



**DATE:** June 28, 2005

**TO:** Katherine Casseday, P.E.  
Director of Traffic Management, SDOT

**FROM:** Jeff Haynie, P.E./Chris Bicket, P.E.  
Transportation Engineering Northwest (TENW)

**RE:** Additional Transportation Assessment  
QFC/University Village Access Study – Seattle, Washington  
TENW Project No. 2400

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This technical memorandum documents an assessment of the additional transportation items you have requested TENW to conduct regarding the analysis of a new traffic signal at NE 45<sup>th</sup> Street/SE QFC Driveway. The information provided in this memo is a supplement to the DRAFT QFC/University Village Access Study dated February 15, 2005.

Our supplemental assessment includes the following four items:

- € A summary of modifications to the Synchro files as requested by the City.
- € A sketch illustrating the proposed improvements to increase the eastbound left-turn storage with a new traffic signal and crosswalk.
- € A summary of LOS at the intersection of NE 45<sup>th</sup> Street/SE QFC Driveway and estimated average and 95<sup>th</sup> percentile queue length for the eastbound left-turn under 2015 PM peak hour conditions with the installation of a signal.
- € A sensitivity analysis summarizing the additional number (and percentage) of eastbound left-turns that could be accommodated in the extended eastbound left-turn lane under 2015 PM peak hour conditions.

### **Modifications to Synchro files**

The City requested to review the Synchro files associated with the DRAFT QFC/University Access Study on March 31, 2005. The following summarizes the changes that were made to the Synchro files as a result of comments received from Chuck Morrison in May 2005:

1. All signals were set to actuated-coordinated except 25th Ave NE/NE 55th St and NE 45th Street/Union Bay Place which were both set to actuated-uncoordinated.
2. Recall modes were modified at all signals based on information from signal timing cards.



3. Geometry was adjusted at NE 45th St/Montlake Blvd to allow better utilization of both left-turn lanes from the viaduct to eastbound on NE 45th St.
4. Modified two intersections on NE 45<sup>th</sup> Street that were inaccurately coded as all-way stops to be two-way stops.

**Proposed Improvements to Eastbound Left-Turn lane**

The existing eastbound left-turn lane at NE 45<sup>th</sup> Street/SE QFC Driveway has approximately 260 feet of storage (see **Attachment A**). With the proposed installation of a traffic signal at the intersection of NE 45<sup>th</sup> Street/SE QFC Driveway, there are two possible locations for a crosswalk across NE 45<sup>th</sup> Street. If the crosswalk were located on the west side of the intersection (Option A), the eastbound left-turn storage could be extended by approximately 30 feet, from 260 feet to 290 feet (see **Attachment B**). If the crosswalk were located on the east side of the intersection (Option B), the eastbound left-turn lane storage could be extended by approximately 45 feet, from 260 feet to 305 feet (see **Attachment C**).

**LOS and Queue Analysis at NE 45<sup>th</sup> St/SE QFC Driveway**

**Level of Service Analysis.** An updated level of service (LOS) analysis was conducted at NE 45<sup>th</sup> Street/SE QFC Driveway for year 2015 PM peak hour conditions with the installation of a traffic signal at the intersection. The LOS analysis was conducted for 2 crosswalk options: A) a crosswalk located on the west side of the intersection and B) a crosswalk located on the east side of the intersection. For Option B it was assumed that southbound left-turns out of QFC/U-Village would have to yield to pedestrians crossing NE 45<sup>th</sup> Street. The updated analysis was based on changes made to the Synchro files as requested by the City in May 2005. The year 2015 LOS results at NE 45<sup>th</sup> Street/SE QFC Driveway are summarized in **Table 1**.

Table 1 2015 PM Peak Hour LOS Summary					
NE 45 <sup>th</sup> Street/SE QFC Driveway	LOS Results			Queue Length for EBLT <sup>4</sup> (ft)	
	LOS <sup>1</sup>	Delay <sup>2</sup>	V/C <sup>3</sup>	50 <sup>th</sup> %	95 <sup>th</sup> %
With new signal and crosswalk on west side	B	15.9	0.70	175'	265'
With new signal and crosswalk on east side	B	17.4	0.70	175'	265'
1. LOS analyses are based on methodologies established in the 2000 Highway Capacity Manual. 2. Delay = average control delay per vehicle. 3. V/C = Volume to Capacity ratio. 4. EBLT = Eastbound Left-Turn					

As shown in **Table 1**, the signalized intersection would be expected to operate at LOS B with an average delay of 15.9 seconds per vehicle during the PM peak hour in 2015 with a crosswalk on the west side of the intersection. With a crosswalk on the east side, the



intersection would be expected to operate at LOS B with an average delay of 17.4 seconds per vehicle during the PM peak hour in 2015. The detailed LOS results are included in **Attachment D**.

**Queuing Analysis.** An updated future year queuing analysis was conducted to document the anticipated average (50<sup>th</sup> percentile) and 95<sup>th</sup> percentile vehicle queue for the eastbound left-turn at the NE 45<sup>th</sup> Street/SE QFC Driveway during the weekday PM peak hour. The queuing analysis was conducted for year 2015 with a new traffic signal at the intersection and with a crosswalk on either the west or east side of the intersection. The updated analysis was based on changes made to the Synchro files as requested by the City in May 2005. The results of the year 2015 queuing analysis are summarized in **Table 1** above.

As shown in **Table 1**, in 2015 with a traffic signal and a crosswalk on either the west or east side of the intersection, the average (50<sup>th</sup> percentile) queue for the eastbound left-turn into the SE QFC Driveway from NE 45<sup>th</sup> Street is anticipated to be 175 feet. The 95<sup>th</sup> percentile queue for the eastbound left-turn is anticipated to be 265 feet. The detailed queue calculations are included in **Attachment D**.

### **Sensitivity Analysis**

A sensitivity analysis was conducted to estimate the number of additional vehicles that could be accommodated in the eastbound left-turn lane at NE 45<sup>th</sup> Street/SE QFC Driveway. The sensitivity analysis was conducted for year 2015 PM peak hour conditions with a traffic signal at the intersection and with a crosswalk on either the east or west side of the intersection.

The sensitivity analysis was conducted by adding an additional 20 vehicles to the baseline eastbound left-turn volume (248 vehicles) and then subsequently adding vehicles 5 at a time until the anticipated 95<sup>th</sup> percentile queue length exceeded the anticipated storage. The results of the sensitivity analysis are summarized in **Table 2**. The detailed queue calculations for the sensitivity analysis are included in **Attachment E**. The LOS results for the sensitivity analysis are also included in **Attachment E**.



