

# LEFT TURN LANE EVALUATION

## Paige Road / Memorial Drive intersection The Colony, Texas

February 6, 2013

Prepared for  
City of The Colony



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02/06/13



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*Firm Registration No. 312*

AVO 28922



**I. INTRODUCTION**

Halff Associates, Inc. (Halff) conducted a Left Turn Lane Evaluation on behalf of the City of The Colony for the Paige Road / Memorial Drive intersection. Figure 1 below is a map detailing the intersection location.



**Figure 1 – Intersection Location Map**

Halff is currently in the design process to widen Memorial Drive from its current 4-lane divided cross-section to a 6-lane divided cross-section. The developer of the currently vacant tract of land located on the southwest corner of the intersection has requested a variance from the City's design standard of 275 feet of storage, for the eastbound left turn lane on Memorial Drive at Paige Road. The developer is requesting this variance in order to acquire a full median opening along Memorial Drive closer to Paige Road than would be feasible with a left turn lane designed to City standards.

Halff conducted weekday AM and PM peak hour turning movement traffic counts at the intersection to identify the current traffic volumes passing through the intersection. Halff then generated trips for nearby vacant land areas, based on City Land Use and Zoning information, and distributed those trips through the Paige Road / Memorial Drive intersection. Halff added those new development trips to the existing traffic volumes at the intersection, and also increased these "total" traffic volumes by an annual growth rate to project a horizon year scenario. For each of these two sets of projected traffic volumes, Halff then analyzed the AM and PM peak hour operations of the intersection, and conducted queuing analyses to determine the maximum queues expected for the eastbound left turn lane. Based on these analyses, Halff developed a recommendation for the storage length of the eastbound left turn lane on Memorial Drive at Paige Road.

## **II. EXISTING and FUTURE ROADWAY CONDITIONS**

Memorial Drive is a 4-lane divided road with dedicated eastbound and westbound left turn lanes at the Paige Road intersection. As mentioned, Halff is currently involved in the design process to improve Memorial Drive to a 6-lane divided road. The proposed lane configurations on Memorial Drive at Paige Road are:

- Left turn lane
- Two through lanes
- Shared through / right turn lane

Paige Road is a 6-lane divided road with dedicated northbound and southbound left turn lanes at the Memorial Drive intersection. There is also a northbound right turn lane in place at the intersection. There are no planned improvements or modifications to the lane configurations on Paige Road at Memorial Drive, as part of the Memorial Drive widening project.

The Paige Road / Memorial Drive intersection is currently signalized, and will remain signalized after the Memorial Drive widening project is completed.

### **III. EXISTING TRAFFIC VOLUMES at STUDY INTERSECTION**

Halff conducted AM and PM peak period turning movement traffic volumes at the Paige Road / Memorial Drive intersection on Thursday, January 10, 2013. Figures 2 and 3 in the Appendix show the AM and PM peak hour volumes at the intersection. A copy of the traffic count data sheet is also provided in the Appendix.

### **IV. LAND USE and TRIP GENERATION for NEARBY VACANT TRACTS**

Halff developed trip generation estimates for three nearby tracts of land that are currently vacant, but when developed, could contribute to traffic growth at the Paige Road / Memorial Drive intersection. The three tracts, their approximate size, and Halff's assumptions for future land use on the tracts, are described below:

#### **Tract 1**

- Located on the southwest quadrant of the Paige Road / Memorial Drive intersection
- Approximately 8.75 acres
- Assumed to develop as Business Park (25% coverage)

#### **Tract 2**

- Located on the east side of Blair Oaks Drive between SH 121 and Memorial Drive
- Approximately 26 acres
- Assumed to develop as a Top Golf facility (16 acres / 64 tee positions) and Business Park (10 acres / 25% coverage)

#### **Tract 3**

- Located on the west side of South Colony Boulevard between SH 121 and Memorial Drive
- Approximately 70 acres
- Assumed to develop as Business Park (25% coverage)

Halff generated trips for these three tracts using the historical trip generation data published by the Institute of Transportation Engineers (ITE) in the publication *Trip Generation Manual, 9<sup>th</sup> Edition*. Trips were generated for the typical weekday AM and PM peak hours. The generated trips for these three tracts are shown in Table 1.

Table 1  
 Estimated Site-Generated One-Way Trips – Nearby Vacant Tracts

Land Use (density) [ITE Code]	AM Peak Hour of Adjacent Street Traffic			PM Peak Hour of Adjacent Street Traffic		
	In	Out	Total	In	Out	Total
Tract 1 - Business Park (108,900 square feet) [770]	131	23	154	41	118	159
Tract 2 – Top Golf (Driving Range) (64 tee positions) [432]	16	10	26	53	53	106
Tract 2 – Business Park (95,290 sf) [770]	116	20	136	37	104	141
Tract 3 – Business Park (762,300 sf) [770]	867	153	1,020	239	679	918

**V. DEVELOPMENT OF PROJECTED TRAFFIC VOLUMES at STUDY INTERSECTION**

Halff distributed the trips generated by the nearby tracts, shown in Table 1, at the Paige Road / Memorial Drive intersection. Halff then added these trips to the existing peak hour traffic volumes at the intersection (shown in Figures 2 and 3 in the Appendix), to estimate the study year 2013 total volumes at the intersection. These projected traffic volumes are shown in Figures 4 and 5 in the Appendix.

To estimate a horizon year scenario, Halff increased the study year 2013 total volumes by a 2 percent annual growth factor for 10 years. These projected horizon year 2023 total volumes at the study intersection are shown in Figures 6 and 7 in the Appendix.

**VI. INTERSECTION ANALYSES**

Halff conducted AM and PM peak hour level-of-service (LOS) and queuing analyses at the Paige Road / Memorial Drive intersection, for the study year 2013 total volumes and the horizon year 2023 total volumes. Results of the analyses were generated using standard procedures outlined in the Highway Capacity Manual (HCM) through the use of the Synchro 8 software package. For reference, all Synchro output / worksheets are provided in the Appendix. LOS and delay have been set by the nation’s transportation officials based upon the amount of delay motorists will tolerate before reaching various degrees of frustration. The LOS criteria for signalized intersections may be found in Table 2.

Table 2  
 Level-of-Service Criteria for Signalized Intersections

Level of Service	Description	Average Stopped Delay (seconds per vehicle)
<b>A and B</b>	No delays at intersection with smooth progression of traffic. Uncongested operations; all vehicles clear in a single signal cycle.	<b>≤ 10.0 &gt; 10.0 and ≤ 20.0</b>
<b>C</b>	Moderate delays at intersections with satisfactory to good progression of traffic. Light congestion; occasional backups on critical approaches.	<b>&gt; 20.0 and ≤ 35.0</b>
<b>D</b>	40-percent probability of delays of one cycle or more at every intersection. No progression of traffic along the roadway with 90 percent probability of being stopped at every intersection experiencing “D” condition. Significant congestion on critical approaches, but intersections are functional. Vehicles required to wait through more than one cycle during short peaks. No long standing lines formed.	<b>&gt; 35.0 and ≤ 55.0</b>
<b>E</b>	Heavy traffic flow condition. Delays of two or more cycles are probable. No progression. 100 percent probability of stopping at intersection. Blockage of intersection may occur if traffic signal does not provide for protected turning movements.	<b>&gt; 55.0 and ≤ 80.0</b>
<b>F</b>	Unstable flow. Heavy congestion. Traffic moves in forced flow condition. Three or more cycles to pass through intersection. Total breakdown with stop-and-go operations.	<b>&gt; 80.0</b>

Halff conducted both the study year 2013 total volume analyses and the horizon year 2023 total volume analyses using the proposed lane assignments and traffic controls presented below:

- Eastbound – left turn lane, two through lanes, shared through / right turn lane
- Westbound – left turn lane, two through lanes, shared through / right turn lane
- Northbound – left turn lane, three through lanes, right turn lane
- Southbound – left turn lane, two through lanes, shared through / right turn lane
- Signalized intersection, with protected / permissive phasing for all left turns

For each scenario, Halff conducted LOS and queuing analyses for two cycle lengths – 90 seconds and 120 seconds. The Synchro software was then allowed to optimize the overall LOS for the intersection for each cycle length.

### LOS Analysis Results

Table 3 shows the LOS results of the AM and PM peak hour intersection analyses for the study year 2013 total volume scenario and for the horizon year 2023 total volume scenario at the Paige Road / Memorial Drive intersection, for a 90-second cycle length. Table 4 shows the LOS results for a 120-second cycle length.

Table 3  
 Intersection LOS Analysis Results – 90-second cycle length

		Study Year 2013 Total Volumes		Horizon Year 2023 Total Volumes	
Intersection	movement	AM Delay / LOS	PM Delay / LOS	AM Delay / LOS	PM Delay \ LOS
Paige Road					
at Memorial Drive	NBL	21.2 / C	15.6 / B	27.1 / C	17.0 / B
	NBT	11.8 / B	23.1 / C	11.5 / B	27.4 / C
	NBR	15.1 / B	24.7 / C	15.5 / B	30.3 / C
	SBL	10.4 / B	17.6 / B	10.2 / B	21.5 / C
	SBT	24.3 / C	19.7 / B	40.2 / D	22.1 / C
	SBR	29.5 / C	20.4 / C	59.3 / F	23.2 / C
	EBL	29.8 / C	26.3 / C	30.9 / C	28.0 / C
	EBT	32.6 / C	33.3 / C	33.2 / C	34.1 / C
	EBR	42.2 / D	40.0 / D	48.5 / D	44.3 / D
	WBL	32.0 / C	20.6 / C	56.5 / E	23.1 / C
	WBT	30.5 / C	27.1 / C	33.3 / C	26.6 / C
	WBR	31.5 / C	28.9 / C	34.9 / C	28.7 / C
	Overall intersection		25.6 / C	24.0 / C	39.6 / D

Table 4  
 Intersection LOS Analysis Results – 120-second cycle length

		Study Year 2013 Total Volumes		Horizon Year 2023 Total Volumes	
Intersection	movement	AM Delay / LOS	PM Delay / LOS	AM Delay / LOS	PM Delay \ LOS
Paige Road					
at Memorial Drive	NBL	22.8 / C	17.8 / B	39.2 / D	19.7 / B
	NBT	12.8 / B	27.7 / C	12.4 / B	29.7 / C
	NBR	15.9 / B	28.8 / C	16.4 / B	31.3 / C
	SBL	11.4 / B	20.1 / C	10.5 / B	23.9 / C
	SBT	24.8 / C	23.7 / C	29.4 / C	23.9 / C
	SBR	28.3 / C	24.3 / C	39.3 / D	24.6 / C
	EBL	43.2 / D	35.6 / D	42.4 / D	37.6 / D
	EBT	48.8 / D	47.5 / D	49.9 / D	51.5 / D
	EBR	73.2 / E	58.8 / E	99.0 / F	81.2 / F
	WBL	37.9 / D	25.2 / C	57.0 / E	27.3 / C
	WBT	41.6 / D	37.1 / D	46.8 / D	38.4 / D
	WBR	42.7 / D	39.3 / D	49.0 / D	41.4 / D
	Overall intersection		29.3 / C	30.1 / C	36.1 / D

The results of the intersection LOS analyses indicate that the Paige Road / Memorial Drive intersection can operate at an overall LOS D or better during both the AM and PM peak hours, for both analysis year scenarios (2013 and 2023) and with either a 90-second cycle length or with a 120-second cycle length. Furthermore, the eastbound left turn movement is projected to operate at a LOS D or better for all analysis scenarios.

