

MEMORIAL DRIVE DRAINAGE AND MOBILITY DRAFT REPORT

Prepared for



TAX INCREMENT REINVESTMENT ZONE No. 17 TIRZ 17

LAN Project #: 120-10308-000-445



**Lockwood, Andrews
& Newnam, Inc.**

A LEO A DALY COMPANY

May 1, 2009

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ID # 2614

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EXECUTIVE SUMMARY

Lockwood, Andrews & Newnam, Inc. (LAN) was contracted by Tax Increment Reinvestment Zone No. 17 (TIRZ 17) to perform and mobility study on Memorial Drive between Beltway 8 Northbound Service Road (NSR) and West Bough Lane in Houston, Texas. LAN has been tasked with analyzing the intersections and investigating left-turn lane alternatives aimed at improving operations. A summary of alternatives is as follows:

Table ES-1 – Summary of Alternatives	
Alternative	Description
No Build	<ul style="list-style-type: none"> No Additional Improvements Proposed
Alternative 1	<ul style="list-style-type: none"> Add an eastbound left-turn lane at Town and Country Village East Driveway
Alternative 2	<ul style="list-style-type: none"> Add an eastbound left-turn lane at Town and Country Village West Driveway Add a westbound left-turn lane at Town and Country Village East Driveway

LAN recommends that two eastbound left-turn lanes be constructed on Memorial Drive (Alternative 2). This recommendation is based on intersection capacity utilization (ICU) level of service (LOS) as well as potential safety benefits. Left-turn lanes have been shown to minimize turn-related crashes and minimize delay to through traffic. Based on these potential benefits, LAN recommends the following:

- Install an eastbound left-turn lane on Memorial Drive and Town and Country Village West Driveway,
- Install an eastbound left-turn lane on Memorial Drive and Town and Country Village East Driveway, and
- Update pavement markings on Memorial Drive between Beltway 8 NSR and West Bough Lane.

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INTRODUCTION

Lockwood, Andrews & Newnam, Inc. (LAN) has been contracted by Tax Increment Reinvestment Zone No. 17 (TIRZ 17) to perform a traffic study on Memorial Drive between Beltway 8 Northbound Service Road (NSR) and West Bough Lane in Houston, Texas. Recent development, including the expansion of Town and Country Village north of the study area has increased traffic; as such, this traffic study was authorized to identify where traffic problems occur and recommend improvements on Memorial Drive. This report has been prepared to document the traffic study, present results found during the analysis and provide recommendations.

STUDY LOCATION

Memorial Drive is an east-west four-lane road that is currently free-flow between Beltway 8 NSR and West Bough Lane. Traffic signals are located at each end of the study area and are located at Beltway 8 NSR and West Bough Lane. The study area is identified in Figure 1 and involves four intersections:

- Memorial Drive and Beltway 8 NSR,
- Memorial Drive and Town and Country Village West Driveway,
- Memorial Drive and Town and Country Village East Driveway, and
- Memorial Drive and West Bough Lane.

Beltway 8 NSR is a four-lane, one-way road at the northbound approach to Memorial Drive and is the eastern intersection of a partial diamond type interchange. Town and Country Village West Driveway and Town and Country Village East Driveway are both four-lane driveways that form three-leg "T" intersections with Memorial Drive. Both driveways have dedicated left-turn and right-turn lanes at the southbound approaches with Memorial Drive. West Bough Lane forms a four-leg intersection with Memorial Drive. Memorial Drive has dedicated left-turn lanes

Memorial Drive Drainage and Mobility

eastbound and westbound at West Bough Lane, while West Bough Lane has a dedicated right-turn lane at the southbound approach with Memorial Drive. South of Memorial Drive, West Bough Lane, also called Broken Bough Drive, is a two-lane road. Figure 2 and Figure 3 show No Build Conditions on Memorial Drive.

Many private residences exist to the south and east of the study area. Town and Country Village north of the study area contains commercial developments including a gas station, grocery store, retail shops and restaurants. Town and Country Village West Driveway and Town and Country Village East Driveway lead directly to a strip center and grocery store, respectively. Recent expansion to Town and Country Village is estimated to add over 33 thousand daily trips.

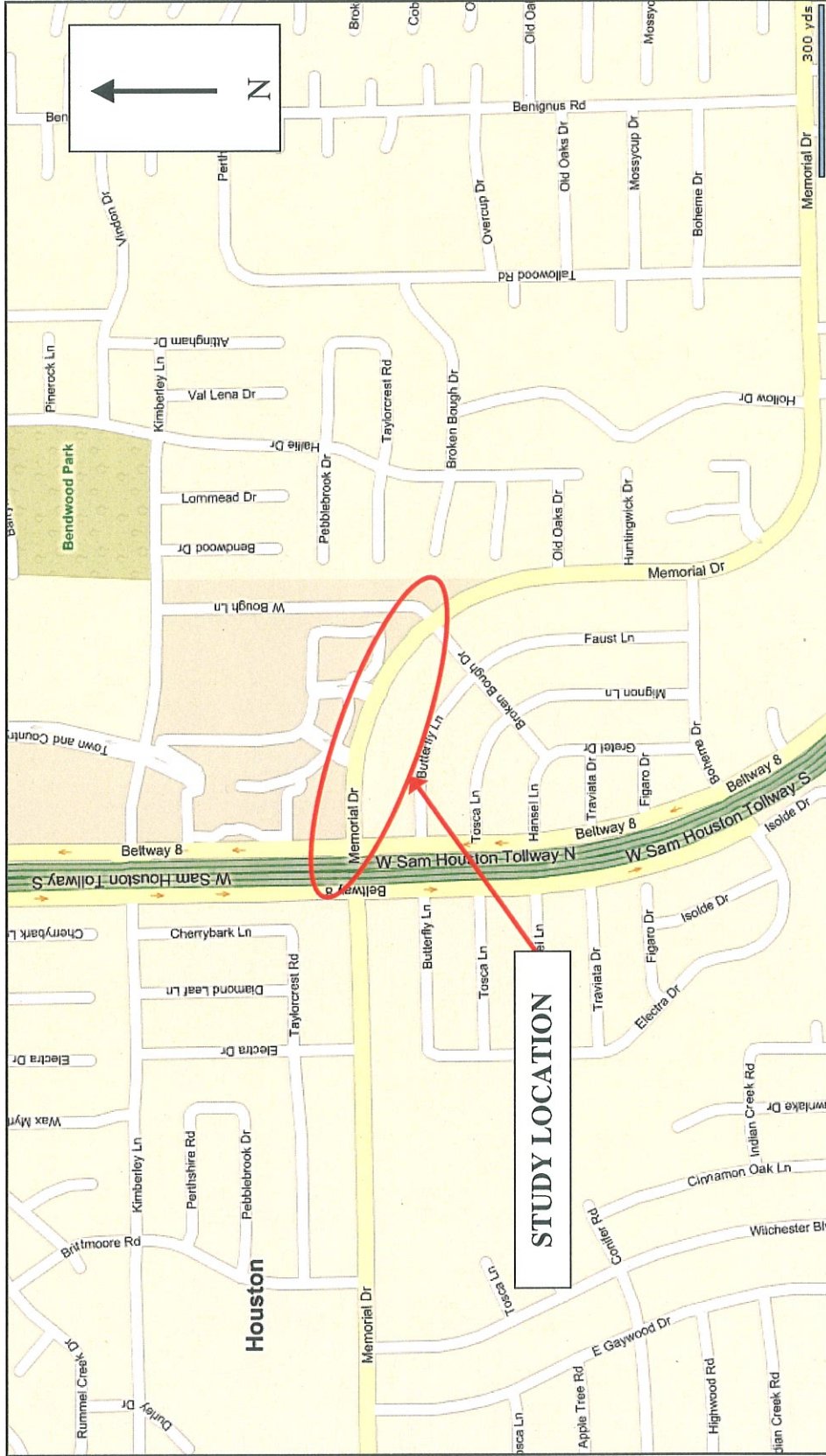


Figure 1 – Memorial Drive Study Location

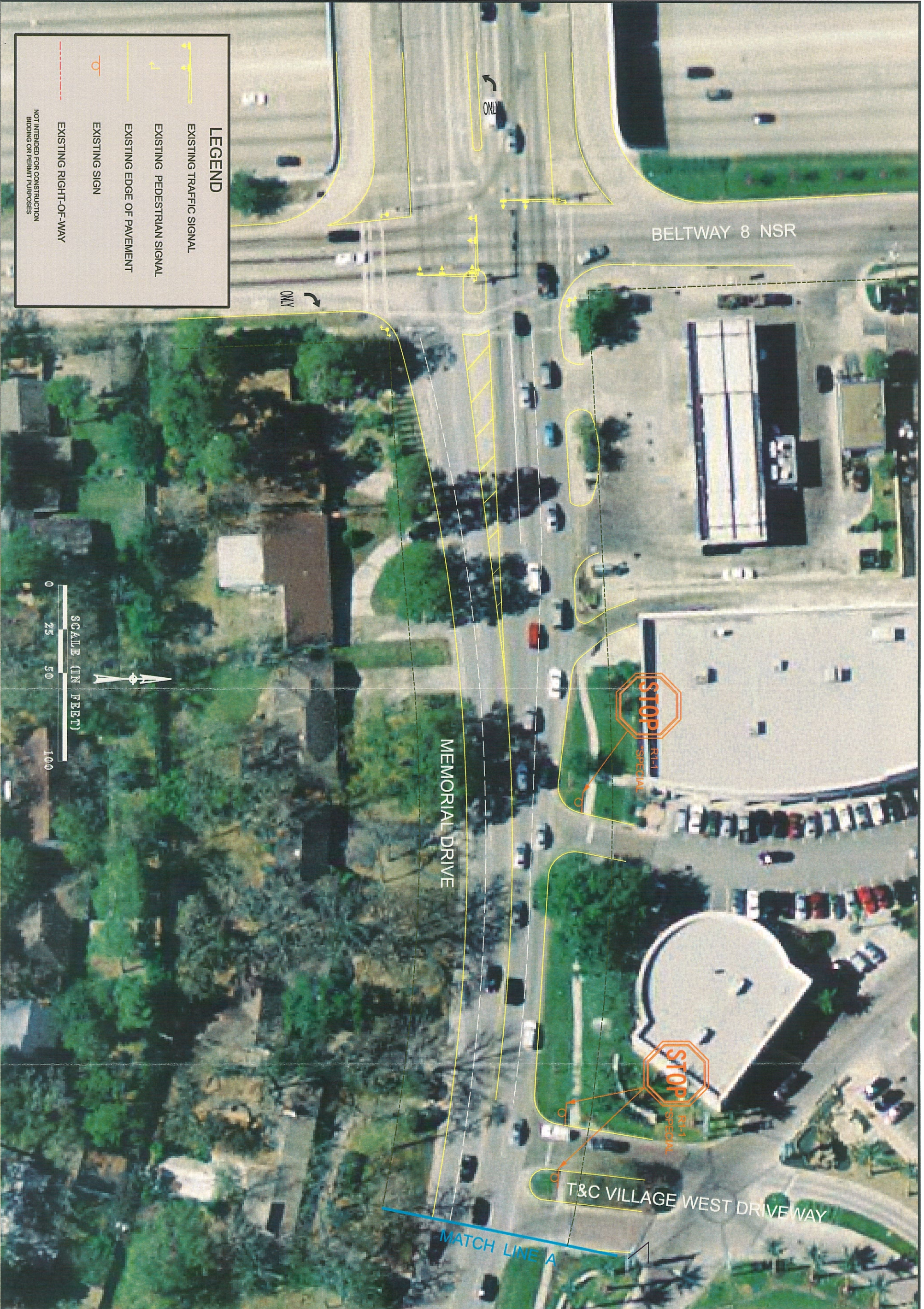


FIGURE 2 - WEST DRIVEWAY EXISTING CONDITIONS

MEMORIAL CITY TIRZ 17

NO BUILD

DATE: May 2009



FIGURE 3 - EAST DRIVEWAY EXISTING CONDITIONS

MEMORIAL CITY TIRZ 17

NO BUILD

FIGURE

3



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DATE: May 2009

METHODOLOGY

Methodology used for this traffic study is as follows:

- Site investigation and observation,
- Collect turning movement counts (TMCs) at the study intersection for six hours,
- Analyze Existing Conditions and future No Build Conditions on Memorial Drive,
- Analyze proposed Build Conditions on Memorial Drive under current year and future year conditions,
- Mitigate failing conditions (if any), and
- Document analysis and findings and provide recommendations.

DATA COLLECTION

LAN collected data with respect to intersection geometry, striping, signage and visible utilities during a field visit to the intersection on December 11, 2008 (site photographs are located in Appendix A). Memorial Drive is a four-lane road with approximate 12-foot lanes. The posted speed on Memorial Drive is 35 mph while the speed limits on West Bough Lane and Beltway 8 NSR are 30 mph and 50 mph, respectively. Pedestrian crosswalks, pedestrian signals and pushbuttons are provided at these two intersections. There is no posted speed on either of the Town and Country Village driveways. All pavement and pavement markings were observed to be in fair to poor condition.

Numerous private driveways exist on the south side of the study area that service residences along Memorial Drive. Sidewalks are located on both sides of Memorial Drive and curb ramps appear to be Americans with Disabilities Act (ADA) compliant at both Beltway 8 NSR and West Bough Lane. Curb and gutter drainage is utilized on Memorial Drive, Beltway 8 NSR and West Bough Lane.

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Data collected for this study included: 24-hour traffic volumes, six-hour TMCs and pedestrian counts. On an average weekday, peak hour traffic on Memorial Drive exceeds 1,500 vehicles per hour. Peak hours were identified between 7:30 AM – 8:30 AM (AM peak hour), 12:00 PM – 1:00 PM (Midday peak hour) and 4:30 PM – 5:30 PM (PM peak hour). A summary of traffic data collected is included in Appendix B.

ANALYSIS

This traffic study analyzes three different alternatives for AM, Midday and PM peak hours. Each scenario is analyzed for current year 2009 and under future traffic conditions in year 2014; a total of 18 scenarios were analyzed. Data was input into Synchro 6.0 traffic models based on TMCs and balanced using 24-hour traffic volumes. Projected traffic volumes were calculated utilizing Houston-Galveston Area Council (H-GAC) growth rates. H-GAC growth rates yield a 1.0 percent annual growth rate on Memorial Drive between years 2009 and 2014. This growth rate was assumed to be uniform throughout the study area and was applied to all traffic volumes.

Existing and No Build Conditions

Existing and No Build Conditions consist of no modification to current roadway traffic control, alignment or geometry. These scenarios serve as a base condition and were analyzed for current year (2009) and future year (2014) traffic conditions for both AM and PM peak hours. Existing and No Build Condition drawings for the study area are presented in Exhibit C1 and Exhibit C2 in Appendix C.

Proposed Conditions

Alternative 1 – Add One Eastbound Left-turn Lane

Alternative 1 involves the construction of a single eastbound left-turn lane at the Town and Country Village East Driveway. The proposed left-turn lane would be designed to City of Houston standards and is 200 feet in length (100 feet storage and 100 feet taper). The proposed left-turn lane is designed to remove left-turn traffic from impeding eastbound through traffic on Memorial Drive. Two eastbound and two westbound through lanes are maintained on Memorial Drive as well as the existing sidewalk. Drawings showing improvements proposed in this alternative are in Exhibit C3 and Exhibit C4 in Appendix C.

Alternative 2 – Add Two Eastbound Left-turn Lanes

Alternative 2 involves the construction of two eastbound left-turn lanes; one at the Town and Country Village West Driveway and the other at the Town and Country Village East Driveway. Both left-turn lanes are designed to City of Houston standards and are 200 feet in length (100 feet storage and 100 feet taper). The proposed left-turn lanes are designed to remove left-turn traffic from impeding eastbound through traffic on Memorial Drive. Two eastbound and two westbound through lanes are maintained on Memorial Drive as well as the existing sidewalk. Drawings showing improvements proposed in this alternative are in Exhibit C5 and Exhibit C6 in Appendix C. A summary of all alternatives is as follows:

Table 1 - Summary of Alternatives	
Alternative	Description
No Build	<ul style="list-style-type: none"> No Additional Improvements Proposed
Alternative 1	<ul style="list-style-type: none"> Add an eastbound left-turn lane at Town and Country Village East Driveway
Alternative 2	<ul style="list-style-type: none"> Add an eastbound left-turn lane at Town and Country Village West Driveway Add a westbound left-turn lane at Town and Country Village East Driveway

Traffic Analysis

Traffic analysis tasks were conducted using Synchro, Version 6.0. Synchro follows procedures developed in the *Highway Capacity Manual* (HCM 2000) (1) and analyzes the study area in its entirety rather than as a series of isolated intersections and driveways. The HCM 2000 is an industry accepted standard for intersection capacity analysis, queuing analysis and signal timing. Synchro allows users to model traffic situations and conduct traffic operational analyses on these models. Various measures of effectiveness (MOEs) can be extracted such as level of service (LOS), delay and vehicle queue lengths. Output can be used to make comparisons between proposed alternatives.

Control delay, measured in seconds per vehicle (sec/veh), was used to determine LOS at intersection approaches. Control delay is the portion of total delay attributed to the traffic control used at an intersection. Control delay includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay (1). Table 2 provides criteria for determining LOS based on delay per vehicle.

LOS	Delay Range for Unsignalized Intersections (sec/veh)	Delay Range for Signalized Intersections (sec/veh)
A	≤10	≤10
B	>10 and ≤15	>10 and ≤ 20
C	>15 and ≤25	>20 and ≤ 35
D	>25 and ≤35	>35 and ≤ 55
E	>35 and ≤50	>55 and ≤ 80
F	>50	>80

The concept of LOS as explained in the HCM 2000 is that it is similar to grades in school – A being the best, F the worst. A more detailed description of LOS for signalized intersections is provided below:

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- *LOS A* describes operations with very low delay, up to 10 sec/veh. This level of service occurs when progression is extremely favorable and most vehicles arrive during the green light. Most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.
- *LOS B* describes operations with delay greater than 10 and up to 20 sec/veh. This level generally occurs with good progression, short cycle lengths, or both. More vehicles stop than with LOS A, causing higher levels of delay.
- *LOS C* describes operations with delay greater than 20 and up to 35 sec/veh. These higher delays may result from fair progression, longer cycle lengths, or both. Individual cycle failures may begin to appear at this level, or all vehicles may not pass through on one cycle. The number of vehicles stopping is significant at this level, though many still pass through the intersection without stopping.
- *LOS D* describes operations with delay greater than 35 and up to 55 sec/veh. At level D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or high v/c ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.
- *LOS E* describes operations with control delay greater than 55 and up to 80 sec/veh. This level is considered by many agencies to be the limit of acceptable delay. These high delay values generally indicate poor progression, long cycle lengths, and high v/c ratios. Individual cycle failures are frequent occurrences.
- *LOS F* describes operations with control delay in excess of 80 sec/veh. This level, considered to be unacceptable to most drivers, often occurs with oversaturation, that is,

when arrival flow rates exceed the capacity of the intersection. Poor progression and long cycle lengths may also be major contributing factors.

A second traffic analysis was performed using the *Intersection Capacity Utilization* (ICU) method. The ICU method differs from the HCM 2000 method for producing MOEs, as the HCM 2000 uses control delay as the primary MOE, while the ICU method uses traffic volume and capacity (2). Like the HCM 2000 method, ICU uses a LOS scale; however the ICU method uses a scale where LOS A is best and LOS H the worst. Using the ICU method is preferred for this study as it analyzes all intersection approaches, whereas only intersection approaches that have traffic control (e.g., stop signs or traffic signals) are analyzed using the HCM 2000 method.

RESULTS

Traffic Analysis

Results of the traffic analysis are presented in Table 3 for delay and LOS, while network MOEs are given in. Detailed results are located in Appendix D.

HCM 2000 analysis results show that left-turn lanes included in Alternative 1 and Alternative 2 only marginally increase performance with respect to delay at intersections on Memorial Drive. Furthermore, network MOEs do not improve when left-turn lanes are analyzed on Memorial Drive. No failing conditions (LOS E or LOS F) resulted in any analysis using the HCM 2000. The HCM 2000 analysis is not ideal for this project, as proposed improvements do not affect approaches that use traffic control such as stop signs or traffic signals.

Improvements as a result of adding left-turn lanes are minimal when using HCM 2000; however, the ICU method shows that Alternative 2 provides the best LOS when using the ICU scale (see Table 5). The ICU method shows that where capacity (storage lanes) is added, intersections function at a higher LOS. Therefore, the addition of left-turn lanes eastbound at Town and

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Country Village East Driveway and Town and Country Village West Driveway allows for an increase in intersection performance. Alternative 1 shows only performance increases where capacity is added at Town and Country Village West Driveway. Where no capacity is added, (Beltway 8 NSR and West Bough Lane), ICU does not show any performance increase.

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Table 3 – Measures of Effectiveness HCM 2000						
AM Peak Hour Intersection	Delay (sec/veh)					
	2009 Existing	2009 Alternative 1	2009 Alternative 2	2014 No Build	2014 Alternative 1	2014 Alternative 2
Beltway 8 and Memorial	33.3	33.3	33.3	34.6	34.6	34.6
Town and Country (West) and Memorial	0.6	0.6	0.5	0.6	0.6	0.5
Town and Country (East) and Memorial	0.8	0.6	0.6	0.8	0.6	0.6
West Bough and Memorial	7.1	7.1	7.1	7.2	7.2	7.2
AM Peak Hour Intersection						
Beltway 8 and Memorial	2009 Existing	2009 Alternative 1	2009 Alternative 2	2014 No Build	2014 Alternative 1	2014 Alternative 2
Town and Country (West) and Memorial	C	C	C	C	C	C
Town and Country (East) and Memorial	A	A	A	A	A	A
West Bough and Memorial	A	A	A	A	A	A
Midday Peak Hour Intersection						
Beltway 8 and Memorial	20.5	20.5	20.5	22.3	22.3	22.3
Town and Country (West) and Memorial	2.4	2.4	2.3	2.6	2.6	2.4
Town and Country (East) and Memorial	1.2	1.1	1.1	1.3	1.1	1.1
West Bough and Memorial	12.4	12.4	12.4	12.5	12.5	12.5
Midday Peak Hour Intersection						
Beltway 8 and Memorial	2009 Existing	2009 Alternative 1	2009 Alternative 2	2014 No Build	2014 Alternative 1	2014 Alternative 2
Town and Country (West) and Memorial	C	C	C	C	C	C
Town and Country (East) and Memorial	A	A	A	A	A	A
West Bough and Memorial	B	B	B	B	B	B
PM Peak Hour Intersection						
Beltway 8 and Memorial	45.5	45.5	45.5	53.8	53.8	53.8
Town and Country (West) and Memorial	2.0	2.0	1.8	2.2	2.2	1.9
Town and Country (East) and Memorial	1.8	1.6	1.6	1.9	1.7	1.7
West Bough and Memorial	19.0	19.0	19.0	20.6	20.6	20.6
PM Peak Hour Intersection						
Beltway 8 and Memorial	2009 Existing	2009 Alternative 1	2009 Alternative 2	2014 No Build	2014 Alternative 1	2014 Alternative 2
Town and Country (West) and Memorial	D	D	D	D	D	D
Town and Country (East) and Memorial	A	A	A	A	A	A
West Bough and Memorial	B	B	B	C	C	C

Italics denote an Unsignalized Intersection



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Table 4 - Network MOEs using the HCM 2000

		AM Peak Hour				
	2009 Existing	2009 Alternative 1	2009 Alternative 2	2014 No Build	2014 Alternative 1	2014 Alternative 2
LOS	B	B	B	B	B	B
Delay (sec/veh)	13.0	13.0	13.0	14.0	14.0	14.0
Average Speed (mph)	17	17	17	17	17	17

		Midday Peak Hour				
	2009 Existing	2009 Alternative 1	2009 Alternative 2	2014 No Build	2014 Alternative 1	2014 Alternative 2
LOS	A	A	A	A	A	A
Delay (sec/veh)	9.0	9.0	9.0	10.0	10.0	10.0
Average Speed (mph)	19	19	19	19	19	19

		PM Peak Hour				
	2009 Existing	2009 Alternative 1	2009 Alternative 2	2014 No Build	2014 Alternative 1	2014 Alternative 2
LOS	B	B	B	C	C	C
Delay (sec/veh)	19.0	19.0	19.0	22.0	22.0	22.0
Average Speed (mph)	13	13	13	12	12	12





Memorial Drive Drainage and Mobility

Table 5 - Measures of Effectiveness ICU Method						
AM Peak Hour Intersection	2009			2014		
	Existing	Alterative 1	Alterative 2	No Build	Alterative 1	Alterative 2
ICU Percentage						
Beltway 8 and Memorial	79%	79%	79%	82%	82%	82%
Town and Country (West) and Memorial	50%	50%	32%	52%	52%	34%
Town and Country (East) and Memorial	52%	33%	33%	53%	34%	34%
West Bough and Memorial	44%	44%	44%	46%	46%	46%
AM Peak Hour Intersection						
Beltway 8 and Memorial	D	D	D	E	E	E
Town and Country (West) and Memorial	A	A	A	A	A	A
Town and Country (East) and Memorial	A	A	A	A	A	A
West Bough and Memorial	A	A	A	A	A	A
Midday Peak Hour Intersection						
Beltway 8 and Memorial	68%	68%	68%	71%	71%	71%
Town and Country (West) and Memorial	58%	58%	42%	60%	60%	44%
Town and Country (East) and Memorial	56%	42%	42%	58%	43%	43%
West Bough and Memorial	56%	56%	56%	58%	58%	58%
Midday Peak Hour Intersection						
Beltway 8 and Memorial	C	C	C	C	C	C
Town and Country (West) and Memorial	B	B	A	B	B	A
Town and Country (East) and Memorial	B	A	A	B	A	A
West Bough and Memorial	B	B	B	B	B	B
PM Peak Hour Intersection						
Beltway 8 and Memorial	87%	87%	87%	91%	91%	91%
Town and Country (West) and Memorial	63%	63%	48%	66%	66%	50%
Town and Country (East) and Memorial	61%	48%	48%	64%	50%	50%
West Bough and Memorial	69%	69%	69%	72%	72%	72%
PM Peak Hour Intersection						
Beltway 8 and Memorial	E	E	E	E	E	E
Town and Country (West) and Memorial	B	B	A	C	C	A
Town and Country (East) and Memorial	B	A	A	B	A	A
West Bough and Memorial	C	C	C	C	C	C



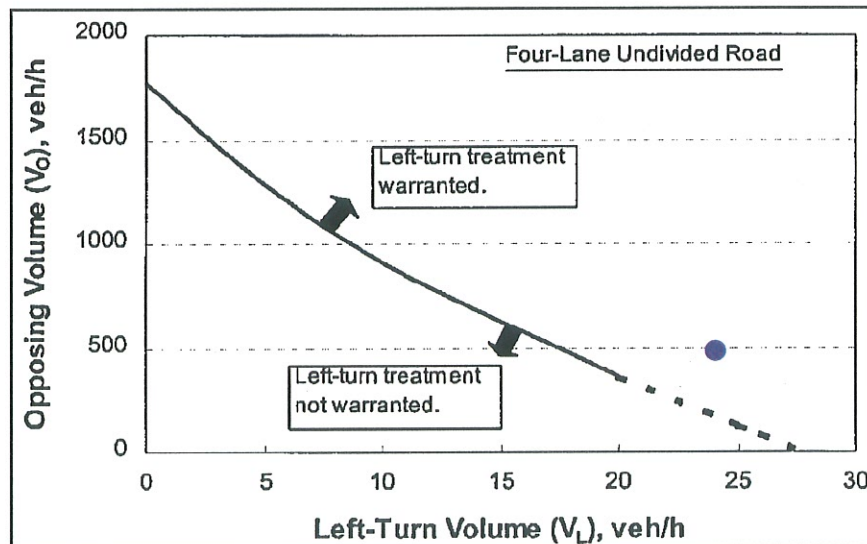
Safety Benefits

Each proposed alternative incorporates a combination of eastbound left-turn lanes on Memorial Drive. Safety benefits associated with adding left-turn lanes are as follows (3):

Left-turn Lane Safety Benefits

- Minimizes turn-related crashes and
- Eliminates unnecessary delay to through movements.