Increase in EBLT Volume	% Increase	Total EBLT Volume	with a crosswalk on the west side		with a crosswalk on the east side	
			50 <sup>th</sup> % Queue (ft)	95 <sup>th</sup> % Queue (ft)	50 <sup>th</sup> % Queue (ft)	95 <sup>th</sup> % Queue (ft)
+20 vehicles	8%	268	190'	285'	190'	285'
+25 vehicles	10%	273	195'	290'	195'	290'
+30 vehicles	12%	278	200'	295'	200'	295'
+35 vehicles	14%	283	200'	295'	200'	295'
+40 vehicles	16%	288	205'	305'	205'	305'
+45 vehicles	18%	293	210'	310'	210'	310'

With a traffic signal at NE 45<sup>th</sup> Street/SE QFC Driveway and a crosswalk on the west side of the intersection, it is estimated that approximately 290 feet of storage could be provided in the eastbound left-turn lane if it were extended. As shown in **Table 2**, the sensitivity analysis shows that under this scenario, an additional 25 vehicles (for a total of approximately 273 vehicles) could be accommodated in the eastbound left-turn lane before the 95<sup>th</sup> percentile queue would be expected to exceed the available storage. Therefore, the eastbound left-turn would be able to accommodate approximately a 10 percent increase volume under this scenario.

With a traffic signal and a crosswalk on the east side of the intersection, it is estimated that approximately 305 feet of storage could be provided in the eastbound left-turn lane if it were extended. As shown in **Table 2**, the sensitivity analysis shows that an additional 40 vehicles (for a total of approximately 288 vehicles) could be accommodated in the eastbound left-turn lane before the 95<sup>th</sup> percentile queue would be expected to exceed the available storage. Therefore, the eastbound left-turn would be able to accommodate approximately a 16 percent increase volume under this scenario.

**Summary & Conclusions**

The 95<sup>th</sup> percentile queue for the eastbound left-turn into the SE QFC Driveway from NE 45<sup>th</sup> Street is anticipated to be 265 feet under 2015 PM peak hour conditions. This anticipated queue of 265 feet could be accommodated within the proposed lengthening of the eastbound left-turn pocket to 290 feet or 305 feet, depending on the location of the crosswalk.

With a traffic signal at NE 45<sup>th</sup> Street/SE QFC Driveway and a crosswalk on the west side of the intersection, an additional 25 vehicles (which is equivalent to a 10 percent increase in volume) could be accommodated in the eastbound left-turn lane (290 feet total storage with improvements).



With a traffic signal and a crosswalk on the east side of the intersection, an additional 40 vehicles (which is equivalent to a 16 percent increase in volume) could be accommodated in the eastbound left-turn lane (305 feet total storage with improvements).

Please contact Jeff Haynie via phone at (425) 485-4663 or via email at [haynie@tenw.com](mailto:haynie@tenw.com) if you have any questions with the information presented in this technical memo.

Attachments A-E

cc: Brian Kemper, SDOT  
Bill Low, Quality Food Centers, Inc.  
Cliff Brown, Quality Food Centers, Inc.  
Mike Derr, Quality Food Center, Inc.



Transportation Engineering NorthWest

# **Attachment A**

## **NE 45<sup>th</sup> Street Existing Conditions**

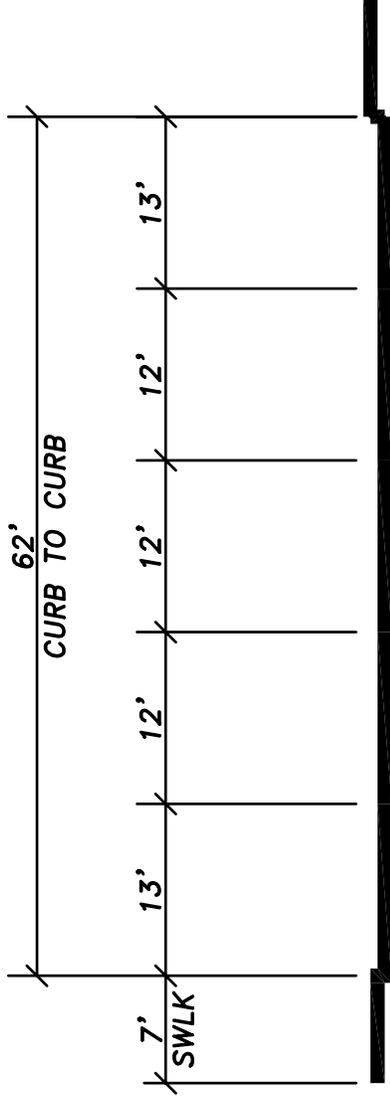
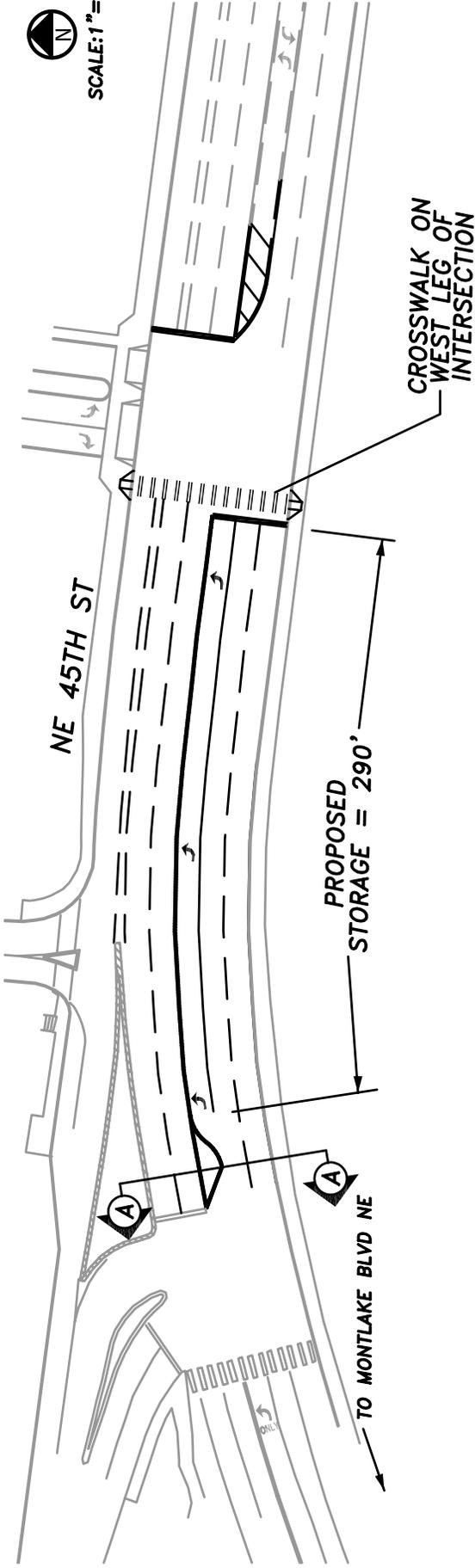




**Attachment B**  
NE 45<sup>th</sup> Street Channelization Revisions  
Option A (Crosswalk on West Side of Intersection)



SCALE: 1" = 80'



**SECTION A-A**  
N.T.S.

DATE:	06/27/05
FILE:	
SHEET:	1 OF 1

**NE 45TH STREET  
CHANNELIZATION REVISIONS  
OPTION A**

TRANSPORTATION ENGINEERING NORTHWEST, LLC  
 PO BOX 65254  
 SEATTLE, WA 98155  
 PHONE: (425) 806-9236  
 FAX: (425) 668-1133  
 CONTACT: CHRIS BICKET, P.E.

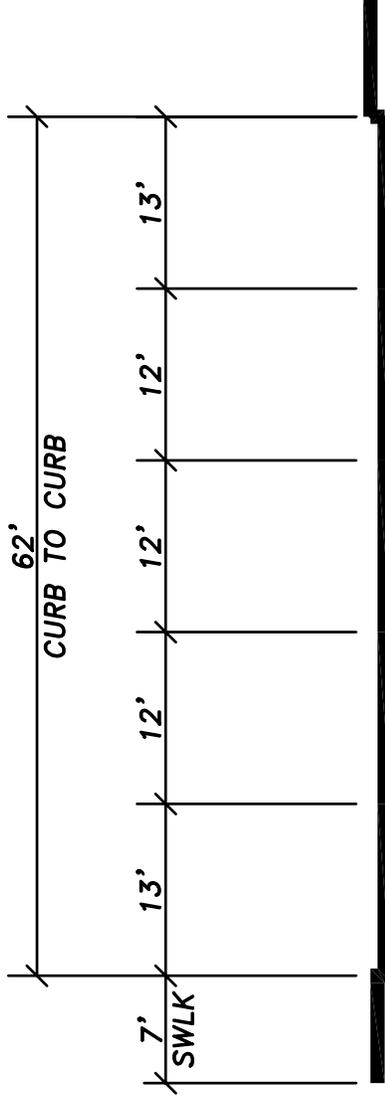
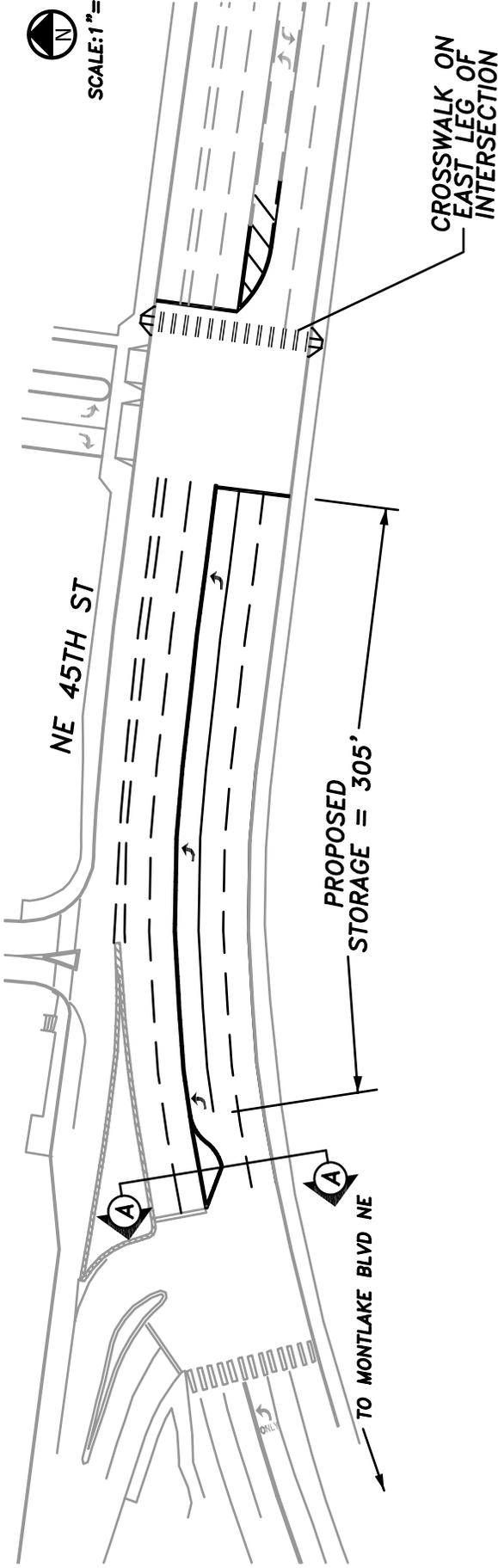




**Attachment C**  
NE 45<sup>th</sup> Street Channelization Revisions  
Option B (Crosswalk on East Side of Intersection)



SCALE: 1" = 80'



**SECTION A-A**  
N.T.S.

DATE:	06/27/05
FILE:	
SHEET:	1 OF 1

**NE 45TH STREET  
CHANNELIZATION REVISIONS  
OPTION B**

TRANSPORTATION ENGINEERING NORTHWEST, LLC  
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 SEATTLE, WA 98155  
 PHONE: (425) 806-9236  
 FAX: (425) 668-1133  
 CONTACT: CHRIS BICKET, P.E.

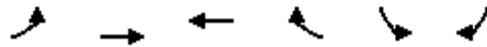




**Attachment D**  
Level of Service and Queue Demand Calculations -  
2015 PM Peak Hour with Traffic Signal at  
NE 45<sup>th</sup> Street/SE QFC Driveway

HCM Signalized Intersection Capacity Analysis  
 13: NE 45th St & SE QFC Dwy

6/28/2005



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↑↑	↑↑↑		↖	↗
Ideal Flow (vphpl)	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	*0.75		1.00	1.00
Frbp, ped/bikes	1.00	1.00	0.99		1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	3539	4122		1787	1574
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	3539	4122		1787	1574
Volume (vph)	248	2136	1552	117	76	119
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	251	2158	1568	118	77	120
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	251	2158	1686	0	77	120
Confl. Peds. (#/hr)				20		20
Heavy Vehicles (%)	2%	2%	2%	2%	1%	1%
Turn Type	Prot				pm+ov	
Protected Phases	1	6	2		7	1
Permitted Phases						7
Actuated Green, G (s)	27.3	94.5	62.2		15.5	42.8
Effective Green, g (s)	28.3	95.5	63.2		16.5	44.8
Actuated g/C Ratio	0.24	0.80	0.53		0.14	0.37
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	417	2816	2171		246	640
v/s Ratio Prot	0.14	c0.61	0.41		c0.04	0.04
v/s Ratio Perm						0.03
v/c Ratio	0.60	0.77	0.78		0.31	0.19
Uniform Delay, d1	40.8	6.4	22.7		46.6	25.3
Progression Factor	0.89	0.64	1.00		1.00	1.00
Incremental Delay, d2	1.7	1.5	2.8		0.7	0.1
Delay (s)	38.0	5.5	25.6		47.4	25.5
Level of Service	D	A	C		D	C
Approach Delay (s)		8.9	25.6		34.0	
Approach LOS		A	C		C	

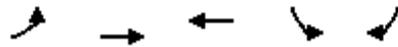
**Intersection Summary**

HCM Average Control Delay	16.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	77.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues

13: NE 45th St & SE QFC Dwy

6/28/2005



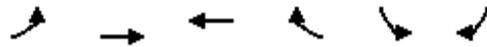
Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	251	2158	1686	77	120
v/c Ratio	0.60	0.75	0.76	0.29	0.21
Control Delay	42.5	6.8	26.1	44.3	23.0
Queue Delay	0.0	0.3	0.0	0.0	0.0
Total Delay	42.5	7.1	26.1	44.3	23.0
Queue Length 50th (ft)	172	341	492	50	54
Queue Length 95th (ft)	m263	337	570	95	95
Internal Link Dist (ft)		175	226	73	
Turn Bay Length (ft)	250				75
Base Capacity (vph)	417	2868	2212	357	585
Starvation Cap Reductn	0	211	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.60	0.81	0.76	0.22	0.21

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 13: NE 45th St & SE QFC Dwy

6/28/2005

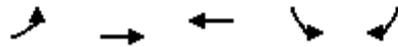


Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↑↑	↑↑↑		↖	↗
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.95	*0.75		1.00	1.00
Frbp, ped/bikes	1.00	1.00	0.99		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	3539	4122		1787	1599
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	3539	4122		1787	1599
Volume (vph)	248	2136	1552	117	76	119
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	251	2158	1568	118	77	120
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	251	2158	1686	0	77	120
Confl. Peds. (#/hr)				20	20	
Heavy Vehicles (%)	2%	2%	2%	2%	1%	1%
Turn Type	Prot				pt+ov	
Protected Phases	1	6	2		7	7 1
Permitted Phases						
Actuated Green, G (s)	27.3	93.2	60.9		16.8	49.1
Effective Green, g (s)	28.3	94.2	61.9		17.8	50.1
Actuated g/C Ratio	0.24	0.78	0.52		0.15	0.42
Clearance Time (s)	5.0	5.0	5.0		5.0	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	417	2778	2126		265	668
v/s Ratio Prot	0.14	c0.61	0.41		c0.04	0.08
v/s Ratio Perm						
v/c Ratio	0.60	0.78	0.79		0.29	0.18
Uniform Delay, d1	40.8	7.1	23.8		45.5	22.0
Progression Factor	0.89	0.67	1.00		1.00	1.00
Incremental Delay, d2	1.7	1.6	3.1		0.6	0.1
Delay (s)	38.0	6.3	26.9		46.1	22.1
Level of Service	D	A	C		D	C
Approach Delay (s)		9.6	26.9		31.5	
Approach LOS		A	C		C	
<b>Intersection Summary</b>						
HCM Average Control Delay			17.4		HCM Level of Service	B
HCM Volume to Capacity ratio			0.70			
Actuated Cycle Length (s)			120.0		Sum of lost time (s)	8.0
Intersection Capacity Utilization			69.9%		ICU Level of Service	C
Analysis Period (min)			15			
c Critical Lane Group						

Queues

13: NE 45th St & SE QFC Dwy

6/28/2005



Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	251	2158	1686	77	120
v/c Ratio	0.60	0.78	0.79	0.29	0.18
Control Delay	42.5	7.6	27.8	44.3	22.0
Queue Delay	0.0	0.4	0.0	0.0	0.0
Total Delay	42.5	8.0	27.8	44.3	22.0
Queue Length 50th (ft)	172	341	492	50	54
Queue Length 95th (ft)	m263	337	570	95	95
Internal Link Dist (ft)		175	226	73	
Turn Bay Length (ft)	250				75
Base Capacity (vph)	417	2777	2134	357	750
Starvation Cap Reductn	0	211	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.60	0.84	0.79	0.22	0.16

Intersection Summary

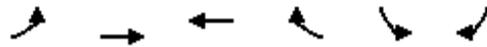
m Volume for 95th percentile queue is metered by upstream signal.



**Attachment E**  
Sensitivity Analysis –  
Level of Service and Queue Demand Calculations

HCM Signalized Intersection Capacity Analysis  
 13: NE 45th St & SE QFC Dwy

6/28/2005



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↑↑	↑↑↑		↖	↗
Ideal Flow (vphpl)	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	*0.75		1.00	1.00
Frbp, ped/bikes	1.00	1.00	0.99		1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	3539	4122		1787	1574
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	3539	4122		1787	1574
Volume (vph)	268	2136	1552	117	76	119
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	271	2158	1568	118	77	120
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	271	2158	1686	0	77	120
Confl. Peds. (#/hr)				20		20
Heavy Vehicles (%)	2%	2%	2%	2%	1%	1%
Turn Type	Prot				pm+ov	
Protected Phases	1	6	2		7	1
Permitted Phases						7
Actuated Green, G (s)	27.7	94.5	61.8		15.5	43.2
Effective Green, g (s)	28.7	95.5	62.8		16.5	45.2
Actuated g/C Ratio	0.24	0.80	0.52		0.14	0.38
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	423	2816	2157		246	645
v/s Ratio Prot	0.15	c0.61	0.41		c0.04	0.04
v/s Ratio Perm						0.03
v/c Ratio	0.64	0.77	0.78		0.31	0.19
Uniform Delay, d1	41.0	6.4	23.1		46.6	25.1
Progression Factor	0.88	0.62	1.00		1.00	1.00
Incremental Delay, d2	2.3	1.4	2.9		0.7	0.1
Delay (s)	38.6	5.4	26.0		47.4	25.2
Level of Service	D	A	C		D	C
Approach Delay (s)		9.1	26.0		33.9	
Approach LOS		A	C		C	

**Intersection Summary**

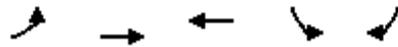
HCM Average Control Delay	16.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	77.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

## Queues

## 13: NE 45th St &amp; SE QFC Dwy

6/28/2005



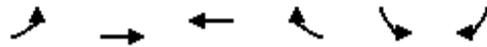
Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	271	2158	1686	77	120
v/c Ratio	0.64	0.75	0.77	0.29	0.20
Control Delay	43.0	6.7	26.6	44.3	22.6
Queue Delay	0.0	0.3	0.0	0.0	0.0
Total Delay	43.0	7.0	26.6	44.3	22.6
Queue Length 50th (ft)	189	335	492	50	54
Queue Length 95th (ft)	m283	325	580	95	94
Internal Link Dist (ft)		175	226	73	
Turn Bay Length (ft)	250				75
Base Capacity (vph)	423	2868	2193	357	590
Starvation Cap Reductn	0	224	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.64	0.82	0.77	0.22	0.20

## Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 13: NE 45th St & SE QFC Dwy