## Queuing Analysis Results

Table 5 shows the results of the AM and PM peak hour queuing analyses for the study year 2013 total volume scenario and for the horizon year 2023 total volume scenario at the Paige Road / Memorial Drive intersection, for a 90-second cycle length. Table 6 shows the queuing results for a 120-second cycle length. The queue lengths shown in Tables 5 and 6 are the “maximum” or 95<sup>th</sup> percentile queues.

Table 5  
 Queuing Analysis Results – 90-second cycle length

		Study Year 2013 Total Volumes		Horizon Year 2023 Total Volumes	
Intersection	movement	AM queue (feet)	PM queue (feet)	AM queue (feet)	PM queue (feet)
Paige Road					
at Memorial Drive	NBL	25	51	28	62
	NBT	36	255	42	337
	NBR	38	52	41	57
	SBL	45	25	51	29
	SBT/R	439	105	679	137
	EBL	92	122	111	146
	EBT/R	59	57	78	67
	WBL	151	168	174	205
	WBT/R	71	40	87	46

Table 6  
 Queuing Analysis Results – 120-second cycle length

		Study Year 2013 Total Volumes		Horizon Year 2023 Total Volumes	
Intersection	movement	AM queue (feet)	PM queue (feet)	AM queue (feet)	PM queue (feet)
Paige Road					
at Memorial Drive	NBL	28	61	38	74
	NBT	42	320	49	409
	NBR	39	56	41	59
	SBL	52	29	60	35
	SBT/R	529	133	723	164
	EBL	119	159	143	191
	EBT/R	78	74	111	99
	WBL	197	219	270	268
	WBT/R	94	52	118	61

The results of the queuing analyses indicate that the maximum (95<sup>th</sup> percentile) queue projected for the eastbound left turn movement is 191 feet, for the horizon year 2023 scenario with a 120-second cycle length.

**VII. SUMMARY and RECOMMENDATIONS**

Halff conducted a Left Turn Lane Evaluation for the Paige Road / Memorial Drive intersection to address a request for a variance from the City of The Colony’s standard left turn lane storage requirement, 275 feet. The variance would apply specifically to the eastbound left turn lane. Halff developed projected traffic volumes at the intersection by adding existing volumes to projected development trips from nearby vacant properties, and by increasing the sum of these volumes by an annual growth rate. Halff then conducted intersection LOS and queuing analyses for the study year 2013 and horizon year 2023 projected peak hour volumes passing through the intersection, and evaluated the results to determine an appropriate storage length for the eastbound left turn lane.

Based on the analysis results, Halff recommends that the eastbound left turn lane provide 200 feet of storage space. This is sufficient to accommodate the projected maximum (95<sup>th</sup> percentile) queue calculated for any of the analysis scenarios (191 feet). Assuming a storage length of 25 feet per vehicle, a 200-foot long turn lane could be expected to accommodate at least 8 vehicles entirely within the lane itself.

It should be noted that representatives for the developer of the vacant tract on the southwest corner of the Paige Road / Memorial Drive intersection observed the intersection during the PM peak period on November 30, 2012. The longest queue observed during the PM peak hour was 9 vehicles, which occurred twice (a copy of this data is included in the Appendix). This observed queue could reasonably be expected to be accommodated entirely within a 200-foot long left turn lane, once the taper is taken into consideration. Widening Memorial Drive will allow more flexibility with the signal timing to address the eastbound left turn demand and accommodate the projected volumes as indicated in the analyses.

