February 15, 2007

Mr. Garry Tucker Robert G. Campbell and Associates 7523 Taggart Lanc Knoxville, Tennessee 37938

RE: HIGDON DRIVE TRAFFIC IMPACT STUDY

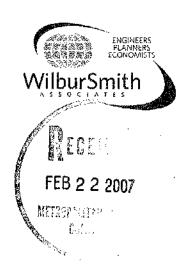
Dear Mr. Tucker:

Wilbur Smith Associates (WSA) is pleased to submit this letter report pertaining to the anticipated traffic impacts of a proposed residential subdivision to be located on the south side of Higdon Drive in northwest Knox County, Tennessee. Figure 1 presents the general site location. Figure 2 presents the proposed conceptual site plan. The scope of this study was defined by the Knox County Department of Engineering and Public Works and the Regional Metropolitan Transportation Planning Organization (TPO) to address geometric conditions and intersection capacity at the site access point and at the intersections of Higdon Drive (east) and Higdon Drive (west) with Oak Ridge Highway (SR 62).

### Data Collection and General Site Description 903

The proposed development will consist of 118 condominium units. The proposed access is a single driveway on the south side of Higdon Drive approximately 450 feet west of the Oak Ridge Highway and Higdon Drive (east) intersection. Build out and full occupancy is expected to occur within two years, or by 2009.

WSA conducted a field investigation in the environs of the proposed development to note any existing or potential geometric deficiencies. Higdon Drive is a local roadway with no posted speed limit that varies in width from 16 to 18 feet and is sloped from east to west at a grade of approximately 5%. Oak Ridge Highway is a two-lane State Highway with 12 foot travel lanes and paved shoulders six feet wide. The posted speed limit is 55 MPH. The available intersection sight distance at the proposed site driveway location is approximately 450 feet to Oak Ridge Highway on the east and approximately 1,300 feet to a vertical curve on the west.



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The recommended alignment of SR 475 is expected to cross Oak Ridge Highway between the two Higdon Drive intersections. However, impacts to the proposed development should be minimal or nonexistent. It is expected that an overpass will be constructed as part of the SR 475 project that will span Oak Ridge Highway, Higdon Drive, and a set of railroad tracks. Therefore, it was assumed that full access will be maintained in the area around the site.

WSA conducted turning movement counts at the intersections of Oak Ridge Highway with Higdon Drive (west) and Higdon Drive (east) on Tuesday, February 6, 2007 and Thursday, February 8, 2007 respectively. The counts were conducted to determine existing traffic volumes and directional distribution in the proposed site vicinity. Figure 3 shows the existing AM and PM peak hour traffic volumes at the count locations. The peak hour was determined to be 7:00-8:00 AM and 4:45-5:45 PM based on the Higdon Drive (east) intersection.

#### **Background Growth of Traffic Volumes**

The Tennessee Department of Transportation (TDOT) maintains a count station on Oak Ridge Highway in the study area. Station #364 is located approximately 0.5 miles west of the Higdon Drive (west) intersection. Annual traffic growth has remained fairly constant during the past twenty years. Recent growth at station #364 has been less than 2%, while a trend line representing traffic growth at the station over the past twenty years results in a growth rate of 2.5% per year. For study purposes, a growth rate of 2.5% per year was used. This annual growth rate was applied to the observed traffic volumes. Figure 4 presents the projected 2009 peak hour traffic at the intersections of Oak Ridge Highway with Higdon Drive (east) and Higdon Drive (west) assuming this background traffic growth.

#### Trip Generation and Trip Distribution of Site Traffic

Table 1 shows the daily, AM peak hour, and PM peak hour traffic expected to be generated by the proposed residential development. The procedures of *Trip Generation*, 7<sup>th</sup> Edition, published by the Institute of Transportation Engineers, were used to estimate these volumes based on locally gathered trip generation data. The TPO published a memorandum ("Local Trip Generation Rates for Multi-Family Residential Uses", August 14, 2000, contained in Appendix) instructing traffic impact study preparers to use the locally obtained data for all multi-family residential developments including apartments, condominiums, and the like.



Higdon Dri		Table IS Trip G	Nivilia		nary	
Time:Period		Total Trips	Pei Enter		Nu Enter	mber Exit
Weekday (24 hours)	V	1,107	50%	50%	554	554
AM Peak Hour	<b>√</b>	62	22%	78%	I4	49
PM Peak Hour	V	89	55%	45%	49	40

The directional distribution of traffic generated by the proposed Higdon Drive subdivision was assumed based on the existing traffic patterns evident in the turning movement counts at the intersections of Oak Ridge Highway with Higdon Drive (east) and Higdon Drive (west). The typical pattern is for traffic to be heavier in one direction in the morning and in the opposite direction in the evening as commuters travel to and return from work. Based on the cited traffic counts, traffic near the proposed site is more heavily oriented (approximately 65% in the AM and 70% in the PM) to and from the west. For study purposes it was assumed that 65% of the proposed subdivision traffic would depart to the west in the morning and 70% would return from the west in the evening. To the east via Oak Ridge Highway, 35% was assigned in the morning and 30% from the east in the evening. Figure 5 shows the directional splits applied to the generated traffic for the proposed subdivision. It should be noted that the eastern and western intersections of Higdon Drive with Oak Ridge Highway generally function as one intersection. Existing traffic counts show that with the exception of a very low number of vehicles, traffic that accesses Higdon Drive going to and from the east uses the eastern intersection and traffic traveling to and from the west uses the western intersection. Therefore, distribution of site related traffic for the purpose of the study maintained this existing traffic pattern.

#### **Traffic Conditions**

Unsignalized intersection capacity analyses were performed for the AM and PM peak hours to evaluate the traffic conditions at the intersections of Oak Ridge Highway with Higdon Drive (east) and Higdon Drive (west) and also at Higdon Drive and the site driveway. The capacity analysis reports are contained in the Appendix. The methodology of the 2000 Highway Capacity Manual as contained in the Highway Capacity Software (version 5.1) was used. One of the measures employed in such analyses is "level of service" (LOS), a qualitative statement of the acceptability of traffic conditions based on delay. The LOS index ranges from LOS A, indicating excellent traffic conditions with minimal delay, to LOS F indicating very congested conditions with excessive delay. LOS D generally is considered the minimum acceptable condition in urban areas.

Based on capacity analyses using the volumes of Figure 3, Oak Ridge Highway drivers currently experience LOS A (AM peak hour) to LOS B (PM peak hour) conditions. With future background traffic growth plus the proposed Higdon Drive subdivision traffic (Figure 6), those conditions are projected to remain at LOS A and B, respectively. Westbound traffic on Oak Ridge Highway will be impeded by vehicles turning left onto Higdon Drive, but their delay will be minimal under all scenarios. Northbound traffic at Higdon Drive (east) and Oak Ridge Highway currently experiences LOS B during the AM peak hour and LOS C during the PM peak hour. These LOS B and LOS C conditions are expected to remain at the completion of the project. Northbound traffic at Higdon Drive (west) and Oak Ridge Highway currently experience LOS C during both the AM and PM peak hours. With the addition of background and site traffic, the intersection is expected to operate at LOS D. However, delays are expected to be minimal and not exceed 33 seconds. Upon site build-out (Figure 6), traffic conditions at the site entrance are projected to be LOS A for drivers during both peak hours. Capacity analysis is summarized in Tables 2, 3, and 4 below.

		Fable 2 e TIS Capacity A Highway and Hig				
Scenario	AM Pea	k-Hour	PM Peak-Hour			
	WB (LOS/Delay)	NB (LOS/Delay)	WB (LOS/Delay)	NB (LOS/Delay)		
Existing	A / 8.1 sec	B / 10.6 sec	B / I0.2 sec	C / 17.7 sec		
Background	A / 8.2 sec	B / 10.8 sec	B / 10.5 sec	C / 18.6 sec		
Build-out	A / 8.2 sec	B / 11.0 sec	B / 10.6 sec	C / 19.4 sec		

	videom som dat vida distrib	Table 3 /e TIS Capacity A Highway and Hig	don Drive (west)				
Scenario	AM Pea	k-Hour	PM Peak-Hour				
	WB (LOS/Delay)	NB (LOS/Delay)	WB (LOS/Delay)	NB (LOS/Delay)			
Existing	A / 8.0 sec	C / 21.0 sec	B / 10.3 sec	C / 22.9 sec			
Background	A / 8.1 sec	C / 22.5 sec	B / 10.6 sec	C / 24.8 sec			
Build-out	A / 8.1 sec	D / 26.5 sec	B / 10.8 sec	D / 38.8 sec			

		Table 4 ve TIS Capacity A on Drive and Site	Driveway		
Scenario	AM Pea		PM Peak-Hour		
Бескатто	WB (LOS/Delay)	NB (LOS/Delay)	WB (LOS/Delay)	NB (LOS/Delay)	
Build-out	A / 7.3 sec	A / 8.8 sec	A / 7.3 sec	A / 8.9 sec	

#### **Evaluation of Signal Warrants**

The need for signalization of the intersections of Oak Ridge Highway with Higdon Drive (east) and Higdon Drive (west) was evaluated. Warrants for traffic signals are set forth in the 2003 Manual on Uniform Traffic Control Devices (MUTCD) published by the FHWA. Three volume-based warrants are defined in the MUTCD as follows:

- Warrant 1: Eight-Hour Vehicular Volume,
- Warrant 2: Four-Hour Vehicular Volume, and
- Warrant 3: Peak Hour.

Warrant 1 is subdivided into three conditions. Condition A (Minimum Vehicular Volume) is applicable where a large volume of intersecting traffic is the principal reason for signalization. Condition B (Interruption of Continuous Traffic) is applicable where major street traffic volumes are so heavy that minor street drivers suffer excessive delay or conflict entering or crossing the major street. The third condition provides for a combination of Conditions A and B.

Due to the fact that Higdon Drive distributes traffic to Oak Ridge Highway at two separate intersections, neither intersection receives enough traffic to warrant a traffic signal. At full build-out, the maximum number of vehicles expected to exit either Higdon Drive intersection onto Oak Ridge Highway during one hour is 39. This volume is well below the threshold set by the MUTCD for the warrant of a traffic signal. Therefore, signalization will not be necessary as a result of this project's construction.

#### Evaluation of Turn Lane Warrants

The need for auxiliary turn lancs at the intersections of Oak Ridge Highway with Higdon Drive (east), Higdon Drive (west), and at the proposed site access point was evaluated. The criteria for such turn-lane warrants are contained in Knox County's Access Control and Driveway Design Policy. The evaluation worksheets are contained in the Appendix.