6/28/2005



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↑↑	↑↑↑		↖	↖
Ideal Flow (vphpl)	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	*0.75		1.00	1.00
Frbp, ped/bikes	1.00	1.00	0.99		1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	3539	4122		1787	1574
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	3539	4122		1787	1574
Volume (vph)	273	2136	1552	117	76	119
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	276	2158	1568	118	77	120
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	276	2158	1686	0	77	120
Confl. Peds. (#/hr)				20		20
Heavy Vehicles (%)	2%	2%	2%	2%	1%	1%
Turn Type	Prot				pm+ov	
Protected Phases	1	6	2		7	1
Permitted Phases						7
Actuated Green, G (s)	27.7	94.5	61.8		15.5	43.2
Effective Green, g (s)	28.7	95.5	62.8		16.5	45.2
Actuated g/C Ratio	0.24	0.80	0.52		0.14	0.38
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	423	2816	2157		246	645
v/s Ratio Prot	0.16	c0.61	0.41		c0.04	0.04
v/s Ratio Perm						0.03
v/c Ratio	0.65	0.77	0.78		0.31	0.19
Uniform Delay, d1	41.2	6.4	23.1		46.6	25.1
Progression Factor	0.89	0.67	1.00		1.00	1.00
Incremental Delay, d2	2.5	1.4	2.9		0.7	0.1
Delay (s)	39.1	5.8	26.0		47.4	25.2
Level of Service	D	A	C		D	C
Approach Delay (s)		9.5	26.0		33.9	
Approach LOS		A	C		C	

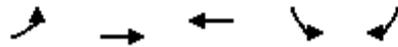
Intersection Summary

HCM Average Control Delay	17.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	77.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues

13: NE 45th St & SE QFC Dwy

6/28/2005



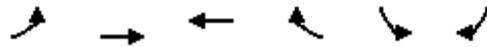
Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	276	2158	1686	77	120
v/c Ratio	0.65	0.75	0.77	0.29	0.20
Control Delay	43.7	7.1	26.7	44.3	22.6
Queue Delay	0.0	0.3	0.0	0.0	0.0
Total Delay	43.7	7.5	26.7	44.3	22.6
Queue Length 50th (ft)	193	373	492	50	54
Queue Length 95th (ft)	m288	353	580	95	94
Internal Link Dist (ft)		175	226	73	
Turn Bay Length (ft)	250				75
Base Capacity (vph)	423	2868	2193	357	591
Starvation Cap Reductn	0	227	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.65	0.82	0.77	0.22	0.20

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 13: NE 45th St & SE QFC Dwy

6/28/2005



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↑↑	↑↑↑		↖	↖
Ideal Flow (vphpl)	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	*0.75		1.00	1.00
Frbp, ped/bikes	1.00	1.00	0.99		1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	3539	4122		1787	1574
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	3539	4122		1787	1574
Volume (vph)	278	2136	1552	117	76	119
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	281	2158	1568	118	77	120
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	281	2158	1686	0	77	120
Confl. Peds. (#/hr)				20		20
Heavy Vehicles (%)	2%	2%	2%	2%	1%	1%
Turn Type	Prot				pm+ov	
Protected Phases	1	6	2		7	1
Permitted Phases						7
Actuated Green, G (s)	27.7	94.5	61.8		15.5	43.2
Effective Green, g (s)	28.7	95.5	62.8		16.5	45.2
Actuated g/C Ratio	0.24	0.80	0.52		0.14	0.38
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	423	2816	2157		246	645
v/s Ratio Prot	0.16	c0.61	0.41		c0.04	0.04
v/s Ratio Perm						0.03
v/c Ratio	0.66	0.77	0.78		0.31	0.19
Uniform Delay, d1	41.3	6.4	23.1		46.6	25.1
Progression Factor	0.89	0.67	1.00		1.00	1.00
Incremental Delay, d2	2.7	1.4	2.9		0.7	0.1
Delay (s)	39.4	5.8	26.0		47.4	25.2
Level of Service	D	A	C		D	C
Approach Delay (s)		9.6	26.0		33.9	
Approach LOS		A	C		C	

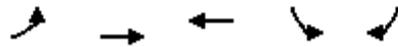
**Intersection Summary**

HCM Average Control Delay	17.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	77.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues

13: NE 45th St & SE QFC Dwy

6/28/2005



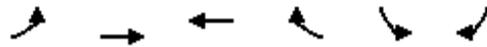
Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	281	2158	1686	77	120
v/c Ratio	0.66	0.75	0.77	0.29	0.20
Control Delay	44.0	7.1	26.7	44.3	22.6
Queue Delay	0.0	0.3	0.0	0.0	0.0
Total Delay	44.0	7.5	26.7	44.3	22.6
Queue Length 50th (ft)	197	374	492	50	54
Queue Length 95th (ft)	m293	354	580	95	94
Internal Link Dist (ft)		175	226	73	
Turn Bay Length (ft)	250				75
Base Capacity (vph)	423	2868	2193	357	591
Starvation Cap Reductn	0	230	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.66	0.82	0.77	0.22	0.20

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 13: NE 45th St & SE QFC Dwy

6/28/2005



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↑↑	↑↑↑		↖	↖
Ideal Flow (vphpl)	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	*0.75		1.00	1.00
Frbp, ped/bikes	1.00	1.00	0.99		1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	3539	4122		1787	1574
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	3539	4122		1787	1574
Volume (vph)	283	2136	1552	117	76	119
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	286	2158	1568	118	77	120
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	286	2158	1686	0	77	120
Confl. Peds. (#/hr)				20		20
Heavy Vehicles (%)	2%	2%	2%	2%	1%	1%
Turn Type	Prot				pm+ov	
Protected Phases	1	6	2		7	1
Permitted Phases						7
Actuated Green, G (s)	28.4	94.5	61.1		15.5	43.9
Effective Green, g (s)	29.4	95.5	62.1		16.5	45.9
Actuated g/C Ratio	0.24	0.80	0.52		0.14	0.38
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	434	2816	2133		246	655
v/s Ratio Prot	0.16	c0.61	c0.41		c0.04	0.04
v/s Ratio Perm						0.03
v/c Ratio	0.66	0.77	0.79		0.31	0.18
Uniform Delay, d1	40.8	6.4	23.6		46.6	24.6
Progression Factor	0.89	0.67	1.00		1.00	1.00
Incremental Delay, d2	2.5	1.4	3.1		0.7	0.1
Delay (s)	38.7	5.8	26.7		47.4	24.7
Level of Service	D	A	C		D	C
Approach Delay (s)		9.6	26.7		33.6	
Approach LOS		A	C		C	

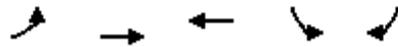
**Intersection Summary**

HCM Average Control Delay	17.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	77.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues

13: NE 45th St & SE QFC Dwy

6/28/2005



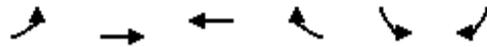
Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	286	2158	1686	77	120
v/c Ratio	0.66	0.75	0.78	0.29	0.20
Control Delay	43.1	7.1	27.5	44.3	22.0
Queue Delay	0.1	0.3	0.0	0.0	0.0
Total Delay	43.3	7.5	27.5	44.3	22.0
Queue Length 50th (ft)	199	375	501	50	53
Queue Length 95th (ft)	m295	355	590	95	92
Internal Link Dist (ft)		175	226	73	
Turn Bay Length (ft)	250				75
Base Capacity (vph)	433	2868	2167	357	600
Starvation Cap Reductn	6	233	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.67	0.82	0.78	0.22	0.20