# APPENDIX

# QUALITY COUNTS, INC.

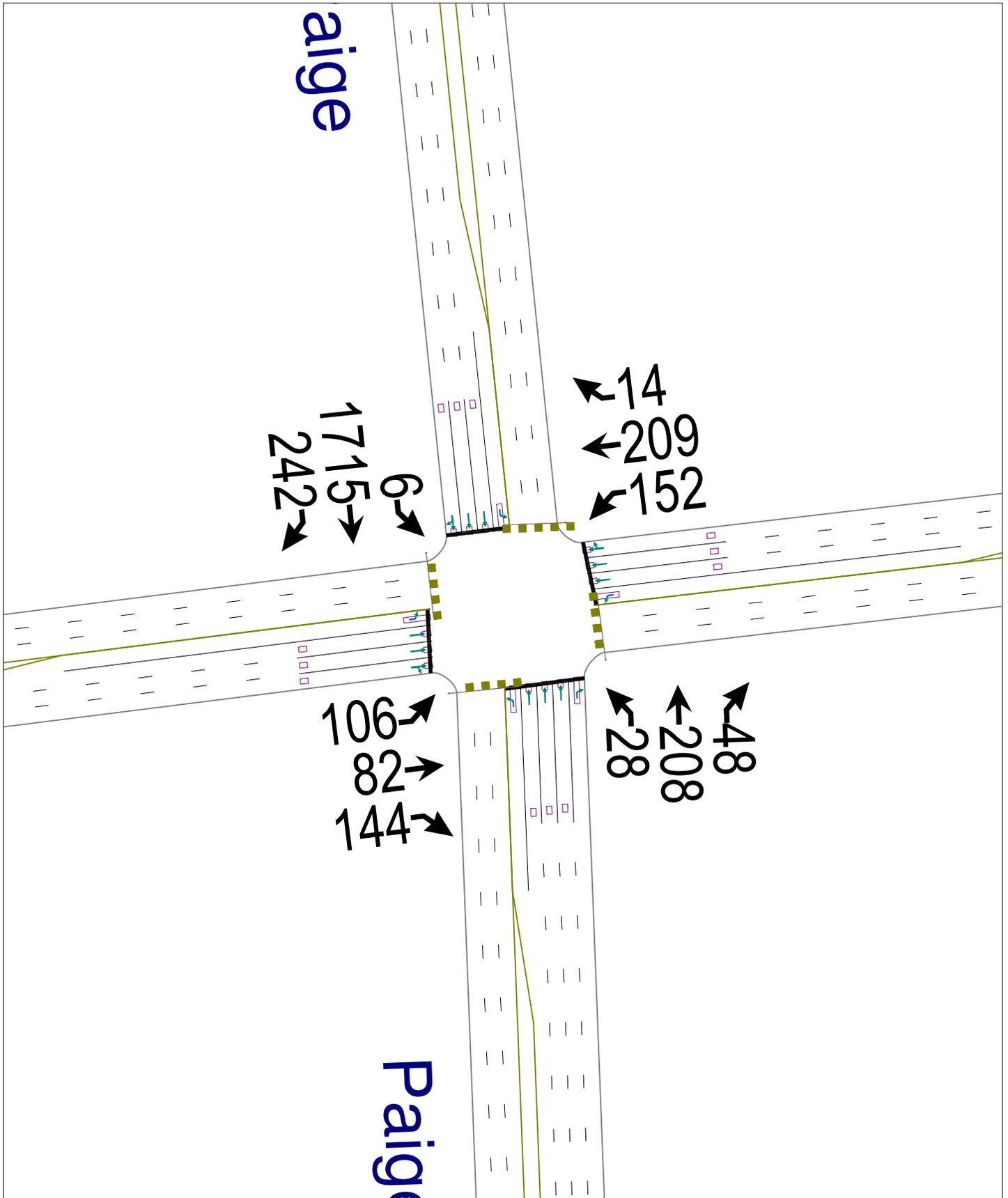
DATA COLLECTION & ANALYSIS  
DALLAS, TX

MEMORIAL @ PAIGE  
THE COLONY, TX  
MILD  
LLL

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Page No : 1

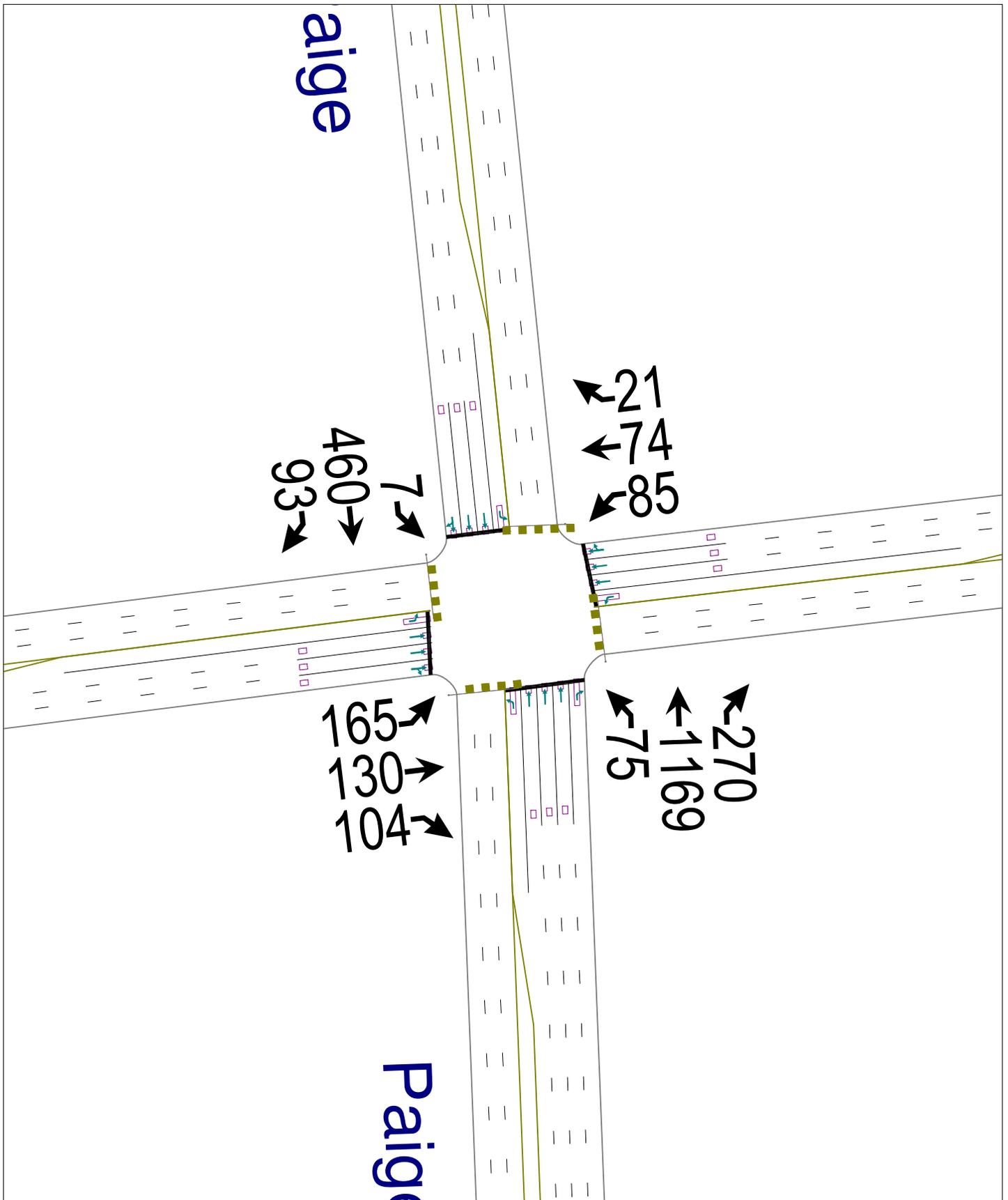
## Groups Printed- Unshifted

Start Time	Southbound					Westbound					Northbound					Eastbound					Int. Total
	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	
07:00 AM	0	330	11	0	341	42	18	1	0	61	2	49	8	0	59	10	8	15	0	33	494
07:15 AM	0	410	15	0	425	41	23	3	0	67	5	65	11	1	82	14	5	26	1	46	620
07:30 AM	2	538	54	0	594	32	36	1	0	69	11	57	7	0	75	15	16	40	0	71	809
07:45 AM	0	443	99	0	542	37	90	5	0	132	4	47	10	0	61	32	22	41	0	95	830
Total	2	1721	179	0	1902	152	167	10	0	329	22	218	36	1	277	71	51	122	1	245	2753
08:00 AM	4	324	74	0	402	42	60	5	0	107	8	39	20	0	67	45	39	37	1	122	698
08:15 AM	2	296	9	0	307	24	9	1	0	34	10	55	14	0	79	44	18	29	0	91	511
08:30 AM	6	258	13	0	277	25	10	0	0	35	3	52	14	0	69	8	13	12	0	33	414
08:45 AM	1	232	12	0	245	17	14	2	0	33	2	57	13	0	72	7	9	15	0	31	381
Total	13	1110	108	0	1231	108	93	8	0	209	23	203	61	0	287	104	79	93	1	277	2004
*** BREAK ***																					
04:30 PM	2	120	19	0	141	12	14	0	0	26	15	238	64	0	317	32	26	9	0	67	551
04:45 PM	3	140	14	10	167	15	21	3	0	39	17	267	59	0	343	48	31	22	0	101	650
Total	5	260	33	10	308	27	35	3	0	65	32	505	123	0	660	80	57	31	0	168	1201
05:00 PM	3	119	19	0	141	27	18	6	0	51	16	268	65	0	349	46	27	24	0	97	638
05:15 PM	2	133	30	0	165	25	17	5	0	47	23	295	71	0	389	43	25	32	0	100	701
05:30 PM	0	106	24	0	130	17	18	5	0	40	24	297	62	0	383	37	39	26	0	102	655
05:45 PM	2	102	20	0	124	16	21	5	0	42	12	309	72	0	393	39	39	22	0	100	659
Total	7	460	93	0	560	85	74	21	0	180	75	1169	270	0	1514	165	130	104	0	399	2653
06:00 PM	0	112	18	0	130	14	11	3	0	28	21	275	84	0	380	39	37	8	0	84	622
06:15 PM	6	116	17	0	139	16	19	12	0	47	17	278	75	0	370	28	19	20	0	67	623
Grand Total	33	3779	448	10	4270	402	399	57	0	858	190	2648	649	1	3488	487	373	378	2	1240	9856
Apprch %	0.8	88.5	10.5	0.2		46.9	46.5	6.6	0		5.4	75.9	18.6	0		39.3	30.1	30.5	0.2		
Total %	0.3	38.3	4.5	0.1	43.3	4.1	4	0.6	0	8.7	1.9	26.9	6.6	0	35.4	4.9	3.8	3.8	0	12.6	