Based on these evaluations, a westbound left-turn lane on Oak Ridge Highway at Higdon Drive (east) is expected to be warranted at project build-out. In addition, an eastbound right-turn lane on Oak Ridge Highway at Higdon Drive (west) is expected to be warranted at project build-out. Both of these turn lanes are primarily warranted due to the high volume of traffic traveling Oak Ridge Highway and not the volume of turning traffic onto Higdon Drive at either intersection. Turn lanes on Higdon Drive at the site driveway are not expected to be warranted.

#### Conclusions and Recommendations

Based on the analyses and evaluations reported herein, WSA reached the following conclusions and makes the recommendations set forth below.

- Sight distance
  - O <u>Discussion</u>: The minimum required sight distance based on the assumed speed limit of 30 MPH on Higdon Drive is 300 feet. Thus, the available sight distance at the proposed driveway location (450 feet plus in both directions) is expected to be more than adequate, even if actual operating speeds exceed the posted limit slightly.
  - Recommendation: Site grading and landscaping should be accomplished to maintain the available sight distance.

#### Intersection spacing

- O <u>Discussion</u>: The nearest public road intersection to the site driveway is the Oak Ridge Highway and Higdon Drive (east) intersection. This intersection is approximately 450 feet from the proposed access, which exceeds the Knox County minimum separation standard
- o Recommendation: None
- Higdon Drive roadway width
  - <u>Discussion</u>: Higdon Drive is a local roadway that varies in width from 16 to 18 feet.
  - Recommendation: At least some portion of Higdon Drive should be widened in order to be brought up to Knox County standards.
- Auxiliary lanes (Oak Ridge Highway at Higdon Drive (east))
  - O <u>Discussion</u>: A westbound left-turn lane from Oak Ridge Highway into Higdon Drive (east) is marginally warranted primarily due to the high volume of through traffic on Oak Ridge Highway and not the volume of turning traffic. The projected level of service for westbound drivers is LOS B upon project build-out.



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Recommendation: Given the very good projected level of service for Oak Ridge Highway drivers, it is recommended that construction of a westbound left-turn lane at this intersection be considered but with due regard to Knox County's overall intersection improvement priorities. Crash experience should be monitored to anticipate a demonstrated need for the turn lane.

Auxiliary lanes (Oak Ridge Highway at Higdon Drive (west))

Oiscussion: An eastbound right-turn lane from Oak Ridge Highway onto Higdon Drive (west) is warranted in the PM peak hour primarily due to the high volume of through traffic on Oak Ridge Highway and not the volume of turning traffic. The projected level of service for eastbound drivers is LOS A.

Recommendation: Given the very good projected level of service for Oak Ridge Highway drivers, it is recommended that construction of a eastbound right-turn lane at this intersection be considered but with due regard to Knox County's overall intersection improvement priorities. Crash experience should be monitored to anticipate a demonstrated need for the turn lane.

Please find enclosed the supporting figures and appendix items cited herein. Do not hesitate to call if you have any questions or wish to discuss this report.

Sincerely,

WILBUR SMITH ASSOCIATES

Kevin A. Cole, PE

Klim S. OR

Senior Transportation Engineer

Enclosures:

**FIGURES** 

Figure 1: Location Map

Figure 2: Site Plan

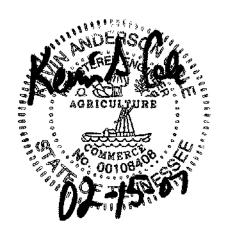
Figure 3: Year 2007 Peak Hour Traffic

Figure 4: Year 2009 Peak Hour Traffic Without Development

Figure 5: Year 2009 Peak Hour Site Generated Traffic

Figure 6: Year 2009 Peak Hour Traffic With Development

<u>APPENDIX</u>



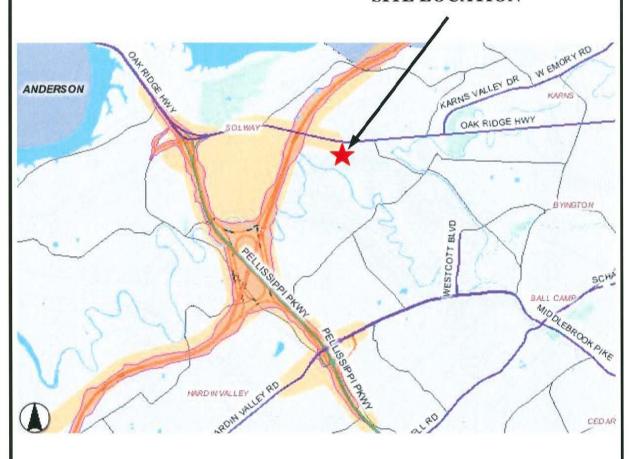
### **FIGURES**

### **LOCATION MAP**

**Proposed Higdon Drive Subdivision Knox County, Tennessee** 

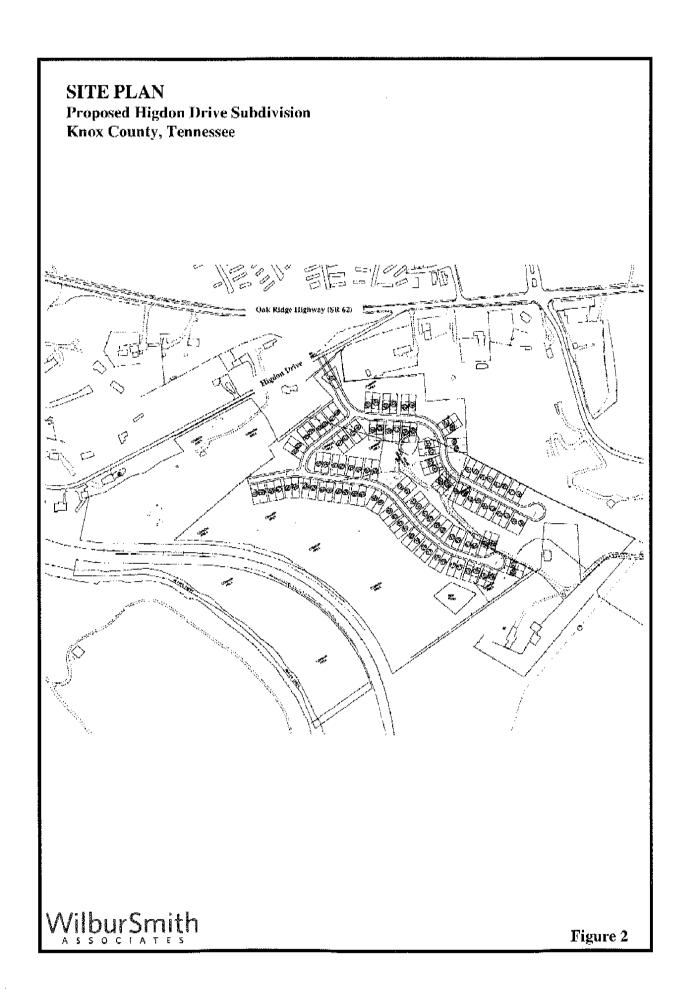


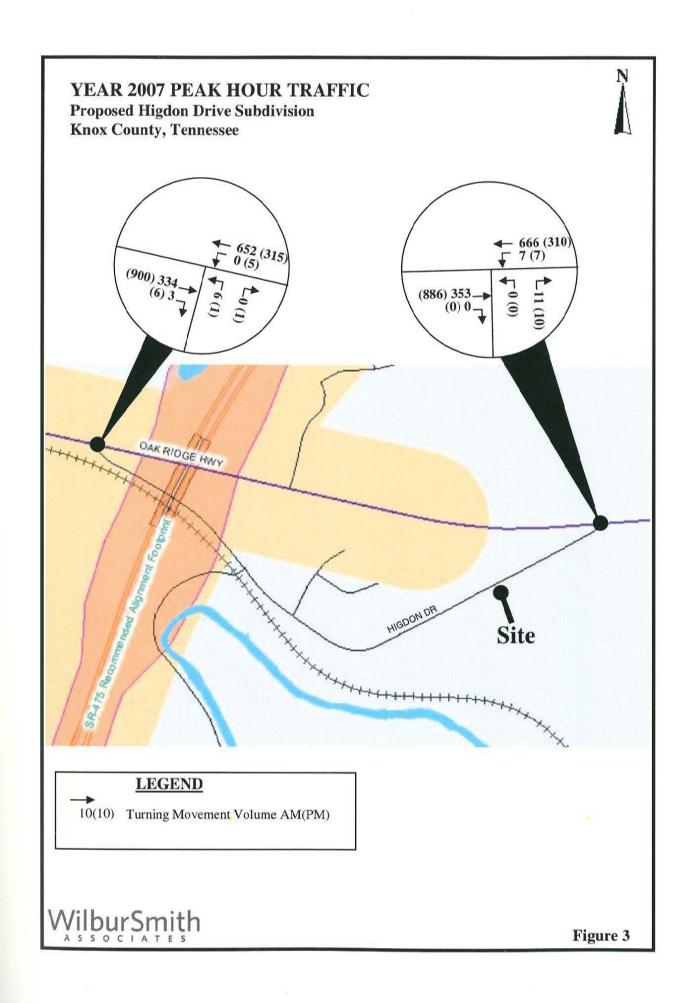
### SITE LOCATION

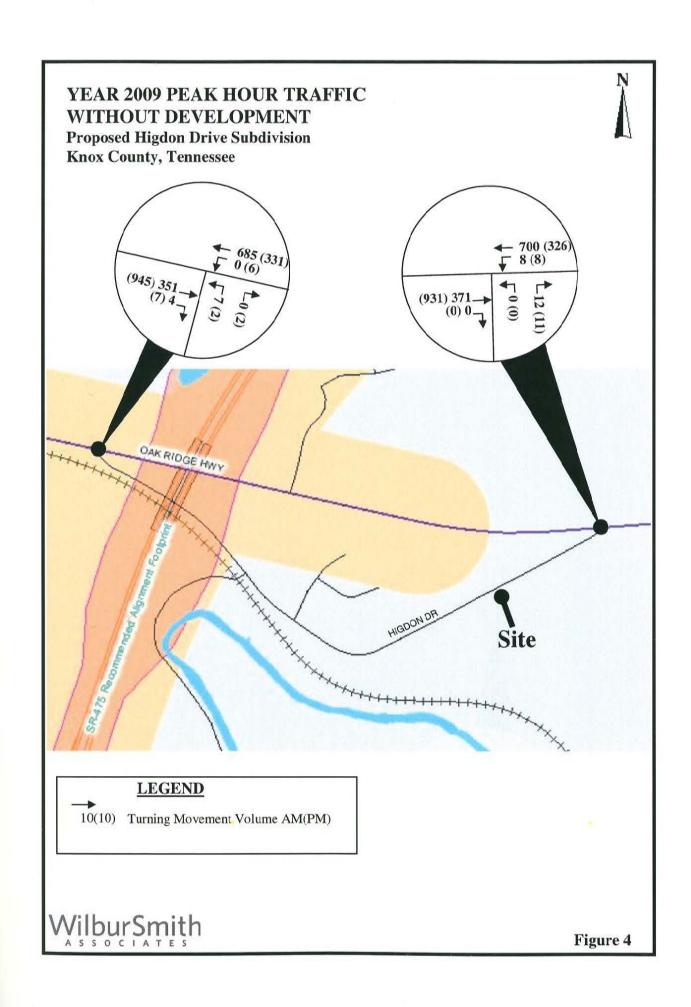


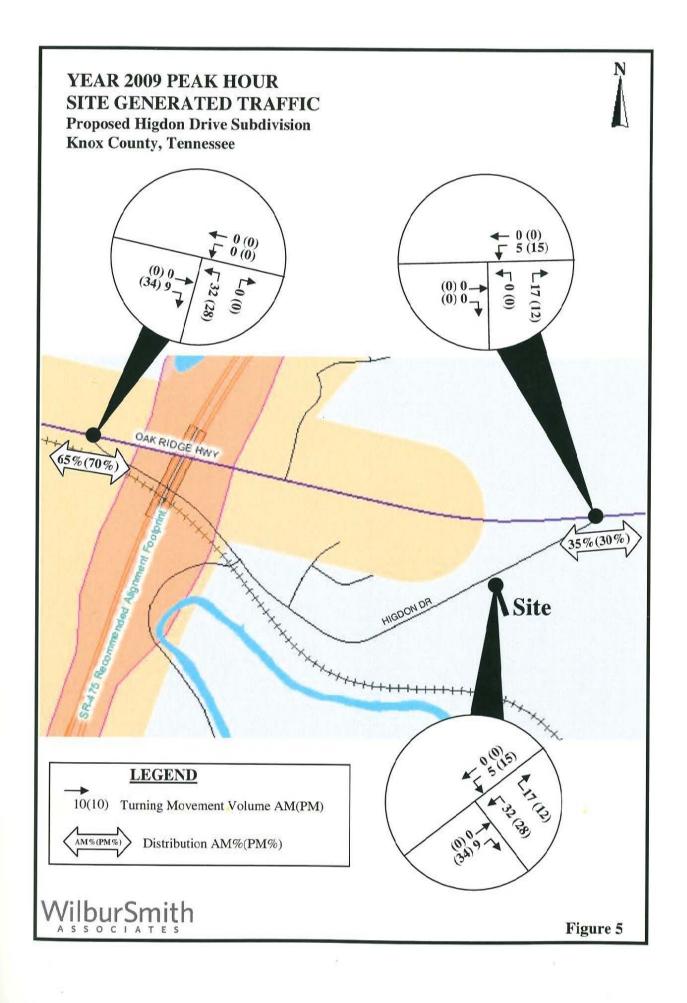
WilburSmith

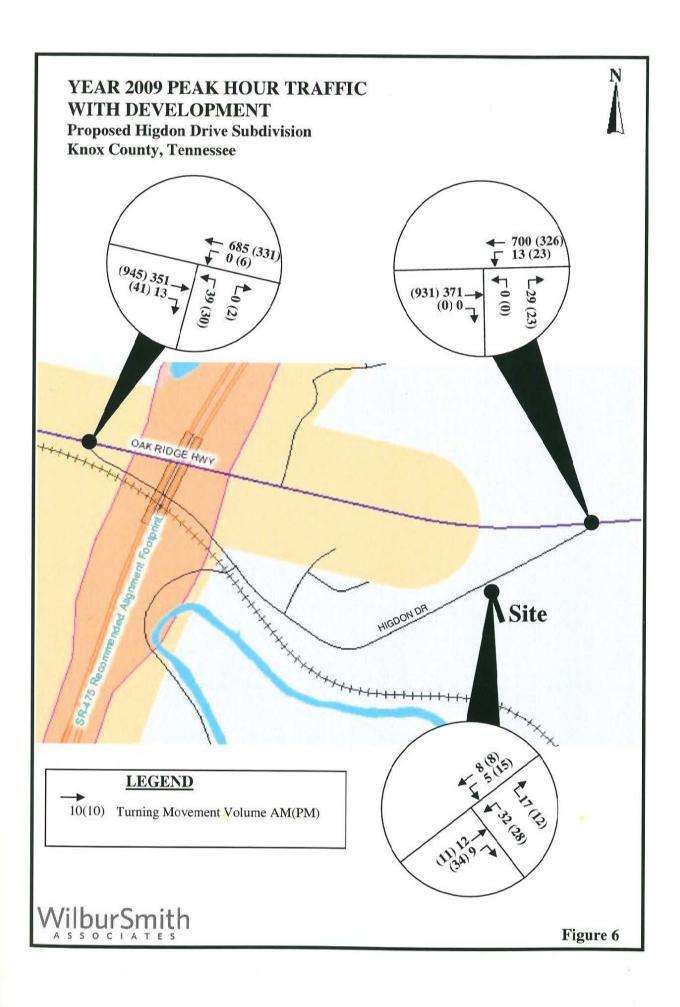
Figure 1











### APPENDIX

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### HISTORICAL ADT'S

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Most Recent	Year	2005	2006

25

Annual Percent Growth 1.64%

Future ADTs per Trend Line

Year ADT
2007 12371
2012 13353
2017 14334
2027 16298
2032 17279

### TRIP GENERATION





### **MEMORANDUM**

To:

Traffic Impact Study Reviewers and Preparers (see attached list)

From:

Mike Conger

Date:

August 14, 2000

Subject: Local Trip Generation Rates for Multi-Family Residential Uses

Attached please find a summary of the final report with data plots for the Knox County Local Apartment Trip Generation Study. As you will recall, this report was discussed when the traffic impact study group last convened this past February. A consensus was reached at that meeting that the trip generation rates developed in the local study should be used for new apartment complexes and any other "multi-family" residential uses that are being proposed.

The MPC voted at its July 2000 meeting to officially amend the Traffic Impact Study Guidelines with language which reads that "trip generation rates for proposed uses shall be calculated using the latest edition of the ITE Trip Generation Manual, or using local data when it is available". This amendment allows the full implementation of the new rates, and they should be used for future proposed multi-family developments unless it can be demonstrated otherwise.

Thanks for your assistance and cooperation in this matter, if there are any questions or comments, please let me know.

# Local Apartment Trip Generation Study

Average Vehicle Trip Ends vs:

**Dwelling Units** 

On a:

Weekday

Number of Studies:

13

Average Number of Dwelling Units:

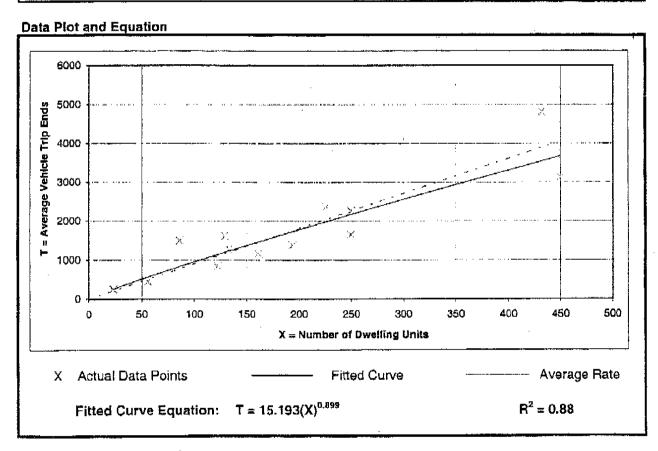
193

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



# 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:

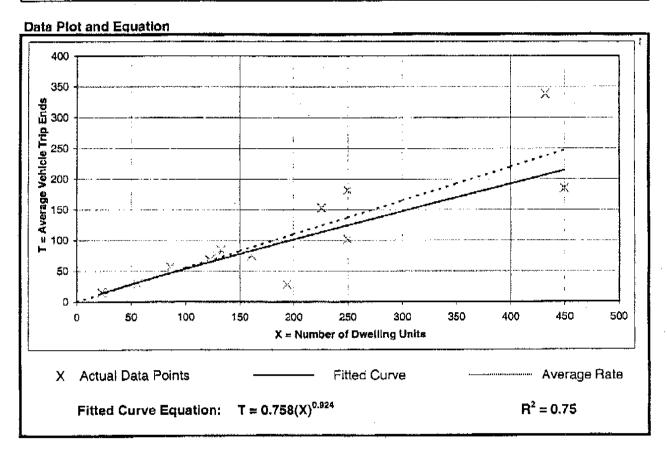
193

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



# 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:

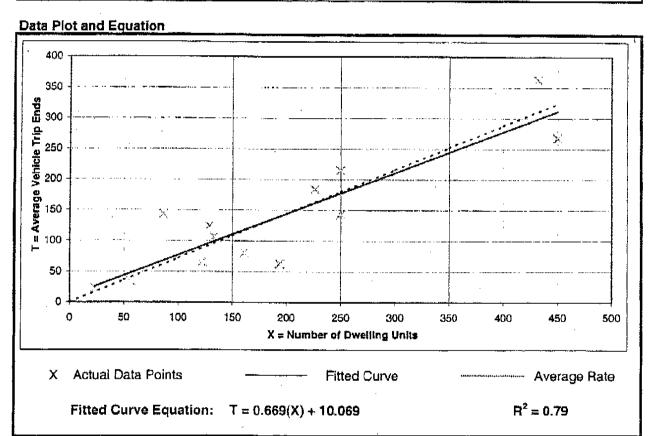
193

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



### ITE Trip Generation Higdon Drive TIS

Local Apartment/ Condominium*							
Dwelling Units =	118						
Average Week	day						
Total =	1,107						
Entering =	50%						
Exiting =	50%						
Entering Traffic =	554						
Exiting Traffic =	554						
AM Peak - Adjacen	t Street						
Total =	62						
Entering =	22%						
Exiting =	78%						
Entering Traffic =	14						
Exiting Traffic =	49						
PM Peak - Adjacent	t Street						
Total =	89						
Entering =	55%						
Exiting =	45%						
Entering Traffic =	49						
Exiting Traffic =	40						

