	20.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations						
Traffic Volume (veh/h)	810	91	38	619	36	26
Future Volume (Veh/h)	810	91	38	619	36	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)	880	99	41	673	39	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			979		1684	930
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			979		1684	930
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			94		60	91
cM capacity (veh/h)			705		97	324

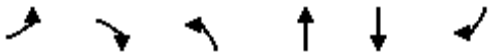
Direction, Lane #	NB 1	SB 1	NW 1
Volume Total	979	714	67
Volume Left	0	41	39
Volume Right	99	0	28
cSH	1700	705	138
Volume to Capacity	0.58	0.06	0.49
Queue Length 95th (ft)	0	5	57
Control Delay (s)	0.0	1.5	53.7
Lane LOS		A	F
Approach Delay (s)	0.0	1.5	53.7
Approach LOS			F

Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	73.9%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	0	26	29	4	35	19
Future Volume (Veh/h)	0	26	29	4	35	19
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	28	32	4	38	21
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	131	34			36	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	131	34			36	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	97			98	
cM capacity (veh/h)	842	1039			1575	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	28	36	59
Volume Left	0	0	38
Volume Right	28	4	0
cSH	1039	1700	1575
Volume to Capacity	0.03	0.02	0.02
Queue Length 95th (ft)	2	0	2
Control Delay (s)	8.6	0.0	4.8
Lane LOS	A		A
Approach Delay (s)	8.6	0.0	4.8
Approach LOS	A		

Intersection Summary			
Average Delay	4.2		
Intersection Capacity Utilization	19.6%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	2	36	14	20	11	2
Future Volume (Veh/h)	2	36	14	20	11	2
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	39	15	22	12	2
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	65	13	14			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	65	13	14			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	96	99			
cM capacity (veh/h)	932	1067	1604			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	41	37	14
Volume Left	2	15	0
Volume Right	39	0	2
cSH	1060	1604	1700
Volume to Capacity	0.04	0.01	0.01
Queue Length 95th (ft)	3	1	0
Control Delay (s)	8.5	3.0	0.0
Lane LOS	A	A	
Approach Delay (s)	8.5	3.0	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	5.0		
Intersection Capacity Utilization	18.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations						
Traffic Volume (veh/h)	726	79	56	629	214	141
Future Volume (Veh/h)	726	79	56	629	214	141
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)	789	86	61	684	233	153
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			875		1638	832
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			875		1638	832
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			92		0	59
cM capacity (veh/h)			771		102	369

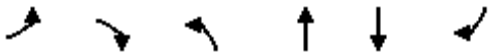
Direction, Lane #	NB 1	SB 1	NW 1
Volume Total	875	745	386
Volume Left	0	61	233
Volume Right	86	0	153
cSH	1700	771	143
Volume to Capacity	0.51	0.08	2.70
Queue Length 95th (ft)	0	6	865
Control Delay (s)	0.0	2.0	834.8
Lane LOS		A	F
Approach Delay (s)	0.0	2.0	834.8
Approach LOS			F

Intersection Summary			
Average Delay	161.4		
Intersection Capacity Utilization	106.6%	ICU Level of Service	G
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	5	28	338	21	16	111
Future Volume (Veh/h)	5	28	338	21	16	111
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	30	367	23	17	121
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	534	378			390	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	534	378			390	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	96			99	
cM capacity (veh/h)	500	668			1169	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	35	390	138
Volume Left	5	0	17
Volume Right	30	23	0
cSH	638	1700	1169
Volume to Capacity	0.05	0.23	0.01
Queue Length 95th (ft)	4	0	1
Control Delay (s)	11.0	0.0	1.1
Lane LOS	B		A
Approach Delay (s)	11.0	0.0	1.1
Approach LOS	B		

Intersection Summary			
Average Delay		1.0	
Intersection Capacity Utilization		29.3%	ICU Level of Service A
Analysis Period (min)		15	



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	3	11	46	242	69	3
Future Volume (Veh/h)	3	11	46	242	69	3
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	3	12	50	263	75	3
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	440	76	78			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	440	76	78			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	99	99	97			
cM capacity (veh/h)	556	985	1520			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	15	313	78
Volume Left	3	50	0
Volume Right	12	0	3
cSH	853	1520	1700
Volume to Capacity	0.02	0.03	0.05
Queue Length 95th (ft)	1	3	0
Control Delay (s)	9.3	1.4	0.0
Lane LOS	A	A	
Approach Delay (s)	9.3	1.4	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	31.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	4	94	244	1	29	68
Future Volume (Veh/h)	4	94	244	1	29	68
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	4	102	265	1	32	74
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	404	266			266	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	404	266			266	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	87			98	
cM capacity (veh/h)	588	773			1298	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	106	266	106
Volume Left	4	0	32
Volume Right	102	1	0
cSH	764	1700	1298
Volume to Capacity	0.14	0.16	0.02
Queue Length 95th (ft)	12	0	2
Control Delay (s)	10.5	0.0	2.5
Lane LOS	B		A
Approach Delay (s)	10.5	0.0	2.5
Approach LOS	B		

Intersection Summary			
Average Delay	2.9		
Intersection Capacity Utilization	34.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	0	33	255	0	11	69
Future Volume (Veh/h)	0	33	255	0	11	69
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	36	277	0	12	75
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	376	277			277	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	376	277			277	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	95			99	
cM capacity (veh/h)	620	762			1286	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	36	277	87
Volume Left	0	0	12
Volume Right	36	0	0
cSH	762	1700	1286
Volume to Capacity	0.05	0.16	0.01
Queue Length 95th (ft)	4	0	1
Control Delay (s)	10.0	0.0	1.1
Lane LOS	A		A
Approach Delay (s)	10.0	0.0	1.1
Approach LOS	A		

Intersection Summary			
Average Delay		1.1	
Intersection Capacity Utilization		23.4%	ICU Level of Service A
Analysis Period (min)		15	

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	0	191	64	0	56	13
Future Volume (Veh/h)	0	191	64	0	56	13
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	208	70	0	61	14
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	206	70			70	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	206	70			70	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	79			96	
cM capacity (veh/h)	751	993			1531	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	208	70	75
Volume Left	0	0	61
Volume Right	208	0	0
cSH	993	1700	1531
Volume to Capacity	0.21	0.04	0.04
Queue Length 95th (ft)	20	0	3
Control Delay (s)	9.6	0.0	6.1
Lane LOS	A		A
Approach Delay (s)	9.6	0.0	6.1
Approach LOS	A		

Intersection Summary			
Average Delay	6.9		
Intersection Capacity Utilization	28.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations						
Traffic Volume (veh/h)	810	274	155	619	153	101
Future Volume (Veh/h)	810	274	155	619	153	101
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)	880	298	168	673	166	110
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			1178		2038	1029
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1178		2038	1029
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			72		0	61
cM capacity (veh/h)			593		45	284

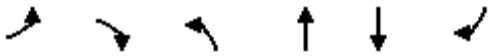
Direction, Lane #	NB 1	SB 1	NW 1
Volume Total	1178	841	276
Volume Left	0	168	166
Volume Right	298	0	110
cSH	1700	593	67
Volume to Capacity	0.69	0.28	4.11
Queue Length 95th (ft)	0	29	Err
Control Delay (s)	0.0	7.7	Err
Lane LOS		A	F
Approach Delay (s)	0.0	7.7	Err
Approach LOS			F

Intersection Summary			
Average Delay	1205.3		
Intersection Capacity Utilization	125.1%	ICU Level of Service	H
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	17	26	221	15	35	319
Future Volume (Veh/h)	17	26	221	15	35	319
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	18	28	240	16	38	347
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	671	248			256	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	671	248			256	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	96	96			97	
cM capacity (veh/h)	409	791			1309	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	46	256	385
Volume Left	18	0	38
Volume Right	28	16	0
cSH	580	1700	1309
Volume to Capacity	0.08	0.15	0.03
Queue Length 95th (ft)	6	0	2
Control Delay (s)	11.7	0.0	1.0
Lane LOS	B		A
Approach Delay (s)	11.7	0.0	1.0
Approach LOS	B		

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	44.6%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	6	49	21	168	229	5
Future Volume (Veh/h)	6	49	21	168	229	5
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	7	53	23	183	249	5
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	480	252	254			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	480	252	254			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	99	93	98			
cM capacity (veh/h)	535	787	1311			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	60	206	254
Volume Left	7	23	0
Volume Right	53	0	5
cSH	746	1311	1700
Volume to Capacity	0.08	0.02	0.15
Queue Length 95th (ft)	7	1	0
Control Delay (s)	10.2	1.0	0.0
Lane LOS	B	A	
Approach Delay (s)	10.2	1.0	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	35.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	3	55	170	4	99	231
Future Volume (Veh/h)	3	55	170	4	99	231
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	3	60	185	4	108	251
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	654	187			189	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	654	187			189	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	93			92	
cM capacity (veh/h)	398	855			1385	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	63	189	359
Volume Left	3	0	108
Volume Right	60	4	0
cSH	811	1700	1385
Volume to Capacity	0.08	0.11	0.08
Queue Length 95th (ft)	6	0	6
Control Delay (s)	9.8	0.0	2.9
Lane LOS	A		A
Approach Delay (s)	9.8	0.0	2.9
Approach LOS	A		

Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	40.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	0	20	169	0	34	244
Future Volume (Veh/h)	0	20	169	0	34	244
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	22	184	0	37	265
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	523	184			184	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	523	184			184	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	97			97	
cM capacity (veh/h)	501	858			1391	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	22	184	302
Volume Left	0	0	37
Volume Right	22	0	0
cSH	858	1700	1391
Volume to Capacity	0.03	0.11	0.03
Queue Length 95th (ft)	2	0	2
Control Delay (s)	9.3	0.0	1.2
Lane LOS	A		A
Approach Delay (s)	9.3	0.0	1.2
Approach LOS	A		

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	36.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	0	135	34	0	197	47
Future Volume (Veh/h)	0	135	34	0	197	47
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	147	37	0	214	51
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	516	37			37	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	516	37			37	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	86			86	
cM capacity (veh/h)	449	1035			1574	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	147	37	265
Volume Left	0	0	214
Volume Right	147	0	0
cSH	1035	1700	1574
Volume to Capacity	0.14	0.02	0.14
Queue Length 95th (ft)	12	0	12
Control Delay (s)	9.1	0.0	6.4
Lane LOS	A		A
Approach Delay (s)	9.1	0.0	6.4
Approach LOS	A		

Intersection Summary			
Average Delay	6.7		
Intersection Capacity Utilization	35.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations						
Traffic Volume (veh/h)	726	79	56	629	214	141
Future Volume (Veh/h)	726	79	56	629	214	141
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)	789	86	61	684	233	153
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			875		1595	789
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			875		1595	789
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			92		0	61
cM capacity (veh/h)			771		108	391

Direction, Lane #	NB 1	NB 2	SB 1	SB 2	NW 1	NW 2
Volume Total	789	86	61	684	233	153
Volume Left	0	0	61	0	233	0
Volume Right	0	86	0	0	0	153
cSH	1700	1700	771	1700	108	391
Volume to Capacity	0.46	0.05	0.08	0.40	2.15	0.39
Queue Length 95th (ft)	0	0	6	0	499	46
Control Delay (s)	0.0	0.0	10.1	0.0	613.3	20.0
Lane LOS			B		F	C
Approach Delay (s)	0.0		0.8		378.1	
Approach LOS					F	

Intersection Summary				
Average Delay	73.1			
Intersection Capacity Utilization	63.4%	ICU Level of Service		B
Analysis Period (min)	15			

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations						
Traffic Volume (veh/h)	810	274	155	619	153	101
Future Volume (Veh/h)	810	274	155	619	153	101
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)	880	298	168	673	166	110
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			1178		1889	880
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1178		1889	880
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			72		0	68
cM capacity (veh/h)			593		55	346

Direction, Lane #	NB 1	NB 2	SB 1	SB 2	NW 1	NW 2
Volume Total	880	298	168	673	166	110
Volume Left	0	0	168	0	166	0
Volume Right	0	298	0	0	0	110
cSH	1700	1700	593	1700	55	346
Volume to Capacity	0.52	0.18	0.28	0.40	3.00	0.32
Queue Length 95th (ft)	0	0	29	0	435	33
Control Delay (s)	0.0	0.0	13.5	0.0	1058.4	20.2
Lane LOS			B		F	C
Approach Delay (s)	0.0		2.7		644.6	
Approach LOS					F	

Intersection Summary			
Average Delay	78.5		
Intersection Capacity Utilization	69.7%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations						
Traffic Volume (vph)	726	79	56	629	214	141
Future Volume (vph)	726	79	56	629	214	141
Turn Type	NA	Perm	pm+pt	NA	Prot	Perm
Protected Phases	2		1	6	8	
Permitted Phases		2	6			8
Detector Phase	2	2	1	6	8	8
Switch Phase						
Minimum Initial (s)	15.0	15.0	5.0	15.0	6.0	6.0
Minimum Split (s)	24.0	24.0	11.0	24.0	24.0	24.0
Total Split (s)	40.0	40.0	11.0	51.0	24.0	24.0
Total Split (%)	53.3%	53.3%	14.7%	68.0%	32.0%	32.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lag	Lag	Lead			
Lead-Lag Optimize?	Yes	Yes	Yes			
Recall Mode	Max	Max	None	Max	None	None
Act Effct Green (s)	39.4	39.4	45.9	45.9	14.1	14.1
Actuated g/C Ratio	0.55	0.55	0.64	0.64	0.20	0.20
v/c Ratio	0.77	0.10	0.22	0.58	0.67	0.35
Control Delay	23.2	4.9	7.7	10.6	36.8	7.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.2	4.9	7.7	10.6	36.8	7.0
LOS	C	A	A	B	D	A
Approach Delay	21.4			10.4	25.0	
Approach LOS	C			B	C	

Intersection Summary	
Cycle Length: 75	
Actuated Cycle Length: 72	
Natural Cycle: 75	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.77	
Intersection Signal Delay: 18.0	Intersection LOS: B
Intersection Capacity Utilization 68.4%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 101: Northshore Dr & Tooles Bend Rd

Lane Group	NBT	NBR	SBL	SBT	NWL	NWR
Lane Group Flow (vph)	789	86	61	684	233	153
v/c Ratio	0.77	0.10	0.22	0.58	0.67	0.35
Control Delay	23.2	4.9	7.7	10.6	36.8	7.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.2	4.9	7.7	10.6	36.8	7.0
Queue Length 50th (ft)	300	4	9	154	95	0
Queue Length 95th (ft)	#568	28	24	280	164	43
Internal Link Dist (ft)	928			822	337	
Turn Bay Length (ft)		150	150		150	
Base Capacity (vph)	1020	897	277	1187	442	511
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.77	0.10	0.22	0.58	0.53	0.30

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations						
Traffic Volume (vph)	726	79	56	629	214	141
Future Volume (vph)	726	79	56	629	214	141
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1863	1583	1770	1863	1770	1583
Flt Permitted	1.00	1.00	0.15	1.00	0.95	1.00
Satd. Flow (perm)	1863	1583	272	1863	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	789	86	61	684	233	153
RTOR Reduction (vph)	0	32	0	0	0	124
Lane Group Flow (vph)	789	54	61	684	233	29
Turn Type	NA	Perm	pm+pt	NA	Prot	Perm
Protected Phases	2		1	6	8	
Permitted Phases		2	6			8
Actuated Green, G (s)	39.4	39.4	48.3	48.3	14.1	14.1
Effective Green, g (s)	39.4	39.4	48.3	48.3	14.1	14.1
Actuated g/C Ratio	0.53	0.53	0.65	0.65	0.19	0.19
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	986	838	234	1209	335	300
v/s Ratio Prot	c0.42		0.01	c0.37	c0.13	
v/s Ratio Perm		0.03	0.16			0.02
v/c Ratio	0.80	0.07	0.26	0.57	0.70	0.10
Uniform Delay, d1	14.3	8.5	10.2	7.2	28.1	24.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	6.8	0.1	0.6	1.9	6.2	0.1
Delay (s)	21.1	8.7	10.8	9.2	34.3	25.0
Level of Service	C	A	B	A	C	C
Approach Delay (s)	19.9			9.3	30.6	
Approach LOS	B			A	C	

Intersection Summary			
HCM 2000 Control Delay	18.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	74.4	Sum of lost time (s)	18.0
Intersection Capacity Utilization	68.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations						
Traffic Volume (vph)	810	274	155	619	153	101
Future Volume (vph)	810	274	155	619	153	101
Turn Type	NA	Perm	pm+pt	NA	Prot	Perm
Protected Phases	2		1	6	8	
Permitted Phases		2	6			8
Detector Phase	2	2	1	6	8	8
Switch Phase						
Minimum Initial (s)	15.0	15.0	5.0	15.0	6.0	6.0
Minimum Split (s)	24.0	24.0	11.0	24.0	24.0	24.0
Total Split (s)	45.0	45.0	11.0	56.0	24.0	24.0
Total Split (%)	56.3%	56.3%	13.8%	70.0%	30.0%	30.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lag	Lag	Lead			
Lead-Lag Optimize?	Yes	Yes	Yes			
Recall Mode	Max	Max	None	Max	None	None
Act Effct Green (s)	39.1	39.1	50.1	50.1	12.2	12.2
Actuated g/C Ratio	0.53	0.53	0.67	0.67	0.16	0.16
v/c Ratio	0.90	0.34	0.76	0.54	0.57	0.31
Control Delay	31.3	7.6	35.3	8.7	36.7	8.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.3	7.6	35.3	8.7	36.7	8.5
LOS	C	A	D	A	D	A
Approach Delay	25.3			14.0	25.4	
Approach LOS	C			B	C	

Intersection Summary	
Cycle Length: 80	
Actuated Cycle Length: 74.3	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.90	
Intersection Signal Delay: 21.2	Intersection LOS: C
Intersection Capacity Utilization 74.7%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 101: Northshore Dr & Tooles Bend Rd

Lane Group	NBT	NBR	SBL	SBT	NWL	NWR
Lane Group Flow (vph)	880	298	168	673	166	110
v/c Ratio	0.90	0.34	0.76	0.54	0.57	0.31
Control Delay	31.3	7.6	35.3	8.7	36.7	8.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.3	7.6	35.3	8.7	36.7	8.5
Queue Length 50th (ft)	338	41	24	133	71	0
Queue Length 95th (ft)	#661	99	#137	262	128	38
Internal Link Dist (ft)	928			822	337	
Turn Bay Length (ft)		75	75		75	
Base Capacity (vph)	980	889	220	1256	429	467
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.90	0.34	0.76	0.54	0.39	0.24

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations						
Traffic Volume (vph)	810	274	155	619	153	101
Future Volume (vph)	810	274	155	619	153	101
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1863	1583	1770	1863	1770	1583
Flt Permitted	1.00	1.00	0.09	1.00	0.95	1.00
Satd. Flow (perm)	1863	1583	165	1863	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	880	298	168	673	166	110
RTOR Reduction (vph)	0	56	0	0	0	92
Lane Group Flow (vph)	880	242	168	673	166	18
Turn Type	NA	Perm	pm+pt	NA	Prot	Perm
Protected Phases	2		1	6	8	
Permitted Phases		2	6			8
Actuated Green, G (s)	39.1	39.1	50.1	50.1	12.2	12.2
Effective Green, g (s)	39.1	39.1	50.1	50.1	12.2	12.2
Actuated g/C Ratio	0.53	0.53	0.67	0.67	0.16	0.16
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	980	833	219	1256	290	259
v/s Ratio Prot	c0.47		0.05	c0.36	c0.09	
v/s Ratio Perm		0.15	0.46			0.01
v/c Ratio	0.90	0.29	0.77	0.54	0.57	0.07
Uniform Delay, d1	15.8	9.8	14.9	6.2	28.6	26.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	12.7	0.9	14.8	1.6	2.7	0.1
Delay (s)	28.5	10.7	29.7	7.8	31.4	26.4
Level of Service	C	B	C	A	C	C
Approach Delay (s)	24.0			12.2	29.4	
Approach LOS	C			B	C	

Intersection Summary			
HCM 2000 Control Delay	20.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	74.3	Sum of lost time (s)	18.0
Intersection Capacity Utilization	74.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Roundabout Analysis

LANE SUMMARY

Site: 101 [AM Peak Hr 2028 HCM 2010]

New Site
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: S. Northshore Dr.													
Lane 1[d]	875	3.0	1257	0.696	100	12.6	LOS B	7.7	196.7	Full	1600	0.0	0.0
Approach	875	3.0		0.696		12.6	LOS B	7.7	196.7				
East: Tooles Bend Rd													
Lane 1[d]	386	3.0	585	0.660	100	20.6	LOS C	5.2	132.8	Full	1600	0.0	0.0
Approach	386	3.0		0.660		20.6	LOS C	5.2	132.8				
North: S. Northshore Dr.													
Lane 1[d]	745	3.0	1049	0.710	100	14.9	LOS B	11.6	297.1	Full	1600	0.0	0.0
Approach	745	3.0		0.710		14.9	LOS B	11.6	297.1				
Intersection	2005	3.0		0.710		15.0	LOS B	11.6	297.1				

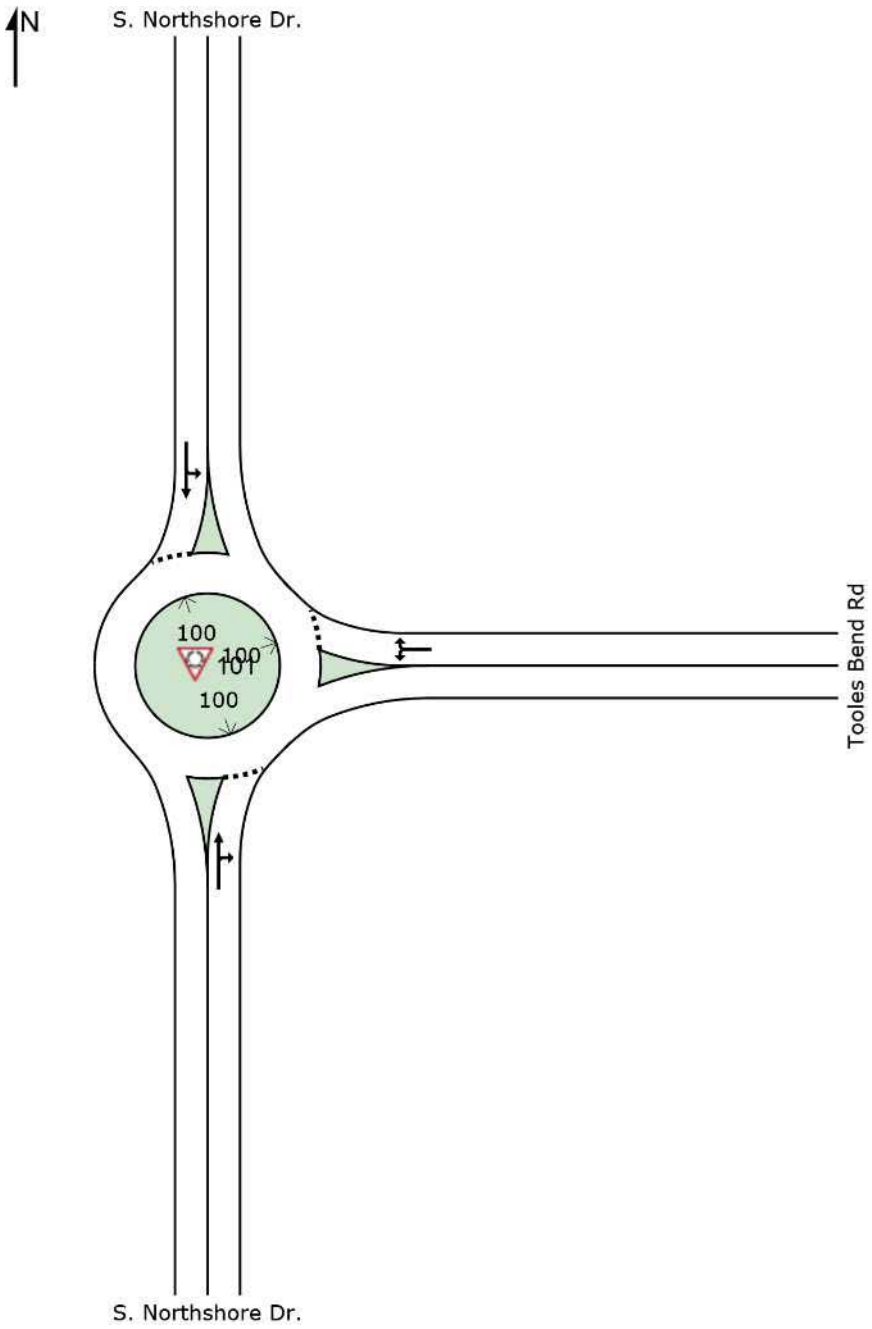
Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

SITE LAYOUT

Site: 101 [AM Peak Hr 2028 HCM 2010]

New Site
Roundabout



LANE SUMMARY

Site: 101 [PM Peak Hr 2028 HCM 2010]

New Site
Roundabout

Lane Use and Performance	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: S. Northshore Dr.													
Lane 1[d]	1178	3.0	922	1.278	100	149.7	LOS F	134.0	3431.6	Full	1600	0.0	36.8
Approach	1178	3.0		1.278		149.7	LOS F	134.0	3431.6				
East: Tooles Bend Rd													
Lane 1[d]	276	3.0	539	0.512	100	16.0	LOS C	2.8	72.5	Full	1600	0.0	0.0
Approach	276	3.0		0.512		16.0	LOS C	2.8	72.5				
North: S. Northshore Dr.													
Lane 1[d]	841	3.0	924	0.910	100	33.0	LOS D	36.8	941.2	Full	1600	0.0	0.0
Approach	841	3.0		0.910		33.0	LOS D	36.8	941.2				
Intersection	2296	3.0		1.278		90.9	LOS F	134.0	3431.6				

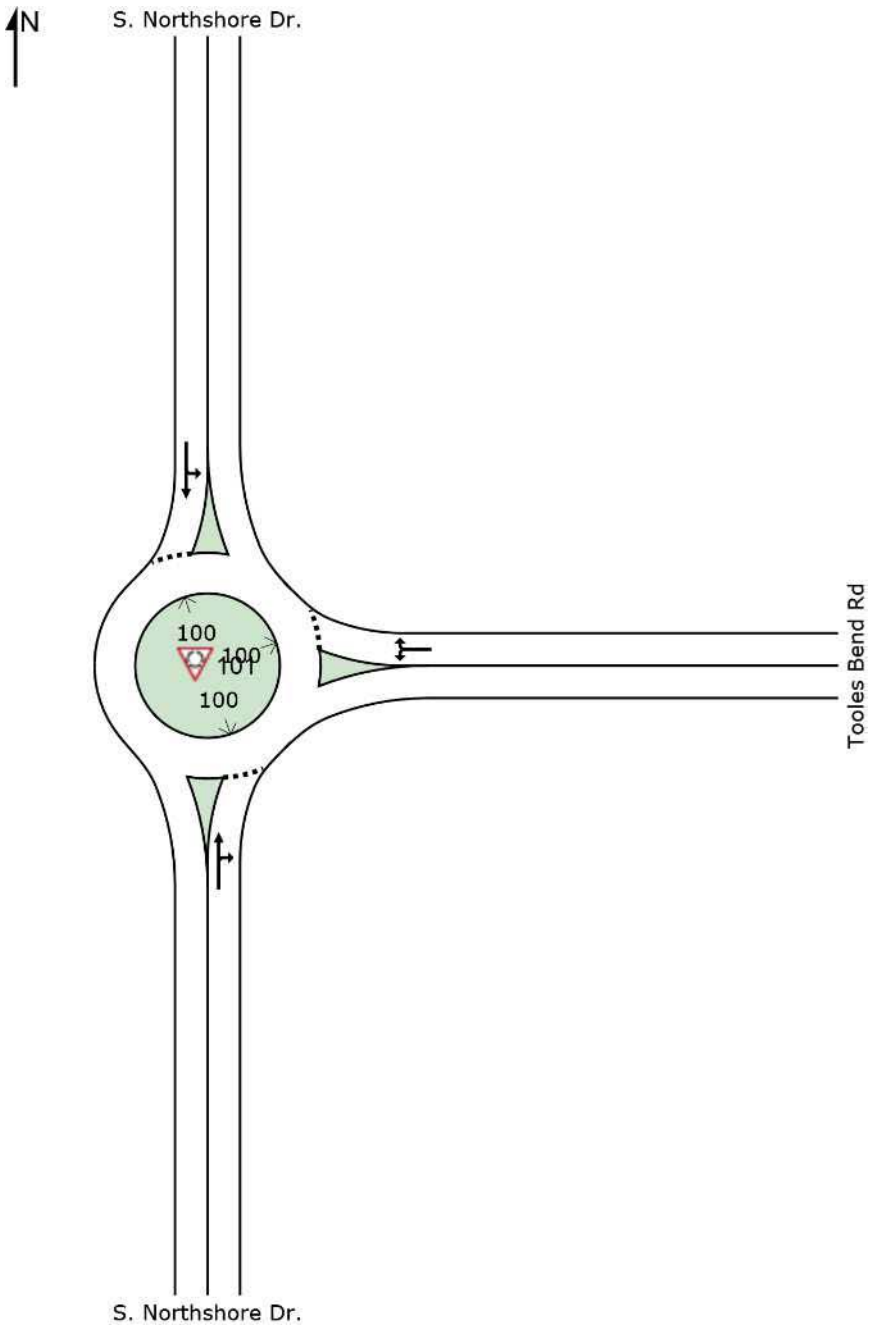
Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

SITE LAYOUT

Site: 101 [PM Peak Hr 2028 HCM 2010]

New Site
Roundabout



LANE SUMMARY

Site: 101 [AM Peak Hr 2028 - MIT HCM 2010]

add separate rt lane on Northshore Dr
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: S. Northshore Dr.													
Lane 1[d]	789	3.0	1030	0.766	100	17.7	LOS C	8.3	211.8	Full	1600	0.0	0.0
Lane 2	86	3.0	1626	0.053	100	0.0	LOS A	0.0	0.0	Short	200	0.0	NA
Approach	875	3.0		0.766		16.0	LOS C	8.3	211.8				
East: Tooles Bend Rd													
Lane 1[d]	386	3.0	487	0.793	100	34.1	LOS D	7.3	186.3	Full	1600	0.0	0.0
Approach	386	3.0		0.793		34.1	LOS D	7.3	186.3				
North: S. Northshore Dr.													
Lane 1[d]	745	3.0	863	0.862	100	28.3	LOS D	24.3	623.0	Full	1600	0.0	0.0
Approach	745	3.0		0.862		28.3	LOS D	24.3	623.0				
Intersection	2005	3.0		0.862		24.0	LOS C	24.3	623.0				

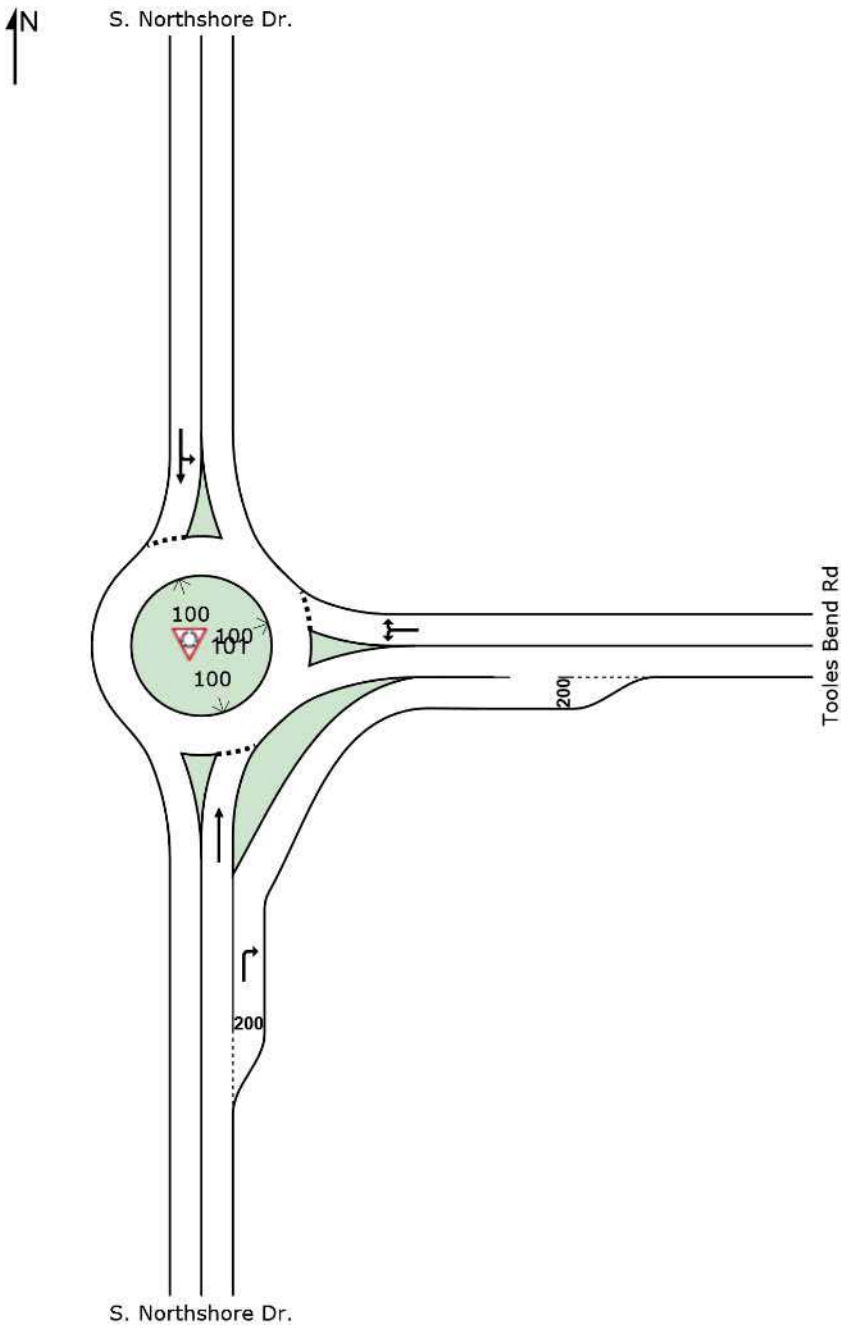
Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

SITE LAYOUT

Site: 101 [AM Peak Hr 2028 - MIT HCM 2010]

add separate rt lane on Northshore Dr
Roundabout



LANE SUMMARY

Site: 101 [PM Peak Hr 2028 - MIT HCM 2010]

add separate rt lane on Northshore Dr
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: S. Northshore Dr.													
Lane 1[d]	880	3.0	922	0.955	100	40.7	LOS E	46.5	1189.9	Full	1600	0.0	0.0
Lane 2	298	3.0	1626	0.183	100	0.0	LOS A	0.0	0.0	Short	200	0.0	NA
Approach	1178	3.0		0.955		30.4	LOS D	46.5	1189.9				
East: Tooles Bend Rd													
Lane 1[d]	276	3.0	443	0.623	100	23.8	LOS C	3.7	94.1	Full	1600	0.0	0.0
Approach	276	3.0		0.623		23.8	LOS C	3.7	94.1				
North: S. Northshore Dr.													
Lane 1[d]	841	3.0	924	0.910	100	33.0	LOS D	36.8	941.2	Full	1600	0.0	0.0
Approach	841	3.0		0.910		33.0	LOS D	36.8	941.2				
Intersection	2296	3.0		0.955		30.5	LOS D	46.5	1189.9				

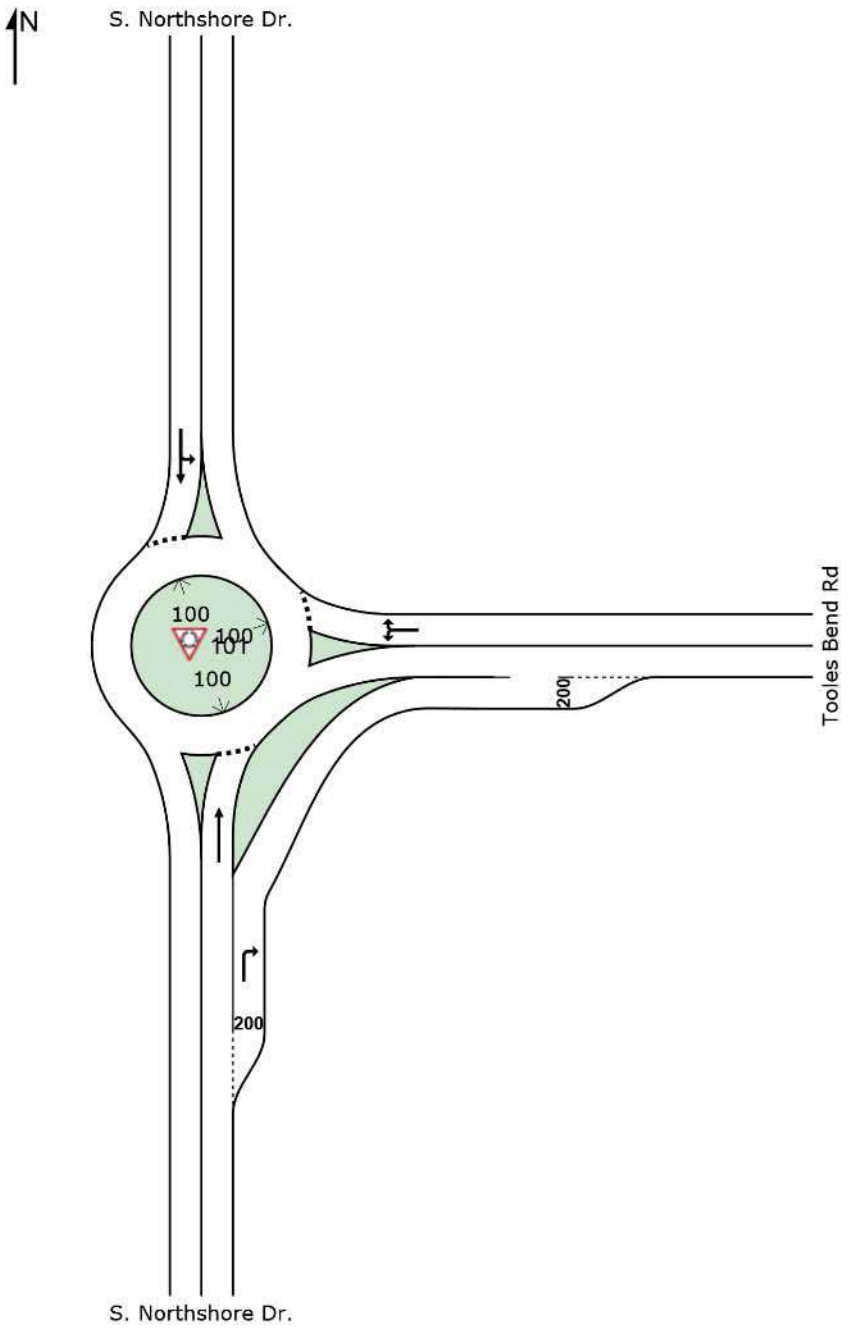
Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

SITE LAYOUT

Site: 101 [PM Peak Hr 2028 - MIT HCM 2010]

add separate rt lane on Northshore Dr
Roundabout



Roundabout Analysis (from June 2018 study)

SINGLE LANE ROUNDABOUT	AM - SINGLE LANE ROUNDABOUT						AM - SINGLE LANE ROUNDABOUT WITH BY-PASS LANE						PM - SINGLE LANE ROUNDABOUT						PM - SINGLE LANE ROUNDABOUT WITH BY-PASS LANE					
	WB		NB		SB		WB		NB		SB		WB		NB		SB		WB		NB		SB	
	L	R	T	R	L	T	L	R	T	R	L	T	L	R	T	R	L	T	L	R	T	R	L	T
Volume	193	127	726	80	57	629	193	127	726	80	57	629	147	96	810	256	143	619	147	96	810	256	143	619
Lane Delay (s/veh)																								
HCM 6																								
SIDRA HCM 6		17.8		12.7		14.0		45.0	15.8	0.0		29.3		20.4		143.6		32.9		34.7	32.5	0.0		32.9
HCS 7.5 HCM 6		17.7		12.7		14.0		17.7	10.7	3.4		14.0		15.8		50.7		15.0		15.8	16.9	5.4		15.0
Synchro 10 HCM 6		17.1		12.4		13.6		19.0	10.5	0.0		10.5		15.2		47.2		14.5		15.2	16.3	0.0		14.5
HCM 2010																								
SIDRA HCS 2010		17.8		12.7		14.0		27.4	17.8	0.0		25.9		16.0		133.8		30.1		22.4	37.9	0.0		30.1
HCS 2010		27.5		24.0		26.0		27.5	17.8	4.2		26.0		22.4		133.9		30.1		22.4	37.9	7.0		30.1
Synchro 10 HCS 2010		26.2		22.9		24.8		26.2	17.2	0.0		24.8		21.5		127.8		28.5		22.5	36.6	7.0		29.8
SIDRA STANDARD																								
SIDRA STANDARD		16.4		13.0		14.6		15.5	8.1	0.0		15.3		20.7		54.1		15.8		17.4	11.2	0.0		16.6
Lane LOS																								
HCM 6																								
SIDRA HCM 6		C		B		B		E	C	A		D		C		F		D		D	D	A		D
HCS 7.5 HCM 6		C		B		B		C	B	A		B		C		F		B		C	C	A		B
Synchro 10 HCM 6		C		B		B		C	B	A		B		C		F		B		C	C	A		B
HCM 2010																								
SIDRA HCS 2010		C		B		B		D	C	A		D		C		F		D		C	E	A		D
HCS 2010		D		C		D		D	C	A		D		C		F		D		C	E	A		D
Synchro 10 HCS 2010		D		C		D		D	C	A		C		C		F		D		C	E	A		D
SIDRA STANDARD																								
SIDRA STANDARD		C		B		B		C	A	A		C		C		F		C		C	B	A		C
95% Queue, (ft)																								
HCM 6																								
SIDRA HCM 6		106		198		265		225	210	0		700		94		3,416		962		131	1,011	-		962
HCS 7.5 HCM 6		98		155		148		98	118	5		148		68		555		173		68	205	25		173
Synchro 10 HCM 6		100		150		150		100	125	0		150		75		525		175		75	200	25		175
SimTraffic 10		132		300		202		160	203	0		176		305		11,613		259		121	558	25		201
HCM 2010																								
SIDRA HCS 2010		106		198		265		139	212	0		593		69		3,273		852		86	1,149	-		852
HCS 2010		143		275		255		143	195	8		255		95		978		310		95	378	33		310
Synchro 10 HCS 2010		125		275		250		125	200	0		250		100		950		300		100	375	25		300
SimTraffic 10		132		300		202		160	203	0		176		305		11,613		259		121	558	25		201
SIDRA STANDARD																								
SIDRA STANDARD		145		249		287		134	145	0		314		149		1,944		308		122	191	0		352
Approach Delay (s/veh)																								
HCM 6																								
SIDRA HCM 6	17.80		12.70		14.00		45.00		14.20		29.30		20.40		143.60		32.90		34.70		24.70		32.90	
HCS 7.5 HCM 6	17.70		12.70		14.00		17.70		10.00		14.00		15.80		50.70		15.00		15.80		14.10		15.00	
Synchro 10 HCM 6	17.10		12.40		13.60		17.10		10.50		13.60		15.20		47.20		14.50		15.20		16.30		14.50	
HCM 2010																								
SIDRA HCS 2010	17.80		12.70		14.00		27.40		16.00		25.90		16.00		133.80		30.10		22.40		28.80		30.10	
HCS 2010	27.46		23.96		25.97		27.46		16.46		25.97		22.40		133.94		30.14		22.40		30.48		30.14	
Synchro 10 HCS 2010	26.20		22.90		24.80		26.20		17.20		24.80		21.50		127.80		28.50		22.50		29.40		29.80	
SIDRA STANDARD																								
SIDRA STANDARD	16.4		13		14.6		15.5		7.3		15.3		20.7		54.1		15.8		17.4		8.5		16.6	
Approach LOS																								
HCM 6																								
SIDRA HCM 6	C		B		B		E		B		D		C		F		D		D		C		D	
HCS 7.5 HCM 6	C		B		B		C		B		B		C		F		B		C		B		B	
Synchro 10 HCM 6	C		B		B		C		B		B		C		E		B		C		C		B	
HCM 2010																								
SIDRA HCS 2010	C		B		B		D		C		D		C		F		D		C		D		D	
HCS 2010	D		C		D		D		C		D		C		F		D		C		D		D	
Synchro 10 HCS 2010	D		C		C		D		C		C		C		F		D		C		D		D	
SIDRA STANDARD																								
SIDRA STANDARD	C		B		B		C		A		C		C		F		C		C		A		C	
Intersection Delay (s/veh | LOS)																								
HCM 6																								
SIDRA HCM 6	14.10		B		25.40		D		88.40		F		28.90		D									
HCS 7.5 HCM 6	14.10		B		12.90		B		33.40		D		14.60		B									
Synchro 10 HCM 6	13.70		B		13.00		B		31.40		D		15.40		C									
HCM 2010																								
SIDRA HCS 2010	14.10		B		21.80		C		81.80		F		28.50		D									
HCS 2010	25.34		D		22.01		C		82.68		F		29.41		D									
Synchro 10 HCS 2010	24.20		C		21.90		C		78.80		F		28.70		D									
SIDRA STANDARD																								
SIDRA STANDARD	14.20		B		11.80		B		36.10		E		12.50		B									

Lane Group	NBT	NBR	SBL	SBT	NWL	NWR
Traffic Volume (vph)	726	80	57	629	193	127
Future Volume (vph)	726	80	57	629	193	127
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Adj. Flow (vph)	789	87	62	684	210	138
Shared Lane Traffic (%)						
Lane Group Flow (vph)	876	0	0	746	348	0

Intersection Summary

Intersection	
Intersection Delay, s/veh	24.2
Intersection LOS	C

Approach	NB	SB	NW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	876	746	348
Demand Flow Rate, veh/h	894	761	355
Vehicles Circulating, veh/h	63	214	805
Vehicles Exiting, veh/h	912	946	152
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	22.9	24.8	26.2
Approach LOS	C	C	D

Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	894	761	355
Cap Entry Lane, veh/h	1061	912	505
Entry HV Adj Factor	0.980	0.981	0.980
Flow Entry, veh/h	876	746	348
Cap Entry, veh/h	1040	895	495
V/C Ratio	0.843	0.834	0.703
Control Delay, s/veh	22.9	24.8	26.2
LOS	C	C	D
95th %tile Queue, veh	11	10	5

Intersection	
Intersection Delay, s/veh	13.7
Intersection LOS	B

Approach	NB	SB	NW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	876	746	348
Demand Flow Rate, veh/h	894	761	355
Vehicles Circulating, veh/h	63	214	805
Vehicles Exiting, veh/h	912	946	152
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	12.4	13.6	17.1
Approach LOS	B	B	C

Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	894	761	355
Cap Entry Lane, veh/h	1294	1109	607
Entry HV Adj Factor	0.980	0.981	0.980
Flow Entry, veh/h	876	746	348
Cap Entry, veh/h	1268	1088	595
V/C Ratio	0.691	0.686	0.585
Control Delay, s/veh	12.4	13.6	17.1
LOS	B	B	C
95th %tile Queue, veh	6	6	4

Intersection: 101: Northshore Dr & Tooles Bend Rd

Movement	NB	SB	NW
Directions Served	TR	LT	LR
Maximum Queue (ft)	376	269	166
Average Queue (ft)	114	82	77
95th Queue (ft)	300	202	132
Link Distance (ft)	15244	9338	305
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 102: Tooles Bend Rd & Badgett Rd

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (ft)	62	45
Average Queue (ft)	20	6
95th Queue (ft)	46	30
Link Distance (ft)	903	855
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 103: Tooles Bend Rd & Tedford Ln

Movement	EB	NB
Directions Served	LR	LT
Maximum Queue (ft)	29	44
Average Queue (ft)	10	3
95th Queue (ft)	32	21
Link Distance (ft)	669	234
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 104: Tooles Bend Rd & North Access

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (ft)	52	66
Average Queue (ft)	25	6
95th Queue (ft)	43	32
Link Distance (ft)	1214	1845
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 105: Tooles Bend Rd & Apt Access

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (ft)	44	29
Average Queue (ft)	22	2
95th Queue (ft)	46	14
Link Distance (ft)	68	234
Upstream Blk Time (%)	0	
Queuing Penalty (veh)	0	
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 106: Tooles Bend Rd & South Access

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (ft)	74	41
Average Queue (ft)	42	4
95th Queue (ft)	65	24
Link Distance (ft)	381	2775
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 0

Lane Group	NBT	NBR	SBL	SBT	NWL	NWR
Traffic Volume (vph)	726	0	57	629	193	127
Future Volume (vph)	726	0	57	629	193	127
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Adj. Flow (vph)	789	0	62	684	210	138
Shared Lane Traffic (%)						
Lane Group Flow (vph)	789	0	0	746	348	0

Intersection Summary

Intersection	
Intersection Delay, s/veh	21.9
Intersection LOS	C

Approach	NB	SB	NW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	789	746	348
Demand Flow Rate, veh/h	805	761	355
Vehicles Circulating, veh/h	63	214	805
Vehicles Exiting, veh/h	912	946	63
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	17.2	24.8	26.2
Approach LOS	C	C	D

Lane	Left	Left	Left
Designated Moves	T	LT	LR
Assumed Moves	T	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	805	761	355
Cap Entry Lane, veh/h	1061	912	505
Entry HV Adj Factor	0.980	0.981	0.980
Flow Entry, veh/h	789	746	348
Cap Entry, veh/h	1040	895	495
V/C Ratio	0.759	0.834	0.703
Control Delay, s/veh	17.2	24.8	26.2
LOS	C	C	D
95th %tile Queue, veh	8	10	5

Intersection	
Intersection Delay, s/veh	13.0
Intersection LOS	B

Approach	NB	SB	NW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	789	746	348
Demand Flow Rate, veh/h	805	761	355
Vehicles Circulating, veh/h	63	214	805
Vehicles Exiting, veh/h	912	946	63
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	10.5	13.6	17.1
Approach LOS	B	B	C

Lane	Left	Left	Left
Designated Moves	T	LT	LR
Assumed Moves	T	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	805	761	355
Cap Entry Lane, veh/h	1294	1109	607
Entry HV Adj Factor	0.980	0.981	0.980
Flow Entry, veh/h	789	746	348
Cap Entry, veh/h	1269	1088	595
V/C Ratio	0.622	0.686	0.585
Control Delay, s/veh	10.5	13.6	17.1
LOS	B	B	C
95th %tile Queue, veh	5	6	4

Intersection: 101: Northshore Dr & Tooles Bend Rd

Movement	NB	SB	NW
Directions Served	T	LT	LR
Maximum Queue (ft)	247	232	208
Average Queue (ft)	74	76	87
95th Queue (ft)	203	176	160
Link Distance (ft)	15244	9338	305
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 102: Tooles Bend Rd & Badgett Rd

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (ft)	50	40
Average Queue (ft)	19	3
95th Queue (ft)	43	20
Link Distance (ft)	903	855
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 103: Tooles Bend Rd & Tedford Ln

Movement	EB	NB
Directions Served	LR	LT
Maximum Queue (ft)	29	57
Average Queue (ft)	10	4
95th Queue (ft)	32	25
Link Distance (ft)	669	234
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 104: Tooles Bend Rd & North Access

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (ft)	57	58
Average Queue (ft)	25	6
95th Queue (ft)	47	30
Link Distance (ft)	1214	1845
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 105: Tooles Bend Rd & Apt Access

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (ft)	53	19
Average Queue (ft)	20	1
95th Queue (ft)	47	9
Link Distance (ft)	68	234
Upstream Blk Time (%)	0	
Queuing Penalty (veh)	0	
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 106: Tooles Bend Rd & South Access

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (ft)	79	54
Average Queue (ft)	42	5
95th Queue (ft)	66	27
Link Distance (ft)	381	2775
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 0

Lane Group	NBT	NBR	SBL	SBT	NWL	NWR
Traffic Volume (vph)	810	256	143	619	147	96
Future Volume (vph)	810	256	143	619	147	96
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Adj. Flow (vph)	880	278	155	673	160	104
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1158	0	0	828	264	0

Intersection Summary

Intersection	
Intersection Delay, s/veh	78.8
Intersection LOS	F

Approach	NB	SB	NW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	1158	828	264
Demand Flow Rate, veh/h	1182	844	269
Vehicles Circulating, veh/h	158	163	898
Vehicles Exiting, veh/h	849	1004	442
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	127.8	28.5	21.5
Approach LOS	F	D	C

Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	1182	844	269
Cap Entry Lane, veh/h	965	960	460
Entry HV Adj Factor	0.980	0.981	0.981
Flow Entry, veh/h	1158	828	264
Cap Entry, veh/h	946	941	452
V/C Ratio	1.225	0.879	0.584
Control Delay, s/veh	127.8	28.5	21.5
LOS	F	D	C
95th %tile Queue, veh	38	12	4

Intersection	
Intersection Delay, s/veh	31.4
Intersection LOS	D

Approach	NB	SB	NW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	1158	828	264
Demand Flow Rate, veh/h	1182	844	269
Vehicles Circulating, veh/h	158	163	898
Vehicles Exiting, veh/h	849	1004	442
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	47.2	14.5	15.2
Approach LOS	E	B	C

Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	1182	844	269
Cap Entry Lane, veh/h	1174	1169	552
Entry HV Adj Factor	0.980	0.981	0.981
Flow Entry, veh/h	1158	828	264
Cap Entry, veh/h	1151	1146	542
V/C Ratio	1.006	0.722	0.487
Control Delay, s/veh	47.2	14.5	15.2
LOS	F	B	C
95th %tile Queue, veh	21	7	3

Intersection: 101: Northshore Dr & Tooles Bend Rd

Movement	NB	SB	NW
Directions Served	TR	LT	LR
Maximum Queue (ft)	9885	314	165
Average Queue (ft)	7407	106	61
95th Queue (ft)	11613	259	119
Link Distance (ft)	13574	11876	305
Upstream Blk Time (%)	0		
Queuing Penalty (veh)	0		
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 102: Tooles Bend Rd & Badgett Rd

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (ft)	49	53
Average Queue (ft)	21	8
95th Queue (ft)	46	35
Link Distance (ft)	903	855
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 103: Tooles Bend Rd & Tedford Ln

Movement	EB	NB
Directions Served	LR	LT
Maximum Queue (ft)	48	49
Average Queue (ft)	25	3
95th Queue (ft)	46	23
Link Distance (ft)	669	234
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 104: Tooles Bend Rd & North Access

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (ft)	51	67
Average Queue (ft)	18	12
95th Queue (ft)	40	46
Link Distance (ft)	1214	1845
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 105: Tooles Bend Rd & Apt Access

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (ft)	35	35
Average Queue (ft)	14	4
95th Queue (ft)	38	21
Link Distance (ft)	68	234
Upstream Blk Time (%)	0	
Queuing Penalty (veh)	0	
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 106: Tooles Bend Rd & South Access

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (ft)	66	79
Average Queue (ft)	37	11
95th Queue (ft)	57	47
Link Distance (ft)	381	2775
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 0

Lane Group	NBT	NBR	SBL	SBT	NWL	NWR
Traffic Volume (vph)	810	0	143	619	147	96
Future Volume (vph)	810	0	143	619	147	96
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Adj. Flow (vph)	880	0	155	673	160	104
Shared Lane Traffic (%)						
Lane Group Flow (vph)	880	0	0	828	264	0

Intersection Summary

Intersection	
Intersection Delay, s/veh	30.8
Intersection LOS	D

Approach	NB	SB	NW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	880	828	264
Demand Flow Rate, veh/h	898	844	269
Vehicles Circulating, veh/h	158	163	898
Vehicles Exiting, veh/h	849	1004	158
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	35.7	28.5	21.5
Approach LOS	E	D	C

Lane	Left	Left	Left
Designated Moves	T	LT	LR
Assumed Moves	T	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	898	844	269
Cap Entry Lane, veh/h	965	960	460
Entry HV Adj Factor	0.980	0.981	0.981
Flow Entry, veh/h	880	828	264
Cap Entry, veh/h	946	941	452
V/C Ratio	0.931	0.879	0.584
Control Delay, s/veh	35.7	28.5	21.5
LOS	E	D	C
95th %tile Queue, veh	15	12	4

Intersection	
Intersection Delay, s/veh	15.4
Intersection LOS	C

Approach	NB	SB	NW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	880	828	264
Demand Flow Rate, veh/h	898	844	269
Vehicles Circulating, veh/h	158	163	898
Vehicles Exiting, veh/h	849	1004	158
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	16.3	14.5	15.2
Approach LOS	C	B	C

Lane	Left	Left	Left
Designated Moves	T	LT	LR
Assumed Moves	T	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	898	844	269
Cap Entry Lane, veh/h	1174	1169	552
Entry HV Adj Factor	0.980	0.981	0.981
Flow Entry, veh/h	880	828	264
Cap Entry, veh/h	1151	1146	542
V/C Ratio	0.765	0.722	0.487
Control Delay, s/veh	16.3	14.5	15.2
LOS	C	B	C
95th %tile Queue, veh	8	7	3

Intersection: 101: Northshore Dr & Tooles Bend Rd

Movement	NB	SB	NW
Directions Served	T	LT	LR
Maximum Queue (ft)	688	250	150
Average Queue (ft)	245	86	67
95th Queue (ft)	558	201	121
Link Distance (ft)	13574	11876	305
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 102: Tooles Bend Rd & Badgett Rd

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (ft)	55	57
Average Queue (ft)	23	7
95th Queue (ft)	48	34
Link Distance (ft)	903	855
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 103: Tooles Bend Rd & Tedford Ln

Movement	EB	NB
Directions Served	LR	LT
Maximum Queue (ft)	51	34
Average Queue (ft)	25	4
95th Queue (ft)	47	22
Link Distance (ft)	669	234
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 104: Tooles Bend Rd & North Access

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (ft)	46	76
Average Queue (ft)	19	11
95th Queue (ft)	38	47
Link Distance (ft)	1214	1845
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 105: Tooles Bend Rd & Apt Access

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (ft)	35	52
Average Queue (ft)	16	5
95th Queue (ft)	40	29
Link Distance (ft)	68	234
Upstream Blk Time (%)	0	
Queuing Penalty (veh)	0	
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 106: Tooles Bend Rd & South Access

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (ft)	75	45
Average Queue (ft)	39	6
95th Queue (ft)	62	30
Link Distance (ft)	381	2775
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 0

LANE SUMMARY

Site: 101 [AM Peak Hr 2028 HCM 6]

New Site
Roundabout

Lane Use and Performance	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: Northshore Dr													
Lane 1[d]	876	3.0	1255	0.698	100	12.7	LOS B	7.7	197.5	Full	1600	0.0	0.0
Approach	876	3.0		0.698		12.7	LOS B	7.7	197.5				
East: Tooles Bend Rd													
Lane 1[d]	348	3.0	585	0.595	100	17.8	LOS C	4.1	105.8	Full	1600	0.0	0.0
Approach	348	3.0		0.595		17.8	LOS C	4.1	105.8				
North: Northshore Dr													
Lane 1[d]	746	3.0	1075	0.694	100	14.0	LOS B	10.3	264.6	Full	1600	0.0	0.0
Approach	746	3.0		0.694		14.0	LOS B	10.3	264.6				
Intersection	1970	3.0		0.698		14.1	LOS B	10.3	264.6				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [AM Peak Hr 2028 HCM 2010]

New Site
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: Northshore Dr													
Lane 1[d]	876	3.0	1255	0.698	100	12.7	LOS B	7.7	197.5	Full	1600	0.0	0.0
Approach	876	3.0		0.698		12.7	LOS B	7.7	197.5				
East: Tooles Bend Rd													
Lane 1[d]	348	3.0	585	0.595	100	17.8	LOS C	4.1	105.8	Full	1600	0.0	0.0
Approach	348	3.0		0.595		17.8	LOS C	4.1	105.8				
North: Northshore Dr													
Lane 1[d]	746	3.0	1075	0.694	100	14.0	LOS B	10.3	264.6	Full	1600	0.0	0.0
Approach	746	3.0		0.694		14.0	LOS B	10.3	264.6				
Intersection	1970	3.0		0.698		14.1	LOS B	10.3	264.6				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [AM Peak Hr 2028 Sidra Std]

New Site
Roundabout

Lane Use and Performance	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: Northshore Dr													
Lane 1[d]	876	3.0	1244	0.704	100	13.0	LOS B	9.7	249.3	Full	1600	0.0	0.0
Approach	876	3.0		0.704		13.0	LOS B	9.7	249.3				
East: Tooles Bend Rd													
Lane 1[d]	348	3.0	609	0.572	100	16.4	LOS C	5.7	145.0	Full	1600	0.0	0.0
Approach	348	3.0		0.572		16.4	LOS C	5.7	145.0				
North: Northshore Dr													
Lane 1[d]	746	3.0	1057	0.705	100	14.6	LOS B	11.2	287.1	Full	1600	0.0	0.0
Approach	746	3.0		0.705		14.6	LOS B	11.2	287.1				
Intersection	1970	3.0		0.705		14.2	LOS B	11.2	287.1				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [AM Peak Hr 2028 - MIT HCM 6]

add separate rt lane on Northshore Dr
Roundabout

Lane Use and Performance													
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: Northshore Dr													
Lane 1[d]	789	3.0	1072	0.736	100	15.8	LOS C	8.2	210.1	Full	1600	0.0	0.0
Lane 2	87	3.0	1626	0.053	100	0.0	LOS A	0.0	0.0	Short	200	0.0	NA
Approach	876	3.0		0.736		14.2	LOS B	8.2	210.1				
East: Tooles Bend Rd													
Lane 1[d]	348	3.0	413	0.842	100	45.0	LOS E	8.8	225.0	Full	1600	0.0	0.0
Approach	348	3.0		0.842		45.0	LOS E	8.8	225.0				
North: Northshore Dr													
Lane 1[d]	746	3.0	857	0.870	100	29.3	LOS D	27.4	700.3	Full	1600	0.0	0.0
Approach	746	3.0		0.870		29.3	LOS D	27.4	700.3				
Intersection	1970	3.0		0.870		25.4	LOS D	27.4	700.3				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [AM Peak Hr 2028 - MIT HCM 2010]

add separate rt lane on Northshore Dr
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: Northshore Dr													
Lane 1[d]	789	3.0	1029	0.767	100	17.8	LOS C	8.3	212.1	Full	1600	0.0	0.0
Lane 2	87	3.0	1626	0.053	100	0.0	LOS A	0.0	0.0	Short	200	0.0	NA
Approach	876	3.0		0.767		16.0	LOS C	8.3	212.1				
East: Tooles Bend Rd													
Lane 1[d]	348	3.0	487	0.715	100	27.4	LOS D	5.4	138.7	Full	1600	0.0	0.0
Approach	348	3.0		0.715		27.4	LOS D	5.4	138.7				
North: Northshore Dr													
Lane 1[d]	746	3.0	884	0.844	100	25.9	LOS D	23.1	592.5	Full	1600	0.0	0.0
Approach	746	3.0		0.844		25.9	LOS D	23.1	592.5				
Intersection	1970	3.0		0.844		21.8	LOS C	23.1	592.5				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [AM Peak Hr 2028 - MIT Sidra Std]

add separate rt lane on Northshore Dr
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: Northshore Dr													
Lane 1[d]	789	3.0	1450	0.544	100	8.1	LOS A	5.7	145.4	Full	1600	0.0	0.0
Lane 2	87	3.0	1626	0.053	100	0.0	LOS A	0.0	0.0	Short	200	0.0	NA
Approach	876	3.0		0.544		7.3	LOS A	5.7	145.4				
East: Tooles Bend Rd													
Lane 1[d]	348	3.0	625	0.556	100	15.5	LOS C	5.2	134.0	Full	1600	0.0	0.0
Approach	348	3.0		0.556		15.5	LOS C	5.2	134.0				
North: Northshore Dr													
Lane 1[d]	746	3.0	1039	0.718	100	15.3	LOS C	12.3	313.6	Full	1600	0.0	0.0
Approach	746	3.0		0.718		15.3	LOS C	12.3	313.6				
Intersection	1970	3.0		0.718		11.8	LOS B	12.3	313.6				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [PM Peak Hr 2028 HCS 6]

New Site
Roundabout

Lane Use and Performance	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: Northshore Dr													
Lane 1[d]	1159	3.0	918	1.262	100	143.6	LOS F	133.4	3415.6	Full	1600	0.0	36.5
Approach	1159	3.0		1.262		143.6	LOS F	133.4	3415.6				
East: Tooles Bend Rd													
Lane 1[d]	264	3.0	463	0.570	100	20.4	LOS C	3.7	93.8	Full	1600	0.0	0.0
Approach	264	3.0		0.570		20.4	LOS C	3.7	93.8				
North: Northshore Dr													
Lane 1[d]	828	3.0	913	0.907	100	32.9	LOS D	37.6	962.2	Full	1600	0.0	0.0
Approach	828	3.0		0.907		32.9	LOS D	37.6	962.2				
Intersection	2251	3.0		1.262		88.4	LOS F	133.4	3415.6				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [PM Peak Hr 2028 HCM 2010]

New Site
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: Northshore Dr													
Lane 1[d]	1159	3.0	935	1.240	100	133.8	LOS F	127.8	3272.6	Full	1600	0.0	33.7
Approach	1159	3.0		1.240		133.8	LOS F	127.8	3272.6				
East: Tooles Bend Rd													
Lane 1[d]	264	3.0	528	0.500	100	16.0	LOS C	2.7	68.6	Full	1600	0.0	0.0
Approach	264	3.0		0.500		16.0	LOS C	2.7	68.6				
North: Northshore Dr													
Lane 1[d]	828	3.0	931	0.890	100	30.1	LOS D	33.3	851.6	Full	1600	0.0	0.0
Approach	828	3.0		0.890		30.1	LOS D	33.3	851.6				
Intersection	2251	3.0		1.240		81.8	LOS F	127.8	3272.6				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [PM Peak Hr 2028 Sidra Std]

New Site
Roundabout

Lane Use and Performance													
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: Northshore Dr													
Lane 1[d]	1159	3.0	1125	1.030	100	54.1	LOS F	75.9	1943.9	Full	1600	0.0	11.1
Approach	1159	3.0		1.030		54.1	LOS F	75.9	1943.9				
East: Tooles Bend Rd													
Lane 1[d]	264	3.0	460	0.574	100	20.7	LOS C	5.8	148.7	Full	1600	0.0	0.0
Approach	264	3.0		0.574		20.7	LOS C	5.8	148.7				
North: Northshore Dr													
Lane 1[d]	828	3.0	1111	0.746	100	15.8	LOS C	12.0	308.2	Full	1600	0.0	0.0
Approach	828	3.0		0.746		15.8	LOS C	12.0	308.2				
Intersection	2251	3.0		1.030		36.1	LOS E	75.9	1943.9				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [PM Peak Hr 2028 - MIT HCM 6]

add separate rt lane on Northshore Dr
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: Northshore Dr													
Lane 1[d]	880	3.0	965	0.913	100	32.5	LOS D	39.5	1011.0	Full	1600	0.0	0.0
Lane 2	278	3.0	1626	0.171	100	0.0	LOS A	0.0	0.0	Short	200	0.0	NA
Approach	1159	3.0		0.913		24.7	LOS C	39.5	1011.0				
East: Tooles Bend Rd													
Lane 1[d]	264	3.0	368	0.718	100	34.7	LOS D	5.1	130.6	Full	1600	0.0	0.0
Approach	264	3.0		0.718		34.7	LOS D	5.1	130.6				
North: Northshore Dr													
Lane 1[d]	828	3.0	913	0.907	100	32.9	LOS D	37.6	962.2	Full	1600	0.0	0.0
Approach	828	3.0		0.907		32.9	LOS D	37.6	962.2				
Intersection	2251	3.0		0.913		28.9	LOS D	39.5	1011.0				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [PM Peak Hr 2028 - MIT Sidra Std]

add separate rt lane on Northshore Dr
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: Northshore Dr													
Lane 1[d]	880	3.0	1328	0.663	100	11.2	LOS B	7.5	191.0	Full	1600	0.0	0.0
Lane 2	278	3.0	1626	0.171	100	0.0	LOS A	0.0	0.0	Short	200	0.0	NA
Approach	1159	3.0		0.663		8.5	LOS A	7.5	191.0				
East: Tooles Bend Rd													
Lane 1[d]	264	3.0	503	0.525	100	17.4	LOS C	4.8	122.1	Full	1600	0.0	0.0
Approach	264	3.0		0.525		17.4	LOS C	4.8	122.1				
North: Northshore Dr													
Lane 1[d]	828	3.0	1091	0.759	100	16.6	LOS C	13.7	351.5	Full	1600	0.0	0.0
Approach	828	3.0		0.759		16.6	LOS C	13.7	351.5				
Intersection	2251	3.0		0.759		12.5	LOS B	13.7	351.5				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [PM Peak Hr 2028 - MIT HCM 2010]

add separate rt lane on Northshore Dr
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: Northshore Dr													
Lane 1[d]	880	3.0	935	0.942	100	37.9	LOS E	44.9	1149.0	Full	1600	0.0	0.0
Lane 2	278	3.0	1626	0.171	100	0.0	LOS A	0.0	0.0	Short	200	0.0	NA
Approach	1159	3.0		0.942		28.8	LOS D	44.9	1149.0				
East: Tooles Bend Rd													
Lane 1[d]	264	3.0	443	0.596	100	22.4	LOS C	3.4	86.1	Full	1600	0.0	0.0
Approach	264	3.0		0.596		22.4	LOS C	3.4	86.1				
North: Northshore Dr													
Lane 1[d]	828	3.0	931	0.890	100	30.1	LOS D	33.3	851.6	Full	1600	0.0	0.0
Approach	828	3.0		0.890		30.1	LOS D	33.3	851.6				
Intersection	2251	3.0		0.942		28.5	LOS D	44.9	1149.0				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

HCS7 Roundabouts Report

General Information

Analyst	KCole
Agency or Co.	TDOT/Knox County
Date Performed	6/20/2018
Analysis Year	2028
Time Analyzed	AM Peak Hour MIT
Project Description	Riverside Venture Residential Development

Site Information

Intersection	Northshore Dr./Tooles Bend Rd.
E/W Street Name	Tooles Bend Rd.
N/S Street Name	Northshore Dr.
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.92
Jurisdiction	Knox County

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment							LR				T				LT	
Volume (V), veh/h					0	193		127	0		726	80	0	57	629	
Percent Heavy Vehicles, %					3	3		3	3		3	3	3	3	3	
Flow Rate (v_{PCE}), pc/h					0	216		142	0		813	90	0	64	704	
Right-Turn Bypass	None				None				Yielding				None			
Conflicting Lanes					1				1				1			
Pedestrians Crossing, p/h					0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)					4.9763			4.9763	4.9763		4.9763	
Follow-Up Headway (s)					2.6087			2.6087	2.6087		2.6087	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h					358			813	90		768	
Entry Volume veh/h					348			789	87		746	
Circulating Flow (v_c), pc/h	984			813			64			216		
Exiting Flow (v_{ex}), pc/h	64			0			955			920		
Capacity (c_{pce}), pc/h					602			1293	1293		1107	
Capacity (c), veh/h					585			1255	1255		1075	
v/c Ratio (x)					0.59			0.63	0.07		0.69	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh					17.7			10.7	3.4		14.0	
Lane LOS					C			B	A		B	
95% Queue, veh					3.9			4.7	0.2		5.9	
Approach Delay, s/veh				17.7			10.0			14.0		
Approach LOS				C			B			B		
Intersection Delay, s/veh | LOS	12.9						B					

HCS7 Roundabouts Report

General Information

Analyst	KCole
Agency or Co.	TDOT/Knox County
Date Performed	6/20/2018
Analysis Year	2028
Time Analyzed	AM Peak Hour
Project Description	Riverside Venture Residential Development

Site Information

Intersection	Northshore Dr./Tooles Bend Rd.
E/W Street Name	Tooles Bend Rd.
N/S Street Name	Northshore Dr.
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.92
Jurisdiction	Knox County

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment							LR				TR				LT	
Volume (V), veh/h					0	193		127	0		726	80	0	57	629	
Percent Heavy Vehicles, %					3	3		3	3		3	3	3	3	3	
Flow Rate (v_{PCE}), pc/h					0	216		142	0		813	90	0	64	704	
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes					1				1				1			
Pedestrians Crossing, p/h					0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)					4.9763			4.9763			4.9763	
Follow-Up Headway (s)					2.6087			2.6087			2.6087	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h					358			903			768	
Entry Volume veh/h					348			877			746	
Circulating Flow (v_c), pc/h	984			813			64			216		
Exiting Flow (v_{ex}), pc/h	154			0			955			920		
Capacity (c_{pce}), pc/h					602			1293			1107	
Capacity (c), veh/h					585			1255			1075	
v/c Ratio (x)					0.59			0.70			0.69	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh					17.7			12.7			14.0	
Lane LOS					C			B			B	
95% Queue, veh					3.9			6.2			5.9	
Approach Delay, s/veh				17.7			12.7			14.0		
Approach LOS				C			B			B		
Intersection Delay, s/veh | LOS	14.1						B					

HCS7 Roundabouts Report

General Information

Analyst	KCole
Agency or Co.	TDOT/Knox County
Date Performed	6/20/2018
Analysis Year	2028
Time Analyzed	PM Peak Hour
Project Description	Riverside Venture Residential Development

Site Information

Intersection	Northshore Dr./Tooles Bend Rd.
E/W Street Name	Tooles Bend Rd.
N/S Street Name	Northshore Dr.
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.92
Jurisdiction	Knox County

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment							LR				TR				LT	
Volume (V), veh/h					0	147		96	0		810	256	0	143	619	
Percent Heavy Vehicles, %					3	3		3	3		3	3	3	3	3	
Flow Rate (v_{PCE}), pc/h					0	165		107	0		907	287	0	160	693	
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes					1				1				1			
Pedestrians Crossing, p/h					0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)					4.9763			4.9763			4.9763	
Follow-Up Headway (s)					2.6087			2.6087			2.6087	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h					272			1194			853	
Entry Volume veh/h					264			1159			828	
Circulating Flow (v_c), pc/h	1018			907			160			165		
Exiting Flow (v_{ex}), pc/h	447			0			1014			858		
Capacity (c_{pce}), pc/h					547			1172			1166	
Capacity (c), veh/h					531			1138			1132	
v/c Ratio (x)					0.50			1.02			0.73	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh					15.8			50.7			15.0	
Lane LOS					C			F			B	
95% Queue, veh					2.7			22.2			6.9	
Approach Delay, s/veh				15.8			50.7			15.0		
Approach LOS				C			F			B		
Intersection Delay, s/veh | LOS	33.4						D					

HCS7 Roundabouts Report

General Information

Analyst	KCole
Agency or Co.	TDOT/Knox County
Date Performed	6/20/2018
Analysis Year	2028
Time Analyzed	PM Peak Hour
Project Description	Riverside Venture Residential Development

Site Information

Intersection	Northshore Dr./Tooles Bend Rd.
E/W Street Name	Tooles Bend Rd.
N/S Street Name	Northshore Dr.
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.92
Jurisdiction	Knox County

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment							LR				T				LT	
Volume (V), veh/h					0	147		96	0		810	256	0	143	619	
Percent Heavy Vehicles, %					3	3		3	3		3	3	3	3	3	
Flow Rate (v_{PCE}), pc/h					0	165		107	0		907	287	0	160	693	
Right-Turn Bypass	None				None				Yielding				None			
Conflicting Lanes					1				1				1			
Pedestrians Crossing, p/h					0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)					4.9763			4.9763	4.9763		4.9763	
Follow-Up Headway (s)					2.6087			2.6087	2.6087		2.6087	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h					272			907	287		853	
Entry Volume veh/h					264			881	279		828	
Circulating Flow (v_c), pc/h	1018			907			160			165		
Exiting Flow (v_{ex}), pc/h	160			0			1014			858		
Capacity (c_{pce}), pc/h					547			1172	1172		1166	
Capacity (c), veh/h					531			1138	1138		1132	
v/c Ratio (x)					0.50			0.77	0.24		0.73	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh					15.8			16.9	5.4		15.0	
Lane LOS					C			C	A		B	
95% Queue, veh					2.7			8.2	1.0		6.9	
Approach Delay, s/veh				15.8			14.1			15.0		
Approach LOS				C			B			B		
Intersection Delay, s/veh | LOS	14.6						B					

ROUNDABOUT REPORT

General Information		Site Information	
Analyst	*KCOLE*	Intersection	*Northshore Dr./Tooles Bend Rd.*
Agency or Co.	*TDOT/Knox Co*	E/W Street Name	*Tooles Bend Rd.*
Date Performed	*6/20/2018*	N/S Street Name	*Northshore Dr.*
Time Period	*AM*	Analysis Year	*2028*
		Project ID	*Riverside Venture Residential Development*

Project Description:

Volume Adjustment and Site Characteristics

	EB				WB				NB				SB			
	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	U
Number of Lanes(N)	*0*	*0*	*0*		*0*	*0*	*0*		*0*	*1*	*0*		*0*	*1*	*0*	
Volume (V), veh/h				*0*	*193*		*127*	*0*		*726*	*80*	*0*	*57*	*629*		*0*
Heavy Veh. Adj. (f_{HV}), %	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
Peak Hour Factor (PHF)	*0.92*	*0.92*	*0.92*	*1.00*	*0.92*	*0.92*	*0.92*	*1.00*	*0.92*	*0.92*	*0.92*	*1.00*	*0.92*	*0.92*	*0.92*	*1.00*
No. of Pedestrians Crossing Entry	*0*				0				0				0			

Critical and Follow-Up Headway Adjustment

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (sec)	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*
Follow-Up Headway (sec)	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*

Flow Computations

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Circulating Flow (V_c), pc/h	*984*			*813*			*64*			*216*		
Exiting Flow (V_{ex}), pc/h	*154*			*0*			*955*			*920*		
Entry Flow (V_e), pc/h		*746*			*358*			*903*			*768*	
Entry Volume veh/h					*348*			*877*			*746*	

Capacity and v/c Ratios

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Capacity (c_{PCE}), pc/h		*422*			*501*			*1060*			*910*	
Capacity (*c*), veh/h		*0*			*486*			*1029*			*883*	
v/c Ratio (X)					*0.72*			*0.85*			*0.84*	

Delay and Level of Service

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh					*27.5*			*24.0*			*26.0*	
Lane LOS					*D*			*C*			*D*	
Lane 95% Queue					*5.7*			*11.0*			*10.2*	
Approach Delay, s/veh				*27.46*			*23.96*			*25.97*		
Approach LOS, s/veh				*D*			*C*			*D*		
Intersection Delay, s/veh	*25.34*											
Intersection LOS	*D*											

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ROUNDABOUT REPORT

General Information		Site Information	
Analyst	*KCOLE*	Intersection	*Northshore Dr./Tooles Bend Rd.*
Agency or Co.	*TDOT/Knox Co*	E/W Street Name	*Tooles Bend Rd.*
Date Performed	*6/20/2018*	N/S Street Name	*Northshore Dr.*
Time Period	*AM*	Analysis Year	*2028*
		Project ID	*Riverside Venture Residential Development*

Project Description:

Volume Adjustment and Site Characteristics

	EB				WB				NB				SB			
	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	U
Number of Lanes(N)	*0*	*0*	*0*		*0*	*0*	*0*		*0*	*1*	*0*		*0*	*1*	*0*	
Volume (V), veh/h				*0*	*193*		*127*	*0*		*726*		*0*	*57*	*629*		*0*
Heavy Veh. Adj. (f_{HV}), %	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
Peak Hour Factor (PHF)	*0.92*	*0.92*	*0.92*	*1.00*	*0.92*	*0.92*	*0.92*	*1.00*	*0.92*	*0.92*	*0.92*	*1.00*	*0.92*	*0.92*	*0.92*	*1.00*
No. of Pedestrians Crossing Entry	*0*				0				0				0			

Critical and Follow-Up Headway Adjustment

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (sec)	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*
Follow-Up Headway (sec)	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*

Flow Computations

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Circulating Flow (V_c), pc/h	*984*			*813*			*64*			*216*		
Exiting Flow (V_{ex}), pc/h	*64*			*0*			*955*			*920*		
Entry Flow (V_e), pc/h		*746*			*358*			*813*	*90*		*768*	
Entry Volume veh/h					*348*			*789*	*87*		*746*	

Capacity and v/c Ratios

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Capacity (c_{PCE}), pc/h		*422*			*501*			*1060*	*1060*		*910*	
Capacity (*c*), veh/h		*0*			*486*			*1029*	*1029*		*883*	
v/c Ratio (X)					*0.72*			*0.77*	*0.08*		*0.84*	

Delay and Level of Service

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh					*27.5*			*17.8*	*4.2*		*26.0*	
Lane LOS					*D*			*C*			*D*	
Lane 95% Queue					*5.7*			*7.8*	*0.3*		*10.2*	
Approach Delay, s/veh				*27.46*			*16.46*			*25.97*		
Approach LOS, s/veh				*D*			*C*			*D*		
Intersection Delay, s/veh	*22.01*											
Intersection LOS	*C*											

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ROUNDABOUT REPORT

General Information		Site Information	
Analyst	*KCOLE*	Intersection	*Northshore Dr./Tooles Bend Rd.*
Agency or Co.	*TDOT/Knox Co*	E/W Street Name	*Tooles Bend Rd.*
Date Performed	*6/20/2018*	N/S Street Name	*Northshore Dr.*
Time Period	*PM*	Analysis Year	*2028*
		Project ID	

Project Description:

Volume Adjustment and Site Characteristics

	EB				WB				NB				SB			
	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	U
Number of Lanes(N)	*0*	*0*	*0*		*0*	*0*	*0*		*0*	*1*	*0*		*0*	*1*	*0*	
Volume (V), veh/h				*0*	*147*		*96*	*0*		*810*	*256*	*0*	*143*	*619*		*0*
Heavy Veh. Adj. (f_{HV}), %	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
Peak Hour Factor (PHF)	*0.92*	*0.92*	*0.92*	*1.00*	*0.92*	*0.92*	*0.92*	*1.00*	*0.92*	*0.92*	*0.92*	*1.00*	*0.92*	*0.92*	*0.92*	*1.00*
No. of Pedestrians Crossing Entry	*0*				0				0				0			

Critical and Follow-Up Headway Adjustment

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (sec)	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*
Follow-Up Headway (sec)	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*

Flow Computations

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Circulating Flow (V_c), pc/h	*1018*			*907*			*160*			*165*		
Exiting Flow (V_{ex}), pc/h	*447*			*0*			*1014*			*858*		
Entry Flow (V_e), pc/h		*833*			*272*			*1194*			*853*	
Entry Volume veh/h					*264*			*1159*			*828*	

Capacity and v/c Ratios

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Capacity (c_{PCE}), pc/h		*408*			*456*			*963*			*958*	
Capacity (*c*), veh/h		*0*			*443*			*935*			*930*	
v/c Ratio (X)					*0.60*			*1.24*			*0.89*	

Delay and Level of Service

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh					*22.4*			*133.9*			*30.1*	
Lane LOS					*C*			*F*			*D*	
Lane 95% Queue					*3.8*			*39.1*			*12.4*	
Approach Delay, s/veh				*22.40*			*133.94*			*30.14*		
Approach LOS, s/veh				*C*			*F*			*D*		
Intersection Delay, s/veh	*82.68*											
Intersection LOS	*F*											

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ROUNDABOUT REPORT

General Information		Site Information	
Analyst	*KCOLE*	Intersection	*Northshore Dr./Tooles Bend Rd.*
Agency or Co.	*TDOT/Knox Co*	E/W Street Name	*Tooles Bend Rd.*
Date Performed	*6/20/2018*	N/S Street Name	
Time Period	*PM W/ NB BYPASS LANE*	Analysis Year	*2028*
		Project ID	*Riverside Venture Residential Development*

Project Description:

Volume Adjustment and Site Characteristics

	EB				WB				NB				SB			
	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	U
Number of Lanes(N)	*0*	*0*	*0*		*0*	*0*	*0*		*0*	*1*	*0*		*0*	*1*	*0*	
Volume (V), veh/h				*0*	*147*		*96*	*0*		*810*	*256*	*0*	*143*	*619*		*0*
Heavy Veh. Adj. (f_{HV}), %	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
Peak Hour Factor (PHF)	*0.92*	*0.92*	*0.92*	*1.00*	*0.92*	*0.92*	*0.92*	*1.00*	*0.92*	*0.92*	*0.92*	*1.00*	*0.92*	*0.92*	*0.92*	*1.00*
No. of Pedestrians Crossing Entry	*0*				0				0				0			

Critical and Follow-Up Headway Adjustment

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (sec)	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*	*5.1929*
Follow-Up Headway (sec)	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*	*3.1858*

Flow Computations

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Circulating Flow (V_c), pc/h	*1018*			*907*			*160*			*165*		
Exiting Flow (V_{ex}), pc/h	*160*			*0*			*1014*			*858*		
Entry Flow (V_e), pc/h		*833*			*272*			*907*	*287*		*853*	
Entry Volume veh/h					*264*			*881*	*279*		*828*	

Capacity and v/c Ratios

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Capacity (c_{PCE}), pc/h		*408*			*456*			*963*	*963*		*958*	
Capacity (*c*), veh/h		*0*			*443*			*935*	*935*		*930*	
v/c Ratio (X)					*0.60*			*0.94*	*0.30*		*0.89*	

Delay and Level of Service

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh					*22.4*			*37.9*	*7.0*		*30.1*	
Lane LOS					*C*			*E*			*D*	
Lane 95% Queue					*3.8*			*15.1*	*1.3*		*12.4*	
Approach Delay, s/veh				*22.40*			*30.48*			*30.14*		
Approach LOS, s/veh				*C*			*D*			*D*		
Intersection Delay, s/veh	*29.41*											
Intersection LOS	*D*											

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Turn Lane Warrant Analysis

CDM Smith

TABLE 5A

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

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

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

AM
(PM)

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					629 (619)
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	=/ > 600
100 - 149 150 - 199	70 60	60 55	50 45	45 40	40 35	35 30
200 - 249 250 - 299	55 50	50 45	40 35	35 30	30 30	30 30
300 - 349 350 - 399	45 40	40 35	35 30	30 25	25 25	25 20
400 - 449 450 - 499	35 30	30 25	30 25	25 20	20 20	20 20
500 - 549 550 - 599	25 25	25 20	20 20	20 20	20 20	15 15
600 - 649 650 - 699	25 20	20 20	20 20	20 20	20 20	15 15
700 - 749 750 or More	20 20	20 20	20 20	15 15	15 15	15 15

805
(834)

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

56
(155)

TABLE 5B

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

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

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 600	+ / > 600
Fewer Than 25 25 - 49					Yes	Yes
80 50 - 99				Yes	Yes	Yes
100 - 149 150 - 199		Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
200 - 249 (256) 250 - 299	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
300 - 349 350 - 399	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

726 (810)

AM

(PM)

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

TABLE 4A

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

AM (PM)

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

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	100 - 149 111	150 - 199	200 - 249	250 - 299	300 - 349 (319)	350 - 399
100 - 149	300	235	185	145	120	100
150 - 199	245	200	160	130	110	90
(236) 200 - 249	205	170	140	115	100 (35)	80
250 - 299	175	150	125	105	90	70
359 300 - 349	155	135	110	95	80	65
350 - 399	135 16	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	460	55	50	45
250 - 299	70	65	55	50	45	40
300 - 349	65	60	50	50	45	40
350 - 399	60	55	50	45	40	40
400 - 449	55	50	45	45	40	35
450 - 499	50	45	45	40	35	35
500 - 549	50	45	40	40	35	35
550 - 599	45	40	40	35	35	35
600 - 649	40	35	35	35	35	30
650 - 699	35	35	35	30	30	30
700 - 749	30	30	30	30	30	30
750 or More	30	30	30	30	30	30

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

TABLE 48
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		(166)	229			
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.

TABLE 4A

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

AM (PM)

(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	460	55	50	45
250 - 299	70	65	55	50	45	40
300 - 349	65	60	50	50	45	40
350 - 399	60	55	50	45	40	40
400 - 449	55	50	45	45	40	35
450 - 499	50	45	45	40	35	35
500 - 549	50	45	40	40	35	35
550 - 599	45	40	40	35	35	35
600 - 649	40	35	35	35	35	30
650 - 699	35	35	35	30	30	30
700 - 749	30	30	30	30	30	30
750 or More	30	30	30	30	30	30

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

TABLE 48
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		(166)	229			
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.

TABLE 4A

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

AM
(PM)

(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	460	55	50	45
250 - 299	70	65	55	50	45	40
300 - 349	65	60	50	50	45	40
350 - 399	60	55	50	45	40	40
400 - 449	55	50	45	45	40	35
450 - 499	50	45	45	40	35	35
500 - 549	50	45	40	40	35	35
550 - 599	45	40	40	35	35	35
600 - 649	40	35	35	35	35	30
650 - 699	35	35	35	30	30	30
700 - 749	30	30	30	30	30	30
750 or More	30	30	30	30	30	30

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

TABLE 4A

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

AM
(PM)

(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 (168)	200 - 249 242	250 - 299	300 - 349	350 - 399
72 100 - 149	300	235	185 46	145	120	100
150 - 199	245	200	160	130	110	90
(234) 200 - 249	205	170 (21)	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	460	55	50	45
250 - 299	70	65	55	50	45	40
300 - 349	65	60	50	50	45	40
350 - 399	60	55	50	45	40	40
400 - 449	55	50	45	45	40	35
450 - 499	50	45	45	40	35	35
500 - 549	50	45	40	40	35	35
550 - 599	45	40	40	35	35	35
600 - 649	40	35	35	35	35	30
650 - 699	35	35	35	30	30	30
700 - 749	30	30	30	30	30	30
750 or More	30	30	30	30	30	30

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

TABLE 48
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		(166)	229			
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.

TABLE 4A

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

AM
(PM)

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

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
69	100 - 149	150 - 199	200 - 249 (243)	250 - 299	300 - 349	350 - 399
100 - 149	300	235	185	145	120	100
(169) 150 - 199	245	200	160 (34)	130	110	90
200 - 249	205	170	140	115	100	80
255 250 - 299 11	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

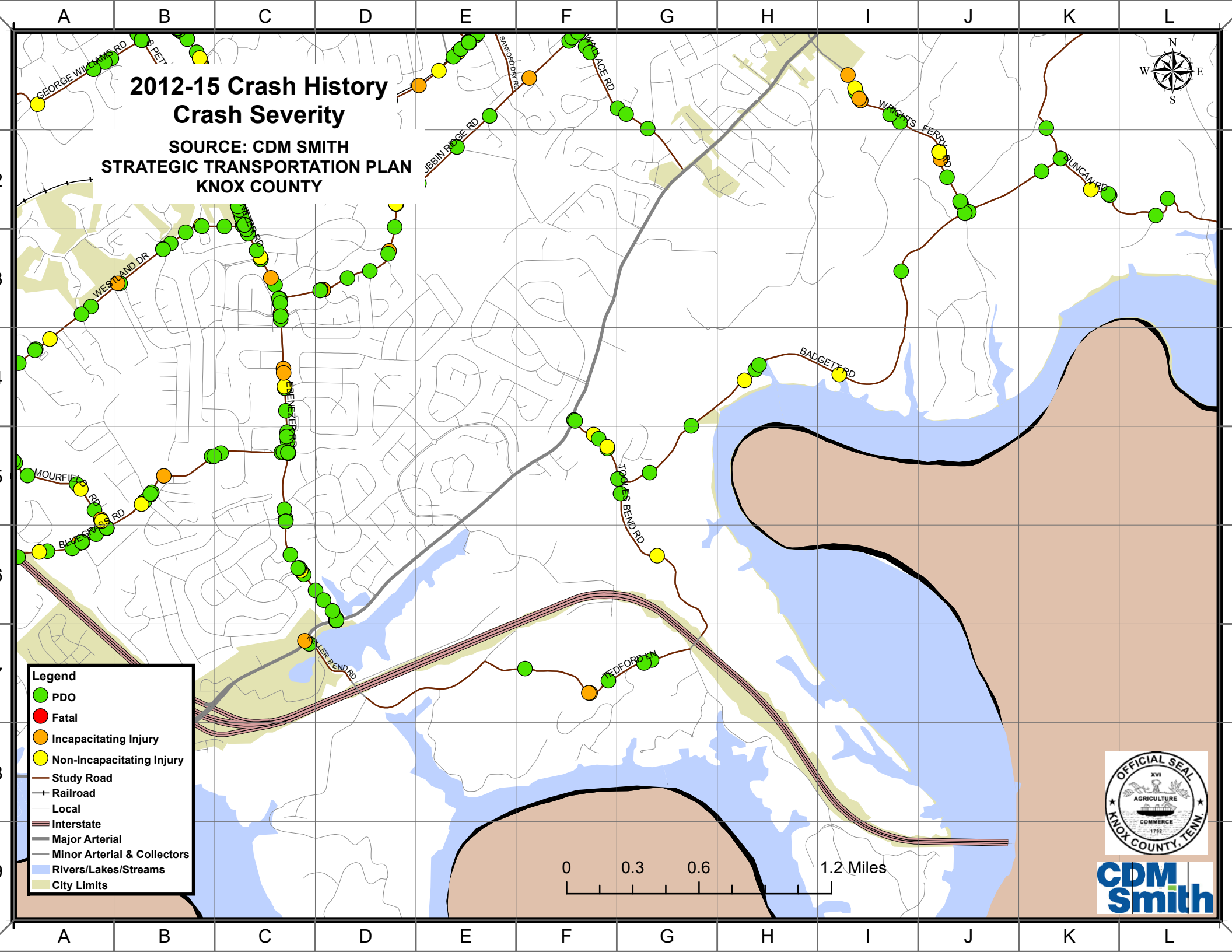
OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	= / > 600
100 - 149	100	80	70	60	55	50
150 - 199	90	75	65	55	50	45
200 - 249	80	72	460	55	50	45
250 - 299	70	65	55	50	45	40
300 - 349	65	60	50	50	45	40
350 - 399	60	55	50	45	40	40
400 - 449	55	50	45	45	40	35
450 - 499	50	45	45	40	35	35
500 - 549	50	45	40	40	35	35
550 - 599	45	40	40	35	35	35
600 - 649	40	35	35	35	35	30
650 - 699	35	35	35	30	30	30
700 - 749	30	30	30	30	30	30
750 or More	30	30	30	30	30	30

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

2016 Knox County Strategic Safety Plan Excerpts

2012-15 Crash History
Crash Severity

SOURCE: CDM SMITH
STRATEGIC TRANSPORTATION PLAN
KNOX COUNTY



Legend

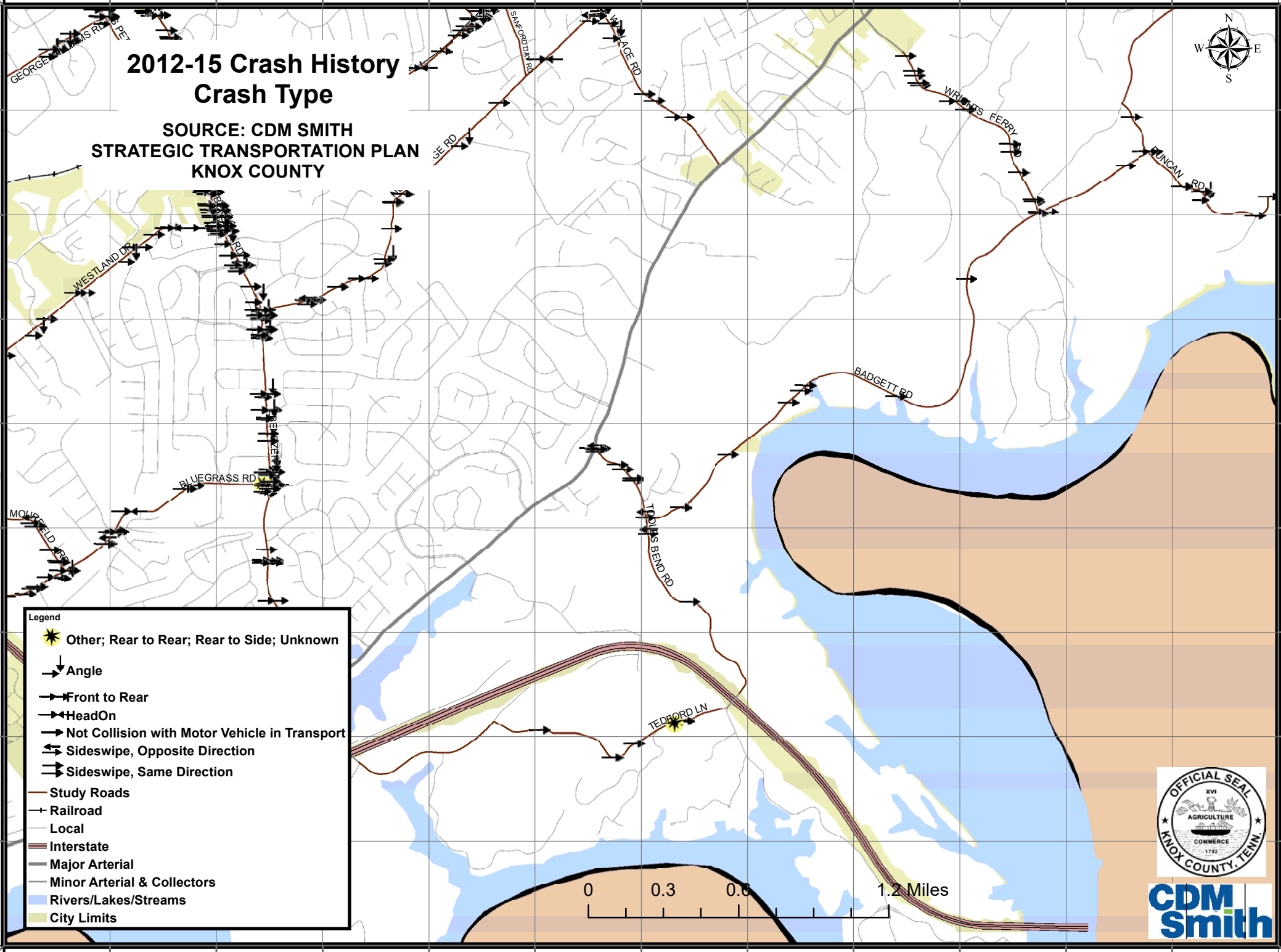
- PDO
- Fatal
- Incapacitating Injury
- Non-Incapacitating Injury
- Study Road
- Railroad
- Local
- Interstate
- Major Arterial
- Minor Arterial & Collectors
- Rivers/Lakes/Streams
- City Limits

OFFICIAL SEAL — KNOX COUNTY, TENN.

CDM Smith

2012-15 Crash History
Crash Type

SOURCE: CDM SMITH
STRATEGIC TRANSPORTATION PLAN
KNOX COUNTY

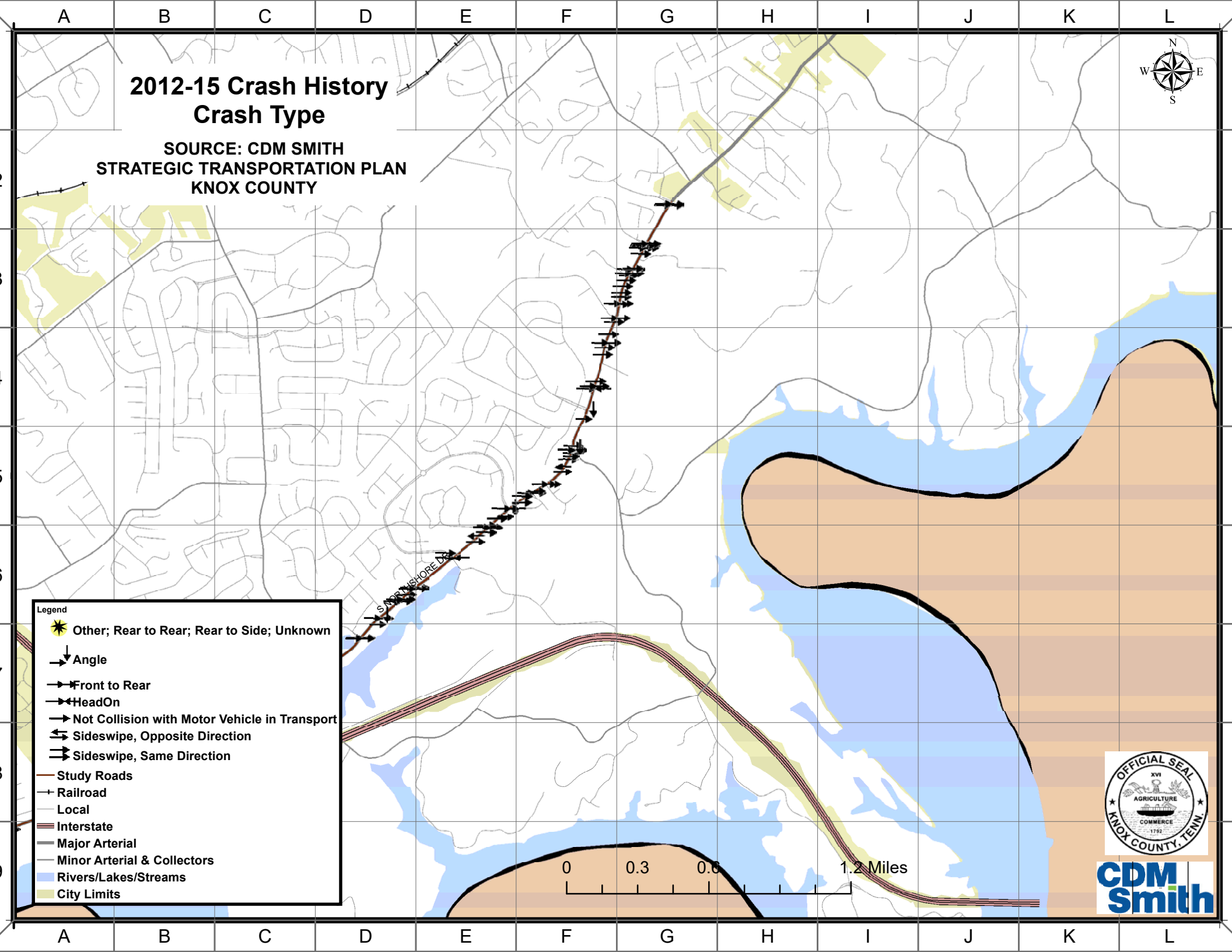


ID	CASE	STREET NAME	BEGIN LIMIT	END LIMIT	RD TYPE	LENGTH	TOTAL WIDTH	ADT	PDO	NON INJ	INJ	FATAL	TOTAL CRASHES	EXPOSURE RATE	CRASH RATE	CRITICAL CRASH RATE	A/C RATIO	SEVERITY INDEX	SCORE 1	MINIMUM STANDARD	SCORE 2	FINAL RANK
492	1	THOMPSON RD	HARDIN VALLEY RD	LOVELL RD	2L	0.5	16	556	5	0	0	0	5	0.406	12.310	9.616	1.280	1.000	1.280	ABOVE	1.280	65
493	1	THOMPSON SCHOOL RD	WODD RD	E EMORY RD	2L	2.2	20	3035	9	2	0	1	12	9.755	1.230	3.071	0.401	1.417	0.568	BELOW	0.568	332
494	1	THORN GROVE PIKE	COUNTY LINE	MIDWAY RD	2L	1.96	20	1510	16	4	4	0	24	4.324	5.550	3.661	1.516	1.500	2.274	BELOW	2.274	25
495	1	THORN GROVE PIKE	MIDWAY RD	WAYLAND RD	2L	5.42	20	943	18	3	2	1	24	7.467	3.214	2.731	1.177	1.458	1.716	BELOW	1.716	237
496	1	THORN GROVE PIKE	WAYLAND RD	ASBURY RD	2L	2.55	20	2410	7	1	2	0	10	8.979	1.114	2.625	0.424	1.600	0.679	BELOW	0.679	317
497	1	THORN GROVE PIKE	ASBURY RD	ASBURY RD	2L	2.07	18	2195	8	4	1	0	13	6.638	1.958	4.070	0.481	1.231	0.592	ABOVE	0.592	327
498	1	THORN GROVE PIKE	ASBURY RD	STRAWBERRY PLAINS PIKE	2L	0.25	20	1691	4	0	0	0	4	0.618	6.476	6.942	0.933	1.000	0.933	BELOW	0.933	104
499	1	TILLERY DR	BELL CAMPGROUND RD	COUNTY LINE	2L	0.05	14	181	0	0	0	0	0	0.013	0.000	0.000	0.000	0.000	0.000	BELOW	0.000	503
500	1	TIPTON STATION RD	MARYVILLE PIKE	W MARTIN MILL PIKE	2L	2.12	18	1600	13	3	0	0	16	4.956	3.229	3.542	0.911	1.000	0.911	BELOW	0.911	278
501	1	TIPTON STATION RD	OWENS RD	MARTIN MILL PIKE	2L	1.71	19	4003	15	3	0	0	18	10.001	1.800	3.057	0.589	1.000	0.589	ABOVE	0.589	154
502	1	TIPTON STATION RD	MARTIN MILL PIKE	CHAPMAN HWY	2L	4.89	20	2260	34	4	1	1	40	16.146	2.477	2.817	0.879	1.200	1.055	BELOW	1.055	91
503	1	TOOLES BEND RD	S NORTHSHORE DR	INTERSTATE 140	2L	1.26	20	1670	7	3	0	0	10	3.074	3.253	4.835	0.673	1.000	0.673	BELOW	0.673	318
504	1	TOPSIDE RD	MARYVILLE PIKE	EAST OF ADMIRALITY LN	2L	1.24	18	680	4	0	0	1	5	1.232	4.059	6.307	0.644	2.000	1.287	BELOW	1.287	253
505	1	TWIN CREEK RD	OWENS RD	W GOV JOHN SEVIER HWY	2L	0.76	14	132	0	0	0	0	0	0.147	0.000	0.000	0.000	0.000	0.000	BELOW	0.000	552
506	1	TWIN CREEK RD	W GOV JOHN SEVIER HWY	TIPTON STATION RD	2L	0.7	16	289	2	0	0	0	2	0.296	6.767	11.081	0.611	1.000	0.611	BELOW	0.611	323
507	1	W BEAVER CREEK DR	CENTRAL AVENUE PIKE	CLINTON HWY	2L	4.97	20	5596	69	7	2	1	79	40.634	1.944	2.498	0.778	1.139	0.887	ABOVE	0.887	109
508	1	W BEAVER CREEK DR	CLINTON HWY	OLD CLINTON PIKE	2L	0.03	18	7430	0	0	0	0	0	0.326	0.000	0.000	0.000	0.000	0.000	ABOVE	0.000	504
509	1	W BEAVER CREEK DR	CLINTON HWY	HARRELL RD	2L	2.44	16	6029	27	6	7	3	43	21.492	2.001	2.701	0.741	1.837	1.361	ABOVE	1.361	60
510	1	W BRUSHY VALLEY DR	HEISKELL RD	EAST OF BELL CAMPGROUND RD	2L	0.81	20	589	2	0	0	0	2	0.697	2.869	6.605	0.434	1.000	0.434	BELOW	0.434	372
511	1	W BRUSHY VALLEY DR	EAST OF BELL CAMPGROUND RD	BELL CAMPGROUND RD	2L	0.92	18	589	3	0	0	0	3	0.792	3.789	6.278	0.604	1.000	0.604	BELOW	0.604	325
512	1	W BRUSHY VALLEY DR	BELL CAMPGROUND RD	COUNTY LINE	2L	0.25	20	705	0	0	1	0	1	0.258	3.883	10.356	0.375	4.000	1.500	BELOW	1.500	245
513	1	W BULLRUN VALLEY DR	NAFF RD	HEISKELL RD	2L	2.23	16	295	1	0	0	0	1	0.961	1.040	6.864	0.152	1.000	0.152	BELOW	0.152	450
514	1	W COPELAND DR	HEISKELL RD	BRICKYARD RD	2L	1.56	18	1408	7	4	0	0	11	3.209	3.428	3.953	0.867	1.000	0.867	BELOW	0.867	291
515	1	W COPELAND DR	BRICKYARD RD	BELL CAMPGROUND RD	2L	0.45	18	1408	1	1	0	0	2	0.926	2.161	5.910	0.366	1.000	0.366	BELOW	0.366	399
516	1	W EMORY RD	KARNS VALLEY DR	HENDERSON RD	2L	0.37	20	923	2	1	0	0	3	0.499	6.013	8.817	0.682	1.000	0.682	BELOW	0.682	133
517	1	W EMORY RD	HENDERSON RD	OAK RIDGE HWY	2L	2.58	18	923	6	1	0	0	7	3.479	2.012	4.689	0.429	1.000	0.429	BELOW	0.429	373
518	1	W HENDRON CHAPEL RD	TIPTON STATION RD	CHAPMAN HWY	2L	0.28	20	4060	2	0	1	0	3	1.661	1.806	4.810	0.376	2.000	0.751	ABOVE	0.751	128
519	1	W MARTIN MILL PIKE	NEUBERT SPRINGS RD	TWIN CREEK RD	2L	1.36	20	1830	13	2	1	0	16	3.636	4.400	4.336	1.015	1.188	1.205	BELOW	1.205	75
520	1	WALBROOK DR	BRIDGEWATER RD	WALKER SPRINGS RD	2L	0.22	38	13097	4	0	0	0	4	4.210	0.950	3.685	0.258	1.000	0.258	N/A	0.258	196
521	1	WALKER SPRINGS RD	WALBROOK DR	N GALLAHER VIEW RD	5L	0.54	64	12595	4	2	0	0	6	9.937	0.604	4.590	0.132	1.000	0.132	N/A	0.132	202
522	1	WALKER SPRINGS RD	N GALLAHER VIEW RD	FOX LONAS DR	2L	0.87	20	2574	6	4	1	0	11	3.272	3.362	4.760	0.706	1.273	0.899	BELOW	0.899	108
523	1	WALLACE RD	NUBBIN RIDGE RD	S NORTHSHORE DR	2L	0.8	20	2230	5	1	0	0	6	2.606	2.302	5.046	0.456	1.000	0.456	BELOW	0.456	367
524	1	WASHINGTON PIKE	MURPHY RD	ELLISTOWN RD	2l	3.58	24	9166	50	8	3	0	61	47.942	1.272	2.858	0.445	1.148	0.511	BELOW	0.511	164
525	1	WASHINGTON PIKE	ELLISTOWN RD	ROBERTS RD	2l	2.79	22	3729	19	4	0	0	23	15.200	1.513	2.376	0.637	1.000	0.637	BELOW	0.637	142
526	1	WASHINGTON PIKE	ROBERTS RD	E EMORY RD	2L	4.61	20	472	9	3	0	0	12	3.179	3.775	3.393	1.113	1.000	1.113	BELOW	1.113	259
527	1	WASHINGTON PIKE - SEE STATE ROUTE DATABASE SEGMENT 9244																				
528	1	WAYLAND RD	STRAWBERRY PLAINS PIKE	THORN GROVE PIKE	2L	2.88	18	768	10	0	0	0	10	3.231	3.095	3.946	0.784	1.000	0.784	BELOW	0.784	305
529	1	WEAVER RD	W BEAVER CREEK DR	OAK RIDGE HWY	2L	0.84	16	1870	12	1	1	1	15	2.295	6.536	5.224	1.251	1.533	1.919	ABOVE	3.919	7
530	1	WELLS DR	BRICKYARD RD	EWING RD	2L	0.2	16	606	2	0	0	0	2	0.177	11.295	15.128	0.747	1.000	0.747	ABOVE	0.747	129
531	1	WESTCOTT BLVD	CANEEL DR	BYINGTON SOLWAY RD	2-TWLTL	0.25	36	2923	6	1	0	0	7	1.068	6.557	6.618	0.991	1.000	0.991	N/A	0.991	97
532	1	WESTERN RD	GREENWELL RD	PELLEAUX RD	2L	0.87	18	365	1	2	0	0	3	0.464	6.466	9.087	0.712	1.000	0.712	BELOW	0.712	310
533	1	WESTLAND DR	EAST OF DEVONSHIRE DR	EAST OF VICAR LN	2L	0.56	18	8267	7	2	0	0	9	6.764	1.331	3.775	0.352	1.000	0.352	ABOVE	0.352	188
534	1	WESTLAND DR	EAST OF VICAR LN	WEST OF S GALLAHER VIEW RD	2L	0.83	26	9390	14	6	0	0	20	11.387	1.756	3.431	0.512	1.000	0.512	N/A	0.512	162
535	1	WESTLAND DR	WEST OF S GALLAHER VIEW RD	EBENEZER RD	2L	1.09	18	9390	20	5	2	0	27	14.953	1.806	3.287	0.549	1.222	0.671	ABOVE	0.671	136
536	1	WESTLAND DR	EBENEZER DR	GLENSPRINGS DR	2-TWLTL	1.13	38	11070	10	2	1	0	13	18.276	0.711	2.966	0.240	1.231	0.295	N/A	0.295	192
537	1	WESTLAND DR	GLENSPRINGS DR	RAMP TO WB INTERSTATE 140	2L	0.71	30	11070	8	3	1	0	12	11.483	1.045	3.427	0.305	1.250	0.381	N/A	0.381	184
538	1	WESTLAND DR	RAMP TO EB INTERSTATE 140	GARRISON RIDGE BLVD	2L	0.26	26	11710	6	0	0	0	6	4.448	1.349	3.635	0.371	1.000	0.371	N/A	0.371	186
539	1	WESTLAND DR	GARRISON RIDGE BLVD	S NORTHSHORE DR	2L	1.28	20	8475	44	9	1	0	54	15.849	3.407	3.259	1.046	1.056	1.104	ABOVE	1.104	88
540	1	WILLIAMS BEND RD	WILLIAMS RD	COUCH MILL RD	2L	1.44	16	180	9	4	1	0	14	0.379	36.969	9.913	3.729	1.214	4.528	BELOW	4.528	205
541	1	WILLIAMS RD	WILLIAMS BEND RD	COUCH MILL RD	2L	1.29	14	220	2	0	0	0	2	0.415	4.824	9.531	0.506	1.000	0.506	BELOW	0.506	354
542	1	WISE SPRINGS RD	RIDGEVIEW RD	MALONEYVILLE RD	2L	0.96	18	638	4	2	1	0	7	0.895	7.823	7.041	1.111	1.429	1.587	BELOW	1.587	242
543	1	WOOD RD	MAJORS RD	THOMPSON SCHOOL RD	2L	1.76	20	622	1	3	2	0	6	1.599	3.751	4.870	0.770	2.000	1.541	BELOW	1.541	244
544	1	WOOD RD	THOMPSON SCHOOL RD	WALTER RD	2L	0.32	16	371	0	0	0	0	0	0.173	0.000	0.000	0.000	0.000	0.000	BELOW	0.000	553
545	1	WOOD RD	WALTER RD	TAZEWELL PIKE	2L	3.03	18	478	1	0	1	0	2	2.116	0.945	5.344	0.177	2.500	0.442	BELOW	0.442	370
546	1	WOODDALE CHURCH RD	STRAWBERRY PLAINS PIKE	MCMILLAN RD	2L	0.96	22	1680	2	0	1	0	3	2.356	1.273	5.186	0.246	2.000	0.491	BELOW	0.491	357
547	1	WOODDALE CHURCH RD	MCMILLAN RD	CORUM RD	2L	0.37	24	1680	1	0	0	0	1	0.908	1.101	7.003	0.157	1.000	0.157	BELOW	0.157	446
548	1	WOODDALE CHURCH RD	CORUM RD	MCCUBBINS RD	2L	0.41	18	1680	1	0	0	0	1	1.006	0.994	6.755	0.147	1.000	0.147	BELOW	0.147	453
549	1	WOODS-SMITH RD	ELLESMERE DR	BARNARD RD	2L	0.08	16	1573	2	0	0	0	2	0.184	10.878	13.941	0.780	1.000	0.780	ABOVE	0.780	221
550	1	WOODS-SMITH RD	BARNARD RD	JOHN MAY DR	2L	0.39	20	1573	4	0	0	0	4	0.896	4.463	7.036	0.634	1.000	0.634	BELOW	0.634	144
551	1	WOODSON DR	HILLTOP RD	MARYVILLE PIKE	2L	0.85	20	1604	3	0	0	0	3	1.992	1.506	5.437	0.277	1.000	0.277	BELOW	0.277	416
552	1	WOODY DR	LOOP RD	CANTON HOLLOW RD	2L	0.94	18	3190	14	2	1	0	17	4.381	3.880	4.442	0.874	1.176	1.028	ABOVE	1.028	94
553	1	WRIGHTS FERRY RD	SOUTH OF NORTHSHORE DR	BADGETT RD	2L	0.9	20	1794	7	2	4	0	13	2.359	5.511	4.313	1.278	1.923	2.457	BELOW	2.457	24
554	1	YARNELL RD	EVERETT RD	LOVELL RD	2L	5.52	22	1720	22	5	1	1	29	13.871	2.091	2.887	0.724	1.276	0.924	BELOW	0.924	276
555	1	YORK RD	HILL RD	ANDERSONVILLE PIKE	2L	0.95	16	374	1	0	0	0	1	0.519	1.926	7.473	0.258	1.000	0.258	BELOW	0.258	427
556	1	YOUNT RD	W EMORY RD	CARPENTER RD	2L	1.08	18	798	4	2	0	0	6	1.259	4.765	6.262	0.761	1.000	0.761	BELOW	0.761	308
557	1	YOUNT RD	CARPENTER RD	BLACKS FERRY RD	2L	0.09	16	601	0	0	0	0	0	0.079	0.000	0.000	0.000	0.000	0.000	ABOVE	0.000	507
558	1	E EMORY RD	NORRIS FWY	EAST OF NORRIS FWY	2L	0.10	37	14367	22	0	0	0	22	2.099	10.481	5.026	2.085	1.000	2.085	N/A	2.085	28
559	1	E EMORY RD	EAST OF NORRIS FWY	WEST OF ANDERSONVILLE PIKE	2L	0.13	22	14367	5	0	0	0	5	2.729	1.832	4.669	0.392	1.000	0.392	ABOVE	0.392	180
560	1	E EMORY RD	WEST OF ANDERSONVILLE PIKE	EAST OF ANDERSONVILLE PIKE	2L	0.17	37	14367	7	1	1	0	9	3.568	2.522	4.356	0.579	1.333	0.772	N/A	0.772	126
561	1	E EMORY RD	EAST OF ANDERSONVILLE PIKE	HALLS HIGH SCHOOL ACCESS	2L	0.13	22	14367	5	0	0	0	5	2.729	1.832	4.669	0.392	1.000	0.392	ABOVE	0.392	181
562	1	E EMORY RD	HALLS HIGH SCHOOL ACCESS	MAYNARDVILLE PIKE	2L	0.05	40	14367	29	1	0	0	30	1.050	28.585	6.281	4.551	1.000	4.551	N/A	4.551	211
563	1	KARNS VALLEY DR	WESTCOTT BLVD	SOUTH OF CHUCH JONES DR	2L	0.48	40	2792	0	0	0	0	0	1.958	0.000	0.000	0.000	0.000	0.000	N/A	0.000	554

LEGEND: Green-Major Arterial; Purple-Minor Arterial; Orange-Major Collector; Red-Minor Collector; Blue-Local Road

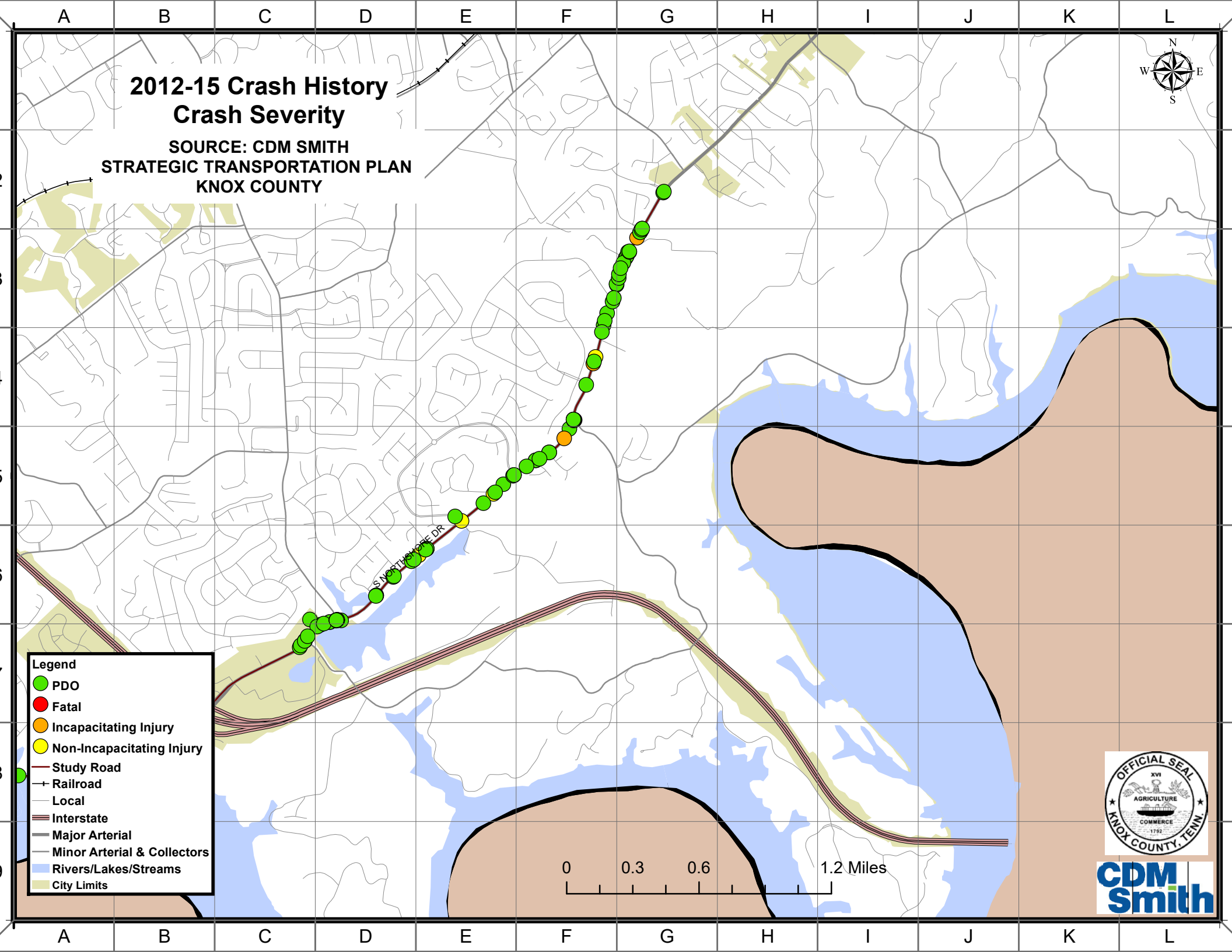
2012-15 Crash History
Crash Type

SOURCE: CDM SMITH
STRATEGIC TRANSPORTATION PLAN
KNOX COUNTY



2012-15 Crash History
Crash Severity

SOURCE: CDM SMITH
STRATEGIC TRANSPORTATION PLAN
KNOX COUNTY



ID	OLD ID	STREET NAME	BEGIN LIMIT	BEGIN MM	END LIMIT	END MM	RD TYPE	LENGTH	TOTAL WIDTH	ADT	PDO	NON INJ	INJ	FATAL	TOTAL CRASHES	EXPOSURE RATE	CRASH RATE	CRITICAL CRASH RATE	A/C RATIO	SEVERITY INDEX	SCORE	FINAL RANK
9158		S NORTHSHORE DR	I-140 EB RAMP	6.52	KROGER PARK DR	6.67	4L-D	0.15	100	14465	0	0	0	0	0	3.170	0.000	0.000	0.000	0.000	0.000	195
9159		S NORTHSHORE DR	KROGER PARK DR	6.67	EAST OF EBENEZER RD	7.30	5L	0.63	64	14465	29	3	1	0	33	13.314	2.479	3.505	0.707	1.091	0.771	85
9160		S NORTHSHORE DR	EAST OF EBENEZER RD	7.30	EAST OF NORTHSHORE HILLS BLVD	7.47	3L	0.17	48	13133	3	0	0	0	3	3.262	0.920	4.456	0.206	1.000	0.206	159
9161		S NORTHSHORE DR	EAST OF NORTHSHORE HILLS BLVD	7.47	WEST OF WHITTINGTON CREEK BLVD	7.90	2L	0.43	24	13133	7	1	0	0	8	8.251	0.970	3.632	0.267	1.000	0.267	150
9162		S NORTHSHORE DR	WEST OF WHITTINGTON CREEK BLVD	7.90	EAST OF WHITTINGTON CREEK BLVD	8.08	2L	0.18	40	13133	1	1	0	0	2	3.454	0.579	4.392	0.132	1.000	0.132	175
9163		S NORTHSHORE DR	EAST OF WHITTINGTON CREEK BLVD	8.08	WEST OF LITTLE CREEK LN	8.22	2L	0.14	22	13133	3	1	0	0	4	2.686	1.489	4.689	0.318	1.000	0.318	142
9164		S NORTHSHORE DR	WEST OF LITTLE CREEK LN	8.22	EAST OF LITTLE CREEK LN	8.34	2L	0.12	35	13133	3	0	0	0	3	2.302	1.303	4.894	0.266	1.000	0.266	151
9165		S NORTHSHORE DR	EAST OF LITTLE CREEK LN	8.34	EAST OF TOOLES BEND RD	8.76	2L	0.42	22	13133	14	2	2	0	18	8.059	2.234	3.648	0.612	1.333	0.816	79
9166		S NORTHSHORE DR	EAST OF TOOLES BEND RD	8.76	EAST OF BICKERSTAFF BLVD	8.90	2L	0.14	37	13133	1	0	0	0	1	2.686	0.372	4.689	0.079	1.000	0.079	179
9167		S NORTHSHORE DR	EAST OF BICKERSTAFF BLVD	8.90	BRANTON BLVD	9.80	2L	0.90	22	13133	28	1	3	0	32	17.269	1.853	3.218	0.576	1.281	0.738	91
9168	482	TAZEWELL PK	COUNTY LINE	29.53	E EMORY RD	25.12	2L	4.41	20	4170	94	13	7	1	115	26.867	4.280	2.175	1.968	1.226	2.413	11
9169	483	TAZEWELL PK	E EMORY RD	8.31	SHANNONDALE RD	2.12	2L	6.19	24	14806	145	20	7	4	176	133.899	1.314	1.847	0.712	1.233	0.877	72
9170		W EMORY RD	BEAVER RIDGE RD	7.61	EAST OF BOYD WALTERS LN	7.99	2L	0.38	24	10074	15	2	0	0	17	5.593	3.040	3.927	0.774	1.000	0.774	84
9171		W EMORY RD	EAST OF BOYD WALTERS LN	7.99	CLINTON HWY	12.00	2L	4.01	26	10074	116	15	5	1	118	59.020	1.999	2.805	0.713	1.169	0.834	76
9172		W EMORY RD	POWELL DR	14.19	E EMORY RD	14.98	5L	0.79	64	16830	28	4	0	0	32	19.425	1.647	3.166	0.520	1.000	0.520	115
9173		W GOVERNOR JOHN SEVIER HWY	STRAWBERRY PLAINS PIKE	13.23	SOUTH OF STRAWBERRY PLAINS PIKE	13.13	2-TWLTL	0.10	68	10113	6	0	0	0	6	1.478	4.061	4.722	0.860	1.000	0.860	73
9174		W GOVERNOR JOHN SEVIER HWY	SOUTH OF STRAWBERRY PLAINS PIKE	13.13	SOUTH OF CINDER LN	11.53	2-TWLTL	1.60	46	10113	26	4	2	0	32	23.640	1.354	2.474	0.547	1.188	0.650	101
9175		W GOVERNOR JOHN SEVIER HWY	SOUTH OF CINDER LN	11.53	NORTH OF FRENCH BROAD RIVER BRIDGE	11.00	2-TWLTL	0.53	47	10113	6	2	1	0	8	7.831	1.022	2.991	0.342	1.375	0.470	123
9176		W GOVERNOR JOHN SEVIER HWY	NORTH OF FRENCH BROAD RIVER BRIDG	11.00	SOUTH OF FRENCH BROAD RIVER BRIDGE	10.85	2L	0.15	44	10113	0	0	0	0	0	2.216	0.000	0.000	0.000	0.000	0.000	196
9177		W GOVERNOR JOHN SEVIER HWY	SOUTH OF FRENCH BROAD RIVER BRIDG	10.85	EAST TN VETERANS CEMETERY ACCESS	10.64	2-TWLTL	0.21	46	10113	3	0	0	0	3	3.103	0.967	3.747	0.258	1.000	0.258	152
9178		W GOVERNOR JOHN SEVIER HWY	EAST TN VETERANS CEMETERY ACCESS	10.64	SOUTH OF STONESILO WAY	9.82	2-TWLTL	0.82	43	10113	7	0	0	1	8	12.116	0.660	2.749	0.240	1.625	0.390	134
9179		W GOVERNOR JOHN SEVIER HWY	SOUTH OF STONESILO WAY	9.82	NORTH OF OLD FRENCH RD	9.21	2L	0.61	34	10113	2	2	1	1	6	9.013	0.666	2.623	0.254	2.333	0.592	107
9180		W GOVERNOR JOHN SEVIER HWY	NORTH OF OLD FRENCH RD	9.21	NORTH OF BURNETT CREEK RD	8.08	2-TWLTL	1.13	42	10113	8	1	0	1	10	16.696	0.599	2.605	0.230	1.500	0.345	138
9181		W GOVERNOR JOHN SEVIER HWY	NORTH OF BURNETT CREEK RD	8.08	SOUTH OF DEWEY BURNETT LN	7.85	2L	0.23	34	10113	1	0	0	0	1	3.398	0.294	4.410	0.067	1.000	0.067	181
9182		W GOVERNOR JOHN SEVIER HWY	SOUTH OF DEWEY BURNETT LN	7.85	SOUTH OF DENWOOD RD	7.49	2-TWLTL	0.36	45	10113	5	2	1	0	8	5.319	1.504	3.713	0.405	1.375	0.557	110
9183		W GOVERNOR JOHN SEVIER HWY	SOUTH OF DENWOOD RD	7.49	SOUTH OF SEVIERVILLE PIKE	7.35	2L	0.14	34	10113	5	0	2	0	7	2.069	3.384	5.048	0.670	1.857	1.245	47
9184		W GOVERNOR JOHN SEVIER HWY	SOUTH OF SEVIERVILLE PIKE	7.35	SOUTH OF KONDA DR	7.10	2-TWLTL	0.25	44	10113	2	0	0	0	2	3.694	0.541	4.049	0.134	1.000	0.134	174
9185		W GOVERNOR JOHN SEVIER HWY	SOUTH OF KONDA DR	7.10	CHAPMAN HWY ACCESS	6.95	2L	0.15	72	10113	3	0	0	0	3	2.216	1.354	4.948	0.274	1.000	0.274	149
9186		W GOVERNOR JOHN SEVIER HWY	CHAPMAN HWY ACCESS	6.95	NORTH OF CHAPMAN HWY	6.85	2L	0.10	60	10113	0	0	1	0	1	1.478	0.677	5.597	0.121	4.000	0.484	120
9187		W GOVERNOR JOHN SEVIER HWY	NORTH OF CHAPMAN HWY	6.85	SOUTH OF CHAPMAN HWY	6.72	2L	0.13	44	10113	0	0	0	0	0	1.921	0.000	0.000	0.000	0.000	0.000	197
9188		W GOVERNOR JOHN SEVIER HWY	SOUTH OF CHAPMAN HWY	6.72	SOUTH OF NORTON RD	6.58	2-TWLTL	0.14	61	14950	4	0	0	0	4	3.058	1.308	4.253	0.308	1.000	0.308	145
9189		W GOVERNOR JOHN SEVIER HWY	SOUTH OF NORTON RD	6.58	NEUBERT SPRINGS ACCESS	4.83	2-TWLTL	1.75	45	14950	18	3	1	0	22	38.223	0.576	2.706	0.213	1.136	0.242	154
9190		W GOVERNOR JOHN SEVIER HWY	NEUBERT SPRINGS ACCESS	4.83	NORTH OF LOFTWOOD DR	4.53	2L	0.30	44	14950	5	0	0	0	5	6.553	0.763	3.799	0.201	1.000	0.201	160
9191		W GOVERNOR JOHN SEVIER HWY	NORTH OF LOFTWOOD DR	4.53	SOUTH OF LOFTWOOD DR	4.23	2-TWLTL	0.30	40	14950	4	2	0	0	6	6.553	0.916	3.549	0.258	1.000	0.258	153
9192		W GOVERNOR JOHN SEVIER HWY	SOUTH OF LOFTWOOD DR	4.23	MARTIN MILL PIKE ACCESS	2.52	2-TWLTL	1.71	45	14950	40	4	2	1	47	37.350	1.258	2.713	0.464	1.234	0.572	108
9193		W GOVERNOR JOHN SEVIER HWY	MARTIN MILL PIKE ACCESS	2.52	SOUTH OF CRENSHAW RD	1.21	2-TWLTL	1.31	43	14950	38	5	4	0	47	28.613	1.643	2.796	0.587	1.255	0.737	92
9194		W GOVERNOR JOHN SEVIER HWY	SOUTH OF CRENSHAW RD	1.21	WEST OF MARYVILLE PIKE	0.99	2L	0.22	36	14950	9	2	0	0	11	4.805	2.289	4.060	0.564	1.000	0.564	109
9195		W GOVERNOR JOHN SEVIER HWY	WEST OF MARYVILLE PIKE	0.58	CITY LIMIT	0.44	2-TWLTL	0.14	42	14950	16	2	0	0	18	3.058	5.886	4.253	1.384	1.000	1.384	40
9196		W RACCOON VALLEY DR	COUNTY LINE	0.00	NAFF RD	0.11	2L	0.11	24	3514	0	0	0	0	0	0.565	0.000	0.000	0.000	0.000	0.000	198
9197		W RACCOON VALLEY DR	NAFF RD	0.11	HEISKELL RD	2.27	2L	2.16	22	3514	27	6	8	1	42	11.089	3.787	2.516	1.505	1.690	2.545	8
9198	527	WASHINGTON PK	E EMORY RD	15.32	E HIGHWAY 61	16.02	2L	0.70	22	571	2	0	0	0	2	0.584	3.425	6.286	0.545	1.000	0.545	112

LEGEND: Yellow-Expressway; Green-Major Arterial; Purple-Minor Arterial; Orange-Major Collector; Blue-Local

Signal Warrant Analysis

INTERSECTION: **NORTHSHORE DR AT TOOLES BEND RD**
SCENARIO: **EXISTING 2018**
DATE: 01/29/2018

		PEDESTRIAN GAPS/HOUR :	0
		ESTABLISHED SCHOOL CROSSING, MINIMUM 20 Xing (YES/NO):	NO
85TH PERCENTILE SPEED:	45	NEAREST SIGNALIZED INTERSECTION:	0
POPULATION:	50,000	IMPROVE PROGRESSION-PLATOONING (YES/NO):	NO
NUMBER OF APPROACHES:	3	MAJOR ROUTES (YES/NO):	NO
LANES ON MAIN STREET:	2	WARRANTS IN 5 YRS (YES/NO):	NO
MINOR STREET APPROACH LANES:	2		
		ALTERNATIVES TO A SIGNAL EXPLORED:	YES
PEDESTRIANS:	N/A	NUMBER OF ACCIDENTS/YR:	6
PEAK-HOUR VOLUME (4-CONSECUTIVE 15MIN PERIODS)	NO	PEAK HOUR DELAY (VEH-HR):	0
MAJOR:	1223		
11% MINOR:	30	PROXIMITY OF RR ON MINOR APPROACH TO MAJOR STREET:	0
		RAIL TRAFFIC FREQUENCY:	0 0
		MINOR APPROACH HIGH-OCCUPANCY BUSES :	0.0% 0
EXISTING OR PROPOSED SIGNAL SYSTEM (YES/NO):	N/A	TRACTOR-TRAILER PERCENTAGE	0.0% 0

	MAIN STREET				MINOR STREET								
HOUR	PEDESTRIAN VOLUME	MAIN STREET VOLUME	PERCENT OF WARRANT 1A 420	PERCENT OF WARRANT 1B 630	MINOR STREET VOLUME	MINIMUM VOLUME WARRANT 1A 140		INTERRUPTION WARRANT 1B 70		COMBINATION WARRANT A&B	4-HOUR WARRANT 2		PEAK HOUR WARRANT 3B	
24-1	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
1-2	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
2-3	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
3-4	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
4-5	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
5-6	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
6-7	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
7-8	0	930	221%	148%	39	28%	NO	56%	NO	NO	49%	NO	24%	NO
8-9	0	1,093	260%	173%	18	13%	NO	26%	NO	NO	23%	NO	15%	NO
9-10	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
10-11	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
11-12	0	735	175%	117%	18	13%	NO	26%	NO	NO	15%	NO	7%	NO
12-13	0	901	215%	143%	20	14%	NO	29%	NO	NO	25%	NO	11%	NO
13-14	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
14-15	0	898	214%	143%	22	16%	NO	31%	NO	NO	28%	NO	12%	NO
15-16	0	1,018	242%	162%	21	15%	NO	30%	NO	NO	26%	NO	15%	NO
16-17	0	1,070	255%	170%	21	15%	NO	30%	NO	NO	26%	NO	17%	NO
17-18	0	1,223	291%	194%	30	21%	NO	43%	NO	NO	38%	NO	30%	NO
18-19	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
19-20	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
20-21	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
21-22	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
22-23	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
23-24	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO

SUMMARY

WARRANT	WARRANT DESCRIPTION	WARRANT OBTAINED?	HOURS	>=90% HOURS	PRIORITY POINTS
1 A	MINIMUM VOLUME:	NO	0	0	0
B	INTERUPTION:	NO	0	0	0
A & B	COMBINATION:	NO	0	N/A	0
2	FOUR-HOUR:	NO	0	0	0
3 A	PEAK HOUR DELAY:	N/A	N/A	N/A	0
B	PEAK HOUR VOLUME:	NO	0	0	0
4 No data collected	MINIMUM PED. VOLUMES:	N/A	N/A	N/A	N/A
5	SCHOOL CROSSING:	NO	N/A	N/A	0
6	CORD. SIGNAL SYSTEM:	NO	N/A	N/A	0
7	ACCIDENT EXPERIENCE:	NO	0	N/A	0
8	ROADWAY NETWORK:	NO	4	N/A	0
9	INTERSECTION NEAR A GRADE CROSS	N/A	0	0	0
			PRIORITY VALUE		0

INTERSECTION: **NORTHSHORE DR AT TOOLES BEND RD**
SCENARIO: **BACKGROUND 2028**
DATE: 02/13/2018

		PEDESTRIAN GAPS/HOUR :	0
		ESTABLISHED SCHOOL CROSSING, MINIMUM 20 Xing (YES/NO):	NO
85TH PERCENTILE SPEED:	45	NEAREST SIGNALIZED INTERSECTION:	0
POPULATION:	50,000	IMPROVE PROGRESSION-PLATOONING (YES/NO):	NO
NUMBER OF APPROACHES:	3	MAJOR ROUTES (YES/NO):	NO
LANES ON MAIN STREET:	2	WARRANTS IN 5 YRS (YES/NO):	NO
MINOR STREET APPROACH LANES:	2		
		ALTERNATIVES TO A SIGNAL EXPLORED:	YES
PEDESTRIANS:	N/A	NUMBER OF ACCIDENTS/YR:	6
PEAK-HOUR VOLUME (4-CONSECUTIVE 15MIN PERIODS)	NO	PEAK HOUR DELAY (VEH-HR):	0
MAJOR:	1467		
18% MINOR:	36	PROXIMITY OF RR ON MINOR APPROACH TO MAJOR STREET:	0
		RAIL TRAFFIC FREQUENCY:	0 0
		MINOR APPROACH HIGH-OCCUPANCY BUSES :	0.0% 0
EXISTING OR PROPOSED SIGNAL SYSTEM (YES/NO):	N/A	TRACTOR-TRAILER PERCENTAGE	0.0% 0

	MAIN STREET				MINOR STREET								
HOUR	PEDESTRIAN VOLUME	MAIN STREET VOLUME	PERCENT OF WARRANT 1A 420	PERCENT OF WARRANT 1B 630	MINOR STREET VOLUME	MINIMUM VOLUME WARRANT 1A 140		INTERRUPTION WARRANT 1B 70		COMBINATION WARRANT A&B	4-HOUR WARRANT 2		PEAK HOUR WARRANT 3B	
24-1	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
1-2	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
2-3	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
3-4	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
4-5	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
5-6	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
6-7	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
7-8	0	1,114	265%	177%	47	34%	NO	67%	NO	NO	59%	NO	41%	NO
8-9	0	1,311	312%	208%	22	16%	NO	31%	NO	NO	28%	NO	22%	NO
9-10	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
10-11	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
11-12	0	883	210%	140%	22	16%	NO	31%	NO	NO	28%	NO	12%	NO
12-13	0	1,081	257%	172%	25	18%	NO	36%	NO	NO	31%	NO	20%	NO
13-14	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
14-15	0	1,077	256%	171%	27	19%	NO	39%	NO	NO	34%	NO	22%	NO
15-16	0	1,220	290%	194%	26	19%	NO	37%	NO	NO	33%	NO	26%	NO
16-17	0	1,283	305%	204%	25	18%	NO	36%	NO	NO	31%	NO	25%	NO
17-18	0	1,467	349%	233%	36	26%	NO	51%	NO	NO	45%	NO	36%	NO
18-19	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
19-20	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
20-21	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
21-22	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
22-23	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
23-24	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO

SUMMARY

WARRANT	WARRANT DESCRIPTION	WARRANT OBTAINED?	HOURS	>=90% HOURS	PRIORITY POINTS
1 A	MINIMUM VOLUME:	NO	0	0	0
B	INTERUPTION:	NO	0	0	0
A & B	COMBINATION:	NO	0	N/A	0
2	FOUR-HOUR:	NO	0	0	0
3 A	PEAK HOUR DELAY:	N/A	N/A	N/A	0
B	PEAK HOUR VOLUME:	NO	0	0	0
4 No data collected	MINIMUM PED. VOLUMES:	N/A	N/A	N/A	N/A
5	SCHOOL CROSSING:	NO	N/A	N/A	0
6	CORD. SIGNAL SYSTEM:	NO	N/A	N/A	0
7	ACCIDENT EXPERIENCE:	NO	0	N/A	0
8	ROADWAY NETWORK:	NO	7	N/A	0
9	INTERSECTION NEAR A GRADE CROSS	N/A	0	0	0
			PRIORITY VALUE		0

INTERSECTION: **NORTHSHORE DR AT TOOLES BEND RD**
SCENARIO: **PROJECTED 2028**
DATE: 07/24/2018

		PEDESTRIAN GAPS/HOUR :	0
		ESTABLISHED SCHOOL CROSSING, MINIMUM 20 Xing (YES/NO):	NO
85TH PERCENTILE SPEED:	45	NEAREST SIGNALIZED INTERSECTION:	0
POPULATION:	50,000	IMPROVE PROGRESSION-PLATOONING (YES/NO):	NO
NUMBER OF APPROACHES:	3	MAJOR ROUTES (YES/NO):	NO
LANES ON MAIN STREET:	2	WARRANTS IN 5 YRS (YES/NO):	NO
MINOR STREET APPROACH LANES:	2		
		ALTERNATIVES TO A SIGNAL EXPLORED:	YES
PEDESTRIANS:	N/A	NUMBER OF ACCIDENTS/YR:	6
PEAK-HOUR VOLUME (4-CONSECUTIVE 15MIN PERIODS)	YES	PEAK HOUR DELAY (VEH-HR):	0
MAJOR:	1802		
194% MINOR:	250	PROXIMITY OF RR ON MINOR APPROACH TO MAJOR STREET:	0
		RAIL TRAFFIC FREQUENCY:	0 0
		MINOR APPROACH HIGH-OCCUPANCY BUSES :	0.0% 0
EXISTING OR PROPOSED SIGNAL SYSTEM (YES/NO):	N/A	TRACTOR-TRAILER PERCENTAGE	0.0% 0

	MAIN STREET				MINOR STREET								
HOUR	PEDESTRIAN VOLUME	MAIN STREET VOLUME	PERCENT OF WARRANT 1A 420	PERCENT OF WARRANT 1B 630	MINOR STREET VOLUME	MINIMUM VOLUME WARRANT 1A 140		INTERRUPTION WARRANT 1B 70		COMBINATION WARRANT A&B	4-HOUR WARRANT 2		PEAK HOUR WARRANT 3B	
24-1	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
1-2	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
2-3	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
3-4	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
4-5	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
5-6	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
6-7	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
7-8	0	1,212	289%	192%	369	263%	YES	527%	YES	YES	461%	YES	369%	YES
8-9	0	1,396	332%	222%	301	215%	YES	430%	YES	YES	376%	YES	301%	YES
9-10	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
10-11	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
11-12	0	982	234%	156%	354	253%	YES	505%	YES	YES	442%	YES	237%	YES
12-13	0	1,183	282%	188%	363	260%	YES	519%	YES	YES	454%	YES	363%	YES
13-14	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
14-15	0	1,227	292%	195%	175	125%	YES	251%	YES	YES	219%	YES	175%	YES
15-16	0	1,400	333%	222%	204	146%	YES	291%	YES	YES	255%	YES	204%	YES
16-17	0	1,463	348%	232%	204	146%	YES	291%	YES	YES	255%	YES	204%	YES
17-18	0	1,802	429%	286%	250	179%	YES	357%	YES	YES	313%	YES	250%	YES
18-19	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
19-20	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
20-21	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
21-22	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
22-23	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
23-24	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO

SUMMARY

WARRANT		WARRANT DESCRIPTION	WARRANT OBTAINED?	HOURS	>=90% HOURS	PRIORITY POINTS
1	A	MINIMUM VOLUME:	YES	8	0	88
	B	INTERUPTION:	YES	8	0	80
	A & B	COMBINATION:	YES	8	N/A	72
2		FOUR-HOUR:	YES	8	0	128
3	A	PEAK HOUR DELAY:	N/A	N/A	N/A	0
	B	PEAK HOUR VOLUME:	YES	8	0	448
4	No data collected	MINIMUM PED. VOLUMES:	N/A	N/A	N/A	N/A
5		SCHOOL CROSSING:	NO	N/A	N/A	0
6		CORD. SIGNAL SYSTEM:	NO	N/A	N/A	0
7		ACCIDENT EXPERIENCE:	YES	8	N/A	115
8		ROADWAY NETWORK:	NO	8	N/A	0
9		INTERSECTION NEAR A GRADE CROSS	N/A	0	0	0
				PRIORITY VALUE		931.2

Signal Warrant Projections - Projected 2028

	Westbound Tooles Bend Road Background Traffic	Westbound Trips Out	Percent Total Trips (1)	Westbound Tooles Bend Road Projected Traffic	Northbound South Northshore Drive Background Traffic	Northbound Trips In (0.35)	Percent Total Trips (1)	Northbound South Northshore Drive Projected Traffic	Southbound South Northshore Drive Background Traffic	Southbound Trips In (0.55)	Percent Total Trips (1)	Northbound South Northshore Drive Projected Traffic
24-1	0	0	0%	0	0	0	0%	0	0	0	0%	0
1-2	0	0	0%	0	0	0	0%	0	0	0	0%	0
2-3	0	0	0%	0	0	0	0%	0	0	0	0%	0
3-4	0	0	0%	0	0	0	0%	0	0	0	0%	0
4-5	0	0	0%	0	0	0	0%	0	0	0	0%	0
5-6	0	0	0%	0	0	0	0%	0	0	0	0%	0
6-7	0	0	0%	0	0	0	0%	0	0	0	0%	0
7-8	47	322	11%	369	565	38	1%	603	551	58	2%	609
8-9	22	279	9%	301	612	28	1%	640	700	56	2%	756
9-10	0	0	0%	0	0	0	0%	0	0	0	0%	0
10-11	0	0	0%	0	0	0	0%	0	0	0	0%	0
11-12	22	332	11%	354	425	33	1%	458	457	66	2%	523
12-13	24	339	11%	363	563	34	1%	597	518	68	2%	586
13-14	0	0	0%	0	0	0	0%	0	0	0	0%	0
14-15	26	149	5%	175	550	60	2%	610	528	89	3%	617
15-16	25	179	6%	204	602	72	2%	674	619	107	4%	726
16-17	25	179	6%	204	580	72	2%	652	704	107	4%	811
17-18	36	214	7%	250	658	134	4%	792	810	200	7%	1010
18-19	0	0	0%	0	0	0	0%	0	0	0	0%	0
19-20	0	0	0%	0	0	0	0%	0	0	0	0%	0
20-21	0	0	0%	0	0	0	0%	0	0	0	0%	0
21-22	0	0	0%	0	0	0	0%	0	0	0	0%	0
22-23	0	0	0%	0	0	0	0%	0	0	0	0%	0
23-24	0	0	0%	0	0	0	0%	0	0	0	0%	0

Distributed peak hour trips from Table 2: Trip Generation

Distributed trips have been synthesized in order to maintain peak periods and applied at similar rate to existing traffic distributions

(1) Percent of Total Trips shown to validate peak period assumptions.
Percent of Total Trips = Trips / Daily Trips (at projected development)

INTERSECTION: **NORTHSHORE DR AT TOOLES BEND RD**
SCENARIO: **PROJECTED 2022-40% BUILD**
DATE: 07/24/2018

		PEDESTRIAN GAPS/HOUR :	0
		ESTABLISHED SCHOOL CROSSING, MINIMUM 20 Xing (YES/NO):	NO
85TH PERCENTILE SPEED:	45	NEAREST SIGNALIZED INTERSECTION:	0
POPULATION:	50,000	IMPROVE PROGRESSION-PLATOONING (YES/NO):	NO
NUMBER OF APPROACHES:	#REF!	MAJOR ROUTES (YES/NO):	NO
LANES ON MAIN STREET:	2	WARRANTS IN 5 YRS (YES/NO):	NO
MINOR STREET APPROACH LANES:	2		
		ALTERNATIVES TO A SIGNAL EXPLORED:	YES
PEDESTRIANS:	N/A	NUMBER OF ACCIDENTS/YR:	6
PEAK-HOUR VOLUME (4-CONSECUTIVE 15MIN PERIODS)	NO	PEAK HOUR DELAY (VEH-HR):	0
MAJOR:	1441		
57% MINOR:	118	PROXIMITY OF RR ON MINOR APPROACH TO MAJOR STREET:	0
		RAIL TRAFFIC FREQUENCY:	0 0
		MINOR APPROACH HIGH-OCCUPANCY BUSES :	0.0% 0
EXISTING OR PROPOSED SIGNAL SYSTEM (YES/NO):	N/A	TRACTOR-TRAILER PERCENTAGE	0.0% 0

	MAIN STREET				MINOR STREET								
HOUR	PEDESTRIAN VOLUME	MAIN STREET VOLUME	PERCENT OF WARRANT 1A 420	PERCENT OF WARRANT 1B 630	MINOR STREET VOLUME	MINIMUM VOLUME WARRANT 1A 140		INTERRUPTION WARRANT 1B 70		COMBINATION WARRANT A&B	4-HOUR WARRANT 2		PEAK HOUR WARRANT 3B	
24-1	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
1-2	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
2-3	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
3-4	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
4-5	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
5-6	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
6-7	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
7-8	0	1,039	247%	165%	171	122%	YES	244%	YES	YES	214%	YES	128%	YES
8-9	0	1,214	289%	193%	131	94%	YES/NO	187%	YES	YES	164%	YES	131%	YES
9-10	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
10-11	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
11-12	0	834	198%	132%	152	109%	YES	217%	YES	YES	164%	YES	76%	NO
12-13	0	1,014	241%	161%	157	112%	YES	225%	YES	YES	197%	YES	112%	YES
13-14	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
14-15	0	1,023	244%	162%	83	60%	NO	119%	YES	NO	104%	YES	61%	NO
15-16	0	1,164	277%	185%	94	67%	NO	135%	YES	NO	118%	YES	89%	NO
16-17	0	1,231	293%	195%	106	76%	NO	152%	YES	NO	133%	YES	106%	YES
17-18	0	1,441	343%	229%	118	84%	NO	169%	YES	YES	148%	YES	118%	YES
18-19	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
19-20	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
20-21	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
21-22	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
22-23	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
23-24	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO

SUMMARY

WARRANT	WARRANT DESCRIPTION	WARRANT OBTAINED?	HOURS	>=90% HOURS	PRIORITY POINTS
1 A	MINIMUM VOLUME:	NO	3	1	33
B	INTERUPTION:	YES	8	0	80
A & B	COMBINATION:	NO	5	N/A	45
2	FOUR-HOUR:	YES	8	0	128
3 A	PEAK HOUR DELAY:	N/A	N/A	N/A	0
B	PEAK HOUR VOLUME:	YES	5	0	280
4 No data collected	MINIMUM PED. VOLUMES:	N/A	N/A	N/A	N/A
5	SCHOOL CROSSING:	NO	N/A	N/A	0
6	CORD. SIGNAL SYSTEM:	NO	N/A	N/A	0
7	ACCIDENT EXPERIENCE:	YES	8	N/A	115
8	ROADWAY NETWORK:	NO	7	N/A	0
9	INTERSECTION NEAR A GRADE CROSS	N/A	0	0	0
			PRIORITY VALUE		681.2

Signal Warrant Projections- 2022 Projected - 40% Development

	Westbound Tooles Bend Road Background Traffic	Westbound Trips Out	Percent Total Trips [1]	Westbound Tooles Bend Road Projected Traffic	Northbound South Northshore Drive Background Traffic	Northbound Trips In (0.35)	Percent Total Trips [1]	Northbound South Northshore Drive Projected Traffic	Southbound South Northshore Drive Background Traffic	Southbound Trips In (0.55)	Percent Total Trips [1]	Northbound South Northshore Drive Projected Traffic
24-1	0	0	0%	0	0	0	0%	0	0	0	0%	0
1-2	0	0	0%	0	0	0	0%	0	0	0	0%	0
2-3	0	0	0%	0	0	0	0%	0	0	0	0%	0
3-4	0	0	0%	0	0	0	0%	0	0	0	0%	0
4-5	0	0	0%	0	0	0	0%	0	0	0	0%	0
5-6	0	0	0%	0	0	0	0%	0	0	0	0%	0
6-7	0	0	0%	0	0	0	0%	0	0	0	0%	0
7-8	42	129	11%	171	496	13	1%	509	509	21	2%	530
8-9	19	112	9%	131	630	11	1%	641	551	22	2%	573
9-10	0	0	0%	0	0	0	0%	0	0	0	0%	0
10-11	0	0	0%	0	0	0	0%	0	0	0	0%	0
11-12	19	133	11%	152	411	13	1%	425	382	27	2%	409
12-13	22	136	11%	157	467	14	1%	480	507	27	2%	534
13-14	0	0	0%	0	0	0	0%	0	0	0	0%	0
14-15	24	60	5%	83	475	21	2%	496	495	33	3%	527
15-16	23	72	6%	94	557	25	2%	582	542	39	3%	581
16-17	23	83	7%	106	634	29	2%	663	522	46	4%	568
17-18	32	86	7%	118	729	47	4%	776	592	73	6%	665
18-19	0	0	0%	0	0	0	0%	0	0	0	0%	0
19-20	0	0	0%	0	0	0	0%	0	0	0	0%	0
20-21	0	0	0%	0	0	0	0%	0	0	0	0%	0
21-22	0	0	0%	0	0	0	0%	0	0	0	0%	0
22-23	0	0	0%	0	0	0	0%	0	0	0	0%	0
23-24	0	0	0%	0	0	0	0%	0	0	0	0%	0

Distributed peak hour trips from Table 2: Trip Generation

Distributed trips have been synthesized in order to maintain peak periods and applied at similar rate to existing traffic distributions

(1) Percent of Total Trips shown to validate peak period assumptions.
Percent of Total Trips = Trips / Daily Trips (at projected development)

CDM Smith
1100 Marion St., Suite 300
Knoxville, Tennessee 37921
tel: 865. 963.4300
fax: 865. 963-4301

July 26, 2018

Ms. Tarren Barrett
Knoxville Regional TPO &
Metropolitan Planning Commission
400 Main Street, Suite 403
Knoxville, TN 37902

RE: Post Oak Bend Subdivision Traffic Impact Study Review Response

Dear Ms. Barrett:

This letter addresses comments from your July 22, 2018 letter to me and John Sexton's comments (and addenda in red text) from his July 12, 2018 memo to Cindy Pionke. My responses are in blue text and, where appropriate, references to changes in the report have been noted.

1. On page 1-4 under Existing Traffic Conditions, the report mentions the width of Tooles Bend Road as being 20 ft wide without shoulders. The width has been evaluated and is not entirely 20 ft. It varies. Please evaluate the entire width of Tooles Bend Road from S Northshore Drive to the secondary entrance.

   This has been done and further discussion is provided on Page 1-4. Additionally, text has been added to discuss the road widths observed on Page 3-4.

   a. On the same page under Sight Distance, the report says that "the developer is aware of these restrictions and is prepared to make modifications to Tooles Bend Road." To what extent is the developer willing to do this? Please explain.

   The developer is willing to make physical vertical and horizontal changes to Tooles Bend Road to achieve adequate sight distance.

2. On page 3-1 first paragraph, the report mentions "the most recent site layout." Please give a date of the site plan for reference.

   This paragraph has been removed as it no longer applies to the study.

   a. What was the reasoning for adding Table 2? The table and discussion about a slightly larger site plan does not seem important to this study.

Table 2 noted the difference between the analyzed traffic and the traffic of an updated site plan. It is no longer necessary in the report as the site plan and analyses are compatible and has been eliminated.

b. In the second paragraph, the report says that the "48 single family lots are not part of this submittal," but the 48 single family lots are included in the trip generation for the whole site. Please explain.

The traffic impact study includes the ultimate buildout of the development to account for all future trips and to ensure that recommended improvements consider all planned development. This is a conservative approach because the 48 lots would be built later. This comment has been provided in the text on Pages 1-1, 3-1, and 4-3.

c. In Table 3, the Senior Adult Attached Housing worksheets from the Trip Generation Manual are not included in the Appendix. The Land Use Code (LUC) for Senior Adult Attached Housing is 252, not 251. Also, the total number of units do not match what the Community brochure says. Please evaluate.

The senior adult housing component of the site plan has been replaced with a condo/townhouse. It is the developer's intent that some of the units be reserved for senior adults, but in an attempt to be conservative, trips were applied using the condo/townhouse category. Table 3 has been revised to match the residential units of the Community brochure dated July 24, 2018.

3. On page 3-2 under Anticipated Trip Distribution Pattern, the travel time survey completed does not account for the left turning delay. Is this the time to get to S Northshore Dr.? The report mentions that the survey times do not include any intersection delay. What does this mean?

This has been further explained on Page 3-2.

a. What is the existing percent distribution to Tedford Lane?

Looking at outbound traffic, it is about 50/50 Tedford Lane and Tooles Bend Road.

4. In the last paragraph of page 3-4, the first line mentions that "Tooles Bend Road can accommodate more than 4,000 VPD." How much more can it accommodate? The current statement makes it very unclear.

Text has been added to Page 3-4 to further explain.

5. In the second paragraph on page 3-7, please reword the last sentence to "LOS B in the AM peak hour and LOS C in the PM peak hour."

   This sentence has been revised.

6. In the analysis, please be consistent with the direction of travel of S Northshore Drive. It mainly is an East-West corridor, not North-South.

   This has been changed in the appropriate locations in the report with specific reference to the following:
   - Pages 1-8 (previously 1-5), 3-4, and 4-1 where Tooles Bend was referenced as northbound;
   - Page 4-1 where South Northshore Drive was referenced as eastbound; and
   - Pages 3-2 and 4-1 where South Northshore Drive was referenced as westbound.

   Please note that on Page 4-2 recommendations to Tooles Bend Road are still referenced in the southbound direction as Tooles Bend Road runs primarily north-south in this vicinity.

7. In the recommended improvements to Tooles Bend Road on page 4-3, the report mentions safety improvements. Please show in a figure where improvements are being proposed along Tooles Bend Road.

   Figures 15 and 16 illustrate these recommended improvements where specific locations are referenced.

8. The developer mentioned that this development will be broken up into phases. The study does not show phases, so please explain.

   The development will be constructed gradually over a 10-year period, so no phases are planned. The 48-units that are separate from the primary development will be constructed later, but still within the 10-year timeframe.

Comments from John Sexton:

i The portion of Northshore Drive within the study area is actually South Northshore Drive. Consider revising here and throughout report.

Did not address.

This has been changed throughout the report, figures, and Appendix.

1-4 Under "Sight Distance" the report assumes a single driveway at the north access point even though the site plan shows two. This is clarified in the "Summary and Recommendations" section, but please add a statement here regarding the two driveways shown vs. the single driveway evaluated.

Apparently, the site plan has been changed to address this item, and the paragraph that discussed it under “Summary and Recommendations” has been removed.

No response required by CDM Smith.

1-5 Under "Traffic Volumes and Level of Service", 1st paragraph, 4th line, add "existing" before "LOS". The existing peak hour factors were utilized in the 2018 capacity analyses, but a default peak hour factor of 0.92 was used in subsequent capacity analyses.

Did not address.

The word “existing” has been added where recommended. I believe that the PHF will smooth out over the 10-year buildout schedule as significant traffic is added to the street network which will reflect peak hour factors more similar to the default 0.92 than existing peak hour factors.

3-2 The assumed trip distribution is 90% to and from S. Northshore Drive via Tooles Bend Road and 5% each on Tedford Lane and Badgett Road. For reference, it should be noted that the split of existing ADTs on these roadways is 62% on Tooles Bend Road, 21% on Tedford Lane and 17% on Badgett Road.

This is sufficiently explained in the text, so disregard.

No response required from CDM Smith.

3-3 Please add a figure or other details to supplement Figure 10 showing the trip distribution percentages at the 3 access points to facilitate checking as well as how the split between the 2 primary access points was estimated.

Did not address.

There are two access points to the main development site (referenced as North Access and South Access). An additional Off-Site Access is for the future developed homesites located off of Tooles Bend Road. The site distribution percentages have been added to Figure 10 and additional text has been provided on Page 3-2.

3-5 Add a statement in Figure 11 to note the trip balancing among the intersections of Tooles Bend Road/Tedford Lane and the 3 access points.

Did not address.

Additional text has been added on Page 3-2 to elaborate on the trip distribution of Tedford Lane and noted on Figure 10.

3-7 The calculation worksheets in the Appendix referenced in the 1st paragraph are a little confusing. Please provide more annotation so that the origin of the numbers is evident.

Did not address.

More detail has been included in the calculation worksheets in the Appendix.

4-1 Under "Northshore Drive at Tooles Bend Road"-

- The recommended taper lengths do not discriminate between approach tapers and bay tapers. Also, the minimum taper lengths need to comply with TDOT design standards based on speed and lateral offset. Did not address.

Noted. The recommendation on Page 4-1 has been expanded to include storage, approach, and bay taper lengths that comply with TDOT design standards.

- It should be noted that construction of the westbound left-turn lane will require widening of the bridge or culvert at Sinking Creek. (Not included in comments sent to engineer).

CDM Smith is aware of this and are developing functional plans for Knox County on the traffic signal and roundabout alternatives.

- It should be noted that installing separate turn lanes on a STOP controlled approach can create operational problems as side-by-side drivers compete for sight distance past one another. The revised study assumes a traffic signal or roundabout, so this comment is no longer applicable.

No response required from CDM Smith.

- Please include evaluation of this intersection as a single-lane roundabout under build-out conditions. Roundabout analysis has been provided.

No response required from CDM Smith.

Under "Badgett Road at Tooles Bend Road"-

- Please add an evaluation of turn lane warrants. Did not address.

The turn lane evaluation has been added to the recommendations on Page 4-2 and Appendix.

- Please comment on the feasibility of improving sight distance at this intersection. (Not included in comments sent to engineer).

Additional text has been added on Page 4-2 indicating it is not feasible to improve the vertical curve.

Under "North Access on Tooles Bend Road"-

- Please provide the turn lane warrant evaluation. This is provided.

No response required from CDM Smith.

- See comments above regarding approach vs. bay tapers and minimum taper lengths. Did not address.

Noted. The recommendation on Page 4-2 has been expanded to include storage, approach, and bay taper lengths that comply with TDOT design standards.

- 2nd paragraph, 4th line, change "agree" to "agreed". Paragraph was removed.

No response required from CDM Smith.

4-2 Under "South Access on Tooles Bend Road"-

- Please provide the turn lane warrant evaluation. This is provided.

No response required from CDM Smith.

- See comments above regarding approach vs. bay tapers and minimum taper lengths. Did not address.

Noted. The recommendation on Page 4-2 has been expanded to include storage, approach, and bay taper lengths that comply with TDOT design standards.

Add turn lane evaluation for the intersection of Tooles Bend Road at Tedford Lane. Did not address.

The turn lane evaluation has been added to the recommendations on Page 4-2 and Appendix.

4-3 • The page was rotated 180 degrees in bound study. The page was rotated 90 degrees, still needs to be rotated another 90 degrees and enlarged for clarity.

This problem has been corrected.

- Please correct the 2028 Projected Traffic AM peak delay and LOS for Tooles Bend Road at Tedford Lane from 10.4 seconds/LOS B to 9.3 seconds/LOS A to match the capacity analysis output in the Appendix. Capacity analyses have been revised and corrected.

No response required from CDM Smith.

Appendix

- The capacity analysis for the Projected 2028 AM Peak with added turn lanes at Northshore Drive/Tooles Bend Road should include the title, “With Improvements”. (Not included in comments sent to engineer).

This option for mitigation to Northshore Drive at Tooles Bend Road is recommended in two stages- adding turn lanes only and full improvements (adding turn lanes with signalization) as shown in the LOS table and referenced on Page 3-4. These improvements are noted in the titles of the analysis reports to maintain clarity.

- The left-turn lane warrant analysis for Northshore Drive at Tooles Bend Road should include the eastbound right-turn volumes on Northshore Drive in the "opposing volume" values since westbound left-turn drivers would have to yield to these vehicles. Did not address.

Noted. The warrant analysis has been revised to include these volumes.

- See comments from page 3-7 regarding the calculation worksheets used to estimate volumes for signal warrant analyses. Did not address.

More detail has been included in the calculation worksheets in the Appendix.

I had a few new comments on the revised study as follows:

On page 3-1,

- In the first paragraph, the engineer states that the TIS analyses reflect a larger level of development than that shown in the site plan. Please provide an explanation for this discrepancy.

Please see the response for comment 2 from Ms. Barrett.

  - In the second paragraph the engineer states that the 48 SF lots west of I-140 are not part of this submittal, but they are in the TIS. Please clarify.

Please see the response for comment 2b from Ms. Barrett.

  - In Table 3, please cite the source for the attached housing daily trip generation.

The attached senior living category no longer applies to the revised trip generation.

  - On page 3-5 (Figure 11) there are numerous errors in the volumes. These should be the sum of volumes shown in Figures 8 and 10, but the numbers do not match.

The volumes have been updated to reflect the site plan and the sums have been verified.

- On page 3-7, second paragraph, the last sentence should be revised to read "... LOS B in the AM peak hour and LOS C in the PM peak hour."

Noted. This sentence has been revised.

- On page 4-1, the discussion of the traffic signal assumes an east-west orientation for S. Northshore Drive, but the roundabout discussion assumes a north-south orientation for S. Northshore Drive. Please make these consistent with the rest of the TIS.

Please see the response for comment 6 from Ms. Barrett.

As requested, I am providing 5 copies and a PDF of the revised study along with these responses. If you need further explanation on these responses, please let me know.

Sincerely,

Allyson N. Foster, PE
Transportation Engineer
CDM Smith Inc.

cc: Mr. Chris Ooten, Safe Harbor Development