Appendix A:

Transportation Conditions Analysis Memorandum

memo

R^3C DESIGN GROUP

STATE OF MISSOURI
SHASHI
K. GANNAVARAM
NUMBER
E-2001018734
REGISTERED PROFESSIONAL ENGINEER

To: Ms. Lara Justesen

From: Shashi Gannavaram, P.E, PTP, AICP, PTOE

CC:

Date: 9/24/2013

Re: Transportation conditions analysis for the Englewood Arts District

1 Introduction

R^3C Design Group, LLC was requested to assist in transportation planning and traffic engineering elements for developing a Circulation Plan for the Englewood Arts District in Independence, Missouri. The Englewood Arts District is on E. Winner Road between Northern Boulevard and Sterling Road.

In particular the existing roadway system in the district is evaluated, including crash rates, the unique median parking and sight-distance challenges. Because the intersection of E. Winner Road and Northern Boulevard, on the west edge of the district, is a complicated five-legged intersection, much of this document describes the inherent challenges of this area and offers positive alternatives for improving the intersection. Finally, priorities are presented for improving the overall traffic flow through the district - both auto and non-motorized.

Exhibit 1: Looking west along E. Winner Road

The arts district is predominantly commercial, including only a few residences on the western end of the project, near Northern Boulevard. The commercial district is comprised mostly of small, personally-owned and operated businesses, providing a wide range of services. The corridor's key attