FEHR PEERS

MEMORANDUM

Date: May 26, 2016

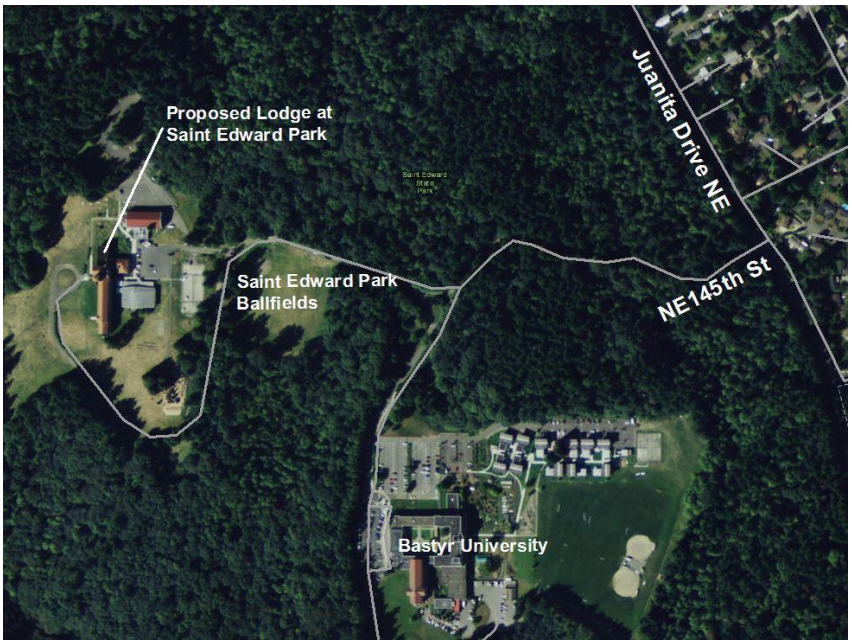
To: Debbie Bent and Kris Overleese, City of Kenmore

From: Kendra Breiland and Sarah Keenan, Fehr & Peers

Subject: Saint Edward Ballfields Traffic and Parking Analysis (Updated)

The City of Kenmore is working with Washington State Parks to propose upgrades to the existing ballfields at Saint Edward State Park. While the ballfields were previously used for games, they have fallen into disrepair and do not currently host games or practices, although they are used for informal recreation. With the upgrades, the City could host two simultaneous games or practices. This memorandum analyzes the project's transportation concurrency status, as well as potential traffic and parking impacts of new vehicle trips associated with the upgrade to the ballfields. Figure 1 shows the location of the ballfields.

Figure 1- Saint Edward Park



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The ballfields are located in Saint Edward State Park. Access to the park by car is through the signalized intersection of NE 145th Street and Juanita Drive. Bastyr University is also located in the park and accessed off of NE 145th Street. Additionally, Daniels Real Estate is submitting a proposal to redevelop the existing vacant seminary building to a hotel, to be called the Lodge at Saint Edward Park.

CONCURRENCY

The City of Kenmore recently updated the way it measures transportation concurrency. Under the new system, the City must evaluate whether there are available mobility units to support the additional travel demand of a proposed use. The City has developed a concurrency calculator which provides the number of mobility units that are currently available and which calculates the mobility unit demand of a proposed development. The City's current capacity is 1,660 mobility units.

Parks are considered a use offering broad public benefit, and as such, are not typically included in concurrency calculations. Therefore, this proposal is not subject to transportation concurrency testing. However, even if the use were evaluated for transportation concurrency, it would be considered concurrent since the proposed ballfields are expected to generate no more than 192 PM peak hour mobility units, which the City has sufficient mobility unit capacity to accommodate.

TRAFFIC

This analysis focuses on the traffic operations impact to the intersection of NE 145th Street and Juanita Drive NE. The intersection has three legs (NE 145th Street tees into Juanita Drive) with a recently constructed signal. Juanita Drive is a north/south two-lane minor arterial that provides access to SR 522 to the north and Kirkland to the south. NE 145th Street is the west leg of the intersection and provides access to Saint Edward State Park. At the intersection of NE 145th Street and Juanita Drive, the northbound approach has an exclusive left turn lane with protected/permissive phasing and a through lane, while the other two legs have a single approaching lane. This report analyzes the existing, existing plus project, future no project, and future plus project conditions for both weekday PM peak (4-6pm) and Saturday afternoon peak (12-2pm).

Existing Conditions

Traffic counts were taken on Tuesday May 3, 2016. The weather was warm and sunny, and there were three youth baseball practices and one youth baseball game scheduled at Bastyr University. The counts were used for existing weekday traffic analysis.

Counts were not taken on Saturday. Instead, the weekday through counts were factored by 75 percent based on a full week of counts taken on Juanita Drive in Kirkland. The traffic turning in and out of the park was not factored down because, although there is less traffic from Bastyr University, there would be more traffic associated with the park on a Saturday. Figure 2 displays the weekday and Saturday existing volumes.

Figure 2- Existing Volumes

The intersection was analyzed using Synchro 8 HCM 2010 analysis software with existing signal timing provided by the City. The intersection currently operates at LOS B with 14.0 seconds of delay on both weekday PM peak and Saturday afternoon peak. Detailed results are provided in the appendix.

The City's Comprehensive Plan standard for operations at this intersection is LOS E. Thus, the intersection currently operates acceptably.