Figure 4 provides a method for analyzing the need for a left-turn lane on the major approach of a stop controlled intersection (3). Using the curve in this figure, both Town and Country Village West Driveway and Town and Country Village East Driveway warrant eastbound left-turn lanes. During the AM peak hour, the *Left-turn Volume* is 24 vehicles and the *Opposing Volume* is 556 vehicles on Town and Country Village West Driveway, while the *Left-turn Volume* is 75 vehicles and the *Opposing Volume* is 547 on Town and Country Village East Driveway. Both points are above the curve in Figure 4 and a northbound left-turn lane is warranted.



*Town and Country Village East Driveway Data Point is off the chart, but is above the curve.

Figure 4 - Guidelines for Determining the Need for a Left-Turn Lane (3)

Cost Estimates

An analysis was performed to determine the cost necessary for implementation of each alternative. The cost estimate represents probable costs; any costs related to utility relocation, landscaping or right-of-way acquisition are not included.

Table 6 provides a breakdown of costs associated with each alternative for year 2009 dollars. Detailed cost estimates are in Appendix E.

Table 6 - Cost Estimates		
No Build	Alternative 1	Alternative 2
-	\$92,000	\$189,000

RECOMMENDATIONS

LAN recommends that two eastbound left-turn lanes be constructed on Memorial Drive (Alternative 2). This recommendation is based on ICU LOS as well as potential safety benefits. Left-turn lanes are known to minimize turn-related crashes and minimize delay to through traffic. Based on these potential benefits, LAN recommends the following:

- Install an eastbound left-turn lane on Memorial Drive and Town and Country Village West Driveway,
- Install an eastbound left-turn lane on Memorial Drive and Town and Country Village East Driveway, and
- Update pavement markings on Memorial Drive between Beltway 8 NSR and West Bough Lane.

REFERENCES

1. *Highway Capacity Manual 2000*. Transportation Research Board, National Research Council, Washington D.C., 2000.
2. *Intersection Capacity Utilization 2003 Edition*. Trafficware, 2003.
3. *Evaluating Intersection Improvements: An Engineering Study Guide*: NCHRP Report 457, Transportation Research Board, National Research Council, Washington, D.C., 2001.

APPENDIX A
SITE PHOTOGRAPHS

Memorial Drive Drainage and Mobility



Photograph 1 - Memorial Drive @ West Bough Lane Looking North



Photograph 2 - Memorial Drive @ West Bough Lane Looking South

Memorial Drive Drainage and Mobility



Photograph 3 - Memorial Drive @ West Bough Lane Looking East



Photograph 4 - Memorial Drive @ West Bough Lane Looking West

Memorial Drive Drainage and Mobility



Photograph 5 - Memorial Drive @ Town and Country Village East Driveway Looking North



Photograph 6 - Memorial Drive @ Town and Country Village East Driveway Looking East

Memorial Drive Drainage and Mobility



Photograph 7 - Memorial Drive @ Town and Country Village East Driveway Looking West



Photograph 8 - Memorial Drive @ Town and Country Village West Driveway Looking North

Memorial Drive Drainage and Mobility



Photograph 9 - Memorial Drive @ Town and Country Village West Driveway Looking East



Photograph 10 - Memorial Drive @ Beltway 8 NSR Looking West

Memorial Drive Drainage and Mobility



Photograph 11 - Memorial Drive @ Beltway 8 NSR Looking North



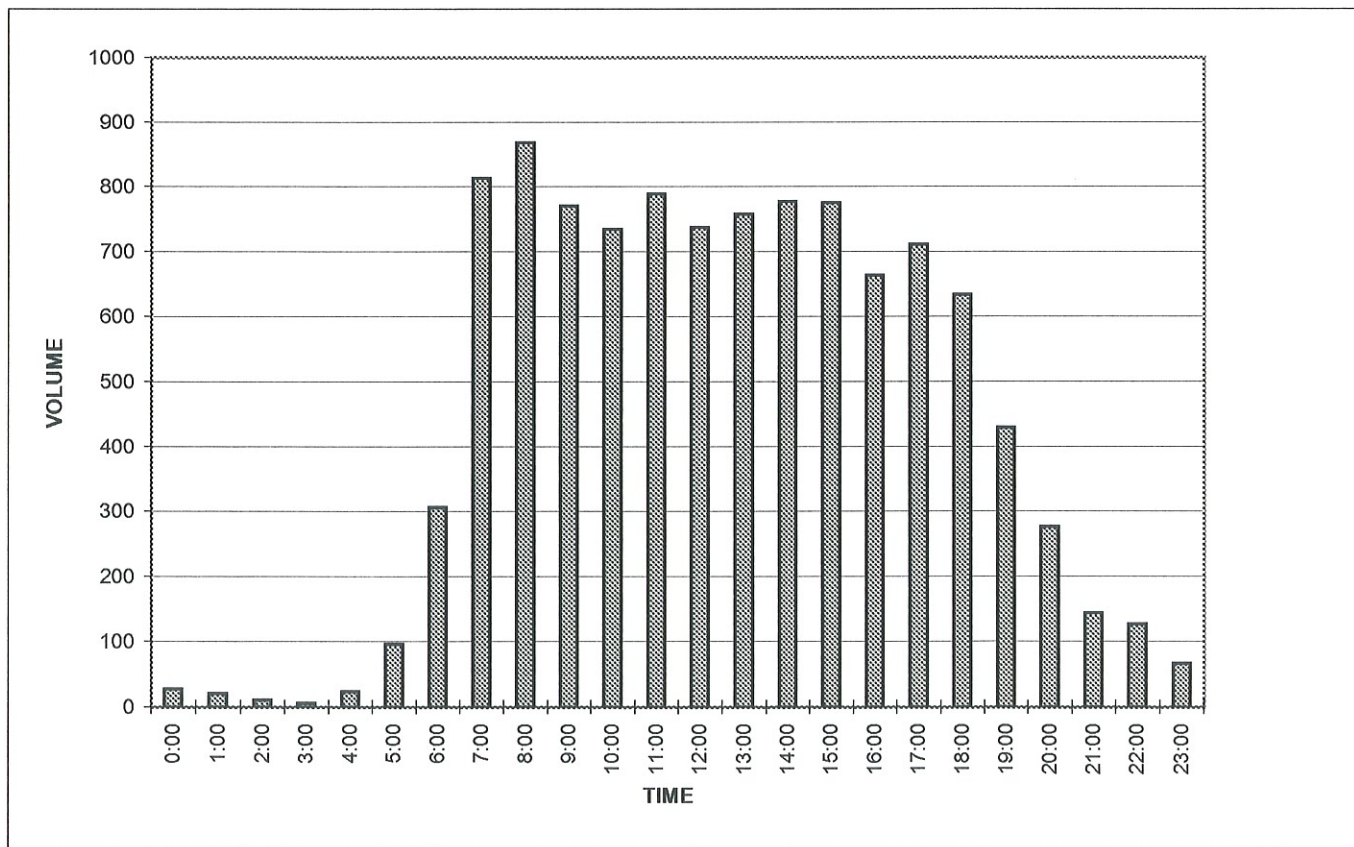
Photograph 12 - Memorial Drive @ Beltway 8 NSR Looking South

APPENDIX B
DATA

24-HOUR TRAFFIC COUNTS

Date Began:
12/17/2008

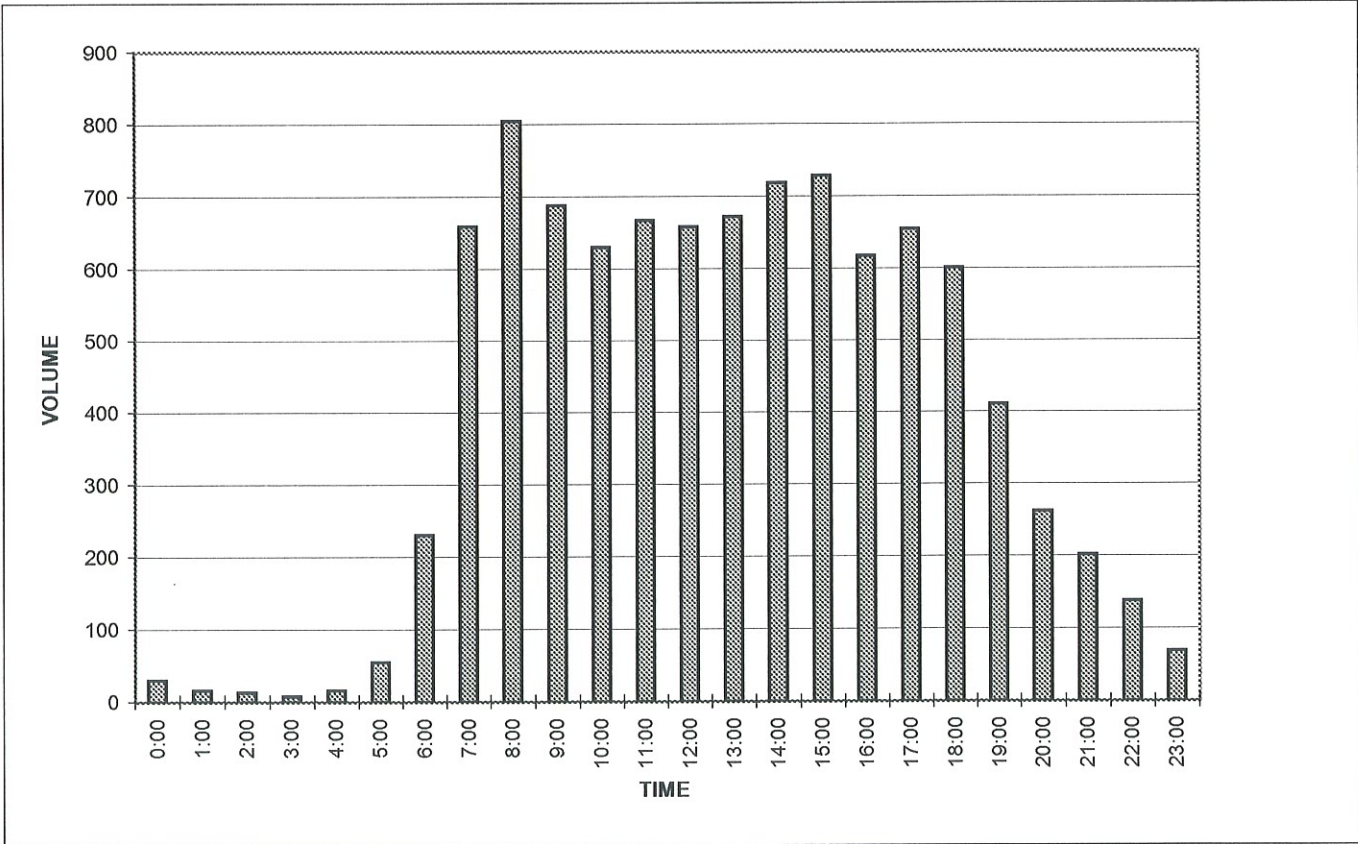
EB Memorial Dr. West of Beltway 8 NBFR					
TIME	0:00	0:15	0:30	0:45	TOTAL
0:00	10	7	5	6	28
1:00	8	4	3	6	21
2:00	3	4	2	2	11
3:00	0	2	2	2	6
4:00	3	4	6	11	24
5:00	12	24	24	36	96
6:00	30	64	94	118	306
7:00	158	194	235	226	813
8:00	268	224	178	198	868
9:00	212	175	210	174	771
10:00	182	166	190	196	734
11:00	188	186	206	209	789
12:00	192	172	190	183	737
13:00	166	213	188	191	758
14:00	208	190	166	214	778
15:00	200	202	184	190	776
16:00	182	164	158	159	663
17:00	172	193	188	158	711
18:00	170	174	126	164	634
19:00	126	109	112	82	429
20:00	84	57	68	68	277
21:00	8	43	55	38	144
22:00	45	25	31	26	127
23:00	23	15	16	13	67
TOTAL:					10,568



EB Memorial Dr. East of Driveway 1

Date Began:
12/17/2008

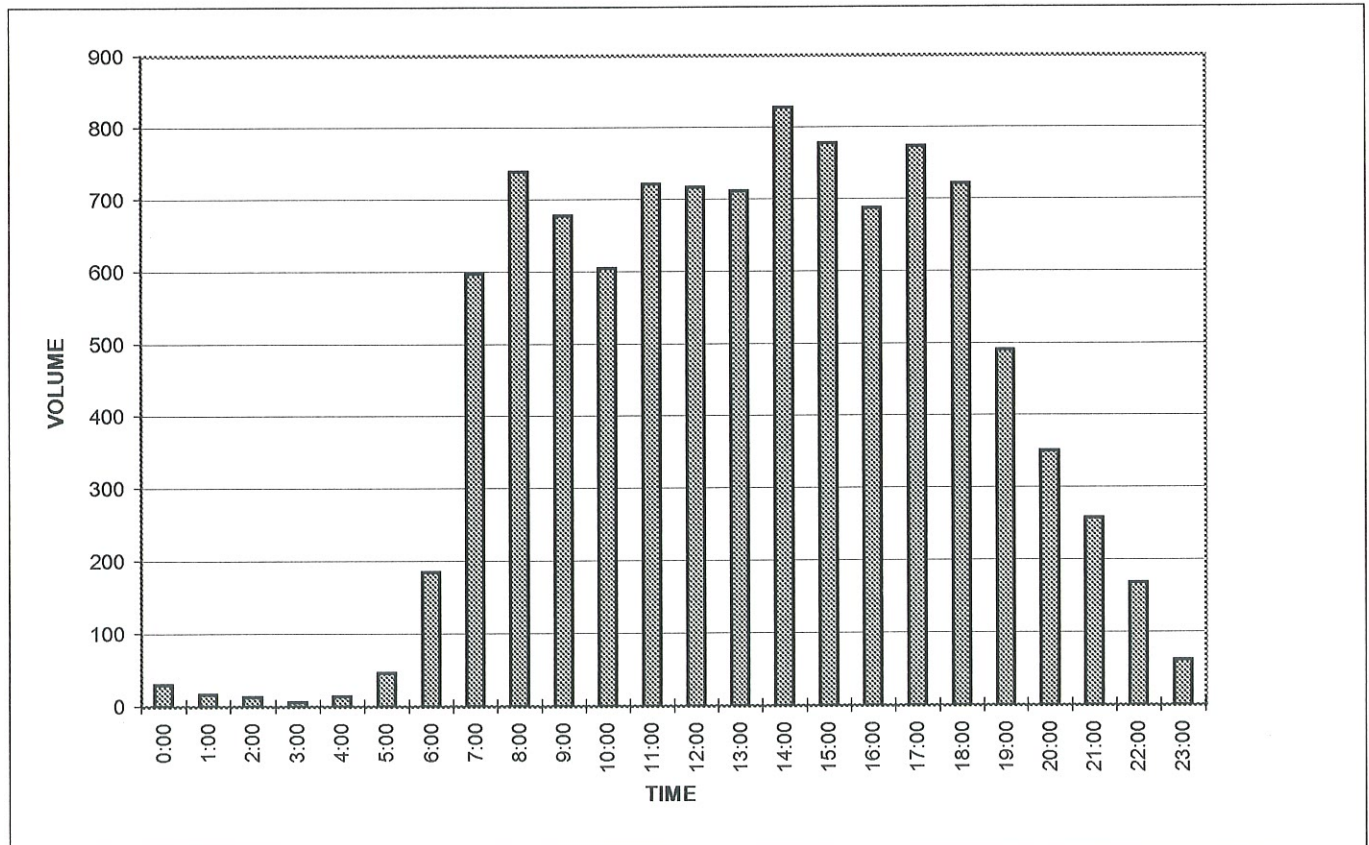
TIME	0:00	0:15	0:30	0:45	TOTAL
0:00	9	8	6	7	30
1:00	4	5	2	5	16
2:00	5	4	2	2	13
3:00	1	4	1	2	8
4:00	4	2	4	6	16
5:00	5	17	10	23	55
6:00	23	48	67	92	230
7:00	130	147	202	180	659
8:00	228	198	184	194	804
9:00	192	150	192	154	688
10:00	170	139	161	160	630
11:00	166	159	175	167	667
12:00	188	152	162	156	658
13:00	137	184	171	180	672
14:00	181	176	167	194	718
15:00	192	186	184	166	728
16:00	154	159	149	155	617
17:00	161	174	154	166	655
18:00	164	162	124	151	601
19:00	120	102	104	85	411
20:00	70	64	64	64	262
21:00	42	62	55	43	202
22:00	46	36	33	23	138
23:00	19	17	15	18	69
TOTAL:	9,547				



EB Memorial Dr. East of W. Bough Ln.

Date Began:
12/17/2008

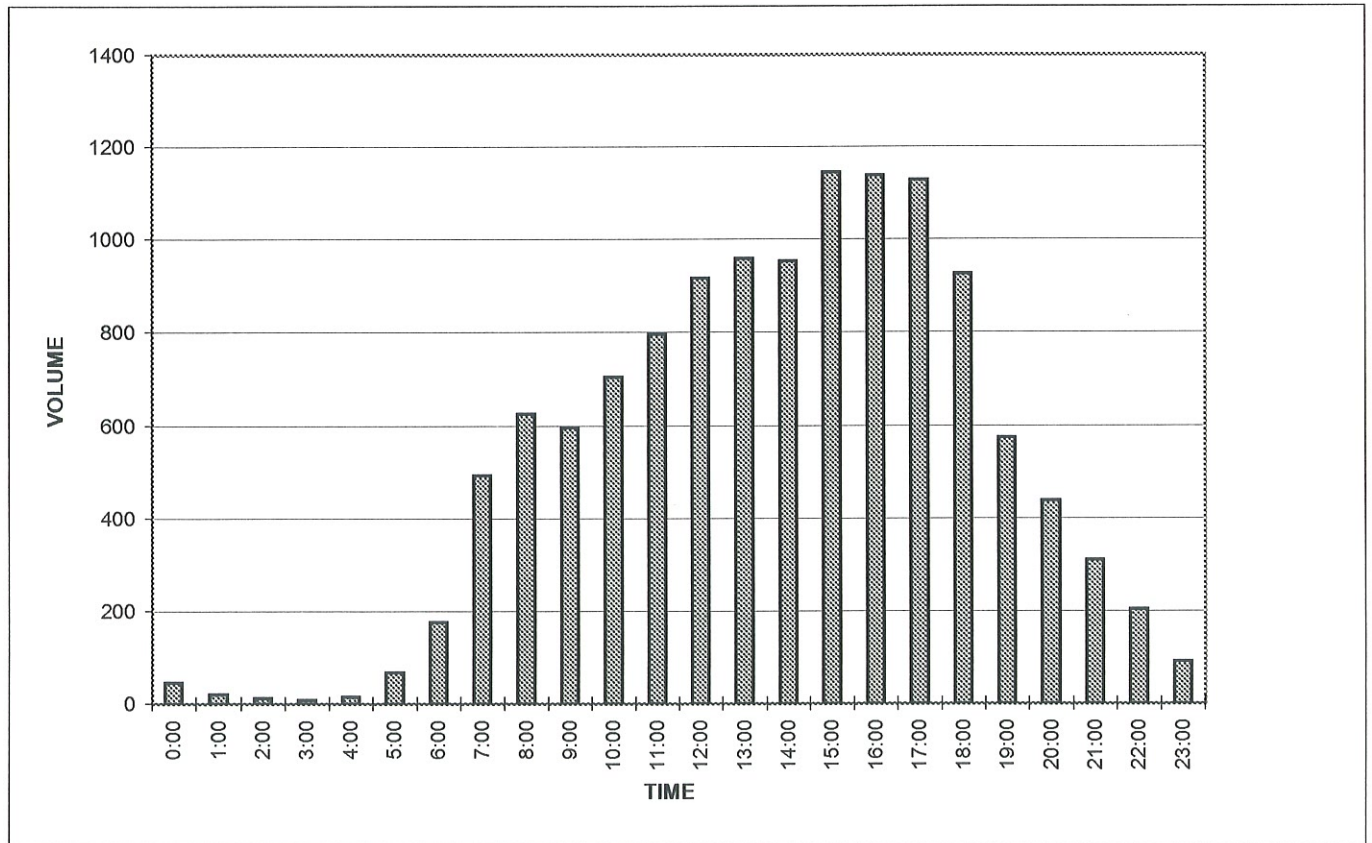
TIME	0:00	0:15	0:30	0:45	TOTAL
0:00	8	6	8	8	30
1:00	6	6	2	3	17
2:00	5	4	2	2	13
3:00	2	0	4	0	6
4:00	3	2	3	6	14
5:00	3	11	11	21	46
6:00	15	32	55	83	185
7:00	104	138	169	186	597
8:00	187	210	176	166	739
9:00	170	176	162	170	678
10:00	165	142	146	151	604
11:00	178	175	182	186	721
12:00	182	188	168	179	717
13:00	152	192	193	174	711
14:00	218	201	190	218	827
15:00	204	205	188	181	778
16:00	176	178	175	158	687
17:00	188	219	174	192	773
18:00	170	189	186	176	721
19:00	138	142	112	99	491
20:00	93	76	84	98	351
21:00	65	82	68	43	258
22:00	54	45	38	31	168
23:00	18	17	14	13	62
TOTAL:	10,194				



WB Memorial Dr. East of W. Bough Ln.