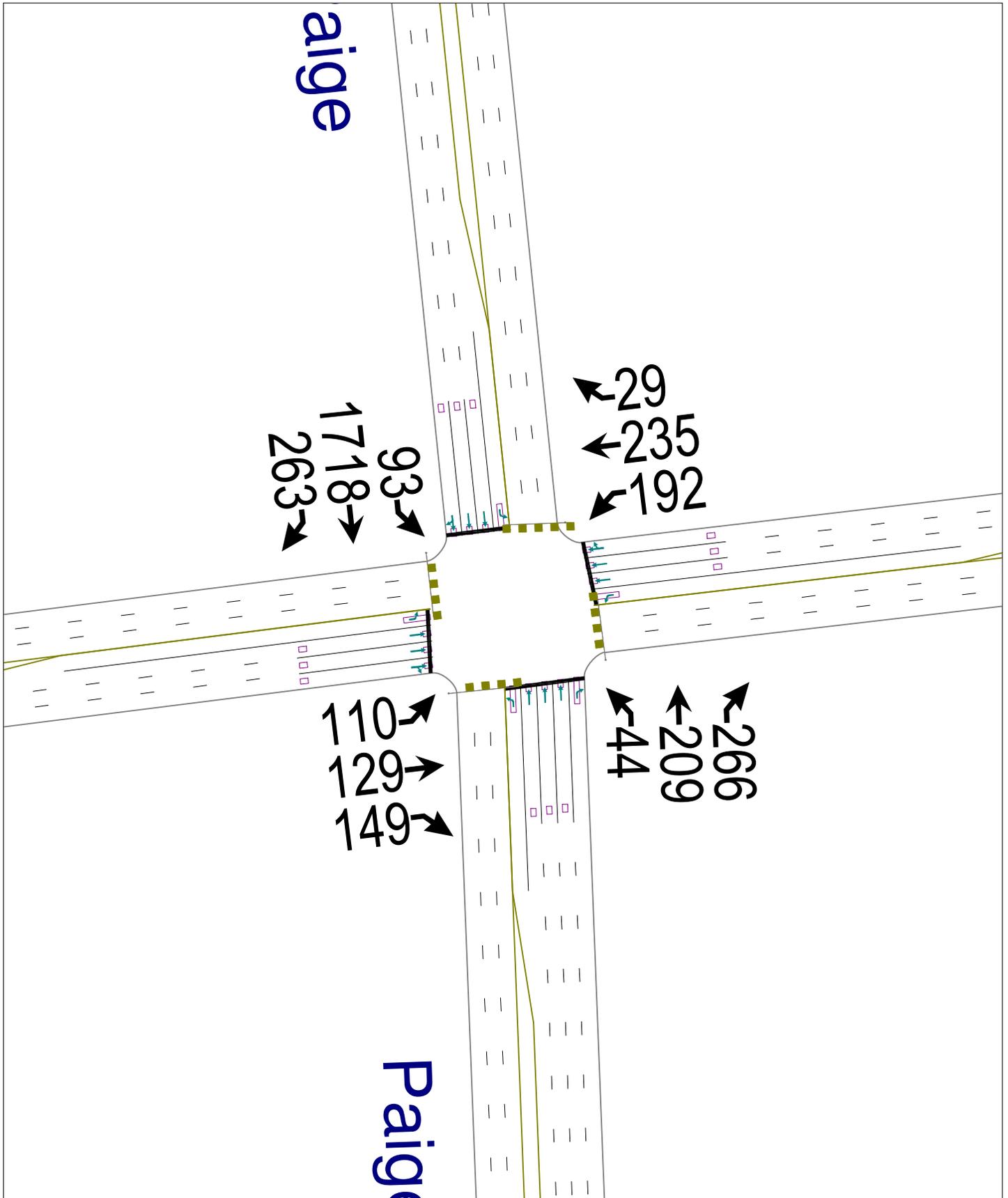
Existing (2013) Volumes - AM Peak Hour

Figure 2  
Paige Rd / Memorial Dr



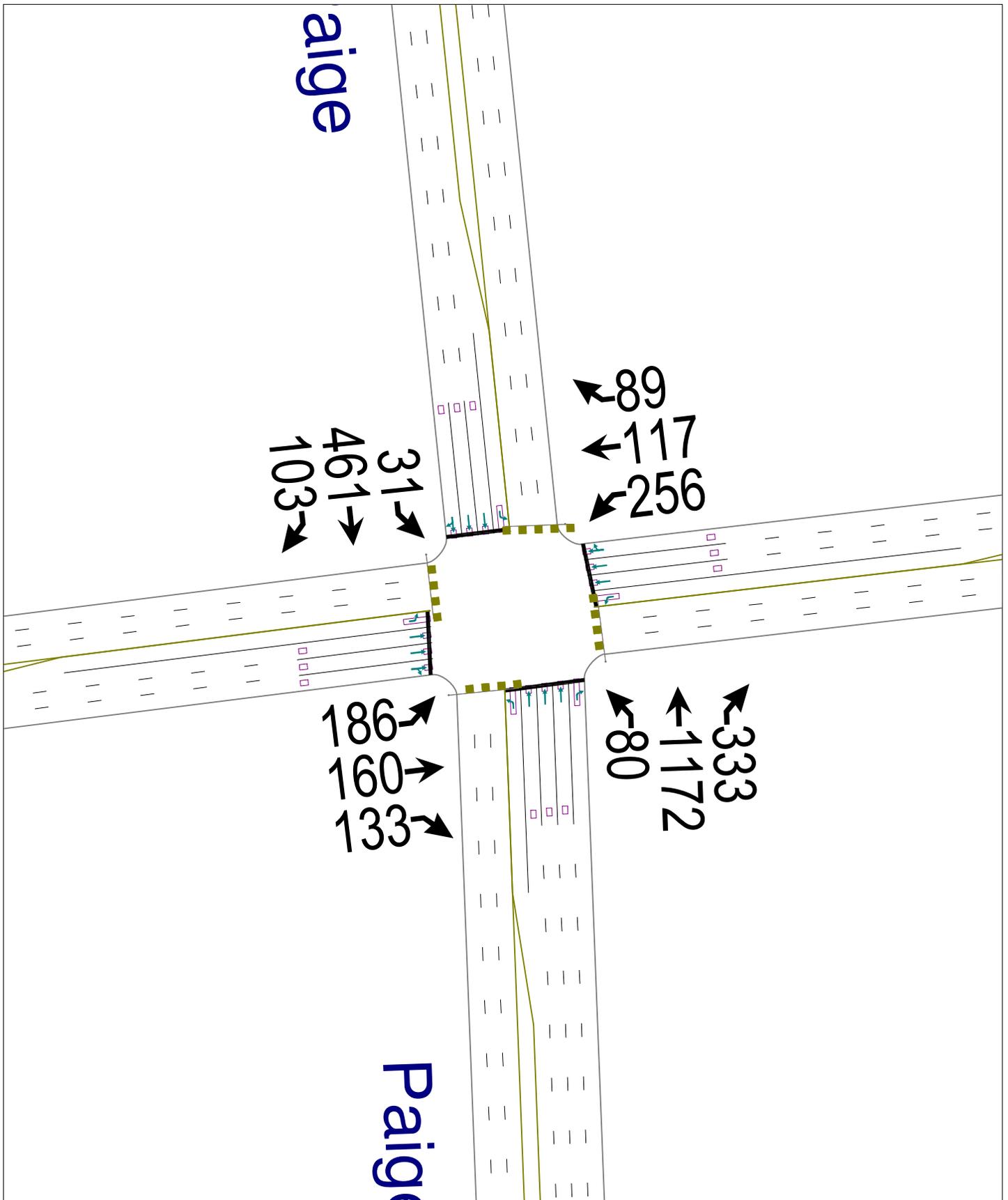
Existing (2013) Volumes - PM Peak Hour

Figure 3  
Paige Rd / Memorial Dr



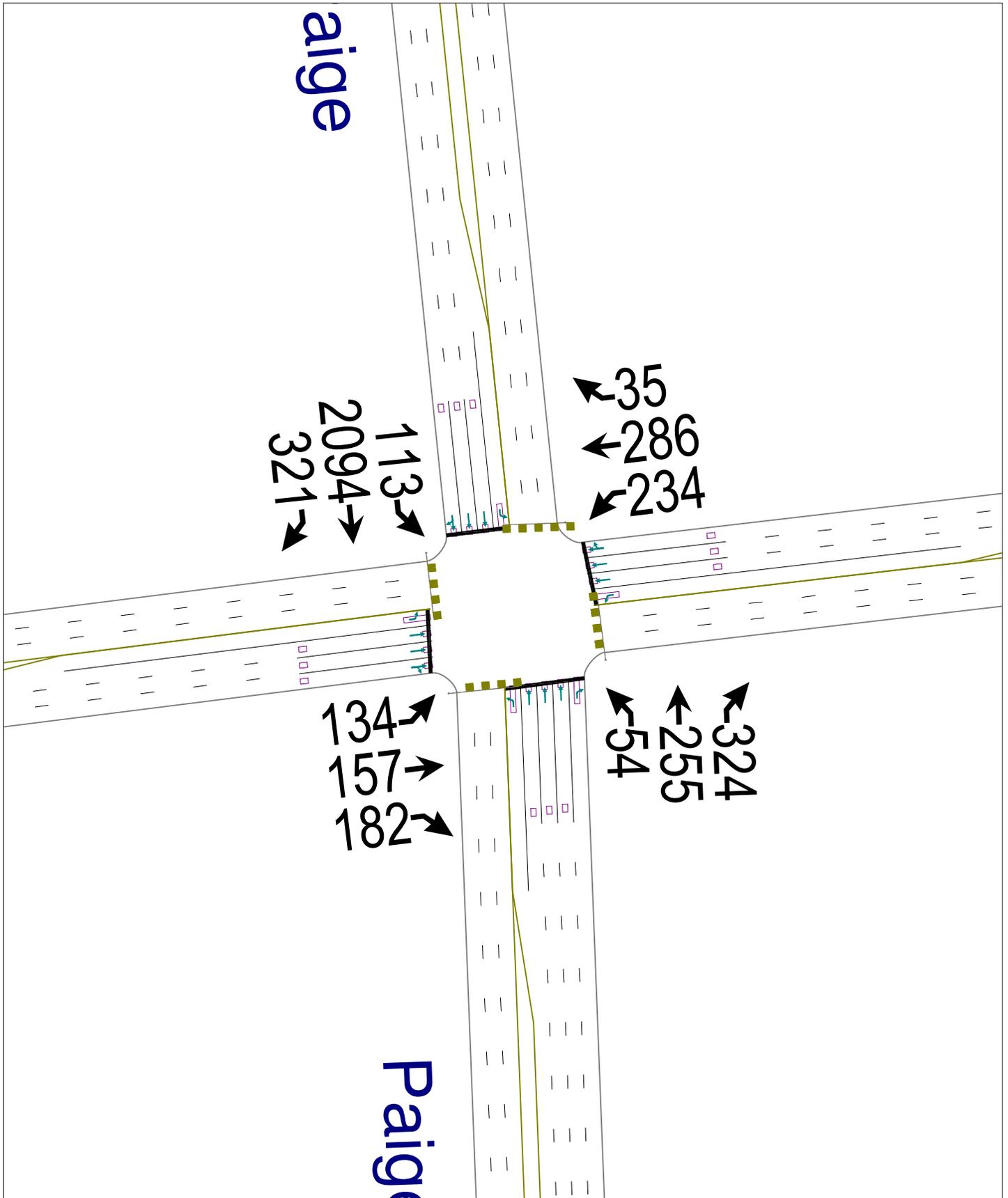
Study Year 2013 Total Volumes - AM Peak Hour

Figure 4  
Paige Rd / Memorial Dr



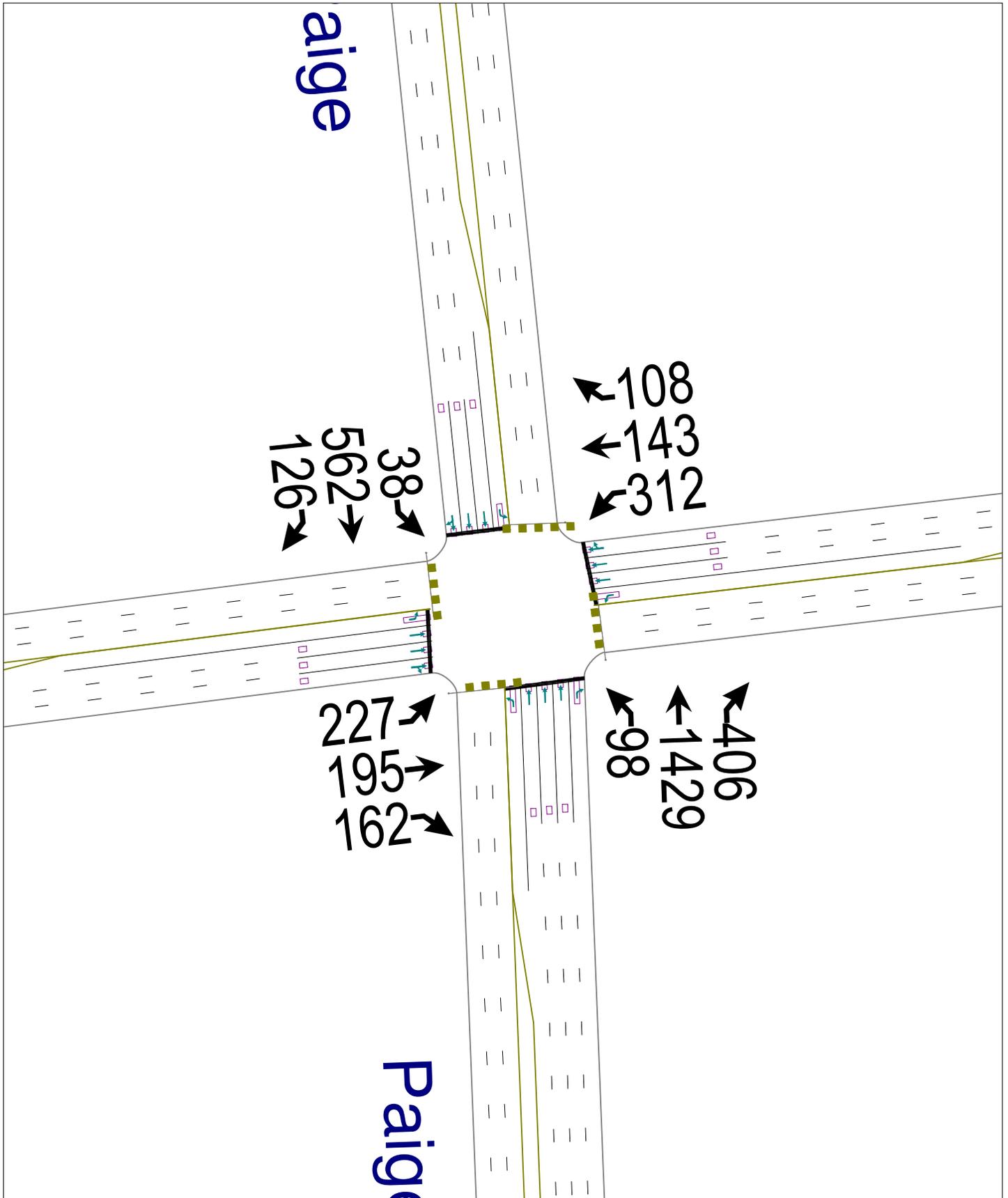
Study Year 2013 Total Volumes - PM Peak Hour