<sup>\*</sup>Trip gen study conducted by the Knoxville MPC

### TRAFFIC COUNTS

Counted by DWS WSA count board D4-2607

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Start Date : 2/8/2007

Page No : 1

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Start Date : 2/8/2007

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04:45 PM	0	0	0	0	. 1	86	0	87	0	0	4	4	0	199	0	199	290
05:00 PM	٥	0	0	0	3	74	0	77	0	0	2	2	Ö	219	ō	219	298
05:15 PM	0	0	0	0	0	80	0	80	0	0	2	2	o	256	O	256	338
05:30 PM	0	0	٥	0	3	70	0	73	0	0	2	2	0	212	0	212	287
Total Volume	0	0	0	0	7	310	0	317	0	o	10	10	0	886	0	886	1213
% App. Total	0	0	0		2.2	97.8	0		0	0	100		0	100	0		
PHF	,000	.000	.000	.000	.583	.901	.000	.911	.000	.000	.625	.625	.000	.865	.000	.865	.897

Counted by DWS WSA count board D4-2607

File Name : OR Hwy-Higdon Dr west Site Code : 00000000

Start Date : 2/6/2007

Page No : 1

Groups Printed- Unshifted

	Hi		rive (wes	st)		Oak R Wes	idge Hw tbound	/y		igdon E	Orive (we	est)	Oak Ridge Hwy Eastbound				
Start Time	Left	Thru		pp. Total	Left	Thru		App. Total	Left	Thru		App. Total	Left	Thru	Right	App, Total	Int. Total
07:00 AM	0	0	. 0	Ö		135	0	135	1	0	0	1 1	0	87	0	87	223
07:15 AM	0	Q	0	0	Ó	156	ő	156	2	ŏ	ŏ	2	ŏ	87	1	88	246
07:30 AM	0	0	0	0	0	163	0	163	2	ō	ŏ	2	ō	78	ò	78	243
07:45 AM	0 .	0	0	0	0	198	0	198	1	0	ō	1	ō	82	2	84	283
Total	0	0	0	0	Q	652	0	652	6	0	0	6	0	334	3	337	995
08:00 AM	0	٥	0	0	1	154	Q	155	1	o	1	2	0	70	0	70	227
08:15 AM	0	. 0	0	0	0	130	0	130	0	O	0	0	0	74	ō	74	204
08:30 AM	0	0	C	0	Ö	107	Ó	107	2	0	0	2	0	48	ō	48	157
08:45 AM	0	0	0	0	0	89	0	89	1	0	0	1	0	62	o	62	152
Total	٥	٥	0	0	1	480	0	481	4	0	1	5	0	254	0	254	740
		* *															
03:00 PM	0	C	0	0	1	62	0	63	0	0	0	0	o	118	2	120	183
03:15 PM	0	0	0	0	O	64	Ö	64	٥	0	0	0	Ó	142	ō	142	206
03:30 PM	0	0	0	0	0	62	0	62	0	0	0	0	0	197	3	200	262
03:45 PM	0	0	0	Ō	0	62	. 0	62	0	0	0	0	0	155	0	155	217
Total	0	0	0	0	1	250	0	251	0	0	0	0	0	612	5	617	868
04:00 PM	0	0	0	0	0	100	0	100	1	0	0	1	Q	133	2	135	236
04:15 PM	0	0	0	0	0	73	0	73	0	0	0	0	0	163	1	164	237
04:30 PM	0	0	0	0	0	68	0	68	0	0	٥	0	0	216	1	217	285
04:45 PM	0	0.	0	0	2	90	0_	92	0	0	0	0	0	205	2	207	299
Total	Ü	U	C	0	2	331	ő	333	1	ŏ	0	1	O	717	6	723	1057
05:00 PM	0	0	0	0	1	75	0	76	0	0	0	0	0	241	1	242 1	318
05:15 PM	0	0	0	0	2	96	ŏ	98	ő	ő	ŏ	ŏ	ŏ	257	ż	259	357
05:30 PM	C	0	0	٥	0	54	Ö	54	1	ō	1	2	ŏ	197	ī	198	254
05:45 PM	Ç	O.	0	0	1	113	0	114	Ó	ò	Ó	ō	ō	166	ċ	166	280
Total	۵	0	0	0	4	338	O	342	1	0	1	2	ō	861	4	865	1209
Grand Total	0	٥	0	0	8	2051	0	2059	12	٥	2	14	0	2778	18	2796	4869
Appreh %	0	Ů.	0	1	0.4	99.6	٥	1	85.7	0	14.3	. !	Ó	99.4	0.6		
Total %	0	٥	0	0	0.2	42.1	0	42.3	0.2	0	0	0.3	0	57.1	0.4	57.4	

	His		rive (we:	st)		Oak Ridge Hwy			Hi	adon D	rive (we	st)		v			
			bound			West	bound				bound	/	Oak Ridge Hwy Eastbound				
Start Time		Thru	Right	App. Total	Left	Thru	Right	Arro Total	Left	Thru	Right	App Total	Left			App. Total	int. Total
Peak Hour Ana	ilysis Fro	om 07:0	O AM to	11:45 A	M - Pes	ik 1 of	1	<del></del>				· 4:7-4.— 1 V.4631				<del></del>	
Peak Hour for I	Entire Int	tersecti	on Begii	ns at 07;	15 AM												
07:15 AM	0	0	0	0	0	156	0	156	2	O	0	2	0	87	1	88	246
07:30 AM	O	0	0	0	0	163	O	163	2	o	0	2	0	78	0	78	243
07:45 AM	0	0	O	0	0	198	0	198	. 1	0	0	1	0	82	2	84	283
08:00 AM	0	0	O	0	1	154	0	155	1	0	1	2	0	70	ð	70	227
Total Volume	0	0	0	0 ]	1	671	O	672	6	Q	1	7	0	317	3	320	999
<u>% App. Total</u>	0	0	0		0.1	99.9	0		85.7	o	14.3		0	99.1	0,9	İ	
PHF	-000	.000	.000	.000	.250	.847	.000	.848	.750	.000	.250	.875	.000	.911	.375	.909	.883

File Name : OR Hwy-Higdon Dr west Site Code : 00000000 Start Date : 2/6/2007

Page No : 2

		South	rive (we: משסם		Oak Ridge Hwy Westbound			Higdon Drive (west) Northbound				Oak Ridge Hwy Eastbound					
Start Time	Left	Thru	Right /	App. Total	Left	Thru	Right	App. Yotal	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Ana	alysis Fro	om 12:0	O PM to	05:45 P	M - Per	ak 1 of	1										
Peak Hour for I	Entire In	tersecti	on Begir	ns at 04:	30 PM												
04:30 PM	0	0	0	. 0	Û	68	0	68	0	0	0	o l	٥	216	. 1	217	285
04:45 PM	a	0	0	0	2	90	0	92	Ō	ō	Ò	اة	ŏ	205	2	207	299
05:00 PM	0	0	0	0	1	75	0	76	0	0	0	o l	ō	241	1	242	318
05:15 PM	0	Ö	0	0	2	96	0	98	Ò	Ó	Ö	o l	ō	257	2	259	357
Total Volume	0	0	0	0	5	329	Q	334	. 0	0	0	0	· · · · · · · · ·	919	6	925	1259
% App. Total	0	0	0	,	1,5	98.5	0		0	0	0	-	ō	99.4	0.6		
PHF	.000	.000	.000	.000	.625	.857	.000	.852	.000	.000	.000	.000	.000	.894	.750	.893	.882

### HIGHWAY CAPACITY ANALYSES

## 2007 EXISTING TRAFFIC CONDITIONS

#### TWO-WAY STOP CONTROL SUMMARY General Information Site Information Analyst **JMC** Intersection Oak Ridge / Higdon Agency/Co. Wilbur Smith Jurisdiction Date Performed 2/12/2007 Analysis Year 2007 Analysis Time Period AM Peak Project Description Existing Conditions East/West Street: Oak Ridge Hwy (east) North/South Street: Higdon Dr intersection Orientation: East-West Study Period (hrs): 0.25Vehicle Volumes and Adjustments Major Street Eastbound Westbound Movement 1 5 6 T^ R L R Volume (veh/h) 0 353 0 7 666 0 Peak-hour factor, PHF 0.88 0.880.88 0.88 0.880.88Hourly Flow Rate (veh/h) 0 401 0 7 756 Proportion of heavy 0 Ö vehicles, P<sub>HV</sub> Median type Undivided RT Channelized? 0 0 Lanes 0 1 0 1 0 Configuration TR LT Upstream Signal 0 Minor Street Northbound Southbound Movement 8 9 10 11 12 L Ţ R L T R Volume (veh/h) 0 0 0 11 Ö 0 Peak-hour factor, PHF 0.880.88 0.88 0.88 0.88 0.88 Hourly Flow Rate (veh/h) 0 0 12 0 0 0 Proportion of heavy 0 0 0 0 vehicles, P<sub>HV</sub> 0 0 Percent grade (%) 0 0 Flared approach Ν Ν Storage 0 0 RT Channelized? 0 0 Lanes 0 0 0 0 0 Configuration LR Control Delay, Queue Length, Level of Service Approach ΕB WB Northbound Southbound Movement 1 4 7 8 10 11 12 Lane Configuration LTLR Volume, v (vph) 7 12 Capacity, c<sub>m</sub> (vph) 1169 653 v/c ratio 0.01 0.02 Queue length (95%) 0.02 0.06 Control Delay (s/veh) 8.1 10.6 LOS Α $\boldsymbol{B}$ Approach delay (s/veh) 10.6