Date Began:
12/17/2008

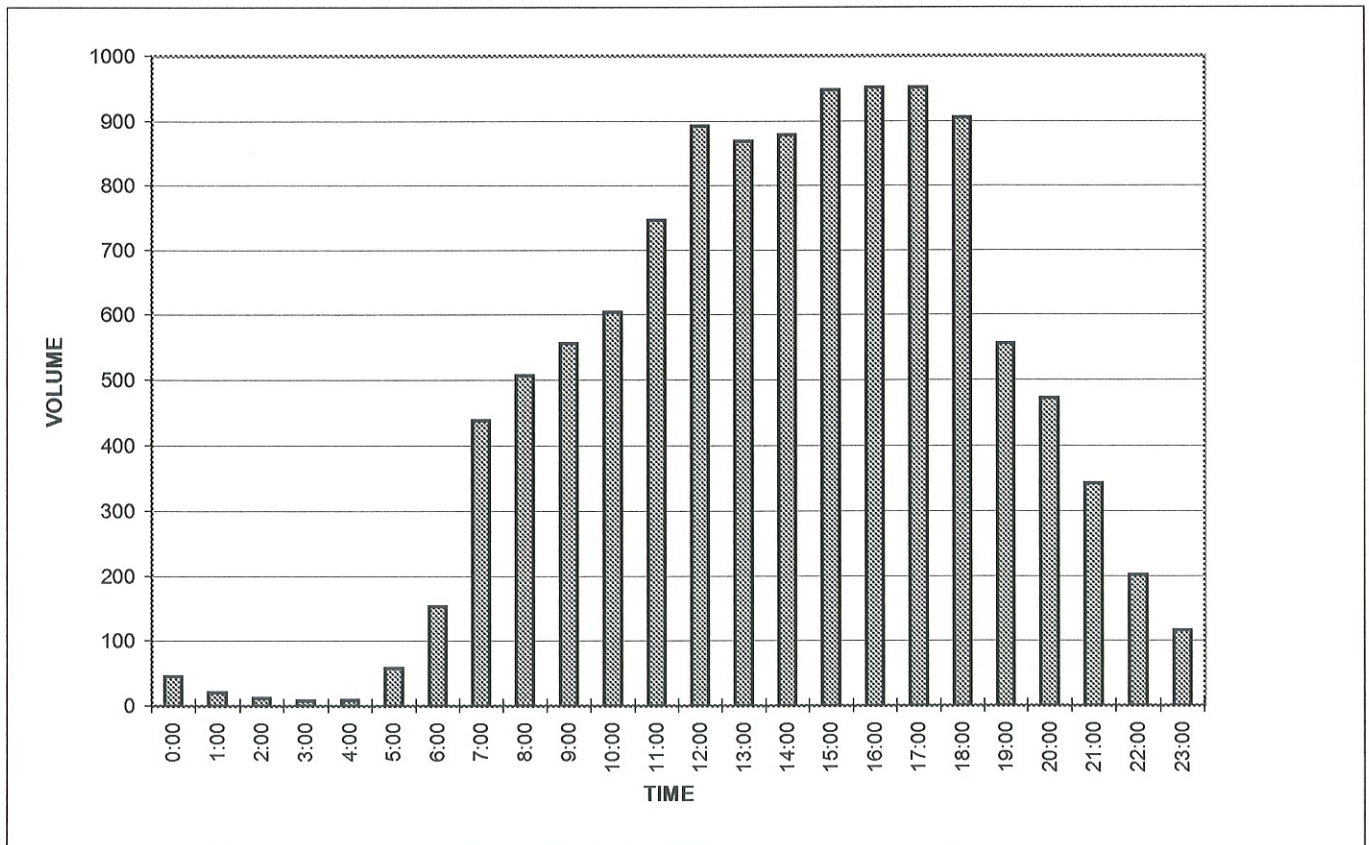
TIME	0:00	0:15	0:30	0:45	TOTAL
0:00	14	9	9	13	45
1:00	7	4	8	2	21
2:00	3	5	2	2	12
3:00	1	4	2	1	8
4:00	3	4	1	7	15
5:00	7	16	15	30	68
6:00	30	40	64	42	176
7:00	64	120	144	165	493
8:00	170	166	126	163	625
9:00	145	125	152	174	596
10:00	182	161	174	187	704
11:00	198	212	180	207	797
12:00	222	242	225	228	917
13:00	219	252	238	250	959
14:00	224	226	272	232	954
15:00	230	274	337	304	1,145
16:00	277	281	301	279	1,138
17:00	304	319	263	242	1,128
18:00	240	243	234	209	926
19:00	178	124	150	123	575
20:00	112	110	110	106	438
21:00	90	104	67	49	310
22:00	62	65	44	33	204
23:00	26	29	21	15	91
TOTAL:	12,345				



WB Memorial Dr. West of Driveway 2

Date Began:
12/17/2008

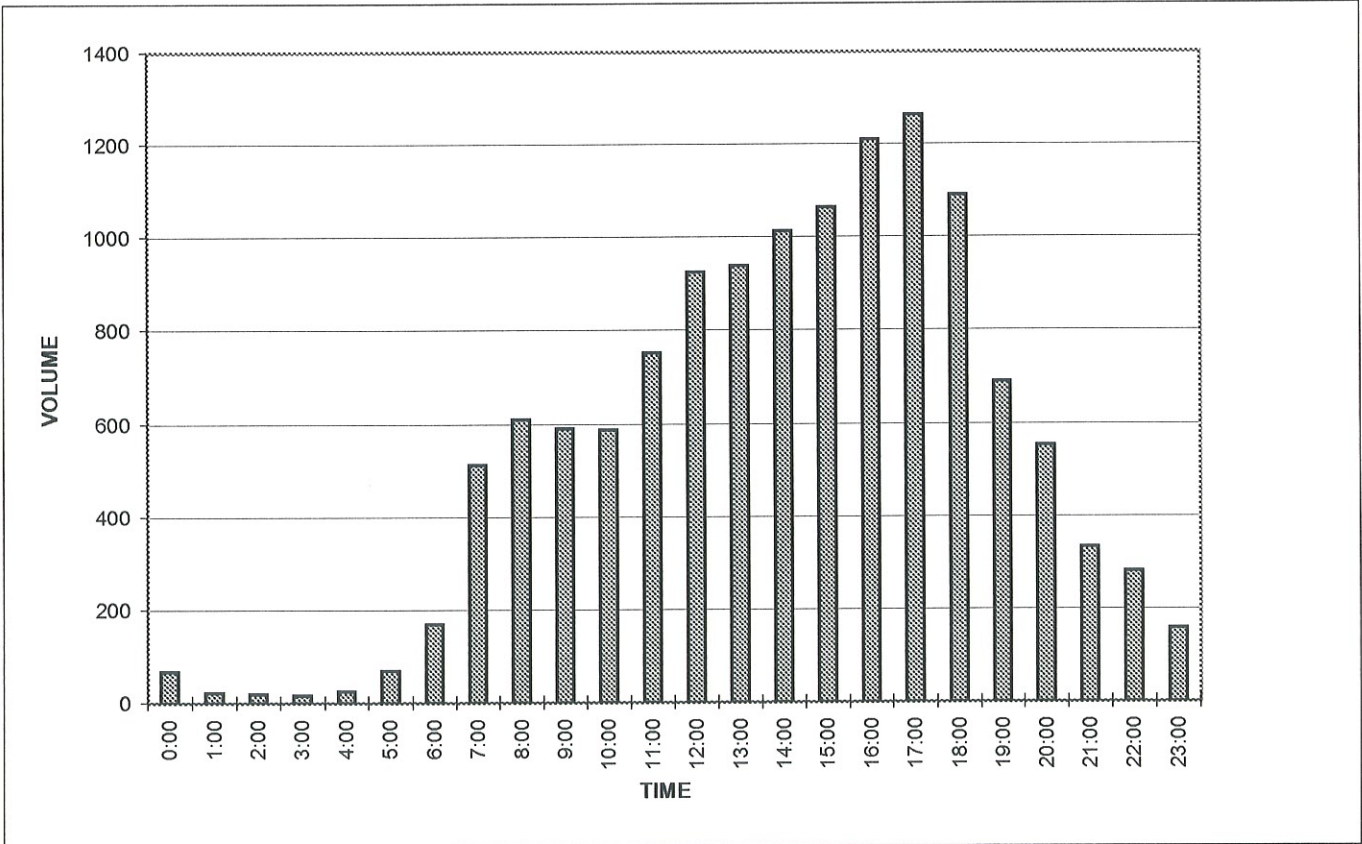
TIME	0:00	0:15	0:30	0:45	TOTAL
0:00	11	12	9	13	45
1:00	7	5	6	3	21
2:00	2	5	3	2	12
3:00	0	4	3	1	8
4:00	2	1	2	4	9
5:00	9	13	14	22	58
6:00	26	34	54	40	154
7:00	54	107	149	128	438
8:00	137	143	110	117	507
9:00	148	132	134	142	556
10:00	150	144	144	166	604
11:00	176	180	183	208	747
12:00	212	214	235	232	893
13:00	213	223	198	235	869
14:00	204	238	216	221	879
15:00	236	269	254	189	948
16:00	192	233	272	255	952
17:00	252	240	220	240	952
18:00	248	242	230	186	906
19:00	160	115	151	130	556
20:00	111	116	117	128	472
21:00	96	102	87	58	343
22:00	62	60	45	35	202
23:00	39	26	31	20	116
TOTAL:	11,247				



WB Memorial Dr. West of Beltway 8 NBFR

Date Began:
12/17/2008

TIME	0:00	0:15	0:30	0:45	TOTAL
0:00	17	20	14	17	68
1:00	7	10	2	3	22
2:00	4	7	4	4	19
3:00	2	4	3	8	17
4:00	1	5	2	17	25
5:00	8	16	21	24	69
6:00	18	44	52	55	169
7:00	83	122	156	152	513
8:00	186	156	134	134	610
9:00	160	142	146	143	591
10:00	142	150	133	164	589
11:00	166	190	205	192	753
12:00	222	223	254	226	925
13:00	238	233	208	259	938
14:00	234	261	238	280	1,013
15:00	281	237	278	268	1,064
16:00	280	282	306	342	1,210
17:00	312	307	330	315	1,264
18:00	315	287	264	224	1,090
19:00	196	150	199	146	691
20:00	146	130	142	136	554
21:00	104	46	104	80	334
22:00	90	71	60	60	281
23:00	55	40	36	28	159
				TOTAL:	12,968





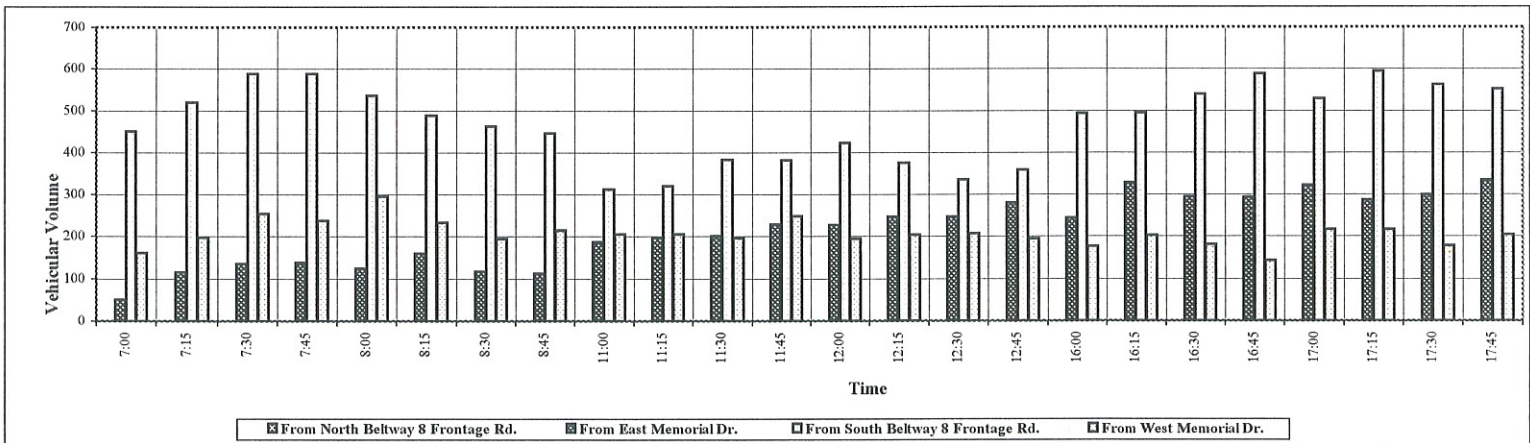
SIX-HOUR TURNING MOVEMENT COUNTS

Memorial at Northbound Beltway 8 Frontage Rd.

December 17, 2008

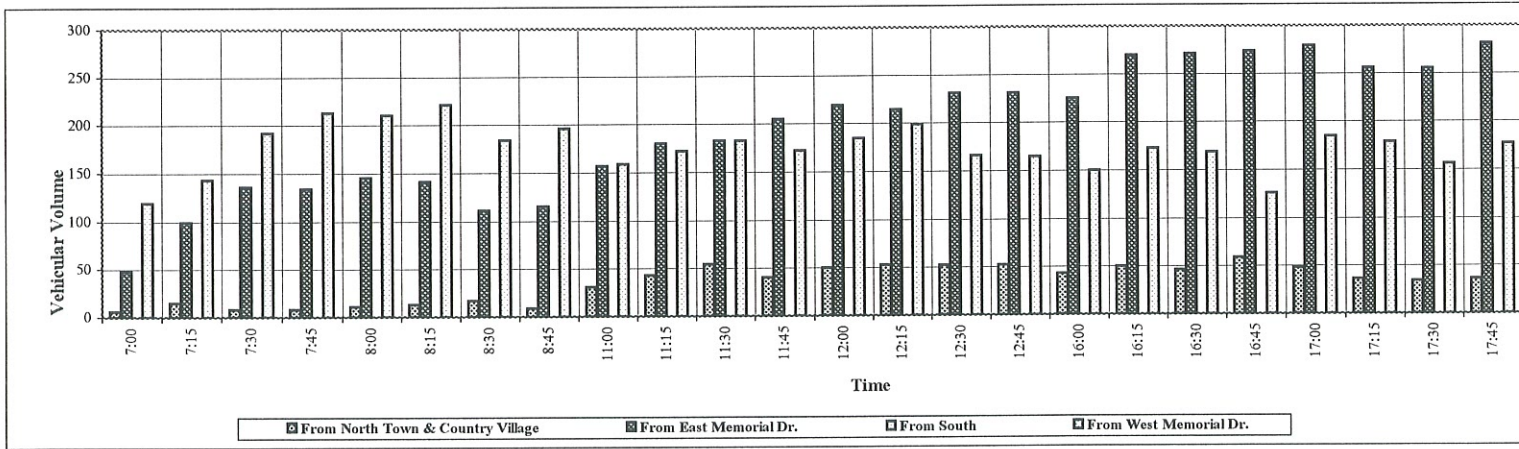
Turning Movement Count

Time	From North					From East					From South					From West				
	Beltway 8 Frontage Rd.					Memorial Dr.					Beltway 8 Frontage Rd.					Memorial Dr.				
	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds
7:00	0	0	0	3	0	0	43	8	0	1	44	376	30	7	2	55	106	0	0	1
7:15	0	0	0	6	0	0	84	31	0	1	58	422	40	1	0	80	117	0	0	0
7:30	0	0	0	5	0	0	104	31	0	0	60	472	56	4	0	90	164	0	0	0
7:45	0	0	0	8	0	0	108	30	0	0	82	439	67	4	0	93	145	0	0	0
Hr. Total:	0	0	0	22	0	0	339	100	0	2	244	1,709	193	16	2	318	532	0	0	1
8:00	0	0	0	9	0	0	104	20	0	0	75	404	57	1	0	93	202	0	0	0
8:15	0	0	0	9	0	0	128	32	0	0	65	372	51	7	0	73	160	0	0	0
8:30	0	0	0	6	0	0	89	27	0	0	50	339	73	4	0	63	131	0	0	0
8:45	0	0	0	6	0	0	81	31	0	1	61	323	61	5	0	58	157	0	0	0
Hr. Total:	0	0	0	30	0	0	402	110	0	1	251	1,438	242	17	0	287	650	0	0	0
11:00	0	0	0	5	0	0	149	38	0	0	33	241	39	8	0	62	144	0	0	0
11:15	0	0	0	7	0	0	166	30	0	0	33	232	55	2	0	75	130	0	0	0
11:30	0	0	0	12	0	0	168	33	0	1	55	276	52	3	1	54	142	0	0	0
11:45	0	0	0	9	0	0	187	41	0	0	40	274	67	2	0	92	156	0	0	0
Hr. Total:	0	0	0	33	0	0	670	142	0	1	161	1,023	213	15	1	283	572	0	0	0
12:00	0	0	0	11	0	0	178	49	0	0	50	294	78	5	0	61	133	0	0	0
12:15	0	0	0	8	0	0	201	45	0	0	59	258	58	5	0	58	146	0	0	0
12:30	0	0	0	6	0	0	212	35	0	0	46	228	62	4	0	77	130	0	0	0
12:45	0	0	0	3	0	0	234	47	0	0	49	257	53	3	0	64	131	0	0	0
Hr. Total:	0	0	0	28	0	0	825	176	0	0	204	1,037	251	17	0	260	540	0	0	0
16:00	0	0	0	5	0	0	229	14	0	0	58	388	47	6	0	64	112	0	0	0
16:15	0	0	0	5	0	0	286	42	0	4	68	387	40	1	0	58	144	0	0	0
16:30	0	0	0	12	0	0	267	27	0	1	66	427	46	1	1	58	122	0	0	0
16:45	0	0	0	5	0	0	260	33	0	0	100	438	50	3	1	49	94	0	0	0
Hr. Total:	0	0	0	27	0	0	1,042	116	0	5	292	1,640	183	11	2	229	472	0	0	0
17:00	0	0	0	8	0	0	289	32	0	0	84	386	58	1	0	64	152	0	0	0
17:15	0	0	0	9	0	0	264	23	0	0	77	468	49	5	0	70	146	0	0	0
17:30	0	0	0	6	0	0	279	20	0	0	85	413	64	1	0	63	115	0	0	0
17:45	0	0	0	8	0	0	298	36	0	0	97	389	65	5	0	73	131	0	0	0
Hr. Total:	0	0	0	31	0	0	1,130	111	0	0	343	1,656	236	12	0	270	544	0	0	0
Gr. Total	0	0	0	171	0	0	4,408	755	0	9	1,495	8,503	1,318	88	5	1,647	3,310	0	0	1
% of Tot.	0%	0%	0%	1%	0%	0%	20%	3%	0%	0%	7%	39%	6%	0%	0%	8%	15%	0%	0%	0%
Apprch%	1%					24%					53%					23%				
% of Apprch	0%	0%	0%	100%	0%	0%	85%	15%	0%	0%	13%	75%	12%	1%	0%	33%	67%	0%	0%	0%
Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds	
From North					From East					From South					From West					



Town Country Village at Memorial (West)
 December 17, 2008
 Turning Movement Count

Time	From North Town & Country Village					From East Memorial Dr.					From South					From West Memorial Dr.				
	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds
7:00	3	0	3	0	0	0	46	2	0	0	0	0	0	0	0	4	115	0	0	0
7:15	5	0	10	0	0	0	94	5	0	0	0	0	0	0	0	7	136	0	0	0
7:30	3	0	5	0	0	0	133	3	0	0	0	0	0	0	0	6	186	0	0	0
7:45	6	0	2	0	0	0	123	11	0	0	0	0	0	0	0	4	209	0	0	0
Hr. Total:	17	0	20	0	0	0	396	21	0	0	0	0	0	0	0	21	646	0	0	0
8:00	5	0	6	0	0	0	131	14	0	0	0	0	0	0	0	10	200	0	0	0
8:15	2	0	11	0	0	0	133	8	0	0	0	0	0	0	0	4	217	0	0	0
8:30	6	0	11	0	0	0	102	9	0	0	0	0	0	0	0	10	174	0	0	0
8:45	4	0	5	0	0	0	107	8	0	0	0	0	0	0	0	6	190	0	0	0
Hr. Total:	17	0	33	0	0	0	473	39	0	0	0	0	0	0	0	30	781	0	0	0
11:00	5	0	26	0	0	0	142	15	0	0	0	0	0	0	0	13	146	0	0	0
11:15	10	0	33	0	0	0	161	19	0	0	0	0	0	0	0	25	147	0	0	0
11:30	18	0	36	0	0	0	163	20	0	0	0	0	0	0	0	15	168	0	0	0
11:45	9	0	31	0	0	0	181	24	0	0	0	0	0	0	0	27	145	0	0	0
Hr. Total:	42	0	126	0	0	0	647	78	0	0	0	0	0	0	0	80	606	0	0	0
12:00	10	0	40	0	1	0	197	22	0	0	0	0	0	0	0	17	168	0	0	0
12:15	12	0	41	0	0	0	190	24	0	0	0	0	0	0	0	29	170	0	0	0
12:30	11	0	41	0	0	0	206	25	0	0	0	0	0	0	0	22	144	0	0	0
12:45	10	0	42	0	0	0	210	21	0	0	0	0	0	0	0	16	149	0	0	0
Hr. Total:	43	0	164	0	1	0	803	92	0	0	0	0	0	0	0	84	631	0	0	0
16:00	2	0	41	0	0	0	218	7	0	0	0	0	0	0	0	5	145	0	0	0
16:15	5	0	45	0	0	0	253	17	0	0	0	0	0	0	0	4	169	0	0	0
16:30	7	0	39	0	0	0	253	18	0	0	0	0	0	0	0	9	160	0	0	0
16:45	13	0	46	0	0	0	240	34	0	1	0	0	0	0	0	9	117	0	0	0
Hr. Total:	27	0	171	0	0	0	964	76	0	1	0	0	0	0	0	27	591	0	0	0
17:00	6	0	42	0	0	0	257	22	0	0	0	0	0	0	0	13	172	0	0	0
17:15	2	0	34	0	0	0	243	13	0	0	0	0	0	0	0	24	155	0	0	0
17:30	0	0	34	0	0	0	248	7	0	0	0	0	0	0	0	5	151	0	0	0
17:45	5	0	31	0	0	0	268	13	0	0	0	0	0	0	0	14	163	0	0	0
Hr. Total:	13	0	141	0	0	0	1,016	55	0	0	0	0	0	0	0	56	641	0	0	0
Gr. Total	159	0	655	0	1	0	4,299	361	0	1	0	0	0	0	0	298	3,896	0	0	0
% of Tot.	2%	0%	7%	0%	0%	0%	44%	4%	0%	0%	0%	0%	0%	0%	0%	3%	40%	0%	0%	0%
Apprch%	8%					48%					0%					43%				
% of Apprch	20%	0%	80%	0%	0%	0%	92%	8%	0%	0%	0%	0%	0%	0%	0%	7%	93%	0%	0%	0%
	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds
	Town & Country Village					Memorial Dr.					From South					Memorial Dr.				
	From North					From East										From West				

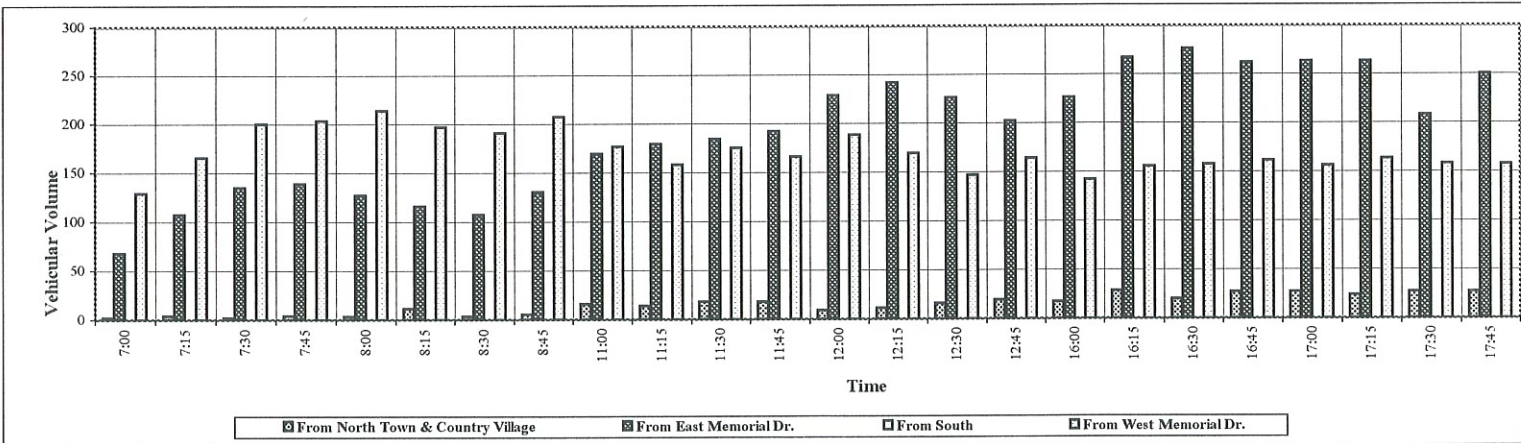


Town Country Village at Memorial (East)

December 17, 2008

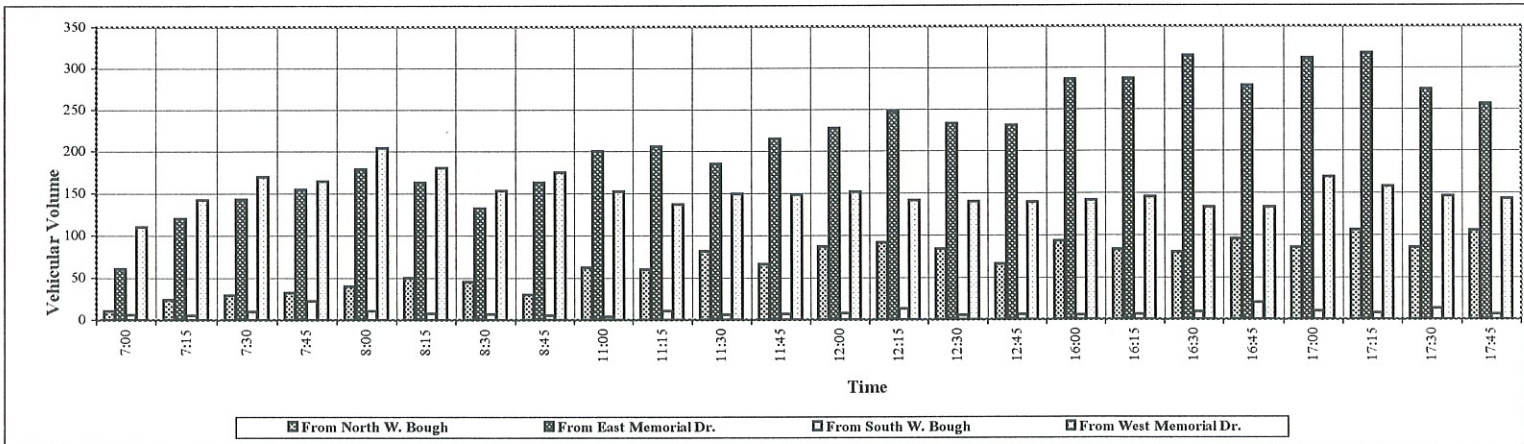
Turning Movement Count

Time	From North					From East					From South					From West				
	Town & Country Village					Memorial Dr.										Memorial Dr.				
	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds
7:00	0	0	2	0	0	0	68	0	0	0	0	0	0	0	0	9	120	0	0	0
7:15	0	0	4	0	0	0	106	1	0	0	0	0	0	0	0	20	145	0	0	0
7:30	0	0	2	0	0	0	134	1	0	0	0	0	0	0	0	10	190	0	0	0
7:45	0	0	4	0	0	0	136	3	0	0	0	0	0	0	0	20	183	0	0	0
Hr. Total:	0	0	12	0	0	0	444	5	0	0	0	0	0	0	0	59	638	0	0	0
8:00	0	0	3	0	1	0	126	1	0	0	0	0	0	0	0	17	197	0	0	0
8:15	2	0	9	0	0	0	112	4	0	0	0	0	0	0	0	28	169	0	0	0
8:30	2	0	1	0	0	0	102	5	0	0	0	0	0	0	0	14	177	0	0	0
8:45	2	0	3	0	0	0	113	17	0	0	0	0	0	0	1	31	176	0	0	0
Hr. Total:	6	0	16	0	1	0	453	27	0	0	0	0	0	0	1	90	719	0	0	0
11:00	4	0	12	0	1	0	164	5	0	0	0	0	0	0	0	19	157	0	0	0
11:15	7	0	7	0	0	0	172	7	0	0	0	0	0	0	0	15	143	0	0	0
11:30	9	0	9	0	0	0	180	4	0	0	0	0	0	0	0	23	152	0	0	0
11:45	5	0	13	0	0	0	183	9	0	0	0	0	0	0	0	16	150	0	0	0
Hr. Total:	25	0	41	0	1	0	699	25	0	0	0	0	0	0	0	73	602	0	0	0
12:00	2	0	7	0	0	0	223	6	0	0	0	0	0	0	0	24	164	0	0	0
12:15	6	0	5	0	0	0	231	11	0	0	0	0	0	0	0	27	142	0	0	0
12:30	6	0	10	0	0	0	215	11	0	0	0	0	0	0	0	15	132	0	0	0
12:45	2	0	17	0	0	0	198	4	0	0	0	0	0	0	0	19	145	0	0	0
Hr. Total:	16	0	39	0	0	0	867	32	0	0	0	0	0	0	0	85	583	0	0	0
16:00	5	0	12	0	0	0	215	11	0	0	0	0	0	0	0	17	125	0	0	0
16:15	4	0	24	0	1	0	246	21	0	0	0	0	0	0	0	25	130	0	0	0
16:30	5	0	15	0	0	0	273	3	0	0	0	0	0	0	0	19	138	0	0	0
16:45	13	0	14	0	0	0	254	8	0	0	0	0	0	0	0	31	130	0	0	0
Hr. Total:	27	0	65	0	1	0	988	43	0	0	0	0	0	0	0	92	523	0	0	0
17:00	7	0	20	0	0	0	255	8	0	0	0	0	0	0	0	14	142	0	0	0
17:15	8	0	16	0	0	0	259	4	0	0	0	0	0	0	0	22	141	0	0	0
17:30	5	0	22	0	0	0	207	1	0	0	0	0	0	0	0	19	139	0	0	0
17:45	7	0	20	0	0	0	248	2	0	0	0	0	0	0	0	23	134	0	0	0
Hr. Total:	27	0	78	0	0	0	969	15	0	0	0	0	0	0	0	78	556	0	0	0
Gr. Total	101	0	251	0	3	0	4,420	147	0	0	0	0	0	0	1	477	3,621	0	0	0
% of Tot.	1%	0%	3%	0%	0%	0%	49%	2%	0%	0%	0%	0%	0%	0%	0%	5%	40%	0%	0%	0%
Approch%	4%					51%					0%					45%				
% of Approch	28%	0%	71%	0%	1%	0%	97%	3%	0%	0%	0%	0%	0%	0%	100%	12%	88%	0%	0%	0%
	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds
	Town & Country Village					Memorial Dr.										Memorial Dr.				
	From North					From East					From South					From West				