Figure 5  
Paige Rd / Memorial Dr



Horizon Year 2023 Total Volumes - AM Peak Hour

Figure 6  
Paige Rd / Memorial Dr



Horizon Year 2023 Total Volumes - PM Peak Hour

Figure 7  
Paige Rd / Memorial Dr

HCM 2010 Signalized Intersection Summary  
1: Paige & Memorial

AM Pk Hr - 2013 Total Vols - 90-sec cycle  
1/24/2013



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↖↗		↖	↖↗		↖	↖↗	↖	↖	↖↗	↖
Volume (vph)	110	129	149	192	235	29	44	209	266	93	1718	263
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Queue, veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking, Bus Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow Rate	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863
Lanes	1	3	0	1	3	0	1	3	1	1	3	0
Capacity, veh/h	376	603	281	348	971	117	183	2543	792	706	2229	338
Arriving On Green	0.07	0.18	0.18	0.10	0.21	0.21	0.04	0.50	0.50	0.04	0.50	0.50
Sat Flow, veh/h	1774.0	3390.2	1583.3	1774.0	4601.5	553.7	1774.0	1583.3	1583.3	1774.0	4458.7	675.1
Grp Volume(v), veh/h	119.6	140.2	162.0	208.7	186.5	100.5	47.8	227.2	289.1	101.1	1414.9	738.4
Grp Sat Flow(s), veh/h/ln	1774.0	1695.1	1583.3	1774.0	1695.1	1765.0	1774.0	1695.1	1583.3	1774.0	1695.1	1743.6
Q Serve(g_s), s	4.9	3.2	8.4	8.1	4.1	4.3	1.1	2.1	10.1	2.5	32.2	33.1
Cycle Q Clear(g_c), s	4.9	3.2	8.4	8.1	4.1	4.3	1.1	2.1	10.1	2.5	32.2	33.1
Proportion In Lane	1.000		1.000	1.000		0.314	1.000		1.000	1.000		0.387
Lane Grp Cap(c), veh/h	376.1	602.7	281.5	347.6	715.7	372.6	183.3	2542.6	791.7	706.4	1695.1	871.8
V/C Ratio(X)	0.318	0.233	0.575	0.600	0.261	0.270	0.261	0.089	0.365	0.143	0.835	0.847
Avail Cap(c_a), veh/h	376.1	602.7	281.5	347.6	715.7	372.6	183.3	2542.6	791.7	706.4	1695.1	871.8
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Uniform Delay (d), s/veh	27.6	31.7	33.9	24.5	29.6	29.7	17.8	11.8	13.8	9.9	19.3	19.5
Incr Delay (d2), s/veh	2.2	0.9	8.3	7.5	0.9	1.8	3.4	0.1	1.3	0.4	5.0	10.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane Group Delay (d), s/veh	29.8	32.6	42.2	32.0	30.5	31.5	21.2	11.8	15.1	10.4	24.3	29.5
Lane Group LOS	C	C	D	C	C	C	C	B	B	B	C	C
Approach Volume, veh/h		422			496			564			2254	
Approach Delay, s/veh		35.5			31.3			14.3			25.4	
Approach LOS		D			C			B			C	

Time	EB		WB		NB		SB	
Assigned Phase	7	4	3	8	5	2	1	6
Phase Duration (G+Y+Rc), s	10.00	20.00	13.00	23.00	8.00	49.00	8.00	49.00
Change Period (Y+Rc), s	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Max Green Setting (Gmax), s	6.00	16.00	9.00	19.00	4.00	45.00	4.00	45.00
Max Q Clear Time (g_c+I1), s	6.91	10.43	10.13	6.29	3.14	12.05	4.48	35.05
Green Extension Time (p_c)	0.00	1.68	0.00	2.83	0.00	24.24	0.00	8.82

Intersection Summary	
HCM 2010 Control Delay	25.6
HCM 2010 Level of Service	C

HCM 2010 Signalized Intersection Summary  
1: Paige & Memorial

PM Pk Hr - 2013 Total Vols - 90-sec cycle  
1/24/2013



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↕	↗	↖	↕	↗	↖	↕	↗	↖	↕	↗
Volume (vph)	186	160	133	256	117	89	80	1172	333	31	461	103
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Queue, veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking, Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow Rate	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863
Lanes	1	3	0	1	3	0	1	3	1	1	3	0
Capacity, veh/h	521	603	281	535	829	387	423	2034	633	245	1626	355
Arriving On Green	0.13	0.18	0.18	0.20	0.24	0.24	0.06	0.40	0.40	0.04	0.39	0.39
Sat Flow, veh/h	1774.0	3390.2	1583.3	1774.0	3390.2	1583.3	1774.0	1583.3	1583.3	1774.0	4180.1	911.9
Grp Volume(v), veh/h	202.2	173.9	144.6	278.3	127.2	96.7	87.0	1273.9	362.0	33.7	404.1	208.9
Grp Sat Flow(s),veh/h/ln	1774.0	1695.1	1583.3	1774.0	1695.1	1583.3	1774.0	1695.1	1583.3	1774.0	1695.1	1701.8
Q Serve(g_s), s	8.0	4.0	7.4	8.9	2.7	4.4	2.5	18.0	16.0	1.0	7.4	7.7
Cycle Q Clear(g_c), s	8.0	4.0	7.4	8.9	2.7	4.4	2.5	18.0	16.0	1.0	7.4	7.7
Proportion In Lane	1.000		1.000	1.000		1.000	1.000		1.000	1.000		0.536
Lane Grp Cap(c), veh/h	521.4	602.7	281.5	535.4	828.7	387.0	423.0	2034.1	633.3	245.2	1318.4	661.8
V/C Ratio(X)	0.388	0.289	0.514	0.520	0.153	0.250	0.206	0.626	0.572	0.137	0.307	0.316
Avail Cap(c_a), veh/h	521.4	602.7	281.5	535.4	828.7	387.0	423.0	2034.1	633.3	245.2	1318.4	661.8
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Uniform Delay (d), s/veh	24.1	32.1	33.5	17.0	26.7	27.4	14.5	21.6	21.0	16.5	19.1	19.2
Incr Delay (d2), s/veh	2.2	1.2	6.6	3.6	0.4	1.5	1.1	1.5	3.7	1.2	0.6	1.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane Group Delay (d), s/veh	26.3	33.3	40.0	20.6	27.1	28.9	15.6	23.1	24.7	17.6	19.7	20.4
Lane Group LOS	C	C	D	C	C	C	B	C	C	B	B	C
Approach Volume, veh/h		521			502			1723			647	
Approach Delay, s/veh		32.4			23.8			23.1			19.8	
Approach LOS		C			C			C			B	

Time	7	4	3	8	5	2	1	6
Assigned Phase	7	4	3	8	5	2	1	6
Phase Duration (G+Y+Rc), s	16.00	20.00	22.00	26.00	9.00	40.00	8.00	39.00
Change Period (Y+Rc), s	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Max Green Setting (Gmax), s	12.00	16.00	18.00	22.00	5.00	36.00	4.00	35.00
Max Q Clear Time (g_c+I1), s	9.97	9.44	10.93	6.43	4.53	20.05	2.99	9.70
Green Extension Time (p_c)	0.11	1.75	0.46	2.87	0.01	11.59	0.00	16.10

Intersection Summary	24.0	C
HCM 2010 Control Delay	24.0	
HCM 2010 Level of Service		C

HCM 2010 Signalized Intersection Summary  
1: Paige & Memorial

AM Pk Hr - 2023 Total Vols - 90-sec cycle  
1/16/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	134	157	182	234	286	35	54	255	324	113	2094	321
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Queue, veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking, Bus Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow Rate	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863
Lanes	1	3	0	1	3	0	1	3	1	1	3	0
Capacity, veh/h	350	603	281	299	870	104	161	2599	809	689	2285	340
Arriving On Green	0.08	0.18	0.18	0.09	0.19	0.19	0.04	0.51	0.51	0.04	0.51	0.51
Sat Flow, veh/h	1774.0	3390.2	1583.3	1774.0	4604.7	551.0	1774.0	1583.3	1583.3	1774.0	4471.1	664.5
Grp Volume(v), veh/h	145.7	170.7	197.8	254.3	227.0	121.9	58.7	277.2	352.2	122.8	1708.5	916.5
Grp Sat Flow(s),veh/h/ln	1774.0	1695.1	1583.3	1774.0	1695.1	1765.5	1774.0	1695.1	1583.3	1774.0	1695.1	1745.5
Q Serve(g_s), s	6.0	3.9	10.6	8.0	5.2	5.4	1.4	2.5	12.6	3.0	44.7	46.0
Cycle Q Clear(g_c), s	6.0	3.9	10.6	8.0	5.2	5.4	1.4	2.5	12.6	3.0	44.7	46.0
Proportion In Lane	1.000		1.000	1.000		0.312	1.000		1.000	1.000		0.381
Lane Grp Cap(c), veh/h	350.3	602.7	281.5	298.6	640.4	333.5	161.4	2599.2	809.3	688.9	1732.8	892.1
V/C Ratio(X)	0.416	0.283	0.703	0.852	0.354	0.366	0.364	0.107	0.435	0.178	0.986	1.027
Avail Cap(c_a), veh/h	350.3	602.7	281.5	298.6	640.4	333.5	161.4	2599.2	809.3	688.9	1732.8	892.1
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Uniform Delay (d), s/veh	27.3	32.0	34.8	31.3	31.7	31.8	20.9	11.4	13.8	9.6	21.7	22.0
Incr Delay (d2), s/veh	3.6	1.2	13.7	25.1	1.5	3.1	6.2	0.1	1.7	0.6	18.6	37.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane Group Delay (d), s/veh	30.9	33.2	48.5	56.5	33.3	34.9	27.1	11.5	15.5	10.2	40.2	59.3
Lane Group LOS	C	C	D	E	C	C	C	B	B	B	D	F
Approach Volume, veh/h		514			603			688			2748	
Approach Delay, s/veh		38.4			43.4			14.9			45.2	
Approach LOS		D			D			B			D	
<b>Timer</b>												
Assigned Phase	7	4		3	8		5	2		1	6	
Phase Duration (G+Y+Rc), s	11.00	20.00		12.00	21.00		8.00	50.00		8.00	50.00	
Change Period (Y+Rc), s	4.00	4.00		4.00	4.00		4.00	4.00		4.00	4.00	
Max Green Setting (Gmax), s	7.00	16.00		8.00	17.00		4.00	46.00		4.00	46.00	
Max Q Clear Time (g_c+I1), s	7.99	12.57		10.00	7.41		3.37	14.59		4.98	48.00	
Green Extension Time (p_c)	0.00	1.40		0.00	2.99		0.00	27.49		0.00	0.00	
<b>Intersection Summary</b>												
HCM 2010 Control Delay			39.6									
HCM 2010 Level of Service			D									

HCM 2010 Signalized Intersection Summary  
 1: Paige & Memorial

PM Pk Hr - 2023 Total Vols - 90-sec cycle  
 1/16/2013

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	227	195	162	312	143	108	98	1429	406	38	562	126
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Queue, veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking, Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow Rate	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863
Lanes	1	3	0	1	3	0	1	3	1	1	3	0
Capacity, veh/h	512	603	281	529	866	405	380	1978	616	199	1529	337
Arriving On Green	0.13	0.18	0.18	0.21	0.26	0.26	0.07	0.39	0.39	0.04	0.37	0.37
Sat Flow, veh/h	1774.0	3390.2	1583.3	1774.0	3390.2	1583.3	1774.0	1583.3	1583.3	1774.0	4171.2	919.4
Grp Volume(v), veh/h	246.7	212.0	176.1	339.1	155.4	117.4	106.5	1553.3	441.3	41.3	494.5	253.3
Grp Sat Flow(s),veh/h/ln	1774.0	1695.1	1583.3	1774.0	1695.1	1583.3	1774.0	1695.1	1583.3	1774.0	1695.1	1700.5
Q Serve(g_s), s	10.0	4.9	9.3	10.9	3.2	5.4	3.1	24.2	21.3	1.3	9.7	10.0
Cycle Q Clear(g_c), s	10.0	4.9	9.3	10.9	3.2	5.4	3.1	24.2	21.3	1.3	9.7	10.0
Proportion In Lane	1.000		1.000	1.000		1.000	1.000		1.000	1.000		0.541
Lane Grp Cap(c), veh/h	512.4	602.7	281.5	528.8	866.4	404.6	380.1	1977.6	615.7	198.6	1243.1	623.5
V/C Ratio(X)	0.482	0.352	0.626	0.641	0.179	0.290	0.280	0.785	0.717	0.208	0.398	0.406
Avail Cap(c_a), veh/h	512.4	602.7	281.5	528.8	866.4	404.6	380.1	1977.6	615.7	198.6	1243.1	623.5
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Uniform Delay (d), s/veh	24.8	32.5	34.2	17.3	26.1	26.9	15.1	24.2	23.3	19.1	21.1	21.2
Incr Delay (d2), s/veh	3.2	1.6	10.1	5.9	0.5	1.8	1.8	3.2	7.0	2.4	1.0	2.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane Group Delay (d), s/veh	28.0	34.1	44.3	23.1	26.6	28.7	17.0	27.4	30.3	21.5	22.1	23.2
Lane Group LOS	C	C	D	C	C	C	B	C	C	C	C	C
Approach Volume, veh/h		635			612			2101			789	
Approach Delay, s/veh		34.6			25.1			27.5			22.4	
Approach LOS		C			C			C			C	
<b>Timer</b>												
Assigned Phase	7	4		3	8		5	2		1	6	
Phase Duration (G+Y+Rc), s	16.00	20.00		23.00	27.00		10.00	39.00		8.00	37.00	
Change Period (Y+Rc), s	4.00	4.00		4.00	4.00		4.00	4.00		4.00	4.00	
Max Green Setting (Gmax), s	12.00	16.00		19.00	23.00		6.00	35.00		4.00	33.00	
Max Q Clear Time (g_c+I1), s	12.02	11.26		12.87	7.37		5.13	26.19		3.26	11.98	
Green Extension Time (p_c)	0.00	1.69		0.55	3.57		0.02	7.82		0.00	16.73	
<b>Intersection Summary</b>												
HCM 2010 Control Delay				27.3								
HCM 2010 Level of Service				C								

HCM 2010 Signalized Intersection Summary  
 1: Paige & Memorial

AM Pk Hr - 2013 Total Vols - 120-sec cycle  
 1/24/2013



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↵	↕↕↕		↵	↕↕↕		↵	↕↕↕	↕	↵	↕↕↕	
Volume (vph)	110	129	149	192	235	29	44	209	266	93	1718	263
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Queue, veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking, Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow Rate	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863
Lanes	1	3	0	1	3	0	1	3	1	1	3	0
Capacity, veh/h	338	452	211	348	920	111	187	2797	871	742	2415	366
Arriving On Green	0.08	0.13	0.13	0.14	0.20	0.20	0.05	0.55	0.55	0.04	0.54	0.54
Sat Flow, veh/h	1774.0	3390.2	1583.3	1774.0	4601.5	553.7	1774.0	1583.3	1583.3	1774.0	4458.7	675.1
Grp Volume(v), veh/h	119.6	140.2	162.0	208.7	186.5	100.5	47.8	227.2	289.1	101.1	1414.9	738.4
Grp Sat Flow(s),veh/h/ln	1774.0	1695.1	1583.3	1774.0	1695.1	1765.0	1774.0	1695.1	1583.3	1774.0	1695.1	1743.6
Q Serve(g_s), s	6.9	4.5	11.9	10.3	5.6	5.8	1.3	2.5	12.1	3.0	39.4	40.4
Cycle Q Clear(g_c), s	6.9	4.5	11.9	10.3	5.6	5.8	1.3	2.5	12.1	3.0	39.4	40.4
Proportion In Lane	1.000		1.000	1.000		0.314	1.000		1.000	1.000		0.387
Lane Grp Cap(c), veh/h	338.1	452.0	211.1	348.4	678.0	353.0	186.5	2796.9	870.8	741.6	1836.4	944.5
V/C Ratio(X)	0.354	0.310	0.767	0.599	0.275	0.285	0.256	0.081	0.332	0.136	0.770	0.782
Avail Cap(c_a), veh/h	338.1	452.0	211.1	348.4	678.0	353.0	186.5	2796.9	870.8	741.6	1836.4	944.5
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Uniform Delay (d), s/veh	40.3	47.0	50.2	30.4	40.6	40.7	19.5	12.7	14.9	11.1	21.6	21.9
Incr Delay (d2), s/veh	2.9	1.8	23.0	7.4	1.0	2.0	3.3	0.1	1.0	0.4	3.2	6.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane Group Delay (d), s/veh	43.2	48.8	73.2	37.9	41.6	42.7	22.8	12.8	15.9	11.4	24.8	28.3
Lane Group LOS	D	D	E	D	D	D	C	B	B	B	C	C
Approach Volume, veh/h		422			496			564			2254	
Approach Delay, s/veh		56.6			40.3			15.2			25.4	
Approach LOS		E			D			B			C	

Time												
Assigned Phase	7	4		3	8		5	2		1	6	
Phase Duration (G+Y+Rc), s	13.00	20.00		21.00	28.00		10.00	70.00		9.00	69.00	
Change Period (Y+Rc), s	4.00	4.00		4.00	4.00		4.00	4.00		4.00	4.00	
Max Green Setting (Gmax), s	9.00	16.00		17.00	24.00		6.00	66.00		5.00	65.00	
Max Q Clear Time (g_c+1), s	8.87	13.85		12.27	7.80		3.33	14.06		5.02	42.40	
Green Extension Time (p_c)	0.00	0.76		0.23	3.16		0.01	33.06		0.00	18.06	

Intersection Summary												
HCM 2010 Control Delay											29.3	
HCM 2010 Level of Service											C	