Existing Plus Project Scenario

The Existing Plus Project scenario adds the project trips from the proposed ballfields upgrade to the existing volumes. The trip generation was estimated based on two games ending and two games beginning during the peak hour for both weekday and Saturday analysis. To be as conservative as possible, the trip generation assumed no carpooling between two coaches and 12 players per team plus one umpire. Parents are assumed to drive the players to the game. Some would stay to watch the game while some leave and come back when the game is ending. The trip generation assumed that ten vehicles would stay for each game, based on the 2007 study of the ballfields by Jones & Stokes[1]. Ten parked cars per game is conservative for trip generation since it assumes more vehicles are entering and exiting through the intersection of 145th Street NE and Juanita Drive during the peak hour. The distribution of trips associated with the ballfields was estimated based on existing counts, with 60 percent of trips coming from and going to the north. The estimated project trip generation is displayed in Figure 3, and the Existing Plus Project Volumes are displayed in Figure 4. The trip generation is assumed to be the same for weekday and Saturday analysis.

[1] Saint Edward State Park Youth Park Parking Study, October 10, 2007, Jones & Stokes

Figure 3- Project Volumes

Figure 4- Existing Plus Project Volumes

The intersection is expected to operate at LOS C with 21.4 seconds of delay during the weekday PM peak. It is expected to operate at LOS C with 21.3 seconds of delay during the Saturday peak. Again, the City's standard for operations at this intersection is LOS E. Thus, the intersection would continue to operate acceptably under this scenario.

Future No Project Scenario

The analysis for the Future No Project scenario was performed to be consistent with the analysis done for the Lodge at Saint Edward Park performed by Heffron Transportation, Inc. The future analysis was performed for the year 2020, which assumes new trips generated by the Lodge, increased traffic volumes along Juanita Drive related to regional growth, as well as additional growth from Bastyr University, as described below. The traffic study for the Lodge did not include Saturday analysis.

Although the ballfields are scheduled to be improved before 2020, this future horizon year provides a conservative basis for the analysis, as it accounts for growth in background traffic. For both weekday and Saturday volumes, an annual growth rate of 1.1 percent was added to the existing volumes along Juanita Drive, plus an additional increase for trips related to growth at Bastyr University. The additional increase in traffic from Bastyr University is based on an annual growth of 4 percent to the campus population.[2] The Future No Project volumes also include the traffic generated by the proposed Lodge at Saint Edward Park. Figure 5 displays the weekday and Saturday Future No Project scenario volumes.

[2] See the Lodge at Saint Edward State Park traffic analysis for additional discussion of how these future year growth assumptions were derived.

Figure 5- Future No Project Volumes

The intersection is expected to operate at LOS C with 20.8 seconds of delay during the weekday PM peak. It is expected to operate at LOS C with 20.7 seconds of delay during the Saturday peak. Again, the City's standard for operations at this intersection is LOS E. Thus, the intersection would continue to operate acceptably under this scenario.

Future Plus Project Scenario

The Future Plus Project scenario adds the project trips displayed in Figure 2 to the Future No Project volumes displayed in Figure 5. The Future Plus Project Volumes are displayed in Figure 6. The project trips account for 49 percent of the future growth in traffic at the intersection.

Figure 6- Future Plus Project Volumes

The intersection is expected to continue operating at LOS C with 31.4 seconds of delay during the weekday PM peak. It is expected to also operate at LOS C with 31.5 seconds of delay during the Saturday peak. Again, for both of these time periods, the intersection of 145th Street NE and Juanita Drive would continue to operate acceptably under the Future Plus Project scenario.

Table 1 summarizes the LOS results for all scenarios. While the delay increases with growth in traffic over time, the newly constructed signal has sufficient capacity to accommodate the increase in vehicle trips. In the recommendations section, we will discuss an option for upgrading the signal timings to reduce the delay at the intersection.

TABLE 1- LOS RESULTS

	Weekday Peak		Saturday Peak	
	LOS	**Delay**	**LOS**	**Delay**
Existing	B	14.0	B	14.0
Existing Plus Project	C	21.4	C	21.3
Future No Project	C	20.8	C	20.7
Future Plus Project	C	31.4	C	31.5

Tables with more detailed results by scenario is provided in the appendix.

PARKING

A parking occupancy study was performed on Saturday May 7, 2016 and on Tuesday May 10, 2016. In total, there are 220 parking spaces available for visitors to Saint Edward State Park, as shown in Figure 7. The Saturday occupancy study was conducted on a warm and sunny day with a bike race, a wedding, and eight youth baseball games at the Bastyr University ballfields. The Tuesday counts were taken on warm and sunny day with five youth baseball practices at the Bastyr University ballfields. The results of the occupancy study are displayed in Table 2. Proposed improvements to the Lodge at Saint Edward are not assumed to affect existing parking, since the developer has committed to mitigate parking impacts.