Memorial at W. Bough
 December 17, 2008
 Turning Movement Count

Time	From North W. Bough					From East Memorial Dr.					From South W. Bough					From West Memorial Dr.				
	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds
7:00	8	0	3	3	0	1	53	7	0	0	2	2	2	7	0	6	102	2	0	0
7:15	14	1	9	6	0	0	95	25	0	0	4	0	1	1	0	4	137	1	0	0
7:30	15	0	14	5	0	0	119	24	0	0	6	4	0	4	0	7	155	8	0	1
7:45	25	1	6	8	0	0	119	35	0	1	7	11	4	4	0	15	144	5	0	0
Hr. Total:	62	2	32	22	0	1	386	91	0	1	19	17	7	16	0	32	538	16	0	1
8:00	25	2	13	9	0	0	123	56	0	0	1	10	0	1	0	7	190	7	0	0
8:15	34	7	9	9	0	0	117	46	0	1	0	7	1	7	0	10	167	3	0	0
8:30	27	6	12	6	0	1	102	29	0	0	2	2	3	4	0	12	140	1	0	0
8:45	21	2	7	6	0	0	120	43	0	0	2	3	0	5	0	15	156	4	0	0
Hr. Total:	107	17	41	30	0	1	462	174	0	1	5	22	4	17	0	44	653	15	0	0
11:00	48	3	11	5	0	0	159	41	0	0	2	1	1	8	1	15	134	3	0	0
11:15	45	3	12	7	0	0	157	49	0	0	5	4	2	2	0	19	116	2	0	0
11:30	49	4	28	12	0	1	147	37	0	1	1	3	2	3	0	18	124	7	0	0
11:45	48	4	14	9	0	0	176	39	0	0	1	5	1	2	0	7	140	1	0	0
Hr. Total:	190	14	65	33	0	1	639	166	0	1	9	13	6	15	1	59	514	13	0	0
12:00	52	5	30	11	0	1	193	34	0	0	0	8	0	5	0	10	139	2	0	0
12:15	55	8	28	8	0	1	196	51	0	0	6	5	2	5	0	16	124	1	0	0
12:30	59	3	22	6	0	0	193	40	0	0	2	3	0	4	0	6	132	2	0	1
12:45	42	4	20	3	0	0	190	41	0	0	2	4	0	3	0	9	128	2	0	0
Hr. Total:	208	20	100	28	0	2	772	166	0	0	10	20	2	17	0	41	523	7	0	1
16:00	68	5	20	5	0	2	221	63	0	0	0	5	0	6	0	14	121	6	0	0
16:15	54	10	19	5	0	0	229	58	0	0	1	5	0	1	0	19	117	9	0	3
16:30	59	3	18	12	0	4	261	50	0	0	4	4	1	1	1	15	112	6	0	0
16:45	64	11	20	5	0	4	226	49	0	0	6	10	4	3	0	15	112	6	0	1
Hr. Total:	245	29	77	27	0	10	937	220	0	0	11	24	5	11	1	63	462	27	0	4
17:00	58	10	17	8	0	1	262	49	0	0	5	3	2	1	0	18	142	9	0	0
17:15	77	11	18	9	0	0	252	66	0	1	2	4	2	5	0	16	134	7	0	0
17:30	53	11	21	6	0	11	200	63	0	0	1	11	1	1	2	17	122	7	0	3
17:45	80	6	19	8	0	1	209	46	0	0	1	5	0	5	0	25	113	5	0	0
Hr. Total:	268	38	75	31	0	13	923	224	0	1	9	23	5	12	2	76	511	28	0	3
Gr. Total	1,080	120	390	171	0	28	4,119	1,041	0	4	63	119	29	88	4	315	3,201	106	0	9
% of Tot.	10%	1%	4%	2%	0%	0%	38%	10%	0%	0%	1%	1%	0%	1%	0%	3%	29%	1%	0%	0%
Apprch%	16%					48%					3%					33%				
% of Apprch	61%	7%	22%	10%	0%	1%	79%	20%	0%	0%	21%	39%	10%	29%	1%	9%	88%	3%	0%	0%
	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds	Left	Thru	Right	U-turn	Peds
	W. Bough					Memorial Dr.					W. Bough					Memorial Dr.				
	From North					From East					From South					From West				



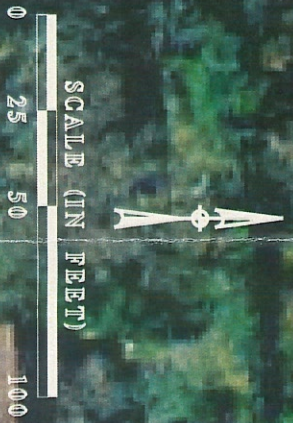
PEAK HOUR DIAGRAMS

APPENDIX C
ALTERNATIVE DRAWINGS

LEGEND


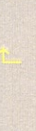




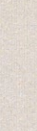
- EXISTING TRAFFIC SIGNAL
- EXISTING PEDESTRIAN SIGNAL
- EXISTING EDGE OF PAVEMENT
- EXISTING SIGN
- EXISTING RIGHT-OF-WAY

NOT INTENDED FOR CONSTRUCTION BIDDING OR PERMIT PURPOSES





LEGEND

-  EXISTING TRAFFIC SIGNAL
-  EXISTING PEDESTRIAN SIGNAL
-  EXISTING EDGE OF PAVEMENT
-  EXISTING RIGHT-OF-WAY
-  PROPOSED IMPROVEMENTS
-  EXISTING SIGN
-  PROPOSED SIGN

NOT INTENDED FOR CONSTRUCTION BIDDING OR PERMIT PURPOSES





MEMORIAL DRIVE TRAFFIC STUDY

MEMORIAL CITY TIRZ 17

ALTERNATIVE 1: ONE LEFT TURN LANE

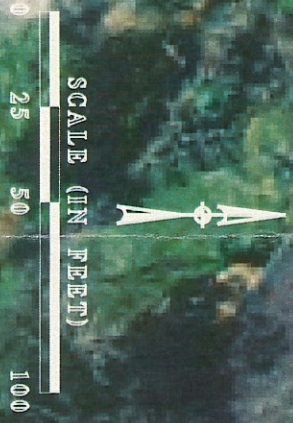




LEGEND

	EXISTING TRAFFIC SIGNAL
	EXISTING PEDESTRIAN SIGNAL
	EXISTING EDGE OF PAVEMENT
	EXISTING RIGHT-OF-WAY
	PROPOSED IMPROVEMENTS
	EXISTING SIGN
	PROPOSED SIGN

NOT INTENDED FOR CONSTRUCTION BIDDING OR PERMIT PURPOSES






















APPENDIX D
SYNCHRO ANALYSIS

HCM Signalized Intersection Capacity Analysis

2: Memorial Drive & Beltway 8 NSR

3/6/2009

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	1.00	0.95			0.91			0.91	1.00			
Fr _t	1.00	1.00			0.97			1.00	0.85			
Fl _t Protected	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (prot)	1770	3539			4931			5049	1583			
Fl _t Permitted	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (perm)	1770	3539			4931			5049	1583			
Volume (vph)	349	671	0	0	444	113	282	1687	231	0	0	0
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	360	692	0	0	458	116	291	1739	238	0	0	0
RTOR Reduction (vph)	0	0	0	0	37	0	0	0	74	0	0	0
Lane Group Flow (vph)	360	692	0	0	537	0	0	2030	164	0	0	0
Turn Type	Prot						Prot		Perm			
Protected Phases	7	4			8		5	2				
Permitted Phases									2			
Actuated Green, G (s)	33.0	54.0			17.0			58.0	58.0			
Effective Green, g (s)	33.0	54.0			17.0			58.0	58.0			
Actuated g/C Ratio	0.28	0.45			0.14			0.48	0.48			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Grp Cap (vph)	487	1593			699			2440	765			
v/s Ratio Prot	c0.20	0.20			c0.11			c0.40				
v/s Ratio Perm									0.10			
v/c Ratio	0.74	0.43			0.77			0.83	0.21			
Uniform Delay, d ₁	39.6	22.6			49.6			26.8	17.9			
Progression Factor	1.00	1.00			0.89			1.00	1.00			
Incremental Delay, d ₂	9.7	0.9			7.8			3.5	0.6			
Delay (s)	49.3	23.4			52.0			30.3	18.5			
Level of Service	D	C			D			C	B			
Approach Delay (s)		32.3			52.0			29.0			0.0	
Approach LOS		C			D			C			A	
Intersection Summary												
HCM Average Control Delay			33.3									HCM Level of Service C
HCM Volume to Capacity ratio			0.79									
Actuated Cycle Length (s)			120.0									Sum of lost time (s) 12.0
Intersection Capacity Utilization			78.8%									ICU Level of Service D
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
 3: Memorial Drive & T&C Village West DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↘	↗
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	24	812	520	36	16	24
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	25	855	547	38	17	25
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		533	797			
pX, platoon unblocked					0.87	
vC, conflicting volume	585				1044	293
vC1, stage 1 conf vol					566	
vC2, stage 2 conf vol					478	
vCu, unblocked vol	585				905	293
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	97				94	96
cM capacity (veh/h)	986				277	704

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	310	570	365	220	17	25
Volume Left	25	0	0	0	17	0
Volume Right	0	0	0	38	0	25
cSH	986	1700	1700	1700	277	704
Volume to Capacity	0.03	0.34	0.21	0.13	0.06	0.04
Queue Length 95th (ft)	2	0	0	0	5	3
Control Delay (s)	1.0	0.0	0.0	0.0	18.8	10.3
Lane LOS	A				C	B
Approach Delay (s)	0.3		0.0		13.7	
Approach LOS					B	

Intersection Summary						
Average Delay			0.6			
Intersection Capacity Utilization		49.8%		ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
 4: Memorial Drive & T&C Village East DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔↔	↔↔		↔	↔
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	75	753	538	9	2	18
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	77	768	549	9	2	18
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage (veh)					0	
Upstream signal (ft)		837	493			
pX, platoon unblocked	0.99				0.89	0.99
vC, conflicting volume	558				1091	279
vC1, stage 1 conf vol					554	
vC2, stage 2 conf vol					537	
vCu, unblocked vol	544				946	262
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	92				99	97
cM capacity (veh/h)	1011				260	729

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	333	512	366	192	2	18
Volume Left	77	0	0	0	2	0
Volume Right	0	0	0	9	0	18
cSH	1011	1700	1700	1700	260	729
Volume to Capacity	0.08	0.30	0.22	0.11	0.01	0.03
Queue Length 95th (ft)	6	0	0	0	1	2
Control Delay (s)	2.6	0.0	0.0	0.0	18.9	10.1
Lane LOS	A				C	B
Approach Delay (s)	1.0		0.0		10.9	
Approach LOS					B	

Intersection Summary						
Average Delay			0.8			
Intersection Capacity Utilization		51.5%		ICU Level of Service		A
Analysis Period (min)			15			

HCM Signalized Intersection Capacity Analysis
 5: Memorial Drive & West Bough Lane

3/6/2009

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95			0.95			1.00		1.00	1.00	
Frt	1.00	0.99			0.96			0.99		1.00	0.88	
Flt Protected	0.95	1.00			1.00			0.99		0.95	1.00	
Satd. Flow (prot)	1770	3521			3405			1812		1770	1636	
Flt Permitted	0.95	1.00			1.00			0.91		0.91	1.00	
Satd. Flow (perm)	1770	3521			3405			1676		1696	1636	
Volume (vph)	39	656	23	0	478	161	14	32	5	99	10	42
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	43	729	26	0	531	179	16	36	6	110	11	47
RTOR Reduction (vph)	0	2	0	0	34	0	0	5	0	0	40	0
Lane Group Flow (vph)	43	753	0	0	676	0	0	53	0	110	18	0
Turn Type	Prot		Prot		Perm			Perm				
Protected Phases	1	6		5	2			4				8
Permitted Phases							4			8		
Actuated Green, G (s)	3.2	43.3			36.1			8.7		8.7	8.7	
Effective Green, g (s)	3.2	43.3			36.1			8.7		8.7	8.7	
Actuated g/C Ratio	0.05	0.72			0.60			0.14		0.14	0.14	
Clearance Time (s)	4.0	4.0			4.0			4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0			3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	94	2541			2049			243		246	237	
v/s Ratio Prot	0.02	c0.21			c0.20							0.01
v/s Ratio Perm								0.03		c0.06		
v/c Ratio	0.46	0.30			0.33			0.22		0.45	0.08	
Uniform Delay, d1	27.6	3.0			5.9			22.6		23.5	22.2	
Progression Factor	0.78	0.54			1.00			1.00		1.00	1.00	
Incremental Delay, d2	3.3	0.3			0.4			0.5		1.3	0.1	
Delay (s)	24.7	1.9			6.4			23.1		24.7	22.3	
Level of Service	C	A			A			C		C	C	
Approach Delay (s)		3.1			6.4			23.1			23.9	
Approach LOS		A			A			C			C	


















Intersection Summary

HCM Average Control Delay	7.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.34		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	44.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis

2: Memorial Drive & Beltway 8 NSR

3/6/2009

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	1.00	0.95			0.91			0.91	1.00			
Frt	1.00	1.00			0.97			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (prot)	1770	3539			4931			5049	1583			
Flt Permitted	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (perm)	1770	3539			4931			5049	1583			
Volume (vph)	349	671	0	0	444	113	282	1687	231	0	0	0
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Adj. Flow (vph)	378	726	0	0	481	122	305	1826	250	0	0	0
RTOR Reduction (vph)	0	0	0	0	37	0	0	0	63	0	0	0
Lane Group Flow (vph)	378	726	0	0	566	0	0	2131	187	0	0	0
Turn Type	Prot						Prot		Perm			
Protected Phases	7	4			8		5	2				
Permitted Phases									2			
Actuated Green, G (s)	32.0	53.0			17.0			59.0	59.0			
Effective Green, g (s)	32.0	53.0			17.0			59.0	59.0			
Actuated g/C Ratio	0.27	0.44			0.14			0.49	0.49			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Grp Cap (vph)	472	1563			699			2482	778			
v/s Ratio Prot	c0.21	0.21			c0.11			c0.42				
v/s Ratio Perm									0.12			
v/c Ratio	0.80	0.46			0.81			0.86	0.24			
Uniform Delay, d1	41.0	23.5			49.9			26.8	17.6			
Progression Factor	1.00	1.00			0.89			1.00	1.00			
Incremental Delay, d2	13.3	1.0			9.6			4.1	0.7			
Delay (s)	54.4	24.5			54.1			31.0	18.3			
Level of Service	D	C			D			C	B			
Approach Delay (s)		34.7			54.1			29.6			0.0	
Approach LOS		C			D			C			A	

Intersection Summary

HCM Average Control Delay	34.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	82.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis

3: Memorial Drive & T&C Village West DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕↕	↕↔		↗	↘
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	24	812	520	36	16	24
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	27	897	575	40	18	27
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		533	797			
pX, platoon unblocked					0.86	
vC, conflicting volume	615				1096	307
vC1, stage 1 conf vol					595	
vC2, stage 2 conf vol					502	
vCu, unblocked vol	615				952	307
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	97				93	96
cM capacity (veh/h)	961				265	689

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	326	598	383	231	18	27
Volume Left	27	0	0	0	18	0
Volume Right	0	0	0	40	0	27
cSH	961	1700	1700	1700	265	689
Volume to Capacity	0.03	0.35	0.23	0.14	0.07	0.04
Queue Length 95th (ft)	2	0	0	0	5	3
Control Delay (s)	1.0	0.0	0.0	0.0	19.5	10.4
Lane LOS	A				C	B
Approach Delay (s)	0.4		0.0		14.1	
Approach LOS					B	

Intersection Summary						
Average Delay			0.6			
Intersection Capacity Utilization		51.8%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
 4: Memorial Drive & T&C Village East DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕↕	↕↕		↗	↗
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	75	753	538	9	2	18
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	80	807	576	10	2	19
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		837	493			
pX, platoon unblocked	0.98				0.88	0.98
vC, conflicting volume	586				1145	293
vC1, stage 1 conf vol					581	
vC2, stage 2 conf vol					564	
vCu, unblocked vol	558				967	259
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	92				99	97
cM capacity (veh/h)	989				252	726

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	349	538	384	202	2	19
Volume Left	80	0	0	0	2	0
Volume Right	0	0	0	10	0	19
cSH	989	1700	1700	1700	252	726
Volume to Capacity	0.08	0.32	0.23	0.12	0.01	0.03
Queue Length 95th (ft)	7	0	0	0	1	2
Control Delay (s)	2.7	0.0	0.0	0.0	19.4	10.1
Lane LOS	A				C	B
Approach Delay (s)	1.1		0.0		11.0	
Approach LOS					B	

Intersection Summary						
Average Delay			0.8			
Intersection Capacity Utilization		53.4%		ICU Level of Service	A	
Analysis Period (min)		15				

HCM Signalized Intersection Capacity Analysis
 5: Memorial Drive & West Bough Lane

3/6/2009


















Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95			0.95			1.00		1.00	1.00	
Fr _t	1.00	0.99			0.96			0.99		1.00	0.88	
Fl _t Protected	0.95	1.00			1.00			0.99		0.95	1.00	
Satd. Flow (prot)	1770	3521			3405			1813		1770	1638	
Fl _t Permitted	0.95	1.00			1.00			0.91		0.90	1.00	
Satd. Flow (perm)	1770	3521			3405			1680		1683	1638	
Volume (vph)	39	656	23	0	478	161	14	32	5	99	10	42
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Adj. Flow (vph)	46	765	27	0	558	188	16	37	6	116	12	49
RTOR Reduction (vph)	0	2	0	0	34	0	0	5	0	0	42	0
Lane Group Flow (vph)	46	790	0	0	712	0	0	54	0	116	19	0
Turn Type	Prot		Prot			Perm			Perm			
Protected Phases	1	6		5	2			4			8	
Permitted Phases							4			8		
Actuated Green, G (s)	3.2	43.1			35.9			8.9		8.9	8.9	
Effective Green, g (s)	3.2	43.1			35.9			8.9		8.9	8.9	
Actuated g/C Ratio	0.05	0.72			0.60			0.15		0.15	0.15	
Clearance Time (s)	4.0	4.0			4.0			4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0			3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	94	2529			2037			249		250	243	
v/s Ratio Prot	0.03	c0.22			c0.21						0.01	
v/s Ratio Perm								0.03		c0.07		
v/c Ratio	0.49	0.31			0.35			0.22		0.46	0.08	
Uniform Delay, d ₁	27.6	3.1			6.1			22.5		23.4	22.0	
Progression Factor	0.73	0.53			1.00			1.00		1.00	1.00	
Incremental Delay, d ₂	3.7	0.3			0.5			0.4		1.4	0.1	
Delay (s)	23.9	1.9			6.6			22.9		24.7	22.2	
Level of Service	C	A			A			C		C	C	
Approach Delay (s)		3.1			6.6			22.9			23.8	
Approach LOS		A			A			C			C	
Intersection Summary												
HCM Average Control Delay			7.2			HCM Level of Service			A			
HCM Volume to Capacity ratio			0.35									
Actuated Cycle Length (s)			60.0			Sum of lost time (s)		8.0				
Intersection Capacity Utilization		45.6%				ICU Level of Service			A			
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

2: Memorial Drive & Beltway 8 NSR

3/6/2009

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0				
Lane Util. Factor	1.00	0.95			0.91			0.91	1.00				
Fr _t	1.00	1.00			0.97			1.00	0.85				
Fl _t Protected	0.95	1.00			1.00			0.99	1.00				
Satd. Flow (prot)	1770	3539			4951			5044	1583				
Fl _t Permitted	0.95	1.00			1.00			0.99	1.00				
Satd. Flow (perm)	1770	3539			4951			5044	1583				
Volume (vph)	260	540	0	0	825	176	204	1037	251	0	0	0	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
Adj. Flow (vph)	289	600	0	0	917	196	227	1152	279	0	0	0	
RTOR Reduction (vph)	0	0	0	0	49	0	0	0	168	0	0	0	
Lane Group Flow (vph)	289	600	0	0	1064	0	0	1379	111	0	0	0	
Turn Type	Prot						Prot		Perm				
Protected Phases	7	4			8		5	2					
Permitted Phases									2				
Actuated Green, G (s)	12.0	32.0			16.0			20.0	20.0				
Effective Green, g (s)	12.0	32.0			16.0			20.0	20.0				
Actuated g/C Ratio	0.20	0.53			0.27			0.33	0.33				
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0				
Lane Grp Cap (vph)	354	1887			1320			1681	528				
v/s Ratio Prot	c0.16	0.17			c0.21			c0.27					
v/s Ratio Perm									0.07				
v/c Ratio	0.82	0.32			0.81			0.82	0.21				
Uniform Delay, d ₁	22.9	7.9			20.5			18.4	14.3				
Progression Factor	1.00	1.00			0.72			1.00	1.00				
Incremental Delay, d ₂	18.5	0.4			5.2			4.6	0.9				
Delay (s)	41.4	8.3			19.9			23.0	15.2				
Level of Service	D	A			B			C	B				
Approach Delay (s)		19.1			19.9			21.7			0.0		
Approach LOS		B			B			C			A		
Intersection Summary													
HCM Average Control Delay			20.5									HCM Level of Service	C
HCM Volume to Capacity ratio			0.81										
Actuated Cycle Length (s)			60.0									Sum of lost time (s)	12.0
Intersection Capacity Utilization			68.4%									ICU Level of Service	C
Analysis Period (min)			15										

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
 3: Memorial Drive & T&C Village West DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕↕	↕↔		↘	↘
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	88	655	761	90	43	148
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	94	697	810	96	46	157
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		533	797			
pX, platoon unblocked	0.90				0.93	0.90
vC, conflicting volume	905				1393	453
vC1, stage 1 conf vol					857	
vC2, stage 2 conf vol					536	
vCu, unblocked vol	790				1165	290
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	87				77	75
cM capacity (veh/h)	747				201	640

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	326	465	540	366	46	157
Volume Left	94	0	0	0	46	0
Volume Right	0	0	0	96	0	157
cSH	747	1700	1700	1700	201	640
Volume to Capacity	0.13	0.27	0.32	0.22	0.23	0.25
Queue Length 95th (ft)	11	0	0	0	21	24
Control Delay (s)	4.1	0.0	0.0	0.0	28.1	12.5
Lane LOS	A				D	B
Approach Delay (s)	1.7		0.0		16.0	
Approach LOS					C	

Intersection Summary						
Average Delay			2.4			
Intersection Capacity Utilization		57.9%		ICU Level of Service		B
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
 4: Memorial Drive & T&C Village East DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕↕	↕↔		↔	↔
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	90	608	817	30	16	34
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	93	627	842	31	16	35
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		837	493			
pX, platoon unblocked	0.86				0.86	0.86
vC, conflicting volume	873				1357	437
vC1, stage 1 conf vol					858	
vC2, stage 2 conf vol					499	
vCu, unblocked vol	691				1252	183
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	88				92	95
cM capacity (veh/h)	774				194	712

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	302	418	562	312	16	35
Volume Left	93	0	0	0	16	0
Volume Right	0	0	0	31	0	35
cSH	774	1700	1700	1700	194	712
Volume to Capacity	0.12	0.25	0.33	0.18	0.08	0.05
Queue Length 95th (ft)	10	0	0	0	7	4
Control Delay (s)	4.1	0.0	0.0	0.0	25.2	10.3
Lane LOS	A				D	B
Approach Delay (s)	1.7		0.0		15.1	
Approach LOS					C	

Intersection Summary						
Average Delay			1.2			
Intersection Capacity Utilization		56.3%		ICU Level of Service		B
Analysis Period (min)			15			

HCM Signalized Intersection Capacity Analysis

5: Memorial Drive & West Bough Lane

3/6/2009


















Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00		1.00	1.00	
Fr _t	1.00	1.00		1.00	0.97			0.98		1.00	0.88	
Fl _t Protected	0.95	1.00		0.95	1.00			0.99		0.95	1.00	
Satd. Flow (prot)	1770	3529		1770	3441			1806		1770	1633	
Fl _t Permitted	0.95	1.00		0.95	1.00			0.94		0.73	1.00	
Satd. Flow (perm)	1770	3529		1770	3441			1720		1368	1633	
Volume (vph)	51	527	11	3	712	161	8	21	5	208	21	100
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	53	543	11	3	734	166	8	22	5	214	22	103
RTOR Reduction (vph)	0	2	0	0	28	0	0	4	0	0	79	0
Lane Group Flow (vph)	53	552	0	3	872	0	0	31	0	214	46	0
Turn Type	Prot		Prot		Perm			Perm				
Protected Phases	1	6		5	2			4			8	
Permitted Phases							4			8		
Actuated Green, G (s)	5.2	33.5		0.8	29.1			13.7		13.7	13.7	
Effective Green, g (s)	5.2	33.5		0.8	29.1			13.7		13.7	13.7	
Actuated g/C Ratio	0.09	0.56		0.01	0.49			0.23		0.23	0.23	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	153	1970		24	1669			393		312	373	
v/s Ratio Prot	c0.03	c0.16		0.00	c0.25						0.03	
v/s Ratio Perm								0.02		c0.16		
v/c Ratio	0.35	0.28		0.12	0.52			0.08		0.69	0.12	
Uniform Delay, d ₁	25.8	6.9		29.3	10.7			18.2		21.2	18.4	
Progression Factor	0.97	0.62		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d ₂	1.3	0.3		2.3	1.2			0.1		6.1	0.1	
Delay (s)	26.4	4.6		31.6	11.8			18.3		27.3	18.5	
Level of Service	C	A		C	B			B		C	B	
Approach Delay (s)		6.5			11.9			18.3			24.1	
Approach LOS		A			B			B			C	

Intersection Summary			
HCM Average Control Delay	12.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	56.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis

2: Memorial Drive & Beltway 8 NSR

3/6/2009

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	1.00	0.95			0.91			0.91	1.00			
Fr _t	1.00	1.00			0.97			1.00	0.85			
Fl _t Protected	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (prot)	1770	3539			4951			5044	1583			
Fl _t Permitted	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (perm)	1770	3539			4951			5044	1583			
Volume (vph)	260	540	0	0	825	176	204	1037	251	0	0	0
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Adj. Flow (vph)	303	630	0	0	962	205	238	1210	293	0	0	0
RTOR Reduction (vph)	0	0	0	0	44	0	0	0	155	0	0	0
Lane Group Flow (vph)	303	630	0	0	1123	0	0	1448	138	0	0	0
Turn Type	Prot						Prot		Perm			
Protected Phases	7	4			8		5	2				
Permitted Phases									2			
Actuated Green, G (s)	12.0	32.0			16.0			20.0	20.0			
Effective Green, g (s)	12.0	32.0			16.0			20.0	20.0			
Actuated g/C Ratio	0.20	0.53			0.27			0.33	0.33			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Grp Cap (vph)	354	1887			1320			1681	528			
v/s Ratio Prot	c0.17	0.18			c0.23			c0.29				
v/s Ratio Perm									0.09			
v/c Ratio	0.86	0.33			0.85			0.86	0.26			
Uniform Delay, d ₁	23.2	7.9			20.9			18.7	14.6			
Progression Factor	1.00	1.00			0.75			1.00	1.00			
Incremental Delay, d ₂	22.4	0.5			6.8			6.1	1.2			
Delay (s)	45.6	8.4			22.5			24.8	15.8			
Level of Service	D	A			C			C	B			
Approach Delay (s)		20.5			22.5			23.3			0.0	
Approach LOS		C			C			C			A	
Intersection Summary												
HCM Average Control Delay			22.3					HCM Level of Service			C	
HCM Volume to Capacity ratio			0.86									
Actuated Cycle Length (s)			60.0					Sum of lost time (s)		12.0		
Intersection Capacity Utilization			71.4%					ICU Level of Service		C		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis
 3: Memorial Drive & T&C Village West DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕↕	↕↔		↗	↗
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	88	655	761	90	43	148
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	98	732	850	101	48	165
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		533	797			
pX, platoon unblocked	0.90				0.94	0.90
vC, conflicting volume	951				1463	475
vC1, stage 1 conf vol					900	
vC2, stage 2 conf vol					562	
vCu, unblocked vol	839				1217	313
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	86				75	73
cM capacity (veh/h)	715				189	617

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	342	488	567	384	48	165
Volume Left	98	0	0	0	48	0
Volume Right	0	0	0	101	0	165
cSH	715	1700	1700	1700	189	617
Volume to Capacity	0.14	0.29	0.33	0.23	0.25	0.27
Queue Length 95th (ft)	12	0	0	0	24	27
Control Delay (s)	4.4	0.0	0.0	0.0	30.4	13.0
Lane LOS	A				D	B
Approach Delay (s)	1.8		0.0		16.9	
Approach LOS					C	

Intersection Summary						
Average Delay			2.6			
Intersection Capacity Utilization		60.1%		ICU Level of Service		B
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
 4: Memorial Drive & T&C Village East DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕↕	↕↕		↗	↗
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	90	608	817	30	16	34
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	97	658	884	32	17	37
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		837	493			
pX, platoon unblocked	0.86				0.86	0.86
vC, conflicting volume	917				1425	458
vC1, stage 1 conf vol					901	
vC2, stage 2 conf vol					524	
vCu, unblocked vol	740				1331	207
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	87				90	95
cM capacity (veh/h)	741				181	687

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	317	439	590	327	17	37
Volume Left	97	0	0	0	17	0
Volume Right	0	0	0	32	0	37
cSH	741	1700	1700	1700	181	687
Volume to Capacity	0.13	0.26	0.35	0.19	0.10	0.05
Queue Length 95th (ft)	11	0	0	0	8	4
Control Delay (s)	4.4	0.0	0.0	0.0	26.9	10.5
Lane LOS	A				D	B
Approach Delay (s)	1.8		0.0		15.8	
Approach LOS					C	

Intersection Summary						
Average Delay			1.3			
Intersection Capacity Utilization		58.4%		ICU Level of Service		B
Analysis Period (min)			15			

HCM Signalized Intersection Capacity Analysis
 5: Memorial Drive & West Bough Lane

3/6/2009

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00		1.00	1.00	
Fr _t	1.00	1.00		1.00	0.97			0.98		1.00	0.88	
Fl _t Protected	0.95	1.00		0.95	1.00			0.99		0.95	1.00	
Satd. Flow (prot)	1770	3528		1770	3441			1807		1770	1632	
Fl _t Permitted	0.95	1.00		0.95	1.00			0.94		0.73	1.00	
Satd. Flow (perm)	1770	3528		1770	3441			1713		1365	1632	
Volume (vph)	51	527	11	3	712	161	8	21	5	208	21	100
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Adj. Flow (vph)	55	570	12	3	771	174	9	23	5	225	23	108
RTOR Reduction (vph)	0	2	0	0	25	0	0	4	0	0	83	0
Lane Group Flow (vph)	55	580	0	3	920	0	0	33	0	225	48	0
Turn Type	Prot		Prot		Perm			Perm				
Protected Phases	1	6		5	2			4				8
Permitted Phases							4			8		
Actuated Green, G (s)	2.8	33.1		0.8	31.1			14.1		14.1	14.1	
Effective Green, g (s)	2.8	33.1		0.8	31.1			14.1		14.1	14.1	
Actuated g/C Ratio	0.05	0.55		0.01	0.52			0.24		0.24	0.24	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	83	1946		24	1784			403		321	384	
v/s Ratio Prot	c0.03	0.16		0.00	c0.27							0.03
v/s Ratio Perm								0.02		c0.16		
v/c Ratio	0.66	0.30		0.12	0.52			0.08		0.70	0.13	
Uniform Delay, d ₁	28.1	7.2		29.3	9.5			17.9		21.0	18.1	
Progression Factor	0.80	0.67		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d ₂	17.4	0.4		2.3	1.1			0.1		6.8	0.1	
Delay (s)	39.9	5.2		31.6	10.6			18.0		27.8	18.2	
Level of Service	D	A		C	B			B		C	B	
Approach Delay (s)		8.2			10.6			18.0			24.3	
Approach LOS		A			B			B			C	

Intersection Summary			
HCM Average Control Delay	12.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	58.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
 2: Memorial Drive & Beltway 8 NSR

3/6/2009



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↙	↑↑			↑↑↑			↔↑↑	↗			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	1.00	0.95			0.91			0.91	1.00			
Fr _t	1.00	1.00			0.99			1.00	0.85			
Fl _t Protected	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (prot)	1770	3539			5012			5045	1583			
Fl _t Permitted	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (perm)	1770	3539			5012			5045	1583			
Volume (vph)	241	514	0	0	1080	115	327	1719	203	0	0	0
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	265	565	0	0	1187	126	359	1889	223	0	0	0
RTOR Reduction (vph)	0	0	0	0	11	0	0	0	90	0	0	0
Lane Group Flow (vph)	265	565	0	0	1302	0	0	2248	133	0	0	0
Turn Type	Prot							Prot		Perm		
Protected Phases	7	4						5	2			
Permitted Phases										2		
Actuated Green, G (s)	16.0	58.0						38.0	54.0	54.0		
Effective Green, g (s)	16.0	58.0						38.0	54.0	54.0		
Actuated g/C Ratio	0.13	0.48						0.32	0.45	0.45		
Clearance Time (s)	4.0	4.0						4.0	4.0	4.0		
Lane Grp Cap (vph)	236	1711						1587	2270	712		
v/s Ratio Prot	c0.15	0.16						c0.26	c0.45			
v/s Ratio Perm										0.08		
v/c Ratio	1.12	0.33						0.82	0.99	0.19		
Uniform Delay, d ₁	52.0	19.1						37.9	32.7	19.8		
Progression Factor	1.00	1.00						0.78	1.00	1.00		
Incremental Delay, d ₂	95.6	0.5						4.2	16.7	0.6		
Delay (s)	147.6	19.6						33.6	49.5	20.4		
Level of Service	F	B						C	D	C		
Approach Delay (s)	60.5							33.6	46.9	0.0		
Approach LOS	E							C	D	A		

Intersection Summary

HCM Average Control Delay	45.5	HCM Level of Service	D
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	86.6%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

3: Memorial Drive & T&C Village West DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕↕	↕↕		↗	↗
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	55	612	1027	87	28	161
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	60	673	1129	96	31	177
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		533	797			
pX, platoon unblocked	0.74				0.78	0.74
vC, conflicting volume	1224				1634	612
vC1, stage 1 conf vol					1176	
vC2, stage 2 conf vol					457	
vCu, unblocked vol	949				1193	120
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	89				81	74
cM capacity (veh/h)	531				159	671

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	285	448	752	472	31	177
Volume Left	60	0	0	0	31	0
Volume Right	0	0	0	96	0	177
cSH	531	1700	1700	1700	159	671
Volume to Capacity	0.11	0.26	0.44	0.28	0.19	0.26
Queue Length 95th (ft)	10	0	0	0	17	26
Control Delay (s)	4.0	0.0	0.0	0.0	33.0	12.3
Lane LOS	A				D	B
Approach Delay (s)	1.6		0.0		15.3	
Approach LOS					C	

Intersection Summary						
Average Delay			2.0			
Intersection Capacity Utilization		63.0%		ICU Level of Service		B
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
 4: Memorial Drive & T&C Village East DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕↕	↕↕		↘	↗
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	89	551	1041	40	33	73
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	93	574	1084	42	34	76
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage (veh)					0	
Upstream signal (ft)		837	493			
pX, platoon unblocked	0.69				0.72	0.69
vC, conflicting volume	1126				1578	563
vC1, stage 1 conf vol					1105	
vC2, stage 2 conf vol					472	
vCu, unblocked vol	741				1167	0
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	85				80	90
cM capacity (veh/h)	598				168	752

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	284	383	723	403	34	76
Volume Left	93	0	0	0	34	0
Volume Right	0	0	0	42	0	76
cSH	598	1700	1700	1700	168	752
Volume to Capacity	0.15	0.23	0.43	0.24	0.20	0.10
Queue Length 95th (ft)	14	0	0	0	18	8
Control Delay (s)	5.4	0.0	0.0	0.0	31.8	10.3
Lane LOS	A				D	B
Approach Delay (s)	2.3		0.0		17.0	
Approach LOS					C	

Intersection Summary						
Average Delay			1.8			
Intersection Capacity Utilization		61.2%		ICU Level of Service		B
Analysis Period (min)			15			

HCM Signalized Intersection Capacity Analysis
 5: Memorial Drive & West Bough Lane

3/6/2009

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00		1.00	1.00	
Fr _t	1.00	0.99		1.00	0.97			0.97		1.00	0.90	
Fl _t Protected	0.95	1.00		0.95	1.00			0.98		0.95	1.00	
Satd. Flow (prot)	1770	3511		1770	3446			1782		1770	1674	
Fl _t Permitted	0.95	1.00		0.95	1.00			0.90		0.72	1.00	
Satd. Flow (perm)	1770	3511		1770	3446			1629		1347	1674	
Volume (vph)	64	500	28	9	1001	214	17	21	9	258	35	73
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	71	556	31	10	1112	238	19	23	10	287	39	81
RTOR Reduction (vph)	0	6	0	0	30	0	0	7	0	0	60	0
Lane Group Flow (vph)	71	581	0	10	1320	0	0	45	0	287	60	0
Turn Type	Prot		Prot		Perm			Perm				
Protected Phases	1	6		5	2			4				8
Permitted Phases							4			8		
Actuated Green, G (s)	5.6	31.7		0.8	26.9			15.5		15.5	15.5	
Effective Green, g (s)	5.6	31.7		0.8	26.9			15.5		15.5	15.5	
Actuated g/C Ratio	0.09	0.53		0.01	0.45			0.26		0.26	0.26	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	165	1855		24	1545			421		348	432	
v/s Ratio Prot	0.04	c0.17		0.01	c0.38							0.04
v/s Ratio Perm								0.03		c0.21		
v/c Ratio	0.43	0.31		0.42	0.85			0.11		0.82	0.14	
Uniform Delay, d ₁	25.7	8.0		29.4	14.8			17.0		21.0	17.1	
Progression Factor	0.77	0.68		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d ₂	1.8	0.4		11.3	6.2			0.1		14.6	0.1	
Delay (s)	21.6	5.9		40.7	21.0			17.1		35.6	17.3	
Level of Service	C	A		D	C			B		D	B	
Approach Delay (s)		7.6			21.2			17.1			30.2	
Approach LOS		A			C			B			C	

Intersection Summary

HCM Average Control Delay	19.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
 2: Memorial Drive & Beltway 8 NSR

3/6/2009



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↘	↕↕			↕↕↕			↕↕↕	↗			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	1.00	0.95			0.91			0.91	1.00			
Frnt	1.00	1.00			0.99			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (prot)	1770	3539			5012			5045	1583			
Flt Permitted	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (perm)	1770	3539			5012			5045	1583			
Volume (vph)	241	514	0	0	1080	115	327	1719	203	0	0	0
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Adj. Flow (vph)	278	593	0	0	1246	133	377	1983	234	0	0	0
RTOR Reduction (vph)	0	0	0	0	8	0	0	0	90	0	0	0
Lane Group Flow (vph)	278	593	0	0	1371	0	0	2360	144	0	0	0
Turn Type	Prot							Prot		Perm		
Protected Phases	7	4			8			5	2			
Permitted Phases												2
Actuated Green, G (s)	14.0	56.0			38.0			56.0	56.0			
Effective Green, g (s)	14.0	56.0			38.0			56.0	56.0			
Actuated g/C Ratio	0.12	0.47			0.32			0.47	0.47			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Grp Cap (vph)	207	1652			1587			2354	739			
v/s Ratio Prot	c0.16	0.17			c0.27			c0.47				
v/s Ratio Perm									0.09			
v/c Ratio	1.34	0.36			0.86			1.00	0.20			
Uniform Delay, d1	53.0	20.5			38.6			32.0	18.8			
Progression Factor	1.00	1.00			0.94			1.00	1.00			
Incremental Delay, d2	183.1	0.6			5.4			19.2	0.6			
Delay (s)	236.1	21.1			41.6			51.2	19.4			
Level of Service	F	C			D			D	B			
Approach Delay (s)		89.7			41.6			48.3			0.0	
Approach LOS		F			D			D			A	

Intersection Summary			
HCM Average Control Delay	53.8	HCM Level of Service	D
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	90.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
 3: Memorial Drive & T&C Village West DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕↕	↕↔		↘	↗
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	55	612	1027	87	28	161
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	63	706	1185	100	32	186
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage (veh)					0	
Upstream signal (ft)		533	797			
pX, platoon unblocked	0.73				0.78	0.73
vC, conflicting volume	1285				1715	643
vC1, stage 1 conf vol					1235	
vC2, stage 2 conf vol					480	
vCu, unblocked vol	1020				1257	139
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	87				78	71
cM capacity (veh/h)	493				146	644

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	299	471	790	495	32	186
Volume Left	63	0	0	0	32	0
Volume Right	0	0	0	100	0	186
cSH	493	1700	1700	1700	146	644
Volume to Capacity	0.13	0.28	0.46	0.29	0.22	0.29
Queue Length 95th (ft)	11	0	0	0	20	30
Control Delay (s)	4.4	0.0	0.0	0.0	36.7	12.8
Lane LOS	A				E	B
Approach Delay (s)	1.7		0.0		16.4	
Approach LOS					C	

Intersection Summary						
Average Delay			2.2			
Intersection Capacity Utilization		65.5%		ICU Level of Service		C
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
 4: Memorial Drive & T&C Village East DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕↕	↕↕		↗	↗
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	89	551	1041	40	33	73
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	97	603	1139	44	36	80
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		837	493			
pX, platoon unblocked	0.69				0.72	0.69
vC, conflicting volume	1182				1656	591
vC1, stage 1 conf vol					1160	
vC2, stage 2 conf vol					496	
vCu, unblocked vol	807				1228	0
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	83				77	89
cM capacity (veh/h)	558				155	743

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	298	402	759	423	36	80
Volume Left	97	0	0	0	36	0
Volume Right	0	0	0	44	0	80
cSH	558	1700	1700	1700	155	743
Volume to Capacity	0.17	0.24	0.45	0.25	0.23	0.11
Queue Length 95th (ft)	16	0	0	0	22	9
Control Delay (s)	5.9	0.0	0.0	0.0	35.2	10.4
Lane LOS	A				E	B
Approach Delay (s)	2.5		0.0		18.1	
Approach LOS					C	

Intersection Summary						
Average Delay			1.9			
Intersection Capacity Utilization		63.6%		ICU Level of Service		B
Analysis Period (min)			15			

HCM Signalized Intersection Capacity Analysis
 5: Memorial Drive & West Bough Lane

3/6/2009



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00		1.00	1.00	
Fr't	1.00	0.99		1.00	0.97			0.98		1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00			0.98		0.95	1.00	
Satd. Flow (prot)	1770	3511		1770	3446			1783		1770	1674	
Flt Permitted	0.95	1.00		0.95	1.00			0.89		0.72	1.00	
Satd. Flow (perm)	1770	3511		1770	3446			1625		1345	1674	
Volume (vph)	64	500	28	9	1001	214	17	21	9	258	35	73
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Adj. Flow (vph)	75	583	33	10	1168	250	20	24	10	301	41	85
RTOR Reduction (vph)	0	6	0	0	29	0	0	7	0	0	63	0
Lane Group Flow (vph)	75	610	0	10	1389	0	0	47	0	301	63	0
Turn Type	Prot			Prot			Perm			Perm		
Protected Phases	1	6		5	2			4				8
Permitted Phases							4				8	
Actuated Green, G (s)	3.3	31.4		0.8	28.9			15.8		15.8	15.8	
Effective Green, g (s)	3.3	31.4		0.8	28.9			15.8		15.8	15.8	
Actuated g/C Ratio	0.06	0.52		0.01	0.48			0.26		0.26	0.26	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	97	1837		24	1660			428		354	441	
v/s Ratio Prot	c0.04	0.17		0.01	c0.40						0.04	
v/s Ratio Perm								0.03		c0.22		
v/c Ratio	0.77	0.33		0.42	0.84			0.11		0.85	0.14	
Uniform Delay, d1	28.0	8.3		29.4	13.5			16.8		21.0	16.9	
Progression Factor	0.90	1.48		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	30.3	0.5		11.3	5.2			0.1		17.4	0.2	
Delay (s)	55.5	12.7		40.7	18.7			16.9		38.4	17.1	
Level of Service	E	B		D	B			B		D	B	
Approach Delay (s)		17.3			18.9			16.9			32.1	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM Average Control Delay	20.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	71.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

2: Memorial Drive & Beltway 8 NSR

3/6/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	1.00	0.95			0.91			0.91	1.00			
Fr _t	1.00	1.00			0.97			1.00	0.85			
Fl _t Protected	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (prot)	1770	3539			4931			5049	1583			
Fl _t Permitted	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (perm)	1770	3539			4931			5049	1583			
Volume (vph)	349	671	0	0	444	113	282	1687	231	0	0	0
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	360	692	0	0	458	116	291	1739	238	0	0	0
RTOR Reduction (vph)	0	0	0	0	37	0	0	0	74	0	0	0
Lane Group Flow (vph)	360	692	0	0	537	0	0	2030	164	0	0	0
Turn Type	Prot						Prot		Perm			
Protected Phases	7	4					5	2				
Permitted Phases									2			
Actuated Green, G (s)	33.0	54.0					17.0	58.0	58.0			
Effective Green, g (s)	33.0	54.0					17.0	58.0	58.0			
Actuated g/C Ratio	0.28	0.45					0.14	0.48	0.48			
Clearance Time (s)	4.0	4.0					4.0	4.0	4.0			
Lane Grp Cap (vph)	487	1593					699	2440	765			
v/s Ratio Prot	c0.20	0.20					c0.11	c0.40				
v/s Ratio Perm									0.10			
v/c Ratio	0.74	0.43					0.77	0.83	0.21			
Uniform Delay, d ₁	39.6	22.6					49.6	26.8	17.9			
Progression Factor	1.00	1.00					0.89	1.00	1.00			
Incremental Delay, d ₂	9.7	0.9					7.8	3.5	0.6			
Delay (s)	49.3	23.4					52.0	30.3	18.5			
Level of Service	D	C					D	C	B			
Approach Delay (s)	32.3						52.0	29.0		0.0		
Approach LOS	C						D	C		A		
Intersection Summary												
HCM Average Control Delay	33.3		HCM Level of Service				C					
HCM Volume to Capacity ratio	0.79											
Actuated Cycle Length (s)	120.0		Sum of lost time (s)				12.0					
Intersection Capacity Utilization	78.8%		ICU Level of Service				D					
Analysis Period (min)	15											
c	Critical Lane Group											

HCM Unsignalized Intersection Capacity Analysis
 3: Memorial Drive & T&C Village West DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕↕	↕↔		↔	↔
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	24	812	520	36	16	24
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	25	855	547	38	17	25
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage (veh)					0	
Upstream signal (ft)		533	797			
pX, platoon unblocked					0.87	
vC, conflicting volume	585				1044	293
vC1, stage 1 conf vol					566	
vC2, stage 2 conf vol					478	
vCu, unblocked vol	585				905	293
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	97				94	96
cM capacity (veh/h)	986				277	704

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	310	570	365	220	17	25
Volume Left	25	0	0	0	17	0
Volume Right	0	0	0	38	0	25
cSH	986	1700	1700	1700	277	704
Volume to Capacity	0.03	0.34	0.21	0.13	0.06	0.04
Queue Length 95th (ft)	2	0	0	0	5	3
Control Delay (s)	1.0	0.0	0.0	0.0	18.8	10.3
Lane LOS	A				C	B
Approach Delay (s)	0.3		0.0		13.7	
Approach LOS					B	

Intersection Summary						
Average Delay			0.6			
Intersection Capacity Utilization		49.8%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
 4: Memorial Drive & T&C Village East DW

3/6/2009






















Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↵	↑↑	↑↑		↵	↵
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	75	753	538	9	2	18
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	77	768	549	9	2	18
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage (veh)					0	
Upstream signal (ft)		837	493			
pX, platoon unblocked	0.99				0.90	0.99
vC, conflicting volume	558				1091	279
vC1, stage 1 conf vol					554	
vC2, stage 2 conf vol					537	
vCu, unblocked vol	544				962	262
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	92				99	97
cM capacity (veh/h)	1011				259	729

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	77	384	384	366	192	2	18
Volume Left	77	0	0	0	0	2	0
Volume Right	0	0	0	0	9	0	18
cSH	1011	1700	1700	1700	1700	259	729
Volume to Capacity	0.08	0.23	0.23	0.22	0.11	0.01	0.03
Queue Length 95th (ft)	6	0	0	0	0	1	2
Control Delay (s)	8.9	0.0	0.0	0.0	0.0	19.0	10.1
Lane LOS	A					C	B
Approach Delay (s)	0.8			0.0		11.0	
Approach LOS						B	

Intersection Summary			
Average Delay		0.6	
Intersection Capacity Utilization	32.6%		ICU Level of Service A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
 5: Memorial Drive & West Bough Lane


















3/6/2009

												
Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95			0.95			1.00		1.00	1.00	
Frt	1.00	0.99			0.96			0.99		1.00	0.88	
Flt Protected	0.95	1.00			1.00			0.99		0.95	1.00	
Satd. Flow (prot)	1770	3521			3405			1812		1770	1636	
Flt Permitted	0.95	1.00			1.00			0.91		0.91	1.00	
Satd. Flow (perm)	1770	3521			3405			1676		1696	1636	
Volume (vph)	39	656	23	0	478	161	14	32	5	99	10	42
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	43	729	26	0	531	179	16	36	6	110	11	47
RTOR Reduction (vph)	0	2	0	0	34	0	0	5	0	0	40	0
Lane Group Flow (vph)	43	753	0	0	676	0	0	53	0	110	18	0
Turn Type	Prot		Prot			Perm			Perm			
Protected Phases	1	6		5	2			4				8
Permitted Phases							4				8	
Actuated Green, G (s)	3.2	43.3			36.1			8.7		8.7	8.7	
Effective Green, g (s)	3.2	43.3			36.1			8.7		8.7	8.7	
Actuated g/C Ratio	0.05	0.72			0.60			0.14		0.14	0.14	
Clearance Time (s)	4.0	4.0			4.0			4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0			3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	94	2541			2049			243		246	237	
v/s Ratio Prot	0.02	c0.21			c0.20							0.01
v/s Ratio Perm								0.03		c0.06		
v/c Ratio	0.46	0.30			0.33			0.22		0.45	0.08	
Uniform Delay, d1	27.6	3.0			5.9			22.6		23.5	22.2	
Progression Factor	0.78	0.54			1.00			1.00		1.00	1.00	
Incremental Delay, d2	3.3	0.3			0.4			0.5		1.3	0.1	
Delay (s)	24.7	1.9			6.4			23.1		24.7	22.3	
Level of Service	C	A			A			C		C	C	
Approach Delay (s)		3.1			6.4			23.1			23.9	
Approach LOS		A			A			C			C	
Intersection Summary												
HCM Average Control Delay			7.1			HCM Level of Service			A			
HCM Volume to Capacity ratio			0.34									
Actuated Cycle Length (s)			60.0			Sum of lost time (s)			8.0			
Intersection Capacity Utilization			44.3%			ICU Level of Service			A			
Analysis Period (min)			15									
c	Critical Lane Group											

HCM Signalized Intersection Capacity Analysis

2: Memorial Drive & Beltway 8 NSR

3/6/2009

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0				
Lane Util. Factor	1.00	0.95			0.91			0.91	1.00				
Frnt	1.00	1.00			0.97			1.00	0.85				
Flt Protected	0.95	1.00			1.00			0.99	1.00				
Satd. Flow (prot)	1770	3539			4931			5049	1583				
Flt Permitted	0.95	1.00			1.00			0.99	1.00				
Satd. Flow (perm)	1770	3539			4931			5049	1583				
Volume (vph)	349	671	0	0	444	113	282	1687	231	0	0	0	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	
Adj. Flow (vph)	378	726	0	0	481	122	305	1826	250	0	0	0	
RTOR Reduction (vph)	0	0	0	0	37	0	0	0	63	0	0	0	
Lane Group Flow (vph)	378	726	0	0	566	0	0	2131	187	0	0	0	
Turn Type	Prot					Prot		Perm					
Protected Phases	7	4			8		5	2					
Permitted Phases									2				
Actuated Green, G (s)	32.0	53.0			17.0			59.0	59.0				
Effective Green, g (s)	32.0	53.0			17.0			59.0	59.0				
Actuated g/C Ratio	0.27	0.44			0.14			0.49	0.49				
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0				
Lane Grp Cap (vph)	472	1563			699			2482	778				
v/s Ratio Prot	c0.21	0.21			c0.11			c0.42					
v/s Ratio Perm									0.12				
v/c Ratio	0.80	0.46			0.81			0.86	0.24				
Uniform Delay, d1	41.0	23.5			49.9			26.8	17.6				
Progression Factor	1.00	1.00			0.89			1.00	1.00				
Incremental Delay, d2	13.3	1.0			9.6			4.1	0.7				
Delay (s)	54.4	24.5			54.1			31.0	18.3				
Level of Service	D	C			D			C	B				
Approach Delay (s)		34.7			54.1			29.6			0.0		
Approach LOS		C			D			C			A		
Intersection Summary													
HCM Average Control Delay			34.6									HCM Level of Service	C
HCM Volume to Capacity ratio			0.83										
Actuated Cycle Length (s)			120.0									Sum of lost time (s)	12.0
Intersection Capacity Utilization			82.2%									ICU Level of Service	E
Analysis Period (min)			15										
c Critical Lane Group													

HCM Unsignalized Intersection Capacity Analysis
 3: Memorial Drive & T&C Village West DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕↕	↕↔		↗	↖
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	24	812	520	36	16	24
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	27	897	575	40	18	27
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		533	797			
pX, platoon unblocked					0.86	
vC, conflicting volume	615				1096	307
vC1, stage 1 conf vol					595	
vC2, stage 2 conf vol					502	
vCu, unblocked vol	615				952	307
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	97				93	96
cM capacity (veh/h)	961				265	689

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	326	598	383	231	18	27
Volume Left	27	0	0	0	18	0
Volume Right	0	0	0	40	0	27
cSH	961	1700	1700	1700	265	689
Volume to Capacity	0.03	0.35	0.23	0.14	0.07	0.04
Queue Length 95th (ft)	2	0	0	0	5	3
Control Delay (s)	1.0	0.0	0.0	0.0	19.5	10.4
Lane LOS	A				C	B
Approach Delay (s)	0.4		0.0		14.1	
Approach LOS					B	

Intersection Summary						
Average Delay			0.6			
Intersection Capacity Utilization		51.8%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
 4: Memorial Drive & T&C Village East DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↑↑	↑↑		↖	↗
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	75	753	538	9	2	18
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	80	807	576	10	2	19
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		837	493			
pX, platoon unblocked	0.98				0.90	0.98
vC, conflicting volume	586				1145	293
vC1, stage 1 conf vol					581	
vC2, stage 2 conf vol					564	
vCu, unblocked vol	558				983	259
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	92				99	97
cM capacity (veh/h)	989				250	726

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	80	403	403	384	202	2	19
Volume Left	80	0	0	0	0	2	0
Volume Right	0	0	0	0	10	0	19
cSH	989	1700	1700	1700	1700	250	726
Volume to Capacity	0.08	0.24	0.24	0.23	0.12	0.01	0.03
Queue Length 95th (ft)	7	0	0	0	0	1	2
Control Delay (s)	9.0	0.0	0.0	0.0	0.0	19.5	10.1
Lane LOS	A					C	B
Approach Delay (s)	0.8			0.0		11.0	
Approach LOS						B	

Intersection Summary							
Average Delay				0.6			
Intersection Capacity Utilization			33.6%		ICU Level of Service		A
Analysis Period (min)			15				























HCM Signalized Intersection Capacity Analysis
 5: Memorial Drive & West Bough Lane

3/6/2009

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95			0.95			1.00		1.00	1.00	
Fr _t	1.00	0.99			0.96			0.99		1.00	0.88	
Fl _t Protected	0.95	1.00			1.00			0.99		0.95	1.00	
Satd. Flow (prot)	1770	3521			3405			1813		1770	1638	
Fl _t Permitted	0.95	1.00			1.00			0.91		0.90	1.00	
Satd. Flow (perm)	1770	3521			3405			1680		1683	1638	
Volume (vph)	39	656	23	0	478	161	14	32	5	99	10	42
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Adj. Flow (vph)	46	765	27	0	558	188	16	37	6	116	12	49
RTOR Reduction (vph)	0	2	0	0	34	0	0	5	0	0	42	0
Lane Group Flow (vph)	46	790	0	0	712	0	0	54	0	116	19	0
Turn Type	Prot			Prot			Perm			Perm		
Protected Phases	1	6		5	2			4			8	
Permitted Phases							4			8		
Actuated Green, G (s)	3.2	43.1			35.9			8.9		8.9	8.9	
Effective Green, g (s)	3.2	43.1			35.9			8.9		8.9	8.9	
Actuated g/C Ratio	0.05	0.72			0.60			0.15		0.15	0.15	
Clearance Time (s)	4.0	4.0			4.0			4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0			3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	94	2529			2037			249		250	243	
v/s Ratio Prot	0.03	c0.22			c0.21						0.01	
v/s Ratio Perm								0.03		c0.07		
v/c Ratio	0.49	0.31			0.35			0.22		0.46	0.08	
Uniform Delay, d ₁	27.6	3.1			6.1			22.5		23.4	22.0	
Progression Factor	0.73	0.53			1.00			1.00		1.00	1.00	
Incremental Delay, d ₂	3.7	0.3			0.5			0.4		1.4	0.1	
Delay (s)	23.9	1.9			6.6			22.9		24.7	22.2	
Level of Service	C	A			A			C		C	C	
Approach Delay (s)		3.1			6.6			22.9			23.8	
Approach LOS		A			A			C			C	
Intersection Summary												
HCM Average Control Delay			7.2			HCM Level of Service			A			
HCM Volume to Capacity ratio			0.35									
Actuated Cycle Length (s)			60.0			Sum of lost time (s)		8.0				
Intersection Capacity Utilization		45.6%				ICU Level of Service		A				
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
 2: Memorial Drive & Beltway 8 NSR

3/6/2009

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			  			  				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	1.00	0.95			0.91			0.91	1.00			
Fr _t	1.00	1.00			0.97			1.00	0.85			
Fl _t Protected	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (prot)	1770	3539			4951			5044	1583			
Fl _t Permitted	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (perm)	1770	3539			4951			5044	1583			
Volume (vph)	260	540	0	0	825	176	204	1037	251	0	0	0
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	289	600	0	0	917	196	227	1152	279	0	0	0
RTOR Reduction (vph)	0	0	0	0	49	0	0	0	168	0	0	0
Lane Group Flow (vph)	289	600	0	0	1064	0	0	1379	111	0	0	0
Turn Type	Prot							Prot		Perm		
Protected Phases	7	4			8			5	2			
Permitted Phases												2
Actuated Green, G (s)	12.0	32.0			16.0			20.0	20.0			
Effective Green, g (s)	12.0	32.0			16.0			20.0	20.0			
Actuated g/C Ratio	0.20	0.53			0.27			0.33	0.33			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Grp Cap (vph)	354	1887			1320			1681	528			
v/s Ratio Prot	c0.16	0.17			c0.21			c0.27				
v/s Ratio Perm									0.07			
v/c Ratio	0.82	0.32			0.81			0.82	0.21			
Uniform Delay, d ₁	22.9	7.9			20.5			18.4	14.3			
Progression Factor	1.00	1.00			0.72			1.00	1.00			
Incremental Delay, d ₂	18.5	0.4			5.2			4.6	0.9			
Delay (s)	41.4	8.3			19.9			23.0	15.2			
Level of Service	D	A			B			C	B			
Approach Delay (s)		19.1			19.9			21.7			0.0	
Approach LOS		B			B			C			A	
Intersection Summary												
HCM Average Control Delay			20.5					HCM Level of Service			C	
HCM Volume to Capacity ratio			0.81									
Actuated Cycle Length (s)			60.0					Sum of lost time (s)		12.0		
Intersection Capacity Utilization			68.4%					ICU Level of Service		C		
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

3: Memorial Drive & T&C Village West DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕↕	↕↔		↗	↗
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	88	655	761	90	43	148
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	94	697	810	96	46	157
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		533	797			
pX, platoon unblocked	0.90				0.93	0.90
vC, conflicting volume	905				1393	453
vC1, stage 1 conf vol					857	
vC2, stage 2 conf vol					536	
vCu, unblocked vol	790				1165	290
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	87				77	75
cM capacity (veh/h)	747				201	640

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	326	465	540	366	46	157
Volume Left	94	0	0	0	46	0
Volume Right	0	0	0	96	0	157
cSH	747	1700	1700	1700	201	640
Volume to Capacity	0.13	0.27	0.32	0.22	0.23	0.25
Queue Length 95th (ft)	11	0	0	0	21	24
Control Delay (s)	4.1	0.0	0.0	0.0	28.1	12.5
Lane LOS	A				D	B
Approach Delay (s)	1.7		0.0		16.0	
Approach LOS					C	

Intersection Summary						
Average Delay			2.4			
Intersection Capacity Utilization		57.9%		ICU Level of Service		B
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
 4: Memorial Drive & T&C Village East DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↙	↑↑	↑↑		↙	↖
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	90	608	817	30	16	34
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	93	627	842	31	16	35
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		837	493			
pX, platoon unblocked	0.86				0.86	0.86
vC, conflicting volume	873				1357	437
vC1, stage 1 conf vol					858	
vC2, stage 2 conf vol					499	
vCu, unblocked vol	691				1252	183
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	88				92	95
cM capacity (veh/h)	774				194	712

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	93	313	313	562	312	16	35
Volume Left	93	0	0	0	0	16	0
Volume Right	0	0	0	0	31	0	35
cSH	774	1700	1700	1700	1700	194	712
Volume to Capacity	0.12	0.18	0.18	0.33	0.18	0.08	0.05
Queue Length 95th (ft)	10	0	0	0	0	7	4
Control Delay (s)	10.3	0.0	0.0	0.0	0.0	25.2	10.3
Lane LOS	B					D	B
Approach Delay (s)	1.3			0.0		15.1	
Approach LOS						C	

Intersection Summary			
Average Delay		1.1	
Intersection Capacity Utilization	41.9%		ICU Level of Service A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis

5: Memorial Drive & West Bough Lane

3/6/2009

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00		1.00	1.00	
Fr _t	1.00	1.00		1.00	0.97			0.98		1.00	0.88	
Fl _t Protected	0.95	1.00		0.95	1.00			0.99		0.95	1.00	
Satd. Flow (prot)	1770	3529		1770	3441			1806		1770	1633	
Fl _t Permitted	0.95	1.00		0.95	1.00			0.94		0.73	1.00	
Satd. Flow (perm)	1770	3529		1770	3441			1720		1368	1633	
Volume (vph)	51	527	11	3	712	161	8	21	5	208	21	100
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	53	543	11	3	734	166	8	22	5	214	22	103
RTOR Reduction (vph)	0	2	0	0	28	0	0	4	0	0	79	0
Lane Group Flow (vph)	53	552	0	3	872	0	0	31	0	214	46	0
Turn Type	Prot		Prot		Perm			Perm				
Protected Phases	1	6		5	2			4			8	
Permitted Phases							4			8		
Actuated Green, G (s)	5.2	33.5		0.8	29.1			13.7		13.7	13.7	
Effective Green, g (s)	5.2	33.5		0.8	29.1			13.7		13.7	13.7	
Actuated g/C Ratio	0.09	0.56		0.01	0.49			0.23		0.23	0.23	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	153	1970		24	1669			393		312	373	
v/s Ratio Prot	c0.03	c0.16		0.00	c0.25						0.03	
v/s Ratio Perm								0.02		c0.16		
v/c Ratio	0.35	0.28		0.12	0.52			0.08		0.69	0.12	
Uniform Delay, d ₁	25.8	6.9		29.3	10.7			18.2		21.2	18.4	
Progression Factor	0.97	0.62		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d ₂	1.3	0.3		2.3	1.2			0.1		6.1	0.1	
Delay (s)	26.4	4.6		31.6	11.8			18.3		27.3	18.5	
Level of Service	C	A		C	B			B		C	B	
Approach Delay (s)		6.5			11.9			18.3			24.1	
Approach LOS		A			B			B			C	

Intersection Summary

HCM Average Control Delay	12.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	56.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis

2: Memorial Drive & Beltway 8 NSR

3/6/2009



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↘	↑↑			↑↑↑			↑↑↑	↑			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	1.00	0.95			0.91			0.91	1.00			
Frt	1.00	1.00			0.97			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (prot)	1770	3539			4951			5044	1583			
Flt Permitted	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (perm)	1770	3539			4951			5044	1583			
Volume (vph)	260	540	0	0	825	176	204	1037	251	0	0	0
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Adj. Flow (vph)	303	630	0	0	962	205	238	1210	293	0	0	0
RTOR Reduction (vph)	0	0	0	0	44	0	0	0	155	0	0	0
Lane Group Flow (vph)	303	630	0	0	1123	0	0	1448	138	0	0	0
Turn Type	Prot						Prot		Perm			
Protected Phases	7	4			8		5	2				
Permitted Phases									2			
Actuated Green, G (s)	12.0	32.0			16.0			20.0	20.0			
Effective Green, g (s)	12.0	32.0			16.0			20.0	20.0			
Actuated g/C Ratio	0.20	0.53			0.27			0.33	0.33			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Grp Cap (vph)	354	1887			1320			1681	528			
v/s Ratio Prot	c0.17	0.18			c0.23			c0.29				
v/s Ratio Perm									0.09			
v/c Ratio	0.86	0.33			0.85			0.86	0.26			
Uniform Delay, d1	23.2	7.9			20.9			18.7	14.6			
Progression Factor	1.00	1.00			0.75			1.00	1.00			
Incremental Delay, d2	22.4	0.5			6.8			6.1	1.2			
Delay (s)	45.6	8.4			22.5			24.8	15.8			
Level of Service	D	A			C			C	B			
Approach Delay (s)		20.5			22.5			23.3			0.0	
Approach LOS		C			C			C			A	

Intersection Summary

HCM Average Control Delay	22.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	71.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
 3: Memorial Drive & T&C Village West DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↑	↑
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	88	655	761	90	43	148
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	98	732	850	101	48	165
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		533	797			
pX, platoon unblocked	0.90				0.94	0.90
vC, conflicting volume	951				1463	475
vC1, stage 1 conf vol					900	
vC2, stage 2 conf vol					562	
vCu, unblocked vol	839				1217	313
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	86				75	73
cM capacity (veh/h)	715				189	617

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	342	488	567	384	48	165
Volume Left	98	0	0	0	48	0
Volume Right	0	0	0	101	0	165
cSH	715	1700	1700	1700	189	617
Volume to Capacity	0.14	0.29	0.33	0.23	0.25	0.27
Queue Length 95th (ft)	12	0	0	0	24	27
Control Delay (s)	4.4	0.0	0.0	0.0	30.4	13.0
Lane LOS	A				D	B
Approach Delay (s)	1.8		0.0		16.9	
Approach LOS					C	

Intersection Summary						
Average Delay			2.6			
Intersection Capacity Utilization		60.1%		ICU Level of Service		B
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
 4: Memorial Drive & T&C Village East DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↗↗	↗↖		↘	↗
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	90	608	817	30	16	34
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	97	658	884	32	17	37
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		837	493			
pX, platoon unblocked	0.86				0.86	0.86
vC, conflicting volume	917				1425	458
vC1, stage 1 conf vol					901	
vC2, stage 2 conf vol					524	
vCu, unblocked vol	740				1331	207
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	87				90	95
cM capacity (veh/h)	741				181	687

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	97	329	329	590	327	17	37
Volume Left	97	0	0	0	0	17	0
Volume Right	0	0	0	0	32	0	37
cSH	741	1700	1700	1700	1700	181	687
Volume to Capacity	0.13	0.19	0.19	0.35	0.19	0.10	0.05
Queue Length 95th (ft)	11	0	0	0	0	8	4
Control Delay (s)	10.6	0.0	0.0	0.0	0.0	26.9	10.5
Lane LOS	B					D	B
Approach Delay (s)	1.4			0.0		15.8	
Approach LOS						C	

Intersection Summary			
Average Delay		1.1	
Intersection Capacity Utilization	43.3%		ICU Level of Service A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
 5: Memorial Drive & West Bough Lane

3/6/2009



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↖	↕		↖	↕			↕		↖	↕	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00		1.00	1.00	
Fr _t	1.00	1.00		1.00	0.97			0.98		1.00	0.88	
Fl _t Protected	0.95	1.00		0.95	1.00			0.99		0.95	1.00	
Satd. Flow (prot)	1770	3528		1770	3441			1807		1770	1632	
Fl _t Permitted	0.95	1.00		0.95	1.00			0.94		0.73	1.00	
Satd. Flow (perm)	1770	3528		1770	3441			1713		1365	1632	
Volume (vph)	51	527	11	3	712	161	8	21	5	208	21	100
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Adj. Flow (vph)	55	570	12	3	771	174	9	23	5	225	23	108
RTOR Reduction (vph)	0	2	0	0	25	0	0	4	0	0	83	0
Lane Group Flow (vph)	55	580	0	3	920	0	0	33	0	225	48	0
Turn Type	Prot		Prot		Perm			Perm				
Protected Phases	1	6		5	2			4			8	
Permitted Phases							4			8		
Actuated Green, G (s)	2.8	33.1		0.8	31.1			14.1		14.1	14.1	
Effective Green, g (s)	2.8	33.1		0.8	31.1			14.1		14.1	14.1	
Actuated g/C Ratio	0.05	0.55		0.01	0.52			0.24		0.24	0.24	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	83	1946		24	1784			403		321	384	
v/s Ratio Prot	c0.03	0.16		0.00	c0.27						0.03	
v/s Ratio Perm								0.02		c0.16		
v/c Ratio	0.66	0.30		0.12	0.52			0.08		0.70	0.13	
Uniform Delay, d ₁	28.1	7.2		29.3	9.5			17.9		21.0	18.1	
Progression Factor	0.80	0.67		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d ₂	17.4	0.4		2.3	1.1			0.1		6.8	0.1	
Delay (s)	39.9	5.2		31.6	10.6			18.0		27.8	18.2	
Level of Service	D	A		C	B			B		C	B	
Approach Delay (s)		8.2			10.6			18.0			24.3	
Approach LOS		A			B			B			C	

Intersection Summary



















HCM Average Control Delay	12.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	58.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

2: Memorial Drive & Beltway 8 NSR

3/6/2009

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	1.00	0.95			0.91			0.91	1.00			
Frts	1.00	1.00			0.99			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (prot)	1770	3539			5012			5045	1583			
Flt Permitted	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (perm)	1770	3539			5012			5045	1583			
Volume (vph)	241	514	0	0	1080	115	327	1719	203	0	0	0
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	265	565	0	0	1187	126	359	1889	223	0	0	0
RTOR Reduction (vph)	0	0	0	0	11	0	0	0	90	0	0	0
Lane Group Flow (vph)	265	565	0	0	1302	0	0	2248	133	0	0	0
Turn Type	Prot							Prot		Perm		
Protected Phases	7	4			8			5	2			
Permitted Phases									2			
Actuated Green, G (s)	16.0	58.0			38.0			54.0	54.0			
Effective Green, g (s)	16.0	58.0			38.0			54.0	54.0			
Actuated g/C Ratio	0.13	0.48			0.32			0.45	0.45			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Grp Cap (vph)	236	1711			1587			2270	712			
v/s Ratio Prot	c0.15	0.16			c0.26			c0.45				
v/s Ratio Perm									0.08			
v/c Ratio	1.12	0.33			0.82			0.99	0.19			
Uniform Delay, d1	52.0	19.1			37.9			32.7	19.8			
Progression Factor	1.00	1.00			0.78			1.00	1.00			
Incremental Delay, d2	95.6	0.5			4.2			16.7	0.6			
Delay (s)	147.6	19.6			33.6			49.5	20.4			
Level of Service	F	B			C			D	C			
Approach Delay (s)		60.5			33.6			46.9			0.0	
Approach LOS		E			C			D			A	
Intersection Summary												
HCM Average Control Delay			45.5			HCM Level of Service			D			
HCM Volume to Capacity ratio			0.95									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			86.6%			ICU Level of Service			E			
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
 3: Memorial Drive & T&C Village West DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕↕	↕↔		↗	↗
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	55	612	1027	87	28	161
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	60	673	1129	96	31	177
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		533	797			
pX, platoon unblocked	0.74				0.78	0.74
vC, conflicting volume	1224				1634	612
vC1, stage 1 conf vol					1176	
vC2, stage 2 conf vol					457	
vCu, unblocked vol	949				1193	120
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	89				81	74
cM capacity (veh/h)	531				159	671

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	285	448	752	472	31	177
Volume Left	60	0	0	0	31	0
Volume Right	0	0	0	96	0	177
cSH	531	1700	1700	1700	159	671
Volume to Capacity	0.11	0.26	0.44	0.28	0.19	0.26
Queue Length 95th (ft)	10	0	0	0	17	26
Control Delay (s)	4.0	0.0	0.0	0.0	33.0	12.3
Lane LOS	A				D	B
Approach Delay (s)	1.6		0.0		15.3	
Approach LOS					C	

Intersection Summary						
Average Delay			2.0			
Intersection Capacity Utilization		63.0%		ICU Level of Service		B
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
 4: Memorial Drive & T&C Village East DW

3/6/2009






















Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↵	↑↑	↑↑		↵	↗
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	89	551	1041	40	33	73
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	93	574	1084	42	34	76
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage (veh)					0	
Upstream signal (ft)		837	493			
pX, platoon unblocked	0.69				0.71	0.69
vC, conflicting volume	1126				1578	563
vC1, stage 1 conf vol					1105	
vC2, stage 2 conf vol					472	
vCu, unblocked vol	741				1270	0
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	85				79	90
cM capacity (veh/h)	598				162	752

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	93	287	287	723	403	34	76
Volume Left	93	0	0	0	0	34	0
Volume Right	0	0	0	0	42	0	76
cSH	598	1700	1700	1700	1700	162	752
Volume to Capacity	0.15	0.17	0.17	0.43	0.24	0.21	0.10
Queue Length 95th (ft)	14	0	0	0	0	19	8
Control Delay (s)	12.1	0.0	0.0	0.0	0.0	33.1	10.3
Lane LOS	B					D	B
Approach Delay (s)	1.7			0.0		17.4	
Approach LOS						C	