HCM 2010 Signalized Intersection Summary  
1: Paige & Memorial

PM Pk Hr - 2013 Total Vols - 120-sec cycle  
1/24/2013



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↕↕↕		↖	↕↕↕		↖	↕↕↕	↗	↖	↕↕↕	
Volume (vph)	186	160	133	256	117	89	80	1172	333	31	461	103
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Queue, veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking, Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow Rate	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863
Lanes	1	3	0	1	3	0	1	3	1	1	3	0
Capacity, veh/h	499	509	238	542	791	369	448	2161	673	264	1742	380
Arriving On Green	0.15	0.15	0.15	0.23	0.23	0.23	0.07	0.43	0.43	0.06	0.42	0.42
Sat Flow, veh/h	1774.0	3390.2	1583.3	1774.0	3390.2	1583.3	1774.0	1583.3	1583.3	1774.0	4180.1	911.9
Grp Volume(v), veh/h	202.2	173.9	144.6	278.3	127.2	96.7	87.0	1273.9	362.0	33.7	404.1	208.9
Grp Sat Flow(s), veh/h/ln	1774.0	1695.1	1583.3	1774.0	1695.1	1583.3	1774.0	1695.1	1583.3	1774.0	1695.1	1701.8
Q Serve(g_s), s	10.8	5.5	10.2	11.5	3.6	6.0	3.1	23.1	20.4	1.2	9.5	9.8
Cycle Q Clear(g_c), s	10.8	5.5	10.2	11.5	3.6	6.0	3.1	23.1	20.4	1.2	9.5	9.8
Proportion In Lane	1.000		1.000	1.000		1.000	1.000		1.000	1.000		0.536
Lane Grp Cap(c), veh/h	498.9	508.5	237.5	542.2	791.0	369.4	448.2	2161.3	672.9	264.2	1412.6	709.1
V/C Ratio(X)	0.405	0.342	0.609	0.513	0.161	0.262	0.194	0.589	0.538	0.128	0.286	0.295
Avail Cap(c_a), veh/h	498.9	508.5	237.5	542.2	791.0	369.4	448.2	2161.3	672.9	264.2	1412.6	709.1
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Uniform Delay (d), s/veh	33.2	45.7	47.7	21.8	36.6	37.6	16.8	26.5	25.7	19.1	23.2	23.3
Incr Delay (d2), s/veh	2.4	1.8	11.1	3.4	0.4	1.7	1.0	1.2	3.1	1.0	0.5	1.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane Group Delay (d), s/veh	35.6	47.5	58.8	25.2	37.1	39.3	17.8	27.7	28.8	20.1	23.7	24.3
Lane Group LOS	D	D	E	C	D	D	B	C	C	C	C	C
Approach Volume, veh/h		521			502			1723			647	
Approach Delay, s/veh		46.0			30.9			27.4			23.7	
Approach LOS		D			C			C			C	

Time												
Assigned Phase	7	4		3	8		5	2		1	6	
Phase Duration (G+Y+Rc), s	22.00	22.00		32.00	32.00		12.00	55.00		11.00	54.00	
Change Period (Y+Rc), s	4.00	4.00		4.00	4.00		4.00	4.00		4.00	4.00	
Max Green Setting (Gmax), s	18.00	18.00		28.00	28.00		8.00	51.00		7.00	50.00	
Max Q Clear Time (g_c+I1), s	12.80	12.25		13.53	7.99		5.14	25.06		3.22	11.80	
Green Extension Time (p_c)	0.24	1.59		0.67	3.15		0.04	16.36		0.01	20.49	

Intersection Summary												
HCM 2010 Control Delay				30.1								
HCM 2010 Level of Service				C								

HCM 2010 Signalized Intersection Summary  
1: Paige & Memorial

AM Pk Hr - 2023 Total Vols - 120-sec cycle  
1/16/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	134	157	182	234	286	35	54	255	324	113	2094	321
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Queue, veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking, Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow Rate	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863
Lanes	1	3	0	1	3	0	1	3	1	1	3	0
Capacity, veh/h	345	452	211	306	767	92	129	2839	884	719	2534	377
Arriving On Green	0.10	0.13	0.13	0.13	0.17	0.17	0.03	0.56	0.56	0.04	0.57	0.57
Sat Flow, veh/h	1774.0	3390.2	1583.3	1774.0	4604.7	551.0	1774.0	1583.3	1583.3	1774.0	4471.1	664.5
Grp Volume(v), veh/h	145.7	170.7	197.8	254.3	227.0	121.9	58.7	277.2	352.2	122.8	1708.5	916.5
Grp Sat Flow(s), veh/h/ln	1774.0	1695.1	1583.3	1774.0	1695.1	1765.5	1774.0	1695.1	1583.3	1774.0	1695.1	1745.5
Q Serve(g_s), s	8.2	5.5	14.8	13.7	7.2	7.4	1.7	3.1	15.2	3.5	52.8	57.5
Cycle Q Clear(g_c), s	8.2	5.5	14.8	13.7	7.2	7.4	1.7	3.1	15.2	3.5	52.8	57.5
Proportion In Lane	1.000		1.000	1.000		0.312	1.000		1.000	1.000		0.381
Lane Grp Cap(c), veh/h	345.2	452.0	211.1	306.2	565.0	294.3	129.2	2839.3	884.0	718.8	1921.1	989.1
V/C Ratio(X)	0.422	0.378	0.937	0.831	0.402	0.414	0.454	0.098	0.398	0.171	0.889	0.927
Avail Cap(c_a), veh/h	345.2	452.0	211.1	306.2	565.0	294.3	129.2	2839.3	884.0	718.8	1921.1	989.1
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(l)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Uniform Delay (d), s/veh	38.5	47.5	51.5	34.7	44.7	44.8	28.1	12.4	15.1	10.0	22.7	23.7
Incr Delay (d2), s/veh	3.8	2.4	47.5	22.3	2.1	4.3	11.1	0.1	1.3	0.5	6.6	15.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane Group Delay (d), s/veh	42.2	49.9	99.0	57.0	46.8	49.0	39.2	12.4	16.4	10.5	29.4	39.3
Lane Group LOS	D	D	F	E	D	D	D	B	B	B	C	D
Approach Volume, veh/h		514			603			688			2748	
Approach Delay, s/veh		66.6			51.5			16.8			31.8	
Approach LOS		E			D			B			C	
<b>Timer</b>												
Assigned Phase	7	4		3	8		5	2		1	6	
Phase Duration (G+Y+Rc), s	16.00	20.00		20.00	24.00		8.00	71.00		9.00	72.00	
Change Period (Y+Rc), s	4.00	4.00		4.00	4.00		4.00	4.00		4.00	4.00	
Max Green Setting (Gmax), s	12.00	16.00		16.00	20.00		4.00	67.00		5.00	68.00	
Max Q Clear Time (g_c+l1), s	10.23	16.85		15.72	9.42		3.68	17.16		5.50	59.48	
Green Extension Time (p_c)	0.06	0.00		0.02	3.17		0.00	40.73		0.00	8.13	
<b>Intersection Summary</b>												
HCM 2010 Control Delay				36.1								
HCM 2010 Level of Service				D								

HCM 2010 Signalized Intersection Summary  
 1: Paige & Memorial

PM Pk Hr - 2023 Total Vols - 120-sec cycle  
 1/16/2013

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	227	195	162	312	143	108	98	1429	406	38	562	126
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Queue, veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking, Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow Rate	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863
Lanes	1	3	0	1	3	0	1	3	1	1	3	0
Capacity, veh/h	503	452	211	543	763	356	379	2204	686	195	1773	391
Arriving On Green	0.17	0.13	0.13	0.26	0.22	0.22	0.05	0.43	0.43	0.04	0.43	0.43
Sat Flow, veh/h	1774.0	3390.2	1583.3	1774.0	3390.2	1583.3	1774.0	1583.3	1583.3	1774.0	4171.2	919.4
Grp Volume(v), veh/h	246.7	212.0	176.1	339.1	155.4	117.4	106.5	1553.3	441.3	41.3	494.5	253.3
Grp Sat Flow(s), veh/h/ln	1774.0	1695.1	1583.3	1774.0	1695.1	1583.3	1774.0	1695.1	1583.3	1774.0	1695.1	1700.5
Q Serve(g_s), s	13.6	6.9	13.0	14.2	4.5	7.4	4.0	29.9	26.3	1.5	11.8	12.1
Cycle Q Clear(g_c), s	13.6	6.9	13.0	14.2	4.5	7.4	4.0	29.9	26.3	1.5	11.8	12.1
Proportion In Lane	1.000		1.000	1.000		1.000	1.000		1.000	1.000		0.541
Lane Grp Cap(c), veh/h	502.6	452.0	211.1	543.0	762.8	356.3	379.2	2203.6	686.1	194.9	1440.8	722.7
V/C Ratio(X)	0.491	0.469	0.834	0.625	0.204	0.330	0.281	0.705	0.643	0.212	0.343	0.350
Avail Cap(c_a), veh/h	502.6	452.0	211.1	543.0	762.8	356.3	379.2	2203.6	686.1	194.9	1440.8	722.7
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Uniform Delay (d), s/veh	34.1	48.1	50.7	21.9	37.8	38.9	17.9	27.7	26.7	21.5	23.2	23.3
Incr Delay (d2), s/veh	3.4	3.5	30.4	5.3	0.6	2.5	1.8	1.9	4.6	2.5	0.7	1.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane Group Delay (d), s/veh	37.6	51.5	81.2	27.3	38.4	41.4	19.7	29.7	31.3	23.9	23.9	24.6
Lane Group LOS	D	D	F	C	D	D	B	C	C	C	C	C
Approach Volume, veh/h		635			612			2101			789	
Approach Delay, s/veh		54.3			32.8			29.5			24.1	
Approach LOS		D			C			C			C	
<b>Timer</b>												
Assigned Phase	7	4		3	8		5	2		1	6	
Phase Duration (G+Y+Rc), s	24.00	20.00		35.00	31.00		10.00	56.00		9.00	55.00	
Change Period (Y+Rc), s	4.00	4.00		4.00	4.00		4.00	4.00		4.00	4.00	
Max Green Setting (Gmax), s	20.00	16.00		31.00	27.00		6.00	52.00		5.00	51.00	
Max Q Clear Time (g_c+I1), s	15.57	15.01		16.18	9.45		5.96	31.90		3.53	14.08	
Green Extension Time (p_c)	0.28	0.42		0.87	3.74		0.00	16.12		0.01	25.63	
<b>Intersection Summary</b>												
HCM 2010 Control Delay			32.8									
HCM 2010 Level of Service			C									