Approach LOS

В

	TWO	-WAY STOP	CONTRO	OL SUM	MARY			
General Information					on S		regaliyan.	Sanion Montas
Analyst	JMC	<u> </u>	Interse		1 m De stroude de la décediment de		ge / Higdo	12710-11483-1149-1149-1149 1
Agency/Co.	Wilbur Smith		Jurisdio				geringae	
Date Performed	2/12/2007		Analysi			2007		
Analysis Time Period	PM Peak				•	2007		
Project Description Exis	tina Conditions	***************************************						
East/West Street: Oak Ri			North/S	outh Stree	et: <i>Higdon D</i>	<u> </u>		
Intersection Orientation:		VM 14. 11.		eriod (hrs		77		i
Vehicle Volumes and	LAdjustmonts		TEN MARKARY	0 - XX	7. 0.20 NATURA - E STANKE		de 27040 (1988) VIII (1988)	
Major Street		Eastbound		<u> </u>		Westbo	d	
Movement	1 1	2	3		4		idid	6
		T	Ř		1	T		R
Volume (veh/h)	0	886	0		7	310		<u> </u>
Peak-hour factor, PHF	0.88	0.88	0.88		0.88	0.88		0.88
Hourly Flow Rate (veh/h)	0	1006	0		7	352		0
Proportion of heavy		Mar-			<u> </u>	i		
vehicles, P <sub>HV</sub>	0		~-		0			
Median type		F-1411		Undivide	ed	.]	i	
RT Channelized?			1 0					
Lanes	0	. 1	0	""	0	1	2/III.	0
Configuration			TR		LT	1		
Upstream Signal		0				0		
Minor Street		Northbound				Southbo	und	
Movement	7	8	9		10	11		12
y <u>4 </u>	L.	Т	R		L	T		R
Volume (veh/h)	0	0	10		0	0		0
Peak-hour factor, PHF	0.88	0.88	0.88		0.88	0.88	11000	0.88
Hourly Flow Rate (veh/h)	0	0	. 11		0	0		0
Proportion of heavy	0	0	0		0	_	,	
vehicles, P <sub>HV</sub>	<u> </u>				0	0		0
Percent grade (%)		0				0		
Flared approach		N				N		
Storage		O	"			0		
RT Channelized?			0					0
Lanes	O "	0	0		0	0		0
Configuration		LR						
Control Delay, Queue Ler	igth, Level of Serv	ice					14075 J. 4- 4	
Approach	EB	WB	1	lorthboun	d	on a constraint of the work	Southbou	nd
Movement	1	4	7	8	9	10	1 11	12
Lane Configuration		LT		LR			<u> </u>	-
Volume, v (vph)	.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	7		11				
Capacity, c <sub>n</sub> (vph)		697		295				
V/c ratio		0.01					-	
Queue length (95%)			<u>'</u>	0.04			-	
		0.03		0.12				
Control Delay (s/veh)		10.2		17.7			-	
<del></del>		B		C				
Approach delay (s/veh)				17.7				
Approach LOS	M-7			C				

	TW	O-WAY STO	P CONT	ROL SU	MMARY								
General Information	1		Site	Inform	ation								
Analyst Agency/Co Date Performed	- JMC Wilbur Smi		Inter Juris	section diction ysis Year	1,10,207	1111111	ge / Higdo	n.					
Analysis Time Period	AM Peak	ak 2007											
Project Description Ex		Por America											
East/West Street: Oak I					reet: Higdon	Dr							
Intersection Orientation:	East-West		Study	/ Period (I	hrs): <i>0.25</i>								
Vehicle Volumes ar	id Adjustments	S CONTRACTOR OF THE											
Major Street	VFS.V.	Eastbound				Westbo	und	27.4 <u>117.1 180.2 .</u>					
Movement	1	2		3	4	5		6					
	<u> </u>	T	TT 77/4	₹	L	····		R					
Volume (veh/h) Peak-hour factor, PHF		334	3		0			0					
	0.88	0.88	0.8		0.88			777-11-11-11					
Hourly Flow Rate (veh/h) Proportion of heavy	O	379	3	-	0	740		0					
vehicles, P <sub>HV</sub>	О			.	0								
<u> </u>					TIPOWALAN								
Median type RT Channelized?			7000	Undiv	ided	· · · · · · · · · · · · · · · · · · ·	T R 652 0 0.88 0.88 740 0  1 0 0 1 0 1 0 0 1 12 T R 0 0 0 0.88 0.88 0 0 0 0 0 0 0						
tanes	0		0										
interior		1	0		<u> </u>	1	7711115						
Configuration Upstream Signal			T/	7	LT								
		0											
Minor Street Movement	7	Northbound					und	,,,,,					
Movement		8			10								
*/	<u></u>	Т	F		L								
Volume (veh/h) Peak-hour factor, PHF	6	0	0		0								
Hourly Flow Rate (veh/h)	0.88 6	0.88	0.5		0.88								
Proportion of heavy	<u>O</u>	0	0		0	0		0					
vehicles, P <sub>HV</sub>	О	0	О		0	0		0					
Percent grade (%)		0											
Flared approach		N						1111/1/14					
Storage	ANNIU	. 0				0		10.11 0					
RT Channelized?			(	)				0					
Lanes	0	o	0		0	0		0					
Configuration		LR					414.14						
Control Delay, Queue Le	ngth, Level of Se	1nA.u			EXP - Career	VIII (1978, 70 and 19	OF CHARACTER						
Approach	EB	WB	States Inches States Control	Northbo	und		 Southbour	3					
Movement	1	4	7	8	9	10	11						
Lane Configuration		LT	,			10	1 1 1	12					
Volume, v (vph)				LR 6			<u> </u>						
Capacity, c <sub>m</sub> (vph)		1188		231									
v/c ratio		0.00		0.03									
Queue length (95%)		0.00		<del></del>									
Control Delay (s/veh)		V	<u> </u>	0.08									
LOS		8.0		21.0	,								
		<u>A</u>		C			<u> </u>						
Approach delay (s/veh)				21.0									
Approach LOS	<del></del>		C										

	. T\	NO-WAY STO	P CONTRO	OL SUM	MARY		
General Informatio	n		Site Ir	nformati	on		
Date Performed	JMC Wilbur Sn 2/12/2007	nith ·	Interse Jurisdio	ction		Oak Ridge / 2007	
Analysis Time Period	PM Peak						
Project Description Ex	kisting Conditions	1976A F9					
East/West Street: Oak	Ridge Hwy (west)				t: Higdon	Dr	
Intersection Orientation:			Study P	eriod (hrs	): 0.25		
Vehicle Volumes a	nd Adjustmen	ts					
Major Street		Eastbound	Links of F. V.		Company Control	Westbound	
Movement	1	2	3		4	5	6
***************************************	<u> </u>	T	R		L	T	R
Volume (veh/h)	0	900	6		. 5	315	0
Peak-hour factor, PHF	0.88	0.88	0.88		0.88	0.88	0.88
Hourly Flow Rate (veh/h Proportion of heavy	) 0	1022	6		5	357	0
vehicles, P <sub>HV</sub>	0				0		·
Median type		- VIALIS		 Undivide			
RT Channelized?		- TOMAN	0	Unamae			
Lanes	O	1	0		. 0	1 .	0 0
Configuration			TR	-	LT	1	<u> </u>
Upstream Signal	11,4,411	0	1//		<u>L. /</u>	0	
Minor Street		Northbound				Southbound	
Movement	7	8	9		10	11	12
\$0. \$0.	L	T	R	***************************************	<u> </u>	T	R
Volume (veh/h)	1	0	7		0	0	0
Peak-hour factor, PHF	0.88	0.88	0.88		0.88	0.88	0.88
Hourly Flow Rate (veh/h)	1	0	1		0	0	0
Proportion of heavy Vehicles, P <sub>HV</sub>	0		0		0	o	О
Percent grade (%)						0	
Flared approach		N			4.00	N	
Storage		0				0	
RT Channelized?			0				0
Lanes	0	0	0	****	0	0	0
Configuration		LR				7000	
Control Delay, Queue L	ength, Level of S	ervice		Mary P. A.C.			
Approach	EB	WB ,	1	Vorthbound	1	Sout	thbound
Movement	1	4	7	8	9	10	11   12
Lane Configuration		· LT		LR	1 PAIA. AL		
Volume, v (vph)		. 5 .		2			
Capacity, c <sub>m</sub> (vph)		683		203	<del> </del>		
₩c ratio		0.01		0.01			
Queue length (95%)		0.02		0.03			
Control Delay (s/veh)		10.3		22.9		1	
<u> </u>		В		C			
Approach delay (s/veh)				22.9	<u> </u>		F
Approach LOS				C			
(CS 200.TM		771	111100			1	

## 2009 BACKGROUND TRAFFIC CONDITIONS

#### TWO-WAY STOP CONTROL SUMMARY General Information Site Information Analyst JMCIntersection Oak Ridge / Higdồn, Agency/Co. Wilbur Smith Jurisdiction Date Performed 2/12/2007 Analysis Year 2009 Analysis Time Period AM Peak Project Description Background Conditions East/West Street: Oak Ridge Hwy (east) North/South Street: Hiadon Dr Intersection Orientation: East-West Study Period (hrs): 0.25 Vehicle Volumes and Adjustments Major Street Eastbound Westbound Movement 3 2 5 6 Т R L Т R Volume (veh/h) 0 371 0 8 700 0 Peak-hour factor, PHF 0.88 0.880.88 0.88 0.88 0.88 Hourly Flow Rate (veh/h) 0 421 0 9 795 0 Proportion of heavy 0 0 vehicles, P<sub>HV</sub> Median type Undivided RT Channelized? 0 0 Lanes 0 1 .0 0 Ō Configuration TR LTUpstream Signal 0 Minor Street Northbound Southbound Movement 8 9 10 11 12 T R L Т R Volume (veh/h) 0 0 12 0 0 0 Peak-hour factor, PHF 0.88 0.88 0.88 0.880.88 0.88 Hourly Flow Rate (veh/h) 0 0 13 0 0 0 Proportion of heavy 0 0 0 0 0 0 vehicles, P<sub>HV</sub> Percent grade (%) 0 0 Flared approach Ν Ν Storage 0 0 RT Channelized? 0 0 Lanes 0 0 0 0 a Configuration LR Control Delay, Queue Length; Level of Service Äpproachi EB WB Northbound Southbound Movement 7 8 10 11 12 Lane Configuration LTLR Volume, v (vph) 9 13 Capacity, c<sub>m</sub> (vph) 1149 637 V/c ratio 0.01 0.02 Queue length (95%) 0.02 0.06 Control Delay (s/veh) 8.2 10.8 Α В

Approach LOS

Approach delay (s/veh)