Figure 7- Existing Parking at Saint Edwards Park

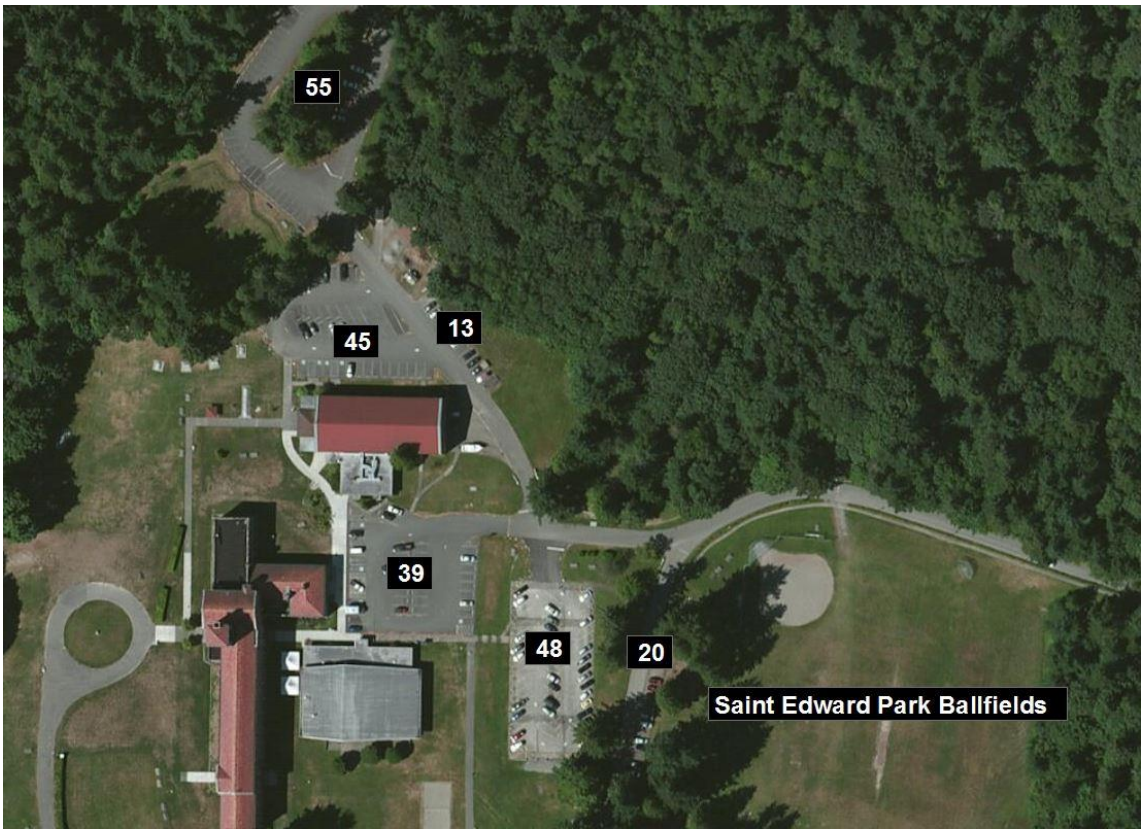

TABLE 2- EXISTING PARKING OCCUPANCY

	Available	Occupied	Percent
Saturday	220	194	88%
Weekday	220	50	23%

Project Parking Generation

For traffic analysis, it was conservative to assume that 10 cars would remain parked during each game, but for parking analysis, it is conservative to assume that more parents are staying to watch the games. Therefore, for the parking analysis, we assumed that 75 percent of parents would stay on site to watch the game and would need to park their vehicle. Based on discussions with the Youth League, all coaches and umpires were assumed to be parents, and the parking demand from coaches and umpires is included in the parking demand for parents. Each game will result in demand for an additional 18 vehicle parking spaces. Since there are two games at a time, the peak

demand could be as high as 36 vehicles. Table 3 summarizes the peak demand when there are two concurrent games at the upgraded ballfields, assuming no change to the existing available parking supply.

TABLE 3- FUTURE PARKING OCCUPANCY

	Available	Occupied	Percent
Saturday	220	230	105%
Weekday	220	86	39%

The parking demand may exceed existing capacity during a busy Saturday with two concurrent games at the proposed ballfields. However, existing parking supplies appear to be sufficient to accommodate weekday demands. The City has some plans for increasing the number of parking spaces available, as described below.

Planned Parking Changes

The City has plans to increase the parking supply with the upgrade to the ballfield. The City can add seven general use parking spaces plus one handicap parking space by extending and paving the unpaved parking (closest to the ballfields). The City also has plans to restripe the northernmost parking lot to add eleven parking spaces. Table 4 summarizes the future parking occupancy with planned expansion of the existing parking.

TABLE 4- FUTURE PARKING OCCUPANCY WITH PLANNED PARKING CHANGES

	Available	Occupied	Percent
Saturday	239	230	96%
Weekday	239	86	36%

With the City's planned improvements to the existing parking, parking demand is not expected to exceed capacity. However, parking demand will be close to capacity at peak park use times, and some circulating may be necessary for drivers.

It should be noted that the City and the State occasionally host special events that utilize the ballfields for parking. The upgraded ballfields will not be used for parking. If this becomes an issue, other alternatives will be considered by State Parks.

RECOMMENDATIONS

It should be noted that this was a very conservative analysis. The below recommendations would help address conditions that could occur under a worst-case scenario. The actual impact of the ballfields are likely to be less than what is presented here.

Traffic

- ***Optimize Signal Timings***

The signalized intersection of NE 145th Street and Juanita Drive NE has the capacity for the increase in vehicle trips related to background growth, development of the Lodge at Saint Edward State Park, and the development of the ballfields. No modifications to the intersection or signal are required. However, minor modifications to the signal timing could help decrease delay, especially for vehicles leaving the park. Optimizing signal timing on a weekday could reduce the overall delay in the Future Plus Project condition from 31.4 to 28.0 seconds. Optimizing the signal timing on a Saturday could reduce the overall delay in the Future Plus Project condition from 31.5 to 24.8 seconds. More detailed tables are provided in the appendix.

Parking

- ***Pave and stripe the gravel parking***
- ***Restripe the northernmost parking lot in order to provide additional parking***
- ***Wayfinding signs should be added throughout the park to direct visitors available parking***

The City's Municipal Code does not specify parking requirements for parks/playfields. Instead the requirement is up to the City Manager. The existing parking is sufficient for weekday games. However, on a busy Saturday, parking demand may exceed existing capacity. As part of the proposed ballfields upgrades, the City plans to restripe the northernmost lot and to pave and stripe the existing gravel parking to make the parking in those areas more efficient.

Current wayfinding in the park could be improved. During our Saturday observations, we noticed that many users didn't know about the parking at the very back of the park – thus, wayfinding signage could be used to help direct visitors to the ballfields as well as to additional parking they may not know about, increasing utilization of less obvious portions of the parking lot and reducing drivers need to circulate in search of parking.

Appendix

Results Analysis

Detailed Results by Scenario

Weekday

	Existing			Existing Plus Project			Future No Project			Future Plus Project			Future Plus Project Optimized		
	Delay	LOS	95th percentile Queue (ft)	Delay	LOS	95th percentile Queue (ft)	Delay	LOS	95th percentile Queue (ft)	Delay	LOS	95th percentile Queue (ft)	Delay	LOS	95th percentile Queue (ft)
EBLR	39.2	D	186	52	D	317	50.9	D	468	74.8	F	468	53.6	D	287
NBL	6.5	A	20	10.4	B	36	9.9	A	44	14.7	B	44	15.8	B	42
NBT	7.6	A	328	10.9	B	337	11.2	B	362	14.5	B	362	15.8	B	355
SBTR	11.1	B	336	17.2	B	418	16.4	B	493	23.5	C	493	26.1	C	472

Saturday

	Existing			Existing Plus Project			Future No Project			Future Plus Project			Future Plus Project Optimized		
	Delay	LOS	95th percentile Queue (ft)	Delay	LOS	95th percentile Queue (ft)	Delay	LOS	95th percentile Queue (ft)	Delay	LOS	95th percentile Queue (ft)	Delay	LOS	95th percentile Queue (ft)
EBLR	39.2	D	186	52	D	317	51.1	D	305	75.5	F	471	42.1	D	287
NBL	5.7	A	20	8.9	A	36	8.5	A	31	12.1	B	44	12.7	B	43
NBT	6.1	A	213	8.8	A	220	8.9	A	234	11.4	B	233	11.9	B	223
SBTR	9.6	A	241	14.7	B	303	14.1	B	296	19.3	B	360	25.9	C	345

HCM 2010 Signalized Intersection Summary
62: Juanita Dr NE

5/17/2016

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	129	103	40	646	456	64
Number	5	12	7	4	8	18
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1798	1834	1825	1825	1909	1948
Adj Flow Rate, veh/h	140	112	43	702	496	70
Adj No. of Lanes	0	0	1	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	0	0	2	2	2	2
Cap, veh/h	159	127	499	1264	963	136
Arrive On Green	0.18	0.18	0.04	0.69	0.59	0.59
Sat Flow, veh/h	900	720	1739	1825	1637	231
Grp Volume(v), veh/h	253	0	43	702	0	566
Grp Sat Flow(s),veh/h/ln	1626	0	1739	1825	0	1869
Q Serve(g_s), s	11.6	0.0	0.7	14.7	0.0	13.7
Cycle Q Clear(g_c), s	11.6	0.0	0.7	14.7	0.0	13.7
Prop In Lane	0.55	0.44	1.00			0.12
Lane Grp Cap(c), veh/h	288	0	499	1264	0	1098
V/C Ratio(X)	0.88	0.00	0.09	0.56	0.00	0.52
Avail Cap(c_a), veh/h	531	0	772	1264	0	1098
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	30.7	0.0	6.4	5.9	0.0	9.3
Incr Delay (d2), s/veh	8.5	0.0	0.1	1.8	0.0	1.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.9	0.0	0.3	7.8	0.0	7.4
LnGrp Delay(d),s/veh	39.2	0.0	6.5	7.6	0.0	11.1
LnGrp LOS	D		A	A		B
Approach Vol, veh/h	253			745	566	
Approach Delay, s/veh	39.2			7.6	11.1	
Approach LOS	D			A	B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4			7	8
Phs Duration (G+Y+Rc), s		18.5		58.0			8.0	50.0
Change Period (Y+Rc), s		5.0		5.0			5.0	5.0
Max Green Setting (Gmax), s		25.0		45.0			15.0	45.0
Max Q Clear Time (g_c+I1), s		13.6		16.7			2.7	15.7
Green Ext Time (p_c), s		0.0		10.0			0.0	10.2

Intersection Summary	
HCM 2010 Ctrl Delay	14.0
HCM 2010 LOS	B

Notes

User approved volume balancing among the lanes for turning movement.

Queues
62: Juanita Dr NE

5/24/2016

Lane Group	EBL	NBL	NBT	SBT
Lane Group Flow (vph)	252	43	702	566
v/c Ratio	0.71	0.09	0.57	0.51
Control Delay	36.7	5.8	10.0	14.1
Queue Delay	0.0	0.0	0.1	0.0
Total Delay	36.7	5.8	10.1	14.1
Queue Length 50th (ft)	104	6	159	174
Queue Length 95th (ft)	186	20	328	336
Internal Link Dist (ft)	1008		621	2055
Turn Bay Length (ft)		200		
Base Capacity (vph)	561	610	1540	1105
Starvation Cap Reductn	0	0	118	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.45	0.07	0.49	0.51

Intersection Summary

HCM 2010 Signalized Intersection Summary
62: Juanita Dr NE

5/17/2016

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	129	103	40	485	342	64
Number	5	12	7	4	8	18
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1798	1834	1825	1825	1909	1948
Adj Flow Rate, veh/h	140	112	43	527	372	70
Adj No. of Lanes	0	0	1	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	0	0	2	2	2	2
Cap, veh/h	159	127	587	1264	919	173
Arrive On Green	0.18	0.18	0.04	0.69	0.59	0.59
Sat Flow, veh/h	900	720	1739	1825	1563	294
Grp Volume(v), veh/h	253	0	43	527	0	442
Grp Sat Flow(s),veh/h/ln	1626	0	1739	1825	0	1857
Q Serve(g_s), s	11.6	0.0	0.7	9.6	0.0	9.9
Cycle Q Clear(g_c), s	11.6	0.0	0.7	9.6	0.0	9.9
Prop In Lane	0.55	0.44	1.00			0.16
Lane Grp Cap(c), veh/h	288	0	587	1264	0	1092
V/C Ratio(X)	0.88	0.00	0.07	0.42	0.00	0.40
Avail Cap(c_a), veh/h	531	0	859	1264	0	1092
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	30.7	0.0	5.7	5.1	0.0	8.5
Incr Delay (d2), s/veh	8.5	0.0	0.1	1.0	0.0	1.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.9	0.0	0.3	5.0	0.0	5.4
LnGrp Delay(d),s/veh	39.2	0.0	5.7	6.1	0.0	9.6
LnGrp LOS	D		A	A		A
Approach Vol, veh/h	253			570	442	
Approach Delay, s/veh	39.2			6.1	9.6	
Approach LOS	D			A	A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4			7	8
Phs Duration (G+Y+Rc), s		18.5		58.0			8.0	50.0
Change Period (Y+Rc), s		5.0		5.0			5.0	5.0
Max Green Setting (Gmax), s		25.0		45.0			15.0	45.0
Max Q Clear Time (g_c+I1), s		13.6		11.6			2.7	11.9
Green Ext Time (p_c), s		0.0		7.1			0.0	7.1

Intersection Summary	
HCM 2010 Ctrl Delay	14.0
HCM 2010 LOS	B

Notes

User approved volume balancing among the lanes for turning movement.

Lane Group	EBL	NBL	NBT	SBT
Lane Group Flow (vph)	252	43	527	442
v/c Ratio	0.71	0.08	0.43	0.40
Control Delay	36.7	5.7	8.0	12.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	36.7	5.7	8.0	12.3
Queue Length 50th (ft)	104	6	103	122
Queue Length 95th (ft)	186	20	213	241
Internal Link Dist (ft)	1008		621	2055
Turn Bay Length (ft)		200		
Base Capacity (vph)	561	681	1540	1101
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.45	0.06	0.34	0.40

Intersection Summary

HCM 2010 Signalized Intersection Summary
62: Juanita Dr NE

5/17/2016

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	185	137	62	675	476	100
Number	5	12	7	4	8	18
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1798	1834	1825	1825	1909	1948
Adj Flow Rate, veh/h	201	149	67	734	517	109
Adj No. of Lanes	0	0	1	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	0	0	2	2	2	2
Cap, veh/h	218	162	405	1179	824	174
Arrive On Green	0.23	0.23	0.05	0.65	0.54	0.54
Sat Flow, veh/h	933	691	1739	1825	1530	323
Grp Volume(v), veh/h	351	0	67	734	0	626
Grp Sat Flow(s),veh/h/ln	1629	0	1739	1825	0	1852
Q Serve(g_s), s	17.6	0.0	1.3	19.9	0.0	19.7
Cycle Q Clear(g_c), s	17.6	0.0	1.3	19.9	0.0	19.7
Prop In Lane	0.57	0.42	1.00			0.17
Lane Grp Cap(c), veh/h	382	0	405	1179	0	998
V/C Ratio(X)	0.92	0.00	0.17	0.62	0.00	0.63
Avail Cap(c_a), veh/h	488	0	635	1179	0	998
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	31.2	0.0	9.7	8.7	0.0	13.4
Incr Delay (d2), s/veh	19.7	0.0	0.2	2.5	0.0	3.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	10.0	0.0	0.6	10.6	0.0	10.7
LnGrp Delay(d),s/veh	50.9	0.0	9.9	11.2	0.0	16.4
LnGrp LOS	D		A	B		B
Approach Vol, veh/h	351			801	626	
Approach Delay, s/veh	50.9			11.1	16.4	
Approach LOS	D			B	B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4			7	8
Phs Duration (G+Y+Rc), s		24.6		58.9			8.9	50.0
Change Period (Y+Rc), s		5.0		5.0			5.0	5.0
Max Green Setting (Gmax), s		25.0		45.0			15.0	45.0
Max Q Clear Time (g_c+I1), s		19.6		21.9			3.3	21.7
Green Ext Time (p_c), s		0.0		10.2			0.1	10.3

Intersection Summary	
HCM 2010 Ctrl Delay	20.8
HCM 2010 LOS	C

Notes

User approved volume balancing among the lanes for turning movement.

Queues
62: Juanita Dr NE

5/24/2016

Lane Group	EBL	NBL	NBT	SBT
Lane Group Flow (vph)	350	67	734	626
v/c Ratio	0.82	0.17	0.63	0.63
Control Delay	45.2	7.6	12.9	19.9
Queue Delay	0.0	0.0	0.1	0.0
Total Delay	45.2	7.6	13.1	19.9
Queue Length 50th (ft)	168	13	233	253
Queue Length 95th (ft)	#303	29	364	407
Internal Link Dist (ft)	1008		621	2055
Turn Bay Length (ft)		200		
Base Capacity (vph)	508	507	1392	990
Starvation Cap Reductn	0	0	117	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.69	0.13	0.58	0.63

Intersection Summary

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

HCM 2010 Signalized Intersection Summary
62: Juanita Dr NE

5/17/2016

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	185	138	64	507	357	103
Number	5	12	7	4	8	18
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1798	1834	1825	1825	1909	1948
Adj Flow Rate, veh/h	201	150	70	551	388	112
Adj No. of Lanes	0	0	1	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	0	0	2	2	2	2
Cap, veh/h	218	163	489	1179	767	221
Arrive On Green	0.23	0.23	0.05	0.65	0.54	0.54
Sat Flow, veh/h	930	694	1739	1825	1425	411
Grp Volume(v), veh/h	352	0	70	551	0	500
Grp Sat Flow(s),veh/h/ln	1629	0	1739	1825	0	1837
Q Serve(g_s), s	17.7	0.0	1.4	12.8	0.0	14.5
Cycle Q Clear(g_c), s	17.7	0.0	1.4	12.8	0.0	14.5
Prop In Lane	0.57	0.43	1.00			0.22
Lane Grp Cap(c), veh/h	382	0	489	1179	0	988
V/C Ratio(X)	0.92	0.00	0.14	0.47	0.00	0.51
Avail Cap(c_a), veh/h	487	0	718	1179	0	988
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	31.2	0.0	8.4	7.5	0.0	12.3
Incr Delay (d2), s/veh	19.8	0.0	0.1	1.3	0.0	1.9
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	10.0	0.0	0.7	6.9	0.0	7.7
LnGrp Delay(d),s/veh	51.1	0.0	8.5	8.9	0.0	14.1
LnGrp LOS	D		A	A		B
Approach Vol, veh/h	352			621	500	
Approach Delay, s/veh	51.1			8.8	14.1	
Approach LOS	D			A	B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4			7	8
Phs Duration (G+Y+Rc), s		24.6		59.0			9.0	50.0
Change Period (Y+Rc), s		5.0		5.0			5.0	5.0
Max Green Setting (Gmax), s		25.0		45.0			15.0	45.0
Max Q Clear Time (g_c+I1), s		19.7		14.8			3.4	16.5
Green Ext Time (p_c), s		0.0		7.8			0.1	7.7

Intersection Summary	
HCM 2010 Ctrl Delay	20.7
HCM 2010 LOS	C

Notes

User approved volume balancing among the lanes for turning movement.

Lane Group	EBL	NBL	NBT	SBT
Lane Group Flow (vph)	351	70	551	500
v/c Ratio	0.83	0.15	0.47	0.51
Control Delay	45.5	7.3	10.2	16.9
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	45.5	7.3	10.2	16.9
Queue Length 50th (ft)	169	14	150	181
Queue Length 95th (ft)	#305	31	234	296
Internal Link Dist (ft)	1008		621	2055
Turn Bay Length (ft)		200		
Base Capacity (vph)	507	582	1389	985
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.69	0.12	0.40	0.51