Queues  
1: Paige & Memorial

AM Pk Hr - 2013 Total Vols - 90-sec cycle

1/24/2013



Lane/Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	120	302	209	287	48	227	289	101	2153
v/c Ratio	0.39	0.33	0.59	0.27	0.30	0.09	0.31	0.16	0.86
Control Delay	27.3	20.8	31.7	28.1	12.8	11.9	2.5	8.9	23.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.3	20.8	31.7	28.1	12.8	11.9	2.5	8.9	23.6
Queue Length 50th (ft)	49	33	90	46	11	23	0	23	367
Queue Length 95th (ft)	92	59	151	71	25	36	38	45	439
Internal Link Dist (ft)		1240		1259		654			724
Turn Bay Length (ft)	275		275		150			150	
Base Capacity (vph)	306	926	352	1072	161	2542	936	641	2514
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.39	0.33	0.59	0.27	0.30	0.09	0.31	0.16	0.86

Queues  
1: Paige & Memorial

PM Pk Hr - 2013 Total Vols - 90-sec cycle

1/24/2013



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	202	319	278	224	87	1274	362	34	613
v/c Ratio	0.46	0.33	0.53	0.18	0.24	0.63	0.43	0.20	0.31
Control Delay	21.5	18.4	22.1	15.5	14.2	23.3	3.7	15.0	17.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	21.5	18.4	22.1	15.5	14.2	23.3	3.7	15.0	17.5
Queue Length 50th (ft)	73	31	105	20	25	207	0	10	76
Queue Length 95th (ft)	122	57	168	40	51	255	52	25	105
Internal Link Dist (ft)		1240		1259		654			724
Turn Bay Length (ft)	275		275		150			150	
Base Capacity (vph)	436	961	523	1235	361	2034	850	168	1963
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.46	0.33	0.53	0.18	0.24	0.63	0.43	0.20	0.31

Base Data Summary

Queues  
1: Paige & Memorial

AM Pk Hr - 2023 Total Vols - 90-sec cycle  
1/16/2013



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	146	369	254	349	59	277	352	123	2625
v/c Ratio	0.47	0.40	0.82	0.36	0.37	0.11	0.36	0.20	1.02
Control Delay	29.7	25.3	49.9	31.0	14.1	11.5	2.5	8.8	46.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.7	25.3	49.9	31.0	14.1	11.5	2.5	8.8	46.0
Queue Length 50th (ft)	62	49	115	59	13	28	0	28	~552
Queue Length 95th (ft)	111	78	#174	87	28	42	41	51	#679
Internal Link Dist (ft)		1240		1259		654			724
Turn Bay Length (ft)	275		275		150			150	
Base Capacity (vph)	308	912	309	962	161	2599	981	626	2570
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.47	0.40	0.82	0.36	0.37	0.11	0.36	0.20	1.02

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

Queues  
1: Paige & Memorial

PM Peak Hour - 2023 Total Volumes - 90-sec cycle

1/16/2013



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	247	388	339	272	107	1553	441	41	748
v/c Ratio	0.58	0.39	0.65	0.21	0.34	0.79	0.50	0.25	0.40
Control Delay	24.1	18.8	24.6	15.2	16.2	27.7	4.1	16.8	20.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.1	18.8	24.6	15.2	16.2	27.7	4.1	16.8	20.0
Queue Length 50th (ft)	90	38	131	24	32	278	0	12	103
Queue Length 95th (ft)	146	67	205	46	62	337	57	29	137
Internal Link Dist (ft)		1240		1259		654			724
Turn Bay Length (ft)	275		275		150			150	
Base Capacity (vph)	427	987	519	1302	315	1977	885	161	1854
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.58	0.39	0.65	0.21	0.34	0.79	0.50	0.25	0.40

Intersection Summary

Queues  
1: Paige & Memorial

AM Pk Hr - 2013 Total Vols - 120-sec cycle  
1/24/2013



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	120	302	209	287	48	227	289	101	2153
v/c Ratio	0.44	0.42	0.57	0.28	0.32	0.08	0.29	0.15	0.79
Control Delay	37.4	30.5	39.5	39.2	14.4	12.8	2.3	9.6	24.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	37.4	30.5	39.5	39.2	14.4	12.8	2.3	9.6	24.4
Queue Length 50th (ft)	69	47	127	65	13	28	0	29	464
Queue Length 95th (ft)	119	78	197	94	28	42	39	52	529
Internal Link Dist (ft)		1240		1259		654			724
Turn Bay Length (ft)	275		275		150			150	
Base Capacity (vph)	274	726	365	1012	151	2796	1000	683	2716
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.44	0.42	0.57	0.28	0.32	0.08	0.29	0.15	0.79

Intersection Summary

Queues  
1: Paige & Memorial

PM Pk Hr - 2013 Total Vols - 120-sec cycle  
1/24/2013



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SEB	SET
Lane Group Flow (vph)	202	319	278	224	87	1274	362	34	613
v/c Ratio	0.47	0.38	0.51	0.19	0.22	0.59	0.41	0.17	0.29
Control Delay	28.0	26.1	28.1	21.1	16.2	27.9	3.7	16.4	21.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.0	26.1	28.1	21.1	16.2	27.9	3.7	16.4	21.6
Queue Length 50th (ft)	101	43	147	28	33	272	0	13	103
Queue Length 95th (ft)	159	74	219	52	61	320	56	29	133
Internal Link Dist (ft)		1240		1259		654			724
Turn Bay Length (ft)	275		275		150			150	
Base Capacity (vph)	434	834	540	1183	397	2161	880	202	2091
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.47	0.38	0.51	0.19	0.22	0.59	0.41	0.17	0.29

Queue Length Summary

Queues  
1: Paige & Memorial

AM Pk Hr - 2023 Total Vols - 120-sec cycle  
1/16/2013



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	146	369	254	349	59	277	352	123	2625
v/c Ratio	0.47	0.53	0.77	0.41	0.49	0.10	0.34	0.18	0.92
Control Delay	38.1	40.6	51.4	44.4	24.0	12.5	2.2	9.5	30.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	38.1	40.6	51.4	44.4	24.0	12.5	2.2	9.5	30.2
Queue Length 50th (ft)	86	76	161	85	16	35	0	35	638
Queue Length 95th (ft)	143	111	#270	118	38	49	41	60	723
Internal Link Dist' (ft)		1240		1259		654			724
Turn Bay Length (ft)	275		275		150			150	
Base Capacity (vph)	309	694	330	846	121	2839	1039	671	2841
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.47	0.53	0.77	0.41	0.49	0.10	0.34	0.18	0.92

**Intersection Summary**

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

Queues  
1: Paige & Memorial

PM Peak Hour - 2023 Total Volumes - 120-sec cycle

1/16/2013



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	247	388	339	272	107	1553	441	41	748
v/c Ratio	0.56	0.51	0.62	0.23	0.33	0.70	0.47	0.30	0.35
Control Delay	29.9	32.5	30.3	21.9	18.5	29.9	3.7	20.9	22.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.9	32.5	30.3	21.9	18.5	29.9	3.7	20.9	22.1
Queue Length 50th (ft)	126	63	184	35	42	352	0	16	130
Queue Length 95th (ft)	191	99	268	61	74	409	59	35	164
Internal Link Dist (ft)		1240		1259		654			724
Turn Bay Length (ft)	275		275		150			150	
Base Capacity (vph)	438	757	545	1160	324	2203	935	135	2132
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.56	0.51	0.62	0.23	0.33	0.70	0.47	0.30	0.35

Intersection Summary

Traffic Counts November 30, 2012: E. Bound Memorial Left Turns to N. Bound Paige  
 Time begins at 4:18 P.M. and ends at 6:30 P.M.

Time Interval 1 minute	Vehicles Arrive for Lt. Turn	Vehicle Max. Storage Lt Turn	Time Interval 1 Minute	Vehicles Arrive for Lt. Turn	Vehicle Max. Storage Lt Turn
418	1	1	531	9	7
419	1	2	532	8	5
420	2	2	533	0	0
421	6	6	534	6	6
422	2	1	535	4	6
423	5	2	536	4	4
424	1	1	537	3	5
425	4	2	538	5	3
426	2	3	540	8	8
427	1	1	541	3	3
428	3	3	542	7	3
429	1	1	543	2	5
430	0	0	544	6	5
431	5	2	545	2	2
432	4	3	546	5	2
433	4	3	547	2	3
434	5	4	548	2	2
435	1	6	549	3	1
436	6	6	550	7	6
437	0	0	551	1	7
438	5	2	552	5	7
439	3	3	553	4	7
440	1	3	554	3	3
441	5	5	555	3	4
442	6	6	556	4	4
443	0	6	557	0	0
444	5	5	558	6	3
445	2	0	559	8	5
446	5	2	600	3	3
447	1	5	601	3	3
448	0	0	602	4	3
449	2	1	603	1	3
450	2	2	604	8	<b>9</b>
451	0	2	605	3	<b>9</b>
452	2	2	604	7	7
453	0	0	607	1	8
454	5	0	608	2	2
455	2	5	609	4	2
456	8	8	610	2	2
457	0	8	611	0	2
458	4	2	612	1	1
459	2	4	613	5	1
500	3	3	614	5	3
501	2	1	615	1	1
502	3	3	616	7	7
503	0	3	617	0	6
504	3	3	618	5	4
505	3	3	619	1	1
506	3	3	620	6	2
507	1	0	621	2	3
508	7	8	622	7	7

Peak  
Peak

509	0	6	623	1	7
510	3	3	625	5	5
511	1	3	626	4	3
512	4	3	627	2	5
513	1	1	628	5	5
515	0	1	629	3	5
516	5	5	630	2	4
517	2	6		220	239
518	1	2	Avg.	3.7	4.0
519	1	2			
520	2	2			
521	10	5			
522	3	5			
523	1	3			
524	0	0			
525	5	3			
526	10	5			
527	4	8			
528	2	2			
529	7	1			
530	1	2			
	202	215			
Avg.	2.8	3.0			

Total Time Period = 212 minutes

Maximum arrival 11 vehicles

Maximum Storage = 9 vehicles

Number of time storage 9 vehicles = 2 cycles

Number of time storage 8 vehicles = 6 cycles

Number of time storage 7 vehicles = 8 cycles