10.8

В

			<u> </u>					
17 47 1 80 1	TM	O-WAY STO	P CONTR	OL SUN	/MARY			
General Informátio						to gradus surce in our gradus surces		
Analyst Agency/Co. Date Performed Analysis Time Period	JMC Wilbur Sm 2/12/2007 PM Peak	ith	Interse Jurisdi	ection			je / Higdan	}
Project Description Ba		775						
East/West Street: Oak I	Ridge Hwy (east)		North/S	South Stre	et: <i>Higdon</i>		IVA	
Intersection Orientation:		***************************************		Period (hr		<i>L</i> //	***************************************	
Vehicle Volumes ar	nd Adjustment		TERMINE CONTROL CONTROL STATE OF	ensuma in the establish	Police and a second state of the second	Was Assistant Services	018-4-50 B (VI-77-4000)	7//32 van 3092-1075
Major Street		Eastbound		<u> </u>		Westbo	<u>,,,44.50,000,00</u>	
Movement	1	2	3		4 .	5	and	6
		T	R		L	T		R
Volume (veh/h)	0	931	0		8	326		0
Peak-hour factor, PHF	0.88	0.88	0.88		0.88	0.88		0.88
Hourly Flow Rate (veh/h)	0	1057	0		9	370		0
Proportion of heavy vehicles, P <sub>HV</sub>	О	***			0			
Median type	****	110011		Undivid	ed	**************************************		
RT Channelized?		V.41.	0	•				0
Lanes	<u> </u>	1	0	· · · · · · · · · · · · · · · · · · ·	0	1		0
Configuration	77707	.,,,,,	TR		LT			1400
Upstream Signal	***************************************	0				0		
Minor Street		Northbound				Southboo	und	
Movement	7	8	9		10	11		12
	L	T	R		Ļ	Т		R
Volume (veh/h)		0	11		0	0		0
Peak-hour factor, PHF	0.88	0.88	0.88		0.88	0.88		0.88
Hourly Flow Rate (veh/h)	0		12		0	0	VIII.4.4.	0
Preportion of heavy vehicles, P <sub>HV</sub>	0	0	0		0	. 0		0
Percent grade (%)		0				0		
Flared approach	MAN	N			- 4-010	N		
Storage		0	;			0		
RT Channelized?			0		TOTAL SECTION AND ADDRESS OF THE PARTY OF TH			0
Lanes	0	0	0		0	0		0
Configuration	111111111111111111111111111111111111111	LR						7-1/10
Control Delay, Queue Le	ength, Level of Se	rvice						
Approach	EB ·	WB		Vorthbour			outhbound	<u> </u>
Movement	1	4	7	8	9	10	11	12
Lane Configuration	The state of the s	LT		LR				1
Volume, v (vph)		9		12				
Capacity, c <sub>m</sub> (vph)		667		276				
vic fatio		0.01						<u> </u>
Queue length (95%)				0.04				
Control Delay (s/veh)		0.04		0.14				
LOS		10.5		18.6				
	Α	В	. <u></u>	C				
Approach delay (s/veh) Approach LOS	VPI AM			18.6				
ESSOUNTM:				. <u>C</u>				
SERVICION TM:								

	TW	O-WAY STOR	CONTR	OL SUM	MARY			
General Information			Site li	nformati	ion			
Analyst	JMC		Interse			Oak Ridg	e / Higdon	4.
Agency/Co.	. Wilbur Smi	ith	Jurisdi	etion			- `	
Date Performed	2/12/2007		Analys	is Year	,	2009		
Analysis Time Period	AM Peak					N		
Project Description Bac		ns -						
East/West Street: Oak R					et: <i>Higdon I</i>	) <i>r</i>		
Intersection Orientation:			Study F	Period (hrs	s): 0.25			
Vehicle Volumes and	d Adjustment							
Major Street		Eastbound	1 -			Westbou	ind	
Movement	1	2	3		4	5		6
57			R		<u>L</u>	T		R
Volume (veh/h)	0.88	351	4		0	685		0
Peak-hour factor, PHF Hourly Flow Rate (veh/h)	0.88	0.88 398	0.88		0.88	0.88		0.88
		390	4		0	778		0
Proportion of heavy vehicles, P <sub>HV</sub>	О				0			
					. 1			
Median type		10.1-11		Undivide	<i>∋a</i>	1		
RT Channelized?	<u></u>		0				***************************************	0
Lanes		1	0		0	1		. 0
Configuration			TR		LT	0		
Upstream Signal								
Minor Street	7 .	Northbound	1 0		40	Southbou	ind ,	40
Movement		8 T	9		10	11		12
WELLS	7		- R		<u> </u>	T		R
Volume (veh/h) Peak-hour factor, PHF	0.88	0	0		0	0		0 0
Hourly Flow Rate (veh/h)	7	<i>0.88</i> 	0.88		0.88 0	0.88		0.88 0
Proportion of heavy			<u></u>					-
vehicles, P <sub>HV</sub>	0	0	0		0	0		0
				·			<u> </u>	
Percent grade (%)		0	1					
Flared approach		N				N .		
Storage		0				0		
RT Channelized?			0					0
Lanes	0	0	0		0	0		0
Configuration		LR						
Control Delay, Queue Le	ngth, Level of S	ervice					Heritan.	
Approach	EB	WB		Northbour	nd		Southbour	nd
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				7 - 7 - 10 - 10 - 10 - 10 - 10 - 10 - 10
Volume, v (vph)		0		7				
Capacity, c <sub>m</sub> (vph)	120000	1168	<u> </u>	213				
ecratio				ļ			11	
		0.00		0.03				
Queue length (95%)		0.00		0.10				
Control Delay (s/veh)		8.1		22.5				
4.9s		Α		C				
Approach delay (s/veh)	44			22.5				
Approach LOS		us.us.		C				
\$645043 (Transport	· · · · · · · · · · · · · · · · · · ·			PARAWAL ALL				

	ΤV	VO-WAY STOP	CONTR	OL SU	MMARY			
General Information			Site li	ıforma	ition			
Analyst Agency/Co. Date Performed	JMC Wilbur Sm 2/12/2007	nith	Interse Jurisdi			Oak Ridg 2009	e / Higdồn	-
Analysis Time Period	PM Peak							
Project Description Bac East/West Street: Oak R		ons	IN author	Yar ikk Ok	oot Hodon		N. F.	
Intersection Orientation:					reet: <i>Higdon</i> rs): <i>0.25</i>	<u>Dr</u>		
<b>2</b>			SAMBOWS	riy borres	Harristanski se	025828211288237881113831		80880 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Vehicle Volumes and Major Street	u Aajustment	<b>S</b> Eastbound				NA o silve		
Movement	1	eastbound	3		4	Westbot	ana	6
Widvernone		T	R		L .	· T		R
Volume (veh/h)	0	945	7		6	331		0
Peak-hour factor, PHF	0.88	0.88	0.88		0.88	0.88		0.88
Hourly Flow Rate (veh/h)	0	1073	7		6	376		0
Proportion of heavy vehicles, P <sub>HV</sub>	О				0			
Median type				Undivi	ded			
RT Channelized?		WWW. Williams	0					0
Lanes	0	1	0		0		11 to 7 mar - 2 m 10 m 100 - 100 m 1	0
Configuration			TR		LT			
Upstream Signal		0	<u> </u>			0		
Minor Street		Northbound				Southbo	und	
Movement	7	8	9		10	11		12
	L	. Т	R		· L	Т		R
Volume (veh/h)	2	0	2		0	0		0
Peak-hour factor, PHF	0.88	0.88	0.88		0.88	0.88		0.88
Hourly Flow Rate (veh/h)	2	0	. 2		0	0		0
Proportion of heavy vehicles, P <sub>HV</sub>	0	0	0		. 0	0		0
Percent grade (%)	A.d	0					ner na na antana ana ana ana ana ana ana an	
Flared approach		N				N		
Storage		0				. 0		
RT Channelized?			0					0
Canes	0	0	0		0	0		0
Configuration	WATER TOTAL	LR						
Control Delay, Queue Le	ngth, Level of S	ervice		经保险				
Approach	EB	WB		Northbo	und		Southboun	d
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
Volume, v (vph)		6	***************************************	4				
<sup>C</sup> apacity, c <sub>m</sub> (∨ph)		653	and the second second second second	186		ann ann an Taonaigh an 18 an Air		
V/c ratio		0.01		0.02				+
Queue length (95%)		0.03		0.02			-	
Control Delay (s/veh)		v			<del>-                                    </del>		-	_
LOS (s/ven)		10.6		24.8				-
Michigan Company Compa		В					J	
Approach delay (s/veh)				24.8				
Approach LOS				С				i

# 2009 PROJECTED TRAFFIC CONDITIONS WITH PROPOSED DEVELOPMENT

<u> </u>	TW	O-WAY STOP	CONTR	OL SUN	//MARY			
General Information		对于特色的研究系	Site I	nformal	ion			
Analyst Agency/Co.	JMC Wilbur Smi		Interse Jurisdi	ection		Oak Ridge /		**************************************
Date Performed	2/12/2007		1	is Year		2009	٠.	•
Analysis Time Period	AM Peak.							
Project Description Bui	d-out Conditions	VIII. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.				***************************************		
East/West Street: Oak F	Ridge Hwy (east)	haw	North/S	South Stre	et: <i>Higdon L</i>			
Intersection Orientation:		, , ranversit		eriod (hr		- ATTOM TABLE		· · · · · · · · · · · · · · · · · · ·
Vehicle Volumes an	d Adjustments							
Major Street		Eastbound	Seemed to the second seems	90 + Ju., 64 34, p. 209 194	The state of the s	Westbound	<u>saaneankun te</u> I	
Movement	1	2	3		. 4	5		6
	L	Т	R		L.	T		R
Volume (veh/h)	0	371	0		17	700		0
Peak-hour factor, PHF	0.88	0.88	0.88		0.88	0.88		0.88
Hourly Flow Rate (veh/h)		421	0		19	795		. 0
Proportion of heavy	0				()			TOVEVALLE
vehicles, P <sub>HV</sub>			-	İ	0			
Median type				Undivid	led			
RT Channelized?			0					0
Lanes	0	1	0		0	1		0
Configuration		,	TR		LT	100000000000000000000000000000000000000		
Upstream Signal		0				0		
Minor Street		Northbound				Southbound		
Movement	7	8	9		10	11	•	12
(SOUTH TO THE SOUTH  L	Т	R		L	T		R	
Volume (veh/h)	0	0	29		0	0		0
Peak-hour factor, PHF	0.88	0.88	0.88		0.88	0.88		0.88
Hourly Flow Rate (veh/h)	0	0	32		0	0		0 .
Proportion of heavy	o	0			<i>(</i> )		1	
√yehicles, P <sub>HV</sub>			0		. <i>O</i>	0		0
Percent grade (%)		0	The same of			0	,	
Flared approach		N				N		
Storage		0				0	_	
RT Channelized?			0					0
Lanes	0	0	0		0	0	-	0
Configuration		LR :	<u> </u>				Percentage	
Control Delay, Queue Le	ngth Level of Se			gada-rafadka	akaratan Bizikara		STATA MARKET	10040000000000000000000000000000000000
Approach	EB	WB	1	Northbou	nd	Sou	uthboun	<u>⊘</u>
Movement	1	4	7	8	9	10	11	_
Lane Configuration	···	LT	/ .		9	10		12
Volume, v (vph)				<u>LR</u>	1			
		19		32				
<sup>C</sup> apacity, c <sub>m</sub> (∨ph)		1149		637	WA Volume Living			
√c ratio		0.02		0.05				
Queue length (95%)		0.05		0.16				<u> </u>
Control Delay (s/veh)		8.2		11.0			· · · · · · · · · · · · · · · · · · ·	
t os		A		B				
Δεριτοach delay (s/veh)	7.5			<u> </u>				
Approach LOS								
				В				