Intersection Summary

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

HCM 2010 Signalized Intersection Summary
62: Juanita Dr NE

5/17/2016

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	243	175	100	675	476	158
Number	5	12	7	4	8	18
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1798	1834	1825	1825	1909	1948
Adj Flow Rate, veh/h	264	190	109	734	517	172
Adj No. of Lanes	0	0	1	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	0	0	2	2	2	2
Cap, veh/h	264	190	318	1113	689	229
Arrive On Green	0.28	0.28	0.05	0.61	0.50	0.50
Sat Flow, veh/h	946	681	1739	1825	1372	457
Grp Volume(v), veh/h	455	0	109	734	0	689
Grp Sat Flow(s),veh/h/ln	1630	0	1739	1825	0	1829
Q Serve(g_s), s	25.0	0.0	2.5	23.5	0.0	27.0
Cycle Q Clear(g_c), s	25.0	0.0	2.5	23.5	0.0	27.0
Prop In Lane	0.58	0.42	1.00			0.25
Lane Grp Cap(c), veh/h	454	0	318	1113	0	918
V/C Ratio(X)	1.00	0.00	0.34	0.66	0.00	0.75
Avail Cap(c_a), veh/h	454	0	519	1113	0	918
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	32.3	0.0	14.1	11.4	0.0	17.9
Incr Delay (d2), s/veh	42.5	0.0	0.6	3.1	0.0	5.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	16.5	0.0	1.2	12.6	0.0	15.0
LnGrp Delay(d),s/veh	74.8	0.0	14.7	14.5	0.0	23.5
LnGrp LOS	F		B	B		C
Approach Vol, veh/h	455			843	689	
Approach Delay, s/veh	74.8			14.5	23.5	
Approach LOS	E			B	C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4			7	8
Phs Duration (G+Y+Rc), s		30.0		59.7			9.7	50.0
Change Period (Y+Rc), s		5.0		5.0			5.0	5.0
Max Green Setting (Gmax), s		25.0		45.0			15.0	45.0
Max Q Clear Time (g_c+I1), s		27.0		25.5			4.5	29.0
Green Ext Time (p_c), s		0.0		9.9			0.2	8.8

Intersection Summary	
HCM 2010 Ctrl Delay	31.4
HCM 2010 LOS	C

Notes

User approved volume balancing among the lanes for turning movement.

Lane Group	EBL	NBL	NBT	SBT
Lane Group Flow (vph)	454	109	734	689
v/c Ratio	0.95	0.34	0.65	0.75
Control Delay	63.5	9.9	14.5	25.4
Queue Delay	0.0	0.0	0.2	0.0
Total Delay	63.5	9.9	14.7	25.4
Queue Length 50th (ft)	250	23	247	314
Queue Length 95th (ft)	#468	44	362	493
Internal Link Dist (ft)	1008		621	2055
Turn Bay Length (ft)		200		
Base Capacity (vph)	477	423	1302	921
Starvation Cap Reductn	0	0	131	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.95	0.26	0.63	0.75

Intersection Summary

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

HCM 2010 Signalized Intersection Summary
62: Juanita Dr NE

5/17/2016

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	243	176	102	507	357	161
Number	5	12	7	4	8	18
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1798	1834	1825	1825	1909	1948
Adj Flow Rate, veh/h	264	191	111	551	388	175
Adj No. of Lanes	0	0	1	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	0	0	2	2	2	2
Cap, veh/h	263	190	400	1113	626	282
Arrive On Green	0.28	0.28	0.05	0.61	0.50	0.50
Sat Flow, veh/h	944	683	1739	1825	1247	563
Grp Volume(v), veh/h	456	0	111	551	0	563
Grp Sat Flow(s),veh/h/ln	1630	0	1739	1825	0	1810
Q Serve(g_s), s	25.0	0.0	2.6	15.1	0.0	20.2
Cycle Q Clear(g_c), s	25.0	0.0	2.6	15.1	0.0	20.2
Prop In Lane	0.58	0.42	1.00			0.31
Lane Grp Cap(c), veh/h	454	0	400	1113	0	908
V/C Ratio(X)	1.00	0.00	0.28	0.50	0.00	0.62
Avail Cap(c_a), veh/h	454	0	600	1113	0	908
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	32.3	0.0	11.8	9.8	0.0	16.2
Incr Delay (d2), s/veh	43.1	0.0	0.4	1.6	0.0	3.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	16.5	0.0	1.2	8.0	0.0	10.8
LnGrp Delay(d),s/veh	75.5	0.0	12.1	11.4	0.0	19.3
LnGrp LOS	F		B	B		B
Approach Vol, veh/h	456			662	563	
Approach Delay, s/veh	75.5			11.5	19.3	
Approach LOS	E			B	B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4			7	8
Phs Duration (G+Y+Rc), s		30.0		59.7			9.7	50.0
Change Period (Y+Rc), s		5.0		5.0			5.0	5.0
Max Green Setting (Gmax), s		25.0		45.0			15.0	45.0
Max Q Clear Time (g_c+I1), s		27.0		17.1			4.6	22.2
Green Ext Time (p_c), s		0.0		8.4			0.2	7.8

Intersection Summary	
HCM 2010 Ctrl Delay	31.5
HCM 2010 LOS	C

Notes

User approved volume balancing among the lanes for turning movement.

Queues
62: Juanita Dr NE

5/24/2016

Lane Group	EBL	NBL	NBT	SBT
Lane Group Flow (vph)	455	111	551	563
v/c Ratio	0.98	0.27	0.48	0.63
Control Delay	70.6	8.7	11.0	21.4
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	70.6	8.7	11.0	21.4
Queue Length 50th (ft)	250	24	159	227
Queue Length 95th (ft)	#471	44	233	360
Internal Link Dist (ft)	1008		621	2055
Turn Bay Length (ft)		200		
Base Capacity (vph)	464	492	1264	892
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.98	0.23	0.44	0.63