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 13: NE 45th St & SE QFC Dwy

6/28/2005



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↑↑	↑↑↑		↖	↗
Ideal Flow (vphpl)	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	*0.75		1.00	1.00
Frbp, ped/bikes	1.00	1.00	0.99		1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	3539	4122		1787	1574
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	3539	4122		1787	1574
Volume (vph)	288	2136	1552	117	76	119
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	291	2158	1568	118	77	120
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	291	2158	1686	0	77	120
Confl. Peds. (#/hr)				20		20
Heavy Vehicles (%)	2%	2%	2%	2%	1%	1%
Turn Type	Prot				pm+ov	
Protected Phases	1	6	2		7	1
Permitted Phases						7
Actuated Green, G (s)	28.4	94.5	61.1		15.5	43.9
Effective Green, g (s)	29.4	95.5	62.1		16.5	45.9
Actuated g/C Ratio	0.24	0.80	0.52		0.14	0.38
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	434	2816	2133		246	655
v/s Ratio Prot	0.16	c0.61	c0.41		c0.04	0.04
v/s Ratio Perm						0.03
v/c Ratio	0.67	0.77	0.79		0.31	0.18
Uniform Delay, d1	40.9	6.4	23.6		46.6	24.6
Progression Factor	0.89	0.68	1.00		1.00	1.00
Incremental Delay, d2	2.8	1.4	3.1		0.7	0.1
Delay (s)	39.1	5.8	26.7		47.4	24.7
Level of Service	D	A	C		D	C
Approach Delay (s)		9.7	26.7		33.6	
Approach LOS		A	C		C	

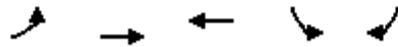
**Intersection Summary**

HCM Average Control Delay	17.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	77.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues

13: NE 45th St & SE QFC Dwy

6/28/2005



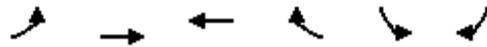
Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	291	2158	1686	77	120
v/c Ratio	0.67	0.75	0.78	0.29	0.20
Control Delay	43.5	7.1	27.5	44.3	22.0
Queue Delay	0.1	0.4	0.0	0.0	0.0
Total Delay	43.6	7.5	27.5	44.3	22.0
Queue Length 50th (ft)	203	376	501	50	53
Queue Length 95th (ft)	m301	348	590	95	92
Internal Link Dist (ft)		175	226	73	
Turn Bay Length (ft)	250				75
Base Capacity (vph)	433	2868	2167	357	600
Starvation Cap Reductn	6	236	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.68	0.82	0.78	0.22	0.20

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 13: NE 45th St & SE QFC Dwy

6/28/2005



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↑↑	↑↑↑		↖	↗
Ideal Flow (vphpl)	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	*0.75		1.00	1.00
Frbp, ped/bikes	1.00	1.00	0.99		1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	3539	4122		1787	1574
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	3539	4122		1787	1574
Volume (vph)	293	2136	1552	117	76	119
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	296	2158	1568	118	77	120
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	296	2158	1686	0	77	120
Confl. Peds. (#/hr)				20		20
Heavy Vehicles (%)	2%	2%	2%	2%	1%	1%
Turn Type	Prot				pm+ov	
Protected Phases	1	6	2		7	1
Permitted Phases						7
Actuated Green, G (s)	28.4	94.5	61.1		15.5	43.9
Effective Green, g (s)	29.4	95.5	62.1		16.5	45.9
Actuated g/C Ratio	0.24	0.80	0.52		0.14	0.38
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	434	2816	2133		246	655
v/s Ratio Prot	0.17	c0.61	c0.41		c0.04	0.04
v/s Ratio Perm						0.03
v/c Ratio	0.68	0.77	0.79		0.31	0.18
Uniform Delay, d1	41.1	6.4	23.6		46.6	24.6
Progression Factor	0.90	0.68	1.00		1.00	1.00
Incremental Delay, d2	3.1	1.4	3.1		0.7	0.1
Delay (s)	39.9	5.8	26.7		47.4	24.7
Level of Service	D	A	C		D	C
Approach Delay (s)		9.9	26.7		33.6	
Approach LOS		A	C		C	

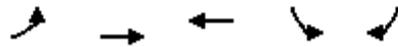
**Intersection Summary**

HCM Average Control Delay	17.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	77.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues

13: NE 45th St & SE QFC Dwy

6/28/2005



Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	296	2158	1686	77	120
v/c Ratio	0.68	0.75	0.78	0.29	0.20
Control Delay	44.3	7.1	27.5	44.3	22.0
Queue Delay	0.2	0.4	0.0	0.0	0.0
Total Delay	44.4	7.5	27.5	44.3	22.0
Queue Length 50th (ft)	207	377	501	50	53
Queue Length 95th (ft) m#308		350	590	95	92
Internal Link Dist (ft)		175	226	73	
Turn Bay Length (ft)	250				75
Base Capacity (vph)	433	2868	2167	357	600
Starvation Cap Reductn	6	239	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.69	0.82	0.78	0.22	0.20

Intersection Summary

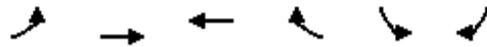
# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 13: NE 45th St & SE QFC Dwy

6/28/2005



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↗↗	↖↖↖		↘	↘
Ideal Flow (vphpl)	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	*0.75		1.00	1.00
Frbp, ped/bikes	1.00	1.00	0.99		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		0.97	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	3539	4122		1731	1599
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	3539	4122		1731	1599
Volume (vph)	268	2136	1552	117	76	119
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	271	2158	1568	118	77	120
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	271	2158	1686	0	77	120
Confl. Peds. (#/hr)				20	20	
Heavy Vehicles (%)	2%	2%	2%	2%	1%	1%
Turn Type	Prot				custom	
Protected Phases	1	6	2			7 1
Permitted Phases					7	
Actuated Green, G (s)	27.7	93.2	60.5		16.8	49.5
Effective Green, g (s)	28.7	94.2	61.5		17.8	50.5
Actuated g/C Ratio	0.24	0.78	0.51		0.15	0.42
Clearance Time (s)	5.0	5.0	5.0		5.0	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	423	2778	2113		257	673
v/s Ratio Prot	0.15	c0.61	c0.41			0.08
v/s Ratio Perm					c0.04	
v/c Ratio	0.64	0.78	0.80		0.30	0.18
Uniform Delay, d1	41.0	7.1	24.1		45.5	21.8
Progression Factor	0.88	0.66	1.00		1.00	1.00
Incremental Delay, d2	2.3	1.6	3.2		0.7	0.1
Delay (s)	38.6	6.2	27.4		46.2	21.9
Level of Service	D	A	C		D	C
Approach Delay (s)		9.9	27.4		31.4	
Approach LOS		A	C		C	

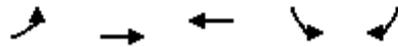
**Intersection Summary**

HCM Average Control Delay	17.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Queues

13: NE 45th St & SE QFC Dwy

6/28/2005



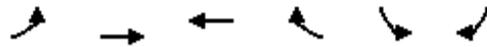
Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	271	2158	1686	77	120
v/c Ratio	0.64	0.78	0.80	0.30	0.18
Control Delay	43.0	7.5	28.4	44.5	21.7
Queue Delay	0.0	0.5	0.0	0.0	0.0
Total Delay	43.0	7.9	28.4	44.5	21.7
Queue Length 50th (ft)	189	335	492	50	54
Queue Length 95th (ft)	m283	325	580	95	94
Internal Link Dist (ft)		175	226	73	
Turn Bay Length (ft)	250				75
Base Capacity (vph)	423	2777	2114	346	755
Starvation Cap Reductn	0	224	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.64	0.85	0.80	0.22	0.16

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 13: NE 45th St & SE QFC Dwy

6/28/2005



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↑↑	↑↑↑		↗	↘
Ideal Flow (vphpl)	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	*0.75		1.00	1.00
Frbp, ped/bikes	1.00	1.00	0.99		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		0.97	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	3539	4122		1731	1599
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	3539	4122		1731	1599
Volume (vph)	273	2136	1552	117	76	119
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	276	2158	1568	118	77	120
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	276	2158	1686	0	77	120
Confl. Peds. (#/hr)				20	20	
Heavy Vehicles (%)	2%	2%	2%	2%	1%	1%
Turn Type	Prot				custom	
Protected Phases	1	6	2			7 1
Permitted Phases					7	
Actuated Green, G (s)	27.7	93.2	60.5		16.8	49.5
Effective Green, g (s)	28.7	94.2	61.5		17.8	50.5
Actuated g/C Ratio	0.24	0.78	0.51		0.15	0.42
Clearance Time (s)	5.0	5.0	5.0		5.0	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	423	2778	2113		257	673
v/s Ratio Prot	0.16	c0.61	c0.41			0.08
v/s Ratio Perm					c0.04	
v/c Ratio	0.65	0.78	0.80		0.30	0.18
Uniform Delay, d1	41.2	7.1	24.1		45.5	21.8
Progression Factor	0.89	0.69	1.00		1.00	1.00
Incremental Delay, d2	2.5	1.5	3.2		0.7	0.1
Delay (s)	39.1	6.5	27.4		46.2	21.9
Level of Service	D	A	C		D	C
Approach Delay (s)		10.2	27.4		31.4	
Approach LOS		B	C		C	

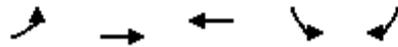
**Intersection Summary**

HCM Average Control Delay	17.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

## Queues

## 13: NE 45th St &amp; SE QFC Dwy

6/28/2005



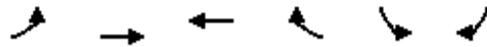
Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	276	2158	1686	77	120
v/c Ratio	0.65	0.78	0.80	0.30	0.18
Control Delay	43.7	7.8	28.4	44.5	21.7
Queue Delay	0.0	0.5	0.0	0.0	0.0
Total Delay	43.7	8.3	28.4	44.5	21.7
Queue Length 50th (ft)	193	373	492	50	54
Queue Length 95th (ft)	m288	353	580	95	94
Internal Link Dist (ft)		175	226	73	
Turn Bay Length (ft)	250				75
Base Capacity (vph)	423	2777	2113	346	755
Starvation Cap Reductn	0	227	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.65	0.85	0.80	0.22	0.16

## Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 13: NE 45th St & SE QFC Dwy

6/28/2005



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↑↑	↑↑↑		↖	↗
Ideal Flow (vphpl)	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	*0.75		1.00	1.00
Frbp, ped/bikes	1.00	1.00	0.99		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		0.97	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	3539	4122		1731	1599
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	3539	4122		1731	1599
Volume (vph)	278	2136	1552	117	76	119
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	281	2158	1568	118	77	120
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	281	2158	1686	0	77	120
Confl. Peds. (#/hr)				20	20	
Heavy Vehicles (%)	2%	2%	2%	2%	1%	1%
Turn Type	Prot				custom	
Protected Phases	1	6	2			7 1
Permitted Phases					7	
Actuated Green, G (s)	27.7	93.2	60.5		16.8	49.5
Effective Green, g (s)	28.7	94.2	61.5		17.8	50.5
Actuated g/C Ratio	0.24	0.78	0.51		0.15	0.42
Clearance Time (s)	5.0	5.0	5.0		5.0	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	423	2778	2113		257	673
v/s Ratio Prot	0.16	c0.61	c0.41			0.08
v/s Ratio Perm					c0.04	
v/c Ratio	0.66	0.78	0.80		0.30	0.18
Uniform Delay, d1	41.3	7.1	24.1		45.5	21.8
Progression Factor	0.89	0.69	1.00		1.00	1.00
Incremental Delay, d2	2.7	1.5	3.2		0.7	0.1
Delay (s)	39.4	6.5	27.4		46.2	21.9
Level of Service	D	A	C		D	C
Approach Delay (s)		10.3	27.4		31.4	
Approach LOS		B	C		C	

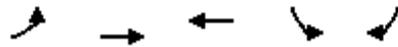
**Intersection Summary**

HCM Average Control Delay	17.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Queues

13: NE 45th St & SE QFC Dwy

6/28/2005



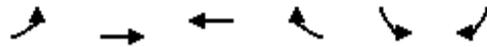
Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	281	2158	1686	77	120
v/c Ratio	0.66	0.78	0.80	0.30	0.18
Control Delay	44.0	7.8	28.4	44.5	21.7
Queue Delay	0.0	0.5	0.0	0.0	0.0
Total Delay	44.0	8.3	28.4	44.5	21.7
Queue Length 50th (ft)	197	374	492	50	54
Queue Length 95th (ft)	m293	354	580	95	94
Internal Link Dist (ft)		175	226	73	
Turn Bay Length (ft)	250				75
Base Capacity (vph)	423	2777	2113	346	755
Starvation Cap Reductn	0	230	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.66	0.85	0.80	0.22	0.16

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 13: NE 45th St & SE QFC Dwy