#### TWO-WAY STOP CONTROL SUMMARY General Information Site Information Analyst JMCIntersection Oak Ridge / Higdða Agency/Co. Wilbur Smith Jurisdiction Date Performed 2/12/2007 Analysis Year 2009 Analysis Time Period PM Peak Project Description Build-out Conditions East/West Street: Oak Ridge Hwy (east) North/South Street: Higdon Dr intersection Orientation: East-West Study Period (hrs): 0.25 Vehicle Volumes and Adjustments Major Street Eastbound Westbound Movement 2 3 6 R Τ R Volume (veh/h) 931 0 23 0 326 0 Peak-hour factor, PHF 0.880.88 0.88 0.88 0.88 0.88 Hourly Flow Rate (veh/h) 0 1057 26 0 370 0 Proportion of heavy 0 0 vehicles, P<sub>HV</sub> Median type Undivided RT Channelized? 0 0 anes 0 1 0

		·		, <del>,</del>	,	
Configuration			TR	LT		
Upstream Signal		0			0	P
Minor Street		Northbound			Southbound	
Movement	7	. 8	9	10	11	12
	L	Т	R	L	T	R
Volume (∨eh/h)	0	0	23	0	. 0	0
Reak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Rourly Flow Rate (veh/h)	O	0	26	0	0 .	0
Proportion of heavy vehicles, P <sub>HV</sub>	0	0	0	o	0	0
Percent grade (%)		0			0	OF THE STATE OF TH
Flared approach		N			N	76.010.3
Storage		0			0	
RT Channelized?	WWW.		0			0
Lanes	0	0	0	0	O	0
Configuration		LR				

Q

1

0

pproach	EB	WB		Northbound		5	Southbound	
fovement	1	4	7	8	9	10	11	12
ane Configuration		LT		LR				
©lume, v (vph)		26		26			**	
epacity, c <sub>m</sub> (vph)		667		276				
/cratio Recue length (95%)		0.04		0.09				
lueue length (95%)		0.12		0.31	who delene			
entrol Delay (s/veh)		10.6		19.4				
28		В		С				
pproach delay (s/veh)				19.4				1
Oproach LOS				С				

	TWO-WAY S	TOP CONTROL SUMMAR	RY
General Information		Site Information	
Analyst Agency/Co. Date Performed Analysis Time Period	JMC Wilbur Smith 2/12/2007 AM Peak	Intersection Jurisdiction Analysis Year	Oak Ridge / Higdon 2009
Project Description Build	11-11-11-11-11		, , , , , , , , , , , , , , , , , , ,
East/West Street: Oak Rid	ge Hwy (west)	North/South Street: Hi	igdon Dr
Intersection Orientation: E		Study Period (hrs): 0.2	25

Vehicle Volumes and .	Adjustments						
Major Street	-11000.5-2	Eastbound			Westbound	the life that we is that with more and a second	
Movement	1	2	3	4	5	6	
		T	R	L	T	R	
Volume (veh/h)	0	351	13	0	685	0	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	
Hourly Flow Rate (veh/h)	0	398	14	0	778	0	
Proportion of heavy vehicles, P <sub>HV</sub>	0			0			
Median type	TO HEADEN		Und	ivided			
RT Channelized?			0			0	
Lanes	0	7	0	0	. 1	0	
Configuration			TR	LT			
Upstream Signal	W4111EW	O		1	0		
Minor Street		Northbound	, , , , , , , , , , , , , , , , , , , ,		Southbound		
Movement	7	8	9	10	11	12	
		_			T	R	
	<u> </u>	T	R	<u> </u>	1		
Volume (veh/h)	39	0	0 R	0	0	0	
Peak-hour factor, PHF	39 0,88		!				
Peak-hour factor, PHF Hourly Flow Rate (veh/h)		0	0	0	0	. 0	
Peak-hour factor, PHF	0.88	0 0.88	0 0.88	0 0.88	0 0.88	. 0 0.88	
Peak-hour factor, PHF Hourly Flow Rate (veh/h) Proportion of heavy	0,88 44	0 0.88 0	0 0.88 0	0 0.88 0	0 0.88 0	0 0.88 0	
Peak-hour factor, PHF Hourly Flow Rate (veh/h) Proportion of heavy vehicles, P <sub>HV</sub>	0,88 44	0 0.88 0	0 0.88 0	0 0.88 0	0 0.88 0 0	0 0.88 0	
Peak-hour factor, PHF Hourly Flow Rate (veh/h) Proportion of heavy vehicles, P <sub>HV</sub> Percent grade (%)	0,88 44	0 0.88 0 0	0 0.88 0	0 0.88 0	0 0.88 0 0	0 0.88 0	
Peak-hour factor, PHF Hourly Flow Rate (veh/h) Proportion of heavy vehicles, P <sub>HV</sub> Percent grade (%) Flared approach	0,88 44	0 0.88 0 0	0 0.88 0	0 0.88 0	0 0.88 0 0 0 N	0 0.88 0	
Peak-hour factor, PHF Hourly Flow Rate (veh/h) Proportion of heavy vehicles, P <sub>HV</sub> Percent grade (%) Flared approach Storage	0,88 44	0 0.88 0 0	0 0.88 0	0 0.88 0	0 0.88 0 0 0 N	0 0.88 0	

Approach	EB	WB	1	Northbound		5	Southbound	
Movement	1	4	7	8	9	10	11	12
ane Configuration		LT		LR	AND OF THE STREET, WAS ARRESTED FOR A STREET, AND A STREET	**		
Valume, v (vph)	/ 1/2/	0		44			/	
Capacity, c <sub>m</sub> (vph)		1158		211				
V/c ratio		0.00		0.21				
Queue length (95%)		0.00		0.76		:		
Control Delay (s/veh)		8.1		26.5				
<u> 208</u>		А		D				
Approach defay (s/veh)		٦.,		26.5				
Approach LOS				D				

		O-WAY STOP		OL SUM	MARY			
General Information		grifaction of security of the con-	Site li	nformat	ion			
Analyst	JMC	1.	Interse	ection		Oak Ridg	e / Higdor	l .
Agency/Co.	Wilbur Smit	h ·	Jurisdi	ction				-
Date Performed	2/12/2007		Analys	is Year		2009		
Analysis Time Period	PM Peak	•						
Project Description Build	d-out Conditions				ereya amazan ini			
East/West Street: Oak Ri			North/S	South Stre	et: <i>Higdon L</i>	Or		
intersection Orientation:				Period (hrs				
Vehicle Volumes and	1 Adjustments						JANES KARA	
Major Street	. Adjustinents	Eastbound	7406 DEPARTA - 65.00	0.4/4/6/6/16 48/4	<u> </u>	Westbou		
Movement	1	2	3		4	5	1110	6
	L.	<u> </u>	R		L	Ť		R
Volume (veh/h)	0	945	41		6	331		0
Peak-hour factor, PHF	0.88	0.88	0.88	· ·	0.88	0.88		0.88
Hourly Flow Rate (veh/h)	0	1073	46		6	376		0
Proportion of heavy						<u></u>		
vehicles, P <sub>HV</sub>	0				0			
Median type	}			Undivide	- d			77117782000
RT Channelized?		1		Unaiviae	ea	1		
2777 7. 1	0		0					0
Lanes	<u> </u>	1	0		0	1		0
Configuration			TR		LT			
Upstream Signal		0	<u> </u>			0	<u></u>	TAN T SERVICE CONTROL OF THE SERVICE CONTROL
Minor Street		Northbound				Southbo	und	
Movement	7	8	9		10	11		12
S	<u></u>	Т	R		L	Т		R
Valume (veh/h)	30	0	2		0	0		0
Reak-hour factor, PHF	0.88	0.88	0.88		0.88	0.88		0.88
Hourly Flow Rate (veh/h)	34	0			0	0		0
Proportion of heavy	0	0			0			_
vehicles, P <sub>HV</sub>		U	0	1	0	. 0		0
Percent grade (%)		Q	'			0		
Hared approach		N				N		
Storage		0				0		
&T Channelized?			0					0
Lanes	0	0	1 0		0	0	***************************************	0
Configuration	- <del></del> -	LR	1					
			One of the substrate of Ventral address of	# 681 8568645 - \$2.070	05) (Man jigali (H. 20) (Man jigan)	W.C.   1008210002240000000000000000000000000000	muchastate divisi nuc	ele lacidă seculor accessos ecu
Control Delay, Queue Le Approach						1		
Movement	EB	WB		Northbour		1	Southbour	
70 40 TW. #	1	4	7	8	9	10	11	12
Larre Configuration		LT		LR				
Xalume, v (vph)		6		36	}			
<sup>Capacity</sup> , c <sub>m</sub> (∨ph)		632		142	,			
Vs ratio		0.01		0.25				
Queue length (95%)							ļ	
Sutrol Deter (20%)		0.03		0.95				
Control Delay (s/veh)		10.8		38.8				
L/S		В		E				
Approach delay (s/veh)				38.8				
Pproach LOS				E				
				Au a		,J		