Intersection Summary

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

HCM 2010 Signalized Intersection Summary
62: Juanita Dr NE

5/17/2016

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	243	175	100	675	476	158
Number	5	12	7	4	8	18
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1798	1834	1825	1825	1909	1948
Adj Flow Rate, veh/h	264	190	109	734	517	172
Adj No. of Lanes	0	0	1	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	0	0	2	2	2	2
Cap, veh/h	280	201	295	1075	655	218
Arrive On Green	0.30	0.30	0.05	0.59	0.48	0.48
Sat Flow, veh/h	946	681	1739	1825	1372	457
Grp Volume(v), veh/h	455	0	109	734	0	689
Grp Sat Flow(s),veh/h/ln	1630	0	1739	1825	0	1829
Q Serve(g_s), s	23.6	0.0	2.6	24.0	0.0	27.4
Cycle Q Clear(g_c), s	23.6	0.0	2.6	24.0	0.0	27.4
Prop In Lane	0.58	0.42	1.00			0.25
Lane Grp Cap(c), veh/h	482	0	295	1075	0	873
V/C Ratio(X)	0.94	0.00	0.37	0.68	0.00	0.79
Avail Cap(c_a), veh/h	546	0	302	1075	0	873
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	29.8	0.0	15.0	12.2	0.0	19.0
Incr Delay (d2), s/veh	23.8	0.0	0.8	3.5	0.0	7.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	13.8	0.0	1.3	13.1	0.0	15.5
LnGrp Delay(d),s/veh	53.6	0.0	15.8	15.8	0.0	26.1
LnGrp LOS	D		B	B		C
Approach Vol, veh/h	455			843	689	
Approach Delay, s/veh	53.6			15.8	26.1	
Approach LOS	D			B	C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4			7	8
Phs Duration (G+Y+Rc), s		30.6		56.0			9.6	46.4
Change Period (Y+Rc), s		5.0		5.0			5.0	5.0
Max Green Setting (Gmax), s		29.0		51.0			5.0	41.0
Max Q Clear Time (g_c+I1), s		25.6		26.0			4.6	29.4
Green Ext Time (p_c), s		0.0		11.3			0.0	7.1

Intersection Summary	
HCM 2010 Ctrl Delay	28.0
HCM 2010 LOS	C

Notes

User approved volume balancing among the lanes for turning movement.

Queues
62: Juanita Dr NE

5/24/2016

Lane Group	EBL	NBL	NBT	SBT
Lane Group Flow (vph)	454	109	734	689
v/c Ratio	0.86	0.44	0.74	0.87
Control Delay	35.6	13.6	17.7	34.0
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	35.6	13.6	17.7	34.0
Queue Length 50th (ft)	141	20	213	255
Queue Length 95th (ft)	#287	42	#355	#472
Internal Link Dist (ft)	1008		621	2055
Turn Bay Length (ft)		200		
Base Capacity (vph)	592	246	991	789
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.77	0.44	0.74	0.87

Intersection Summary

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

HCM 2010 Signalized Intersection Summary
62: Juanita Dr NE

5/17/2016

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	243	176	102	507	357	161
Number	5	12	7	4	8	18
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1798	1834	1825	1825	1909	1948
Adj Flow Rate, veh/h	264	191	111	551	388	175
Adj No. of Lanes	0	0	1	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	0	0	2	2	2	2
Cap, veh/h	285	207	329	984	489	220
Arrive On Green	0.30	0.30	0.07	0.54	0.39	0.39
Sat Flow, veh/h	944	683	1739	1825	1247	563
Grp Volume(v), veh/h	456	0	111	551	0	563
Grp Sat Flow(s),veh/h/ln	1630	0	1739	1825	0	1810
Q Serve(g_s), s	17.1	0.0	2.2	12.6	0.0	17.3
Cycle Q Clear(g_c), s	17.1	0.0	2.2	12.6	0.0	17.3
Prop In Lane	0.58	0.42	1.00			0.31
Lane Grp Cap(c), veh/h	493	0	329	984	0	709
V/C Ratio(X)	0.92	0.00	0.34	0.56	0.00	0.79
Avail Cap(c_a), veh/h	543	0	349	984	0	709
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	21.3	0.0	12.1	9.6	0.0	16.9
Incr Delay (d2), s/veh	20.8	0.0	0.6	2.3	0.0	8.9
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	10.5	0.0	1.1	6.9	0.0	10.4
LnGrp Delay(d),s/veh	42.1	0.0	12.7	11.9	0.0	25.9
LnGrp LOS	D		B	B		C
Approach Vol, veh/h	456			662	563	
Approach Delay, s/veh	42.1			12.0	25.9	
Approach LOS	D			B	C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4			7	8
Phs Duration (G+Y+Rc), s		24.1		39.0			9.3	29.7
Change Period (Y+Rc), s		5.0		5.0			5.0	5.0
Max Green Setting (Gmax), s		21.0		34.0			5.0	24.0
Max Q Clear Time (g_c+I1), s		19.1		14.6			4.2	19.3
Green Ext Time (p_c), s		0.0		7.3			0.0	2.8

Intersection Summary	
HCM 2010 Ctrl Delay	24.8
HCM 2010 LOS	C

Notes

User approved volume balancing among the lanes for turning movement.

Lane Group	EBL	NBL	NBT	SBT
Lane Group Flow (vph)	455	111	551	563
v/c Ratio	0.86	0.36	0.56	0.71
Control Delay	35.7	11.1	12.7	22.9
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	35.7	11.1	12.7	22.9
Queue Length 50th (ft)	141	21	137	182
Queue Length 95th (ft)	#287	43	223	#345
Internal Link Dist (ft)	1008		621	2055
Turn Bay Length (ft)		200		
Base Capacity (vph)	592	311	990	788
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.77	0.36	0.56	0.71

Intersection Summary

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