Intersection Summary			
Average Delay		1.6	
Intersection Capacity Utilization	48.3%		ICU Level of Service A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
5: Memorial Drive & West Bough Lane

3/6/2009

												
Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00		1.00	1.00	
Fr _t	1.00	0.99		1.00	0.97			0.97		1.00	0.90	
Fl _t Protected	0.95	1.00		0.95	1.00			0.98		0.95	1.00	
Satd. Flow (prot)	1770	3511		1770	3446			1782		1770	1674	
Fl _t Permitted	0.95	1.00		0.95	1.00			0.90		0.72	1.00	
Satd. Flow (perm)	1770	3511		1770	3446			1629		1347	1674	
Volume (vph)	64	500	28	9	1001	214	17	21	9	258	35	73
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	71	556	31	10	1112	238	19	23	10	287	39	81
RTOR Reduction (vph)	0	6	0	0	30	0	0	7	0	0	60	0
Lane Group Flow (vph)	71	581	0	10	1320	0	0	45	0	287	60	0
Turn Type	Prot			Prot			Perm			Perm		
Protected Phases	1	6		5	2			4				8
Permitted Phases							4			8		
Actuated Green, G (s)	5.6	31.7		0.8	26.9			15.5		15.5	15.5	
Effective Green, g (s)	5.6	31.7		0.8	26.9			15.5		15.5	15.5	
Actuated g/C Ratio	0.09	0.53		0.01	0.45			0.26		0.26	0.26	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	165	1855		24	1545			421		348	432	
v/s Ratio Prot	0.04	c0.17		0.01	c0.38							0.04
v/s Ratio Perm								0.03		c0.21		
v/c Ratio	0.43	0.31		0.42	0.85			0.11		0.82	0.14	
Uniform Delay, d ₁	25.7	8.0		29.4	14.8			17.0		21.0	17.1	
Progression Factor	0.77	0.68		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d ₂	1.8	0.4		11.3	6.2			0.1		14.6	0.1	
Delay (s)	21.6	5.9		40.7	21.0			17.1		35.6	17.3	
Level of Service	C	A		D	C			B		D	B	
Approach Delay (s)		7.6			21.2			17.1			30.2	
Approach LOS		A			C			B			C	
Intersection Summary												
HCM Average Control Delay			19.0			HCM Level of Service			B			
HCM Volume to Capacity ratio			0.74									
Actuated Cycle Length (s)			60.0			Sum of lost time (s)			8.0			
Intersection Capacity Utilization			69.0%			ICU Level of Service			C			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: Memorial Drive & Beltway 8 NSR

3/6/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	1.00	0.95			0.91			0.91	1.00			
Fr _t	1.00	1.00			0.99			1.00	0.85			
Fl _t Protected	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (prot)	1770	3539			5012			5045	1583			
Fl _t Permitted	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (perm)	1770	3539			5012			5045	1583			
Volume (vph)	241	514	0	0	1080	115	327	1719	203	0	0	0
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Adj. Flow (vph)	278	593	0	0	1246	133	377	1983	234	0	0	0
RTOR Reduction (vph)	0	0	0	0	8	0	0	0	90	0	0	0
Lane Group Flow (vph)	278	593	0	0	1371	0	0	2360	144	0	0	0
Turn Type	Prot						Prot		Perm			
Protected Phases	7	4			8		5	2				
Permitted Phases									2			
Actuated Green, G (s)	14.0	56.0			38.0			56.0	56.0			
Effective Green, g (s)	14.0	56.0			38.0			56.0	56.0			
Actuated g/C Ratio	0.12	0.47			0.32			0.47	0.47			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Grp Cap (vph)	207	1652			1587			2354	739			
v/s Ratio Prot	c0.16	0.17			c0.27			c0.47				
v/s Ratio Perm									0.09			
v/c Ratio	1.34	0.36			0.86			1.00	0.20			
Uniform Delay, d ₁	53.0	20.5			38.6			32.0	18.8			
Progression Factor	1.00	1.00			0.94			1.00	1.00			
Incremental Delay, d ₂	183.1	0.6			5.4			19.2	0.6			
Delay (s)	236.1	21.1			41.6			51.2	19.4			
Level of Service	F	C			D			D	B			
Approach Delay (s)		89.7			41.6			48.3			0.0	
Approach LOS		F			D			D			A	
Intersection Summary												
HCM Average Control Delay		53.8										
HCM Volume to Capacity ratio		1.00										
Actuated Cycle Length (s)		120.0							12.0			
Intersection Capacity Utilization		90.5%										
Analysis Period (min)		15										
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis
 3: Memorial Drive & T&C Village West DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕↕	↕↔		↗	↗
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	55	612	1027	87	28	161
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	63	706	1185	100	32	186
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		533	797			
pX, platoon unblocked	0.73				0.78	0.73
vC, conflicting volume	1285				1715	643
vC1, stage 1 conf vol					1235	
vC2, stage 2 conf vol					480	
vCu, unblocked vol	1020				1257	139
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	87				78	71
cM capacity (veh/h)	493				146	644

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	299	471	790	495	32	186
Volume Left	63	0	0	0	32	0
Volume Right	0	0	0	100	0	186
cSH	493	1700	1700	1700	146	644
Volume to Capacity	0.13	0.28	0.46	0.29	0.22	0.29
Queue Length 95th (ft)	11	0	0	0	20	30
Control Delay (s)	4.4	0.0	0.0	0.0	36.7	12.8
Lane LOS	A				E	B
Approach Delay (s)	1.7		0.0		16.4	
Approach LOS					C	

Intersection Summary						
Average Delay			2.2			
Intersection Capacity Utilization			65.5%		ICU Level of Service	C
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
 4: Memorial Drive & T&C Village East DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↵	↑↑	↑↑		↵	↵
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	89	551	1041	40	33	73
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	97	603	1139	44	36	80
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage (veh)					0	
Upstream signal (ft)		837	493			
pX, platoon unblocked	0.69				0.71	0.69
vC, conflicting volume	1182				1656	591
vC1, stage 1 conf vol					1160	
vC2, stage 2 conf vol					496	
vCu, unblocked vol	807				1332	0
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	83				76	89
cM capacity (veh/h)	558				149	743

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	97	301	301	759	423	36	80
Volume Left	97	0	0	0	0	36	0
Volume Right	0	0	0	0	44	0	80
cSH	558	1700	1700	1700	1700	149	743
Volume to Capacity	0.17	0.18	0.18	0.45	0.25	0.24	0.11
Queue Length 95th (ft)	16	0	0	0	0	23	9
Control Delay (s)	12.8	0.0	0.0	0.0	0.0	36.8	10.4
Lane LOS	B					E	B
Approach Delay (s)	1.8			0.0		18.6	
Approach LOS						C	

Intersection Summary							
Average Delay				1.7			
Intersection Capacity Utilization			50.1%		ICU Level of Service		A
Analysis Period (min)			15				

HCM Signalized Intersection Capacity Analysis
 5: Memorial Drive & West Bough Lane

3/6/2009

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00		1.00	1.00	
Fr _t	1.00	0.99		1.00	0.97			0.98		1.00	0.90	
Fl _t Protected	0.95	1.00		0.95	1.00			0.98		0.95	1.00	
Satd. Flow (prot)	1770	3511		1770	3446			1783		1770	1674	
Fl _t Permitted	0.95	1.00		0.95	1.00			0.89		0.72	1.00	
Satd. Flow (perm)	1770	3511		1770	3446			1625		1345	1674	
Volume (vph)	64	500	28	9	1001	214	17	21	9	258	35	73
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Adj. Flow (vph)	75	583	33	10	1168	250	20	24	10	301	41	85
RTOR Reduction (vph)	0	6	0	0	29	0	0	7	0	0	63	0
Lane Group Flow (vph)	75	610	0	10	1389	0	0	47	0	301	63	0
Turn Type	Prot		Prot		Perm			Perm				
Protected Phases	1	6		5	2			4				8
Permitted Phases							4			8		
Actuated Green, G (s)	3.3	31.4		0.8	28.9			15.8		15.8	15.8	
Effective Green, g (s)	3.3	31.4		0.8	28.9			15.8		15.8	15.8	
Actuated g/C Ratio	0.06	0.52		0.01	0.48			0.26		0.26	0.26	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	97	1837		24	1660			428		354	441	
v/s Ratio Prot	c0.04	0.17		0.01	c0.40							0.04
v/s Ratio Perm								0.03		c0.22		
v/c Ratio	0.77	0.33		0.42	0.84			0.11		0.85	0.14	
Uniform Delay, d ₁	28.0	8.3		29.4	13.5			16.8		21.0	16.9	
Progression Factor	0.90	1.48		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d ₂	30.3	0.5		11.3	5.2			0.1		17.4	0.2	
Delay (s)	55.5	12.7		40.7	18.7			16.9		38.4	17.1	
Level of Service	E	B		D	B			B		D	B	
Approach Delay (s)		17.3			18.9			16.9			32.1	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM Average Control Delay	20.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	71.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
 2: Memorial Drive & Beltway 8 NSR

3/6/2009



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↘	↕↕			↕↕↕			↕↕↕	↗			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	1.00	0.95			0.91			0.91	1.00			
Fr _t	1.00	1.00			0.97			1.00	0.85			
Fl _t Protected	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (prot)	1770	3539			4931			5049	1583			
Fl _t Permitted	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (perm)	1770	3539			4931			5049	1583			
Volume (vph)	349	671	0	0	444	113	282	1687	231	0	0	0
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	360	692	0	0	458	116	291	1739	238	0	0	0
RTOR Reduction (vph)	0	0	0	0	37	0	0	0	74	0	0	0
Lane Group Flow (vph)	360	692	0	0	537	0	0	2030	164	0	0	0
Turn Type	Prot							Prot		Perm		
Protected Phases	7	4			8			5	2			
Permitted Phases												2
Actuated Green, G (s)	33.0	54.0			17.0			58.0	58.0			
Effective Green, g (s)	33.0	54.0			17.0			58.0	58.0			
Actuated g/C Ratio	0.28	0.45			0.14			0.48	0.48			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Grp Cap (vph)	487	1593			699			2440	765			
v/s Ratio Prot	c0.20	0.20			c0.11			c0.40				
v/s Ratio Perm									0.10			
v/c Ratio	0.74	0.43			0.77			0.83	0.21			
Uniform Delay, d ₁	39.6	22.6			49.6			26.8	17.9			
Progression Factor	1.00	1.00			0.89			1.00	1.00			
Incremental Delay, d ₂	9.7	0.9			7.8			3.5	0.6			
Delay (s)	49.3	23.4			52.0			30.3	18.5			
Level of Service	D	C			D			C	B			
Approach Delay (s)		32.3			52.0			29.0			0.0	
Approach LOS		C			D			C			A	

Intersection Summary

HCM Average Control Delay	33.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	78.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
 3: Memorial Drive & T&C Village West DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↕	↕		↖	↗
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	24	812	520	36	16	24
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	25	855	547	38	17	25
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type						
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume						
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol						
tC, single (s)						
tC, 2 stage (s)						
tF (s)						
p0 queue free %						
cM capacity (veh/h)						

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	25	427	427	365	220	17	25
Volume Left	25	0	0	0	0	17	0
Volume Right	0	0	0	0	38	0	25
cSH	986	1700	1700	1700	1700	277	704
Volume to Capacity	0.03	0.25	0.25	0.21	0.13	0.06	0.04
Queue Length 95th (ft)	2	0	0	0	0	5	3
Control Delay (s)	8.7	0.0	0.0	0.0	0.0	18.8	10.3
Lane LOS	A					C	B
Approach Delay (s)	0.3			0.0		13.7	
Approach LOS						B	

Intersection Summary			
Average Delay		0.5	
Intersection Capacity Utilization	32.4%		ICU Level of Service A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
 4: Memorial Drive & T&C Village East DW

3/6/2009






















Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↵	↕↕	↕↕		↵	↵
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	75	753	538	9	2	18
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	77	768	549	9	2	18
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		837	493			
pX, platoon unblocked	0.99				0.90	0.99
vC, conflicting volume	558				1091	279
vC1, stage 1 conf vol					554	
vC2, stage 2 conf vol					537	
vCu, unblocked vol	544				962	262
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	92				99	97
cM capacity (veh/h)	1011				259	729

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	77	384	384	366	192	2	18
Volume Left	77	0	0	0	0	2	0
Volume Right	0	0	0	0	9	0	18
cSH	1011	1700	1700	1700	1700	259	729
Volume to Capacity	0.08	0.23	0.23	0.22	0.11	0.01	0.03
Queue Length 95th (ft)	6	0	0	0	0	1	2
Control Delay (s)	8.9	0.0	0.0	0.0	0.0	19.0	10.1
Lane LOS	A					C	B
Approach Delay (s)	0.8			0.0		11.0	
Approach LOS						B	

Intersection Summary			
Average Delay		0.6	
Intersection Capacity Utilization	32.6%		ICU Level of Service A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
 5: Memorial Drive & West Bough Lane

3/6/2009

												
Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95			0.95			1.00		1.00	1.00	
Fr't	1.00	0.99			0.96			0.99		1.00	0.88	
Flt Protected	0.95	1.00			1.00			0.99		0.95	1.00	
Satd. Flow (prot)	1770	3521			3405			1812		1770	1636	
Flt Permitted	0.95	1.00			1.00			0.91		0.91	1.00	
Satd. Flow (perm)	1770	3521			3405			1676		1696	1636	
Volume (vph)	39	656	23	0	478	161	14	32	5	99	10	42
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	43	729	26	0	531	179	16	36	6	110	11	47
RTOR Reduction (vph)	0	2	0	0	34	0	0	5	0	0	40	0
Lane Group Flow (vph)	43	753	0	0	676	0	0	53	0	110	18	0
Turn Type	Prot			Prot			Perm			Perm		
Protected Phases	1	6		5	2			4				8
Permitted Phases							4			8		
Actuated Green, G (s)	3.2	43.3			36.1			8.7		8.7		8.7
Effective Green, g (s)	3.2	43.3			36.1			8.7		8.7		8.7
Actuated g/C Ratio	0.05	0.72			0.60			0.14		0.14		0.14
Clearance Time (s)	4.0	4.0			4.0			4.0		4.0		4.0
Vehicle Extension (s)	3.0	3.0			3.0			3.0		3.0		3.0
Lane Grp Cap (vph)	94	2541			2049			243		246		237
v/s Ratio Prot	0.02	c0.21			c0.20							0.01
v/s Ratio Perm								0.03		c0.06		
v/c Ratio	0.46	0.30			0.33			0.22		0.45		0.08
Uniform Delay, d1	27.6	3.0			5.9			22.6		23.5		22.2
Progression Factor	0.78	0.54			1.00			1.00		1.00		1.00
Incremental Delay, d2	3.3	0.3			0.4			0.5		1.3		0.1
Delay (s)	24.7	1.9			6.4			23.1		24.7		22.3
Level of Service	C	A			A			C		C		C
Approach Delay (s)		3.1			6.4			23.1				23.9
Approach LOS		A			A			C				C
Intersection Summary												
HCM Average Control Delay			7.1			HCM Level of Service				A		
HCM Volume to Capacity ratio			0.34									
Actuated Cycle Length (s)			60.0			Sum of lost time (s)				8.0		
Intersection Capacity Utilization			44.3%			ICU Level of Service				A		
Analysis Period (min)			15									
c	Critical Lane Group											

HCM Signalized Intersection Capacity Analysis
 2: Memorial Drive & Beltway 8 NSR

3/6/2009



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↘	↕↕			↕↕↕			↕↕↕	↗			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	1.00	0.95			0.91			0.91	1.00			
Flt	1.00	1.00			0.97			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (prot)	1770	3539			4931			5049	1583			
Flt Permitted	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (perm)	1770	3539			4931			5049	1583			
Volume (vph)	349	671	0	0	444	113	282	1687	231	0	0	0
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Adj. Flow (vph)	378	726	0	0	481	122	305	1826	250	0	0	0
RTOR Reduction (vph)	0	0	0	0	37	0	0	0	63	0	0	0
Lane Group Flow (vph)	378	726	0	0	566	0	0	2131	187	0	0	0
Turn Type	Prot							Prot		Perm		
Protected Phases	7	4			8			5	2			
Permitted Phases												2
Actuated Green, G (s)	32.0	53.0			17.0			59.0	59.0			
Effective Green, g (s)	32.0	53.0			17.0			59.0	59.0			
Actuated g/C Ratio	0.27	0.44			0.14			0.49	0.49			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Grp Cap (vph)	472	1563			699			2482	778			
v/s Ratio Prot	c0.21	0.21			c0.11			c0.42				
v/s Ratio Perm									0.12			
v/c Ratio	0.80	0.46			0.81			0.86	0.24			
Uniform Delay, d1	41.0	23.5			49.9			26.8	17.6			
Progression Factor	1.00	1.00			0.89			1.00	1.00			
Incremental Delay, d2	13.3	1.0			9.6			4.1	0.7			
Delay (s)	54.4	24.5			54.1			31.0	18.3			
Level of Service	D	C			D			C	B			
Approach Delay (s)		34.7			54.1			29.6			0.0	
Approach LOS		C			D			C			A	

Intersection Summary			
HCM Average Control Delay	34.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	82.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
 3: Memorial Drive & T&C Village West DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↑↑	↑↑		↖	↗
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	24	812	520	36	16	24
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	27	897	575	40	18	27
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		533	797			
pX, platoon unblocked					0.86	
vC, conflicting volume	615				1096	307
vC1, stage 1 conf vol					595	
vC2, stage 2 conf vol					502	
vCu, unblocked vol	615				955	307
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	97				93	96
cM capacity (veh/h)	961				265	689

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	27	449	449	383	231	18	27
Volume Left	27	0	0	0	0	18	0
Volume Right	0	0	0	0	40	0	27
cSH	961	1700	1700	1700	1700	265	689
Volume to Capacity	0.03	0.26	0.26	0.23	0.14	0.07	0.04
Queue Length 95th (ft)	2	0	0	0	0	5	3
Control Delay (s)	8.9	0.0	0.0	0.0	0.0	19.6	10.4
Lane LOS	A					C	B
Approach Delay (s)	0.3			0.0		14.1	
Approach LOS						B	

Intersection Summary			
Average Delay		0.5	
Intersection Capacity Utilization	33.6%		ICU Level of Service A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
 4: Memorial Drive & T&C Village East DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↕	↕		↖	↗
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	75	753	538	9	2	18
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	80	807	576	10	2	19
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage (veh)					0	
Upstream signal (ft)		837	493			
pX, platoon unblocked	0.98				0.90	0.98
vC, conflicting volume	586				1145	293
vC1, stage 1 conf vol					581	
vC2, stage 2 conf vol					564	
vCu, unblocked vol	558				983	259
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	92				99	97
cM capacity (veh/h)	989				250	726




















Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	80	403	403	384	202	2	19
Volume Left	80	0	0	0	0	2	0
Volume Right	0	0	0	0	10	0	19
cSH	989	1700	1700	1700	1700	250	726
Volume to Capacity	0.08	0.24	0.24	0.23	0.12	0.01	0.03
Queue Length 95th (ft)	7	0	0	0	0	1	2
Control Delay (s)	9.0	0.0	0.0	0.0	0.0	19.5	10.1
Lane LOS	A					C	B
Approach Delay (s)	0.8			0.0		11.0	
Approach LOS						B	

Intersection Summary			
Average Delay		0.6	
Intersection Capacity Utilization	33.6%		ICU Level of Service A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis

5: Memorial Drive & West Bough Lane

3/6/2009

												
Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95			0.95			1.00		1.00	1.00	
Fr _t	1.00	0.99			0.96			0.99		1.00	0.88	
Fl _t Protected	0.95	1.00			1.00			0.99		0.95	1.00	
Satd. Flow (prot)	1770	3521			3405			1813		1770	1638	
Fl _t Permitted	0.95	1.00			1.00			0.91		0.90	1.00	
Satd. Flow (perm)	1770	3521			3405			1680		1683	1638	
Volume (vph)	39	656	23	0	478	161	14	32	5	99	10	42
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Adj. Flow (vph)	46	765	27	0	558	188	16	37	6	116	12	49
RTOR Reduction (vph)	0	2	0	0	34	0	0	5	0	0	42	0
Lane Group Flow (vph)	46	790	0	0	712	0	0	54	0	116	19	0
Turn Type	Prot			Prot			Perm			Perm		
Protected Phases	1	6		5	2			4				8
Permitted Phases							4			8		
Actuated Green, G (s)	3.2	43.1			35.9			8.9		8.9		8.9
Effective Green, g (s)	3.2	43.1			35.9			8.9		8.9		8.9
Actuated g/C Ratio	0.05	0.72			0.60			0.15		0.15		0.15
Clearance Time (s)	4.0	4.0			4.0			4.0		4.0		4.0
Vehicle Extension (s)	3.0	3.0			3.0			3.0		3.0		3.0
Lane Grp Cap (vph)	94	2529			2037			249		250		243
v/s Ratio Prot	0.03	c0.22			c0.21							0.01
v/s Ratio Perm								0.03		c0.07		
v/c Ratio	0.49	0.31			0.35			0.22		0.46		0.08
Uniform Delay, d ₁	27.6	3.1			6.1			22.5		23.4		22.0
Progression Factor	0.73	0.53			1.00			1.00		1.00		1.00
Incremental Delay, d ₂	3.7	0.3			0.5			0.4		1.4		0.1
Delay (s)	23.9	1.9			6.6			22.9		24.7		22.2
Level of Service	C	A			A			C		C		C
Approach Delay (s)		3.1			6.6			22.9				23.8
Approach LOS		A			A			C				C























Intersection Summary

HCM Average Control Delay	7.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.35		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	45.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
 2: Memorial Drive & Beltway 8 NSR

3/6/2009

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations		 			  			  					
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0				
Lane Util. Factor	1.00	0.95			0.91			0.91	1.00				
Fr't	1.00	1.00			0.97			1.00	0.85				
Flt Protected	0.95	1.00			1.00			0.99	1.00				
Satd. Flow (prot)	1770	3539			4951			5044	1583				
Flt Permitted	0.95	1.00			1.00			0.99	1.00				
Satd. Flow (perm)	1770	3539			4951			5044	1583				
Volume (vph)	260	540	0	0	825	176	204	1037	251	0	0	0	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
Adj. Flow (vph)	289	600	0	0	917	196	227	1152	279	0	0	0	
RTOR Reduction (vph)	0	0	0	0	49	0	0	0	168	0	0	0	
Lane Group Flow (vph)	289	600	0	0	1064	0	0	1379	111	0	0	0	
Turn Type	Prot							Prot		Perm			
Protected Phases	7	4			8			5	2				
Permitted Phases									2				
Actuated Green, G (s)	12.0	32.0			16.0			20.0	20.0				
Effective Green, g (s)	12.0	32.0			16.0			20.0	20.0				
Actuated g/C Ratio	0.20	0.53			0.27			0.33	0.33				
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0				
Lane Grp Cap (vph)	354	1887			1320			1681	528				
v/s Ratio Prot	c0.16	0.17			c0.21			c0.27					
v/s Ratio Perm									0.07				
v/c Ratio	0.82	0.32			0.81			0.82	0.21				
Uniform Delay, d1	22.9	7.9			20.5			18.4	14.3				
Progression Factor	1.00	1.00			0.72			1.00	1.00				
Incremental Delay, d2	18.5	0.4			5.2			4.6	0.9				
Delay (s)	41.4	8.3			19.9			23.0	15.2				
Level of Service	D	A			B			C	B				
Approach Delay (s)		19.1			19.9			21.7			0.0		
Approach LOS		B			B			C			A		
Intersection Summary													
HCM Average Control Delay			20.5		HCM Level of Service				C				
HCM Volume to Capacity ratio			0.81										
Actuated Cycle Length (s)			60.0		Sum of lost time (s)				12.0				
Intersection Capacity Utilization			68.4%		ICU Level of Service				C				
Analysis Period (min)			15										
c Critical Lane Group													

HCM Unsignalized Intersection Capacity Analysis
 3: Memorial Drive & T&C Village West DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↙	↑↑	↑↗		↘	↘
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	88	655	761	90	43	148
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	94	697	810	96	46	157
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		533	797			
pX, platoon unblocked	0.90				0.92	0.90
vC, conflicting volume	905				1393	453
vC1, stage 1 conf vol					857	
vC2, stage 2 conf vol					536	
vCu, unblocked vol	790				1234	290
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	87				76	75
cM capacity (veh/h)	747				194	640

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	94	348	348	540	366	46	157
Volume Left	94	0	0	0	0	46	0
Volume Right	0	0	0	0	96	0	157
cSH	747	1700	1700	1700	1700	194	640
Volume to Capacity	0.13	0.20	0.20	0.32	0.22	0.24	0.25
Queue Length 95th (ft)	11	0	0	0	0	22	24
Control Delay (s)	10.5	0.0	0.0	0.0	0.0	29.2	12.5
Lane LOS	B					D	B
Approach Delay (s)	1.2			0.0		16.2	
Approach LOS						C	

Intersection Summary							
Average Delay			2.3				
Intersection Capacity Utilization		42.1%		ICU Level of Service		A	
Analysis Period (min)		15					

HCM Unsignalized Intersection Capacity Analysis
 4: Memorial Drive & T&C Village East DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↘	↑↑	↑↘		↘	↗
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	90	608	817	30	16	34
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	93	627	842	31	16	35
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage (veh)					0	
Upstream signal (ft)		837	493			
pX, platoon unblocked	0.86				0.86	0.86
vC, conflicting volume	873				1357	437
vC1, stage 1 conf vol					858	
vC2, stage 2 conf vol					499	
vCu, unblocked vol	691				1252	183
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	88				92	95
cM capacity (veh/h)	774				194	712

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	93	313	313	562	312	16	35
Volume Left	93	0	0	0	0	16	0
Volume Right	0	0	0	0	31	0	35
cSH	774	1700	1700	1700	1700	194	712
Volume to Capacity	0.12	0.18	0.18	0.33	0.18	0.08	0.05
Queue Length 95th (ft)	10	0	0	0	0	7	4
Control Delay (s)	10.3	0.0	0.0	0.0	0.0	25.2	10.3
Lane LOS	B					D	B
Approach Delay (s)	1.3			0.0		15.1	
Approach LOS						C	