6/28/2005



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↵	↑↑	↑↑↑		↵	↵
Ideal Flow (vphpl)	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	*0.75		1.00	1.00
Frbp, ped/bikes	1.00	1.00	0.99		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		0.97	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	3539	4122		1731	1599
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	3539	4122		1731	1599
Volume (vph)	283	2136	1552	117	76	119
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	286	2158	1568	118	77	120
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	286	2158	1686	0	77	120
Confl. Peds. (#/hr)				20	20	
Heavy Vehicles (%)	2%	2%	2%	2%	1%	1%
Turn Type	Prot				custom	
Protected Phases	1	6	2			7 1
Permitted Phases					7	
Actuated Green, G (s)	28.4	93.2	59.8		16.8	50.2
Effective Green, g (s)	29.4	94.2	60.8		17.8	51.2
Actuated g/C Ratio	0.24	0.78	0.51		0.15	0.43
Clearance Time (s)	5.0	5.0	5.0		5.0	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	434	2778	2088		257	682
v/s Ratio Prot	0.16	c0.61	c0.41			0.08
v/s Ratio Perm					c0.04	
v/c Ratio	0.66	0.78	0.81		0.30	0.18
Uniform Delay, d1	40.8	7.1	24.7		45.5	21.3
Progression Factor	0.89	0.69	1.00		1.00	1.00
Incremental Delay, d2	2.5	1.5	3.5		0.7	0.1
Delay (s)	38.7	6.5	28.2		46.2	21.4
Level of Service	D	A	C		D	C
Approach Delay (s)		10.2	28.2		31.1	
Approach LOS		B	C		C	

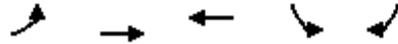
**Intersection Summary**

HCM Average Control Delay	18.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

## Queues

## 13: NE 45th St &amp; SE QFC Dwy

6/28/2005



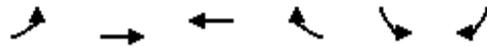
Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	286	2158	1686	77	120
v/c Ratio	0.66	0.78	0.81	0.30	0.18
Control Delay	43.1	7.8	29.3	44.5	21.1
Queue Delay	0.1	0.5	0.0	0.0	0.0
Total Delay	43.3	8.3	29.3	44.5	21.1
Queue Length 50th (ft)	199	375	501	50	53
Queue Length 95th (ft)	m295	355	590	95	92
Internal Link Dist (ft)		175	226	73	
Turn Bay Length (ft)	250				75
Base Capacity (vph)	433	2777	2088	346	765
Starvation Cap Reductn	6	233	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.67	0.85	0.81	0.22	0.16

## Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 13: NE 45th St & SE QFC Dwy

6/28/2005



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↗↗	↖↖↖		↘	↘
Ideal Flow (vphpl)	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	*0.75		1.00	1.00
Frbp, ped/bikes	1.00	1.00	0.99		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		0.97	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	3539	4122		1731	1599
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	3539	4122		1731	1599
Volume (vph)	288	2136	1552	117	76	119
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	291	2158	1568	118	77	120
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	291	2158	1686	0	77	120
Confl. Peds. (#/hr)				20	20	
Heavy Vehicles (%)	2%	2%	2%	2%	1%	1%
Turn Type	Prot				custom	
Protected Phases	1	6	2			7 1
Permitted Phases					7	
Actuated Green, G (s)	28.4	93.2	59.8		16.8	50.2
Effective Green, g (s)	29.4	94.2	60.8		17.8	51.2
Actuated g/C Ratio	0.24	0.78	0.51		0.15	0.43
Clearance Time (s)	5.0	5.0	5.0		5.0	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	434	2778	2088		257	682
v/s Ratio Prot	0.16	c0.61	c0.41			0.08
v/s Ratio Perm					c0.04	
v/c Ratio	0.67	0.78	0.81		0.30	0.18
Uniform Delay, d1	40.9	7.1	24.7		45.5	21.3
Progression Factor	0.89	0.69	1.00		1.00	1.00
Incremental Delay, d2	2.8	1.5	3.5		0.7	0.1
Delay (s)	39.1	6.5	28.2		46.2	21.4
Level of Service	D	A	C		D	C
Approach Delay (s)		10.3	28.2		31.1	
Approach LOS		B	C		C	

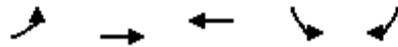
**Intersection Summary**

HCM Average Control Delay	18.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

## Queues

## 13: NE 45th St &amp; SE QFC Dwy

6/28/2005



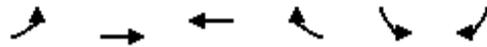
Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	291	2158	1686	77	120
v/c Ratio	0.67	0.78	0.81	0.30	0.18
Control Delay	43.5	7.8	29.3	44.5	21.1
Queue Delay	0.1	0.5	0.0	0.0	0.0
Total Delay	43.6	8.3	29.3	44.5	21.1
Queue Length 50th (ft)	203	376	501	50	53
Queue Length 95th (ft)	m301	348	590	95	92
Internal Link Dist (ft)		175	226	73	
Turn Bay Length (ft)	250				75
Base Capacity (vph)	433	2777	2088	346	765
Starvation Cap Reductn	6	236	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.68	0.85	0.81	0.22	0.16

## Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 13: NE 45th St & SE QFC Dwy

6/28/2005



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↑↑	↑↑↑		↖	↗
Ideal Flow (vphpl)	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	*0.75		1.00	1.00
Frbp, ped/bikes	1.00	1.00	0.99		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		0.97	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	3539	4122		1731	1599
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	3539	4122		1731	1599
Volume (vph)	293	2136	1552	117	76	119
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	296	2158	1568	118	77	120
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	296	2158	1686	0	77	120
Confl. Peds. (#/hr)				20	20	
Heavy Vehicles (%)	2%	2%	2%	2%	1%	1%
Turn Type	Prot				custom	
Protected Phases	1	6	2			7 1
Permitted Phases					7	
Actuated Green, G (s)	28.4	93.2	59.8		16.8	50.2
Effective Green, g (s)	29.4	94.2	60.8		17.8	51.2
Actuated g/C Ratio	0.24	0.78	0.51		0.15	0.43
Clearance Time (s)	5.0	5.0	5.0		5.0	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	434	2778	2088		257	682
v/s Ratio Prot	0.17	c0.61	c0.41			0.08
v/s Ratio Perm					c0.04	
v/c Ratio	0.68	0.78	0.81		0.30	0.18
Uniform Delay, d1	41.1	7.1	24.7		45.5	21.3
Progression Factor	0.90	0.73	1.00		1.00	1.00
Incremental Delay, d2	3.1	1.5	3.5		0.7	0.1
Delay (s)	39.9	6.7	28.2		46.2	21.4
Level of Service	D	A	C		D	C
Approach Delay (s)		10.7	28.2		31.1	
Approach LOS		B	C		C	

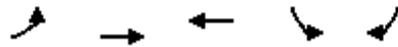
**Intersection Summary**

HCM Average Control Delay	18.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Queues

13: NE 45th St & SE QFC Dwy

6/28/2005



Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	296	2158	1686	77	120
v/c Ratio	0.68	0.78	0.81	0.30	0.18
Control Delay	44.3	8.1	29.3	44.5	21.1
Queue Delay	0.2	0.5	0.0	0.0	0.0
Total Delay	44.4	8.6	29.3	44.5	21.1
Queue Length 50th (ft)	207	377	501	50	53
Queue Length 95th (ft) m#308		350	590	95	92
Internal Link Dist (ft)		175	226	73	
Turn Bay Length (ft)	250				75
Base Capacity (vph)	433	2777	2088	346	765
Starvation Cap Reductn	6	239	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.69	0.85	0.81	0.22	0.16

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.