	٠	:						
	ΤV	VO-WAY STO	P CONTR	OL SUM	MARY		·	
General Information			Site I	nformati	on			
Analyst	JMC		Inters	ection		Higdon / S	lite. 🖫	
Agency/Co.	Wilbur Sn		Jurisd					
Date Performed	2/13/2007		Analy:	sis Year		2009		
Analysis Time Period	AM Peak	Ame has a sure a				•		
Project Description Build East/West Street: Higdon			North/	South Stree	t: Site Driv	(014/21/		
Intersection Orientation:		***************************************		Period (hrs)		Oway		
Vehicle Volumes and	Property of the second second	te Walia			av Vez (Harrista)			
Major Street		Eastbound	zyskiem nekenynyttis jest	ngana ay dayera ±sakasi 	Gody of Mark 1972 Services	Westbou	nd	SHERRE PROMORES
Movement	1	2	3		4	5		6
	L	T	R		L	T		R
Volume (veh/h)	0	12	9		5	8		0
Peak-hour factor, PHF	0.88	0.88	0.88	3	0.88	0.88		0.88
Hourly Flow Rate (veh/h)	0	13	10		5	9		0
Proportion of heavy vehicles, P <sub>HV</sub>	0				0			W. M.
Median type				 Undivide	d			<u> </u>
RT Channelized?	<u> </u>		0	Unaivide	<u></u>			0
Lanes	0	1	0		0	1		0
Configuration	<u> </u>		TR		LT			
Upstream Signal		0		···.		0		
Minor Street		Northbound	<del></del>			Southbou	nd	
Movement	7	8	9		10	11		12
	<u> </u>	Т	R		L	• Т		R
Volume (veh/h)	32	0	17		0	0		0
Peak-hour factor, PHF	0.88	0.88	0.88	3	0.88	0.88	<u> </u>	0.88
Hourly Flow Rate (veh/h) Proportion of heavy	36	0	19	<del></del>	<u></u>	0		<u> </u>
vehicles, P <sub>HV</sub>	0	0	0		0	0		0
Percent grade (%)	1	()				.!		
Flared approach	<u> </u>	0 . N			T.	T N	1	
Storage		0				0		
RT Channelized?	-		0			<del>                                     </del>		0
Lanes	0	0	0		0	0		0
Configuration	0	LR	-					<u> </u>
Control Delay, Queue Ler	oth Levelists							
Approach	EB	WB	yenderiyeriyeriyeri T	Northboun	d d	5	Southboun	id
Movement	1	4	7	8	9	10	11	12
Sine Configuration	!	LT		LR		'		
Valume, v (vph)		5		55				
Capacity, c <sub>m</sub> (vph)	· · ·	1605		1007				
We ratio				<del>!</del>				
N. C.		0.00	1	0.05				

os

Oiseue length (95%)

Control Delay (s/veh)

Approach delay (s/veh)

0.17

8.8

Α

8.8

Α

0.01

7.3

Α

	TWO-WAY S	TOP CONTROL SUMMAR	Υ
General Information		Site Information	
Analyst Agency/Co. Date Performed Analysis Time Period	JMC Wilbur Smith 2/13/2007 PM Peak	Intersection Jurisdiction Analysis Year	Higdon / Site
Project Description Build	-out Conditions		
East/West Street: Higdon	Dr	North/South Street: Si	ite Driveway
Intersection Orientation: E	=ast-West	Study Period (hrs): 0.2	25
Vehicle Volumes and	Adjustments		

fajor Street		Eastbound		Westbound			
ovement	1 .	2	3	4	5	6	
:	L	Υ	R	L.	T	R	
olume (veh/h)	0	11	34	15	8	0	
eak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	
ourly Flow Rate (veh/h)	0	12	38	17	9	0	
proportion of heavy chicles, P <sub>HV</sub>	0			О			
ledian type			Und	ivided		•	
T Channelized?			0			0	
anes	0	1	O	0	1	0	
enfiguration			TR	· LT			
pstream Signal		0			0	,	
inor Street		Northbound		Southbound			
dovement	7	8	9	10	11	12	
	L	·T	R	L	Т	R	
/olume (veh/h)	28	O	12	0	0	0	
eak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	
ourly Flow Rate (veh/h)	31	0	13	0	0	0	
Proportion of heavy whicles, P <sub>HV</sub>	0	. о	0	o	o	0	
ercent grade (%)		0	<del>,</del>		0		
ared approach		N	1.		N		
Storage	7 - 471	0			0		
Channelized?			0			0	
anes	0	0	0	0	0	0	
onfiguration		LR					

pproach	Ę₿	WB		Northbound		Southbound		
evernent	<sup>*</sup> 1	4	7	8	. 9	10	11	12
ne Configuration		LT		LR				
lume, v (vph)	Y THE TAXABLE PARTY OF THE PART	17		44				
apacity, c <sub>m</sub> (vph)	•	1570		958			Want - 1	
© ratio		0.01		0.05				
Leue length (95%)		0.03		0.14				
Ontrol Delay (s/veh)	And the second s	7.3		8.9				
993		Α		A				
pproach delay (s/veh)				8.9	mr. p.			
Proach LOS		444		A				

### SIGNAL WARRANTS

Table 4C-1. Warrant 1, Eight-Hour Vehicular Volume

Condition A—Minimum Vehicular Volume									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%ª	80% <sup>b</sup>	70%	56%⁴	100%	80%	70%	<u>° 56%°</u>
1 2 or more 2 or more 1	1 1 2 or more 2 or more	500 600 600 500	400 480 480 400	350 420 420 350	280 336 336 280	150 150 200 200	120 120 160 160	105 105 140 140	84 84 112 112

Condition B—Interruption of Continuous Traffic										
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)				
Major Street	Minor Street	100%°	80%	<u>70%°</u>	56% <sup>d</sup>	100%	80%	<sup>5</sup> 70%	6° 56%°	
1 2 or more 2 or more 1	1 1 2 or more 2 or more	750 ± 900 900 750	600 720 720 600	525 630 630 525	420 504 504 420	75 <b>(</b> 75 100 100	60 60 80 80	53 ( 53 70 70	42 42 56 56	

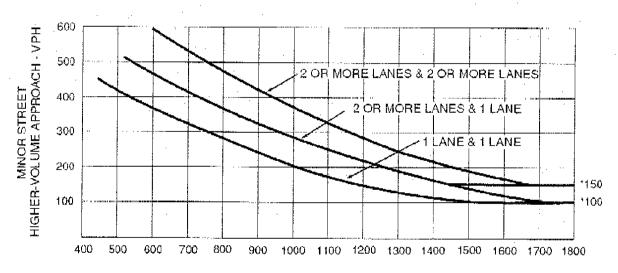
<sup>៊ី</sup> Basic minimum hourly volume.

Used for combination of Conditions A and B after adequate trial of other remedial measures.

May be used when the major-street speed exceeds 70 km/h or exceeds 40 mph or in an isolated community with a population of less than 10,000.

May be used for combination of Conditions A and B after adequate trial of other remedial measures when the majorstreet speed exceeds 70 km/h or exceeds 40 mph or in an isolated community with a population of less than 10,000.

Figure 4C-3. Warrant 3, Peak Hour

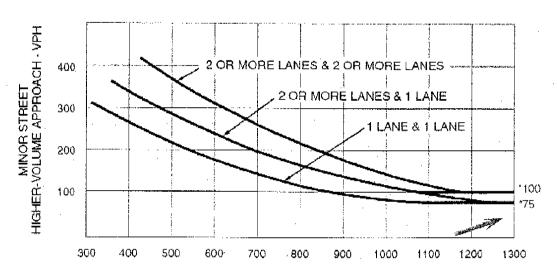


#### MAJOR STREET—TOTAL OF BOTH APPROACHES— VEHICLES PER HOUR (VPH)

\*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

#### Figure 4C-4. Warrant 3, Peak Hour (70% Factor)

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 70 km/h OR ABOVE 40 mph ON MAJOR STREET)



MAJOR STREET—TOTAL OF BOTH APPROACHES— VEHICLES PER HOUR (VPH)

\*Note: 100 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 75 vph applies as the lower threshold volume for a minor-street approach with one lane.

#### **TURN-LANE WARRANTS**

TABLE 7A

## LEFT-TURN LANE VOLUME THRESHOLDS FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 56 MPH OR OVER

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

OPPOSING	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *								
VOLUME	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	350 - 399			
100 - 149	150	75	60	45	35	30			
150 - 199	110	65	55	40	35	30			
200 - 249	85	60	50	35	30	30			
250 - 299	70	55	45	35	30	30			
300 - 349	60	50	40	30	25	25			
350 - 399	55	45	35	30	325	25			
<b>4</b> 00 - 449	50	<b>40</b>	30	25	20	20			
450 - 499	45	35	30	25	20	20			
500 - 549	40	30	25	20	20	20			
550 - 599	40	25	20	20	20	20			
600 - 649	35	20	20	20	20	75			
650 - 699	35	20	20	20	15	15			
700 - 749	30	20	20	15	15	15			
750 or More	30	20	15	15		15			

OPPOSING	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *							
VOLUME	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	=/ > 600		
100 - 149	30	25	25	20	20	20		
150 - 199	30	25	25	20	20	20		
200 - 249	30	25	25	20	20	15		
250 - 299	30	25	25	20	20	15		
300 - 349	25	25	. 20	20	15	(15)		
350 - 399	25	25	20	20	15			
<b>400 - 449</b>	20	20	20	15	15	15		
450 <b>-</b> 499	20	20	20	15	15	15		
500 + 549	20	20	15	15	15	15		
550 - 599	20	15	15	15	15	15		
600 - 649	15	15	15	15	15	15		
650 <b>-</b> 699	15	15	15	1 <b>5</b>	15	15		
700 - 749	15	15	15	15	15	15		
750 or More	15	15	15	15	15	15		

<sup>\*</sup> Or through volume only if a right-turn lane exists.

TABLE 7B

## RIGHT-TURN LANE VOLUME THRESHOLDS FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 56 MPH OR OVER

RIGHT-TURN	THROUGH VOLUME PLUS LEFT-TURN VOLUME *								
VOLUME [	< 100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399			
Ferver Than 25 25 - 49 50 - 99				11 71.7411					
1 <b>00</b> - 149 150 - 199					Yes	Yes Yes			
200 - 249 250 - 299	×		Yes	Yes Yes	Yes Yes	Yes Yes			
300 - 349 350 - 399	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			

RIGHT-TURN	THROUGH VOLUME PLUS LEFT-TURN VOLUME *								
VOLUME	350 - 399	400 - 449	450 - 499	500 - 549	550 - 600	+ / > 600			
Fewer Than 25 25 - 49 50 - 99		Yes	Yes Yes	Yes Yes	Yes Yes	Q'ES Yes			
100 - 149	Yes	Yes	Yes	Yes	Yes	Yes			
150 <b>-</b> 199	Yes	Yes	Yes	Yes	Yes	Yes			
200 - 249	Yes	Yes	Yes	Yes	Yes	Yes			
250 - 299	Yes	Yes	Yes	Yes	Yes	Yes			
300 - 349	Yes	Yes	Yes	Yes	Yes	Yes			
350 - 399	Yes	Yes	Yes	Yes	Yes	Yes			
<b>400</b> - 449	Yes	Yes	Yes	Yes	Yes	Yes			
<b>4</b> 50 - 499	Yes	Yes	Yes	Yes	Yes	Yes			
500 - 549	Yes	Yes	Yes	Yes	Yes	Yes			
550 • 599	Yes	Yes	Yes	Yes	Yes	Yes			
600 or More	Yes	Yes	Yes	Yes	Y'es	Yes			

<sup>\*</sup> Or through volume only if a left-turn lane exists.