Intersection Summary			
Average Delay		1.1	
Intersection Capacity Utilization	41.9%		ICU Level of Service A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
 5: Memorial Drive & West Bough Lane

3/6/2009

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00		1.00	1.00	
Fr't	1.00	1.00		1.00	0.97			0.98		1.00	0.88	
Flt Protected	0.95	1.00		0.95	1.00			0.99		0.95	1.00	
Satd. Flow (prot)	1770	3529		1770	3441			1806		1770	1633	
Flt Permitted	0.95	1.00		0.95	1.00			0.94		0.73	1.00	
Satd. Flow (perm)	1770	3529		1770	3441			1720		1368	1633	
Volume (vph)	51	527	11	3	712	161	8	21	5	208	21	100
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	53	543	11	3	734	166	8	22	5	214	22	103
RTOR Reduction (vph)	0	2	0	0	28	0	0	4	0	0	79	0
Lane Group Flow (vph)	53	552	0	3	872	0	0	31	0	214	46	0
Turn Type	Prot		Prot		Perm			Perm				
Protected Phases	1	6		5	2			4				8
Permitted Phases							4				8	
Actuated Green, G (s)	5.2	33.5		0.8	29.1			13.7		13.7	13.7	
Effective Green, g (s)	5.2	33.5		0.8	29.1			13.7		13.7	13.7	
Actuated g/C Ratio	0.09	0.56		0.01	0.49			0.23		0.23	0.23	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	153	1970		24	1669			393		312	373	
v/s Ratio Prot	c0.03	c0.16		0.00	c0.25							0.03
v/s Ratio Perm								0.02		c0.16		
v/c Ratio	0.35	0.28		0.12	0.52			0.08		0.69	0.12	
Uniform Delay, d1	25.8	6.9		29.3	10.7			18.2		21.2	18.4	
Progression Factor	0.97	0.62		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	1.3	0.3		2.3	1.2			0.1		6.1	0.1	
Delay (s)	26.4	4.6		31.6	11.8			18.3		27.3	18.5	
Level of Service	C	A		C	B			B		C	B	
Approach Delay (s)		6.5			11.9			18.3			24.1	
Approach LOS		A			B			B			C	

Intersection Summary			
HCM Average Control Delay	12.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	56.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
 2: Memorial Drive & Beltway 8 NSR

3/6/2009



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↙	↕			↕			↕	↗			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	1.00	0.95			0.91			0.91	1.00			
Fr _t	1.00	1.00			0.97			1.00	0.85			
Fl _t Protected	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (prot)	1770	3539			4951			5044	1583			
Fl _t Permitted	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (perm)	1770	3539			4951			5044	1583			
Volume (vph)	260	540	0	0	825	176	204	1037	251	0	0	0
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Adj. Flow (vph)	303	630	0	0	962	205	238	1210	293	0	0	0
RTOR Reduction (vph)	0	0	0	0	44	0	0	0	155	0	0	0
Lane Group Flow (vph)	303	630	0	0	1123	0	0	1448	138	0	0	0
Turn Type	Prot							Prot		Perm		
Protected Phases	7	4			8			5	2			
Permitted Phases												2
Actuated Green, G (s)	12.0	32.0			16.0			20.0	20.0			
Effective Green, g (s)	12.0	32.0			16.0			20.0	20.0			
Actuated g/C Ratio	0.20	0.53			0.27			0.33	0.33			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Grp Cap (vph)	354	1887			1320			1681	528			
v/s Ratio Prot	c0.17	0.18			c0.23			c0.29				
v/s Ratio Perm									0.09			
v/c Ratio	0.86	0.33			0.85			0.86	0.26			
Uniform Delay, d ₁	23.2	7.9			20.9			18.7	14.6			
Progression Factor	1.00	1.00			0.75			1.00	1.00			
Incremental Delay, d ₂	22.4	0.5			6.8			6.1	1.2			
Delay (s)	45.6	8.4			22.5			24.8	15.8			
Level of Service	D	A			C			C	B			
Approach Delay (s)		20.5			22.5			23.3			0.0	
Approach LOS		C			C			C			A	

Intersection Summary

HCM Average Control Delay	22.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	71.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
 3: Memorial Drive & T&C Village West DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↵	↑↑	↑↑		↵	↵
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	88	655	761	90	43	148
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	98	732	850	101	48	165
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		533	797			
pX, platoon unblocked	0.90				0.92	0.90
vC, conflicting volume	951				1463	475
vC1, stage 1 conf vol					900	
vC2, stage 2 conf vol					562	
vCu, unblocked vol	839				1287	313
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	86				74	73
cM capacity (veh/h)	715				183	617

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	98	366	366	567	384	48	165
Volume Left	98	0	0	0	0	48	0
Volume Right	0	0	0	0	101	0	165
cSH	715	1700	1700	1700	1700	183	617
Volume to Capacity	0.14	0.22	0.22	0.33	0.23	0.26	0.27
Queue Length 95th (ft)	12	0	0	0	0	25	27
Control Delay (s)	10.8	0.0	0.0	0.0	0.0	31.5	13.0
Lane LOS	B					D	B
Approach Delay (s)	1.3			0.0		17.1	
Approach LOS						C	

Intersection Summary			
Average Delay		2.4	
Intersection Capacity Utilization	43.6%		ICU Level of Service A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
 4: Memorial Drive & T&C Village East DW

3/6/2009






















Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↵	↑↑	↑↑		↵	↵
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	90	608	817	30	16	34
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	97	658	884	32	17	37
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		837	493			
pX, platoon unblocked	0.86				0.86	0.86
vC, conflicting volume	917				1425	458
vC1, stage 1 conf vol					901	
vC2, stage 2 conf vol					524	
vCu, unblocked vol	740				1331	207
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	87				90	95
cM capacity (veh/h)	741				181	687

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	97	329	329	590	327	17	37
Volume Left	97	0	0	0	0	17	0
Volume Right	0	0	0	0	32	0	37
cSH	741	1700	1700	1700	1700	181	687
Volume to Capacity	0.13	0.19	0.19	0.35	0.19	0.10	0.05
Queue Length 95th (ft)	11	0	0	0	0	8	4
Control Delay (s)	10.6	0.0	0.0	0.0	0.0	26.9	10.5
Lane LOS	B					D	B
Approach Delay (s)	1.4			0.0		15.8	
Approach LOS						C	

Intersection Summary			
Average Delay		1.1	
Intersection Capacity Utilization	43.3%		ICU Level of Service A
Analysis Period (min)	15		


















HCM Signalized Intersection Capacity Analysis
 5: Memorial Drive & West Bough Lane

3/6/2009

												
Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00		1.00	1.00	
Fr't	1.00	1.00		1.00	0.97			0.98		1.00	0.88	
Flt Protected	0.95	1.00		0.95	1.00			0.99		0.95	1.00	
Satd. Flow (prot)	1770	3528		1770	3441			1807		1770	1632	
Flt Permitted	0.95	1.00		0.95	1.00			0.94		0.73	1.00	
Satd. Flow (perm)	1770	3528		1770	3441			1713		1365	1632	
Volume (vph)	51	527	11	3	712	161	8	21	5	208	21	100
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Adj. Flow (vph)	55	570	12	3	771	174	9	23	5	225	23	108
RTOR Reduction (vph)	0	2	0	0	25	0	0	4	0	0	83	0
Lane Group Flow (vph)	55	580	0	3	920	0	0	33	0	225	48	0
Turn Type	Prot		Prot		Perm			Perm				
Protected Phases	1	6		5	2			4				8
Permitted Phases							4				8	
Actuated Green, G (s)	2.8	33.1		0.8	31.1			14.1		14.1	14.1	
Effective Green, g (s)	2.8	33.1		0.8	31.1			14.1		14.1	14.1	
Actuated g/C Ratio	0.05	0.55		0.01	0.52			0.24		0.24	0.24	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	83	1946		24	1784			403		321	384	
v/s Ratio Prot	c0.03	0.16		0.00	c0.27						0.03	
v/s Ratio Perm								0.02		c0.16		
v/c Ratio	0.66	0.30		0.12	0.52			0.08		0.70	0.13	
Uniform Delay, d1	28.1	7.2		29.3	9.5			17.9		21.0	18.1	
Progression Factor	0.80	0.67		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	17.4	0.4		2.3	1.1			0.1		6.8	0.1	
Delay (s)	39.9	5.2		31.6	10.6			18.0		27.8	18.2	
Level of Service	D	A		C	B			B		C	B	
Approach Delay (s)		8.2			10.6			18.0			24.3	
Approach LOS		A			B			B			C	
Intersection Summary												
HCM Average Control Delay			12.4			HCM Level of Service				B		
HCM Volume to Capacity ratio			0.58									
Actuated Cycle Length (s)			60.0			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			58.2%			ICU Level of Service				B		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
 2: Memorial Drive & Beltway 8 NSR

3/6/2009

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	1.00	0.95			0.91			0.91	1.00			
Frt	1.00	1.00			0.99			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (prot)	1770	3539			5012			5045	1583			
Flt Permitted	0.95	1.00			1.00			0.99	1.00			
Satd. Flow (perm)	1770	3539			5012			5045	1583			
Volume (vph)	241	514	0	0	1080	115	327	1719	203	0	0	0
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	265	565	0	0	1187	126	359	1889	223	0	0	0
RTOR Reduction (vph)	0	0	0	0	11	0	0	0	90	0	0	0
Lane Group Flow (vph)	265	565	0	0	1302	0	0	2248	133	0	0	0
Turn Type	Prot						Prot		Perm			
Protected Phases	7	4			8		5	2				
Permitted Phases									2			
Actuated Green, G (s)	16.0	58.0			38.0			54.0	54.0			
Effective Green, g (s)	16.0	58.0			38.0			54.0	54.0			
Actuated g/C Ratio	0.13	0.48			0.32			0.45	0.45			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Grp Cap (vph)	236	1711			1587			2270	712			
v/s Ratio Prot	c0.15	0.16			c0.26			c0.45				
v/s Ratio Perm									0.08			
v/c Ratio	1.12	0.33			0.82			0.99	0.19			
Uniform Delay, d1	52.0	19.1			37.9			32.7	19.8			
Progression Factor	1.00	1.00			0.78			1.00	1.00			
Incremental Delay, d2	95.6	0.5			4.2			16.7	0.6			
Delay (s)	147.6	19.6			33.6			49.5	20.4			
Level of Service	F	B			C			D	C			
Approach Delay (s)		60.5			33.6			46.9			0.0	
Approach LOS		E			C			D			A	
Intersection Summary												
HCM Average Control Delay			45.5					HCM Level of Service		D		
HCM Volume to Capacity ratio			0.95									
Actuated Cycle Length (s)			120.0					Sum of lost time (s)		12.0		
Intersection Capacity Utilization			86.6%					ICU Level of Service		E		
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
 3: Memorial Drive & T&C Village West DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↙	↑↑	↑↘		↙	↘
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	55	612	1027	87	28	161
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	60	673	1129	96	31	177
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage (veh)					0	
Upstream signal (ft)		533	797			
pX, platoon unblocked	0.74				0.78	0.74
vC, conflicting volume	1224				1634	612
vC1, stage 1 conf vol					1176	
vC2, stage 2 conf vol					457	
vCu, unblocked vol	949				1218	120
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	89				80	74
cM capacity (veh/h)	531				158	671

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	60	336	336	752	472	31	177
Volume Left	60	0	0	0	0	31	0
Volume Right	0	0	0	0	96	0	177
cSH	531	1700	1700	1700	1700	158	671
Volume to Capacity	0.11	0.20	0.20	0.44	0.28	0.20	0.26
Queue Length 95th (ft)	10	0	0	0	0	17	26
Control Delay (s)	12.6	0.0	0.0	0.0	0.0	33.3	12.3
Lane LOS	B					D	B
Approach Delay (s)	1.0			0.0		15.4	
Approach LOS						C	

Intersection Summary			
Average Delay		1.8	
Intersection Capacity Utilization	47.8%		ICU Level of Service A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
 4: Memorial Drive & T&C Village East DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↑↑	↑↑		↖	↗
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	89	551	1041	40	33	73
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	93	574	1084	42	34	76
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage (veh)					0	
Upstream signal (ft)		837	493			
pX, platoon unblocked	0.69				0.71	0.69
vC, conflicting volume	1126				1578	563
vC1, stage 1 conf vol					1105	
vC2, stage 2 conf vol					472	
vCu, unblocked vol	741				1270	0
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	85				79	90
cM capacity (veh/h)	598				162	752

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	93	287	287	723	403	34	76
Volume Left	93	0	0	0	0	34	0
Volume Right	0	0	0	0	42	0	76
cSH	598	1700	1700	1700	1700	162	752
Volume to Capacity	0.15	0.17	0.17	0.43	0.24	0.21	0.10
Queue Length 95th (ft)	14	0	0	0	0	19	8
Control Delay (s)	12.1	0.0	0.0	0.0	0.0	33.1	10.3
Lane LOS	B					D	B
Approach Delay (s)	1.7			0.0		17.4	
Approach LOS						C	

Intersection Summary			
Average Delay		1.6	
Intersection Capacity Utilization	48.3%		ICU Level of Service A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
 5: Memorial Drive & West Bough Lane

3/6/2009























Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00		1.00	1.00	
Fr't	1.00	0.99		1.00	0.97			0.97		1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00			0.98		0.95	1.00	
Satd. Flow (prot)	1770	3511		1770	3446			1782		1770	1674	
Flt Permitted	0.95	1.00		0.95	1.00			0.90		0.72	1.00	
Satd. Flow (perm)	1770	3511		1770	3446			1629		1347	1674	
Volume (vph)	64	500	28	9	1001	214	17	21	9	258	35	73
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	71	556	31	10	1112	238	19	23	10	287	39	81
RTOR Reduction (vph)	0	6	0	0	30	0	0	7	0	0	60	0
Lane Group Flow (vph)	71	581	0	10	1320	0	0	45	0	287	60	0
Turn Type	Prot		Prot		Perm			Perm				
Protected Phases	1	6		5	2			4				8
Permitted Phases							4			8		
Actuated Green, G (s)	5.6	31.7		0.8	26.9			15.5		15.5	15.5	
Effective Green, g (s)	5.6	31.7		0.8	26.9			15.5		15.5	15.5	
Actuated g/C Ratio	0.09	0.53		0.01	0.45			0.26		0.26	0.26	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	165	1855		24	1545			421		348	432	
v/s Ratio Prot	0.04	c0.17		0.01	c0.38							0.04
v/s Ratio Perm								0.03		c0.21		
v/c Ratio	0.43	0.31		0.42	0.85			0.11		0.82	0.14	
Uniform Delay, d1	25.7	8.0		29.4	14.8			17.0		21.0	17.1	
Progression Factor	0.77	0.68		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	1.8	0.4		11.3	6.2			0.1		14.6	0.1	
Delay (s)	21.6	5.9		40.7	21.0			17.1		35.6	17.3	
Level of Service	C	A		D	C			B		D	B	
Approach Delay (s)		7.6			21.2			17.1			30.2	
Approach LOS		A			C			B			C	

Intersection Summary

HCM Average Control Delay	19.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
 2: Memorial Drive & Beltway 8 NSR

3/6/2009

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations		 			  			  					
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0				
Lane Util. Factor	1.00	0.95			0.91			0.91	1.00				
Fr _t	1.00	1.00			0.99			1.00	0.85				
Fl _t Protected	0.95	1.00			1.00			0.99	1.00				
Satd. Flow (prot)	1770	3539			5012			5045	1583				
Fl _t Permitted	0.95	1.00			1.00			0.99	1.00				
Satd. Flow (perm)	1770	3539			5012			5045	1583				
Volume (vph)	241	514	0	0	1080	115	327	1719	203	0	0	0	
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	
Adj. Flow (vph)	278	593	0	0	1246	133	377	1983	234	0	0	0	
RTOR Reduction (vph)	0	0	0	0	8	0	0	0	90	0	0	0	
Lane Group Flow (vph)	278	593	0	0	1371	0	0	2360	144	0	0	0	
Turn Type	Prot						Prot		Perm				
Protected Phases	7	4			8			5	2				
Permitted Phases									2				
Actuated Green, G (s)	14.0	56.0			38.0			56.0	56.0				
Effective Green, g (s)	14.0	56.0			38.0			56.0	56.0				
Actuated g/C Ratio	0.12	0.47			0.32			0.47	0.47				
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0				
Lane Grp Cap (vph)	207	1652			1587			2354	739				
v/s Ratio Prot	c0.16	0.17			c0.27			c0.47					
v/s Ratio Perm									0.09				
v/c Ratio	1.34	0.36			0.86			1.00	0.20				
Uniform Delay, d ₁	53.0	20.5			38.6			32.0	18.8				
Progression Factor	1.00	1.00			0.94			1.00	1.00				
Incremental Delay, d ₂	183.1	0.6			5.4			19.2	0.6				
Delay (s)	236.1	21.1			41.6			51.2	19.4				
Level of Service	F	C			D			D	B				
Approach Delay (s)		89.7			41.6			48.3			0.0		
Approach LOS		F			D			D			A		

Intersection Summary

HCM Average Control Delay	53.8	HCM Level of Service	D
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	90.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
 3: Memorial Drive & T&C Village West DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↵	↑↑	↑↑		↵	↵
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	55	612	1027	87	28	161
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	63	706	1185	100	32	186
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		533	797			
pX, platoon unblocked	0.73				0.77	0.73
vC, conflicting volume	1285				1715	643
vC1, stage 1 conf vol					1235	
vC2, stage 2 conf vol					480	
vCu, unblocked vol	1020				1283	139
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	87				78	71
cM capacity (veh/h)	493				144	644

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	63	353	353	790	495	32	186
Volume Left	63	0	0	0	0	32	0
Volume Right	0	0	0	0	100	0	186
cSH	493	1700	1700	1700	1700	144	644
Volume to Capacity	0.13	0.21	0.21	0.46	0.29	0.22	0.29
Queue Length 95th (ft)	11	0	0	0	0	20	30
Control Delay (s)	13.4	0.0	0.0	0.0	0.0	37.0	12.8
Lane LOS	B					E	B
Approach Delay (s)	1.1			0.0		16.4	
Approach LOS						C	

Intersection Summary			
Average Delay		1.9	
Intersection Capacity Utilization	49.9%		ICU Level of Service A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
 4: Memorial Drive & T&C Village East DW

3/6/2009



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↙	↑↑	↑↑		↘	↘
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	89	551	1041	40	33	73
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	97	603	1139	44	36	80
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					Raised	
Median storage veh					0	
Upstream signal (ft)		837	493			
pX, platoon unblocked	0.69				0.71	0.69
vC, conflicting volume	1182				1656	591
vC1, stage 1 conf vol					1160	
vC2, stage 2 conf vol					496	
vCu, unblocked vol	807				1332	0
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	83				76	89
cM capacity (veh/h)	558				149	743

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	97	301	301	759	423	36	80
Volume Left	97	0	0	0	0	36	0
Volume Right	0	0	0	0	44	0	80
cSH	558	1700	1700	1700	1700	149	743
Volume to Capacity	0.17	0.18	0.18	0.45	0.25	0.24	0.11
Queue Length 95th (ft)	16	0	0	0	0	23	9
Control Delay (s)	12.8	0.0	0.0	0.0	0.0	36.8	10.4
Lane LOS	B					E	B
Approach Delay (s)	1.8			0.0		18.6	
Approach LOS						C	

Intersection Summary			
Average Delay		1.7	
Intersection Capacity Utilization	50.1%		ICU Level of Service A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis

5: Memorial Drive & West Bough Lane

3/6/2009



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00		1.00	1.00	
Fr _t	1.00	0.99		1.00	0.97			0.98		1.00	0.90	
Fl _t Protected	0.95	1.00		0.95	1.00			0.98		0.95	1.00	
Satd. Flow (prot)	1770	3511		1770	3446			1783		1770	1674	
Fl _t Permitted	0.95	1.00		0.95	1.00			0.89		0.72	1.00	
Satd. Flow (perm)	1770	3511		1770	3446			1625		1345	1674	
Volume (vph)	64	500	28	9	1001	214	17	21	9	258	35	73
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Adj. Flow (vph)	75	583	33	10	1168	250	20	24	10	301	41	85
RTOR Reduction (vph)	0	6	0	0	29	0	0	7	0	0	63	0
Lane Group Flow (vph)	75	610	0	10	1389	0	0	47	0	301	63	0
Turn Type	Prot		Prot		Perm			Perm				
Protected Phases	1	6		5	2			4			8	
Permitted Phases							4				8	
Actuated Green, G (s)	3.3	31.4		0.8	28.9			15.8		15.8	15.8	
Effective Green, g (s)	3.3	31.4		0.8	28.9			15.8		15.8	15.8	
Actuated g/C Ratio	0.06	0.52		0.01	0.48			0.26		0.26	0.26	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	97	1837		24	1660			428		354	441	
v/s Ratio Prot	c0.04	0.17		0.01	c0.40						0.04	
v/s Ratio Perm								0.03		c0.22		
v/c Ratio	0.77	0.33		0.42	0.84			0.11		0.85	0.14	
Uniform Delay, d ₁	28.0	8.3		29.4	13.5			16.8		21.0	16.9	
Progression Factor	0.90	1.48		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d ₂	30.3	0.5		11.3	5.2			0.1		17.4	0.2	
Delay (s)	55.5	12.7		40.7	18.7			16.9		38.4	17.1	
Level of Service	E	B		D	B			B		D	B	
Approach Delay (s)		17.3			18.9			16.9			32.1	
Approach LOS		B			B			B			C	

Intersection Summary

HCM Average Control Delay	20.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	71.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

APPENDIX E
PRELIMINARY COST ESTIMATE

MEMORIAL DRIVE
ALTERNATIVE 1
COST ESTIMATE

ALTERNATIVE 1					
ITEM #	DESCRIPTION	UNIT	UNIT COST	TOTAL	ITEM COST
02751	SAWCUT PAVEMENT	LF	\$4.00	76	\$304
104 2021	REMOVING CONC (CURB)	LF	\$6.86	612	\$4,198
110-2001	EXCAVATION (ROADWAY)	CY	\$4.70	441	\$2,073
134 2001	BACKFILL (TY A)	CY	\$17.00	122	\$2,074
275-2010	CEMENT TREAT (SUBGRADE) (8")	SY	\$3.14	662	\$2,079
360 2005	CONC PVMT (CONT REINF-CRCP) (10")	SY	\$43.68	662	\$28,916
420 2129	CL S CONC (RAISED MEDIAN)	CY	\$150.00	22	\$3,300
529 2001	CONC CURB (TY 1)	LF	\$6.73	788	\$5,303
529 2003	CONC CURB & GUTTER (TY 1)	LF	\$21.38	622	\$13,298
644 2013	INS SM RD SN SUP&AM TY 10BWG(2) SA (P)	EA	\$880.91	5	\$4,405
644 2077	REMOVE SM RD SN SUP & AM (SIGN ONLY)	EA	\$54.38	5	\$272
666 2015	REFL PAV MRK TY I (W) 6" (BRK) (100MIL)	LF	\$0.38	1,246	\$473
666 2094	REFL PAV MRK TY I (W) (WORD) (100MIL)	EA	\$136.00	2	\$272
666 2149	REF PAV MRK (W) 6" (SLD)	LF	\$0.18	156	\$28
666 2160	REF PAV MRK (W) (ARROW)	EA	\$50.00	2	\$100
677 2002	ELIM EXT PAV MRK & MRKS (6")	LF	\$0.27	2,406	\$650
					\$67,745

Cost estimates do not include utility relocation, landscaping or right-of-way acquisition

Contingency	15.0%
Mobilization	10.0%
Engineering	10.0%

TOTAL	\$91,456
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MEMORIAL DRIVE
ALTERNATIVE 2
COST ESTIMATE

ALTERNATIVE 2					
ITEM #	DESCRIPTION	UNIT	UNIT COST	TOTAL	ITEM COST
02751	SAWCUT PAVEMENT	LF	\$4.00	146	\$584
104 2021	REMOVING CONC (CURB)	LF	\$6.86	1,036	\$7,107
110-2001	EXCAVATION (ROADWAY)	CY	\$4.70	1,230	\$5,781
134 2001	BACKFILL (TY A)	CY	\$17.00	160	\$2,720
275-2010	CEMENT TREAT (SUBGRADE) (8")	SY	\$3.14	1,845	\$5,793
360 2005	CONC PVMT (CONT REINF-CRCP) (10")	SY	\$43.68	1,845	\$80,590
420 2129	CL S CONC (RAISED MEDIAN)	CY	\$150.00	22	\$3,300
529 2001	CONC CURB (TY 1)	LF	\$6.73	1,113	\$7,490
529 2003	CONC CURB & GUTTER (TY 1)	LF	\$21.38	785	\$16,783
644 2013	INS SM RD SN SUP&AM TY 10BWG(2) SA (P)	EA	\$880.91	8	\$7,047
644 2077	REMOVE SM RD SN SUP & AM (SIGN ONLY)	EA	\$54.38	8	\$435
666 2015	REFL PAV MRK TY I (W) 6" (BRK) (100MIL)	LF	\$0.38	2,151	\$817
666 2094	REFL PAV MRK TY I (W) (WORD) (100MIL)	EA	\$136.00	3	\$408
666 2149	REF PAV MRK (W) 6" (SLD)	LF	\$0.18	270	\$49
666 2160	REF PAV MRK (W) (ARROW)	EA	\$50.00	3	\$150
677 2002	ELIM EXT PAV MRK & MRKS (6")	LF	\$0.27	2,875	\$776
					\$139,831

Cost estimates do not include utility relocation, landscaping or right-of-way acquisition

Contingency 15.0%
Mobilization 10.0%
Engineering 10.0%

TOTAL	\$188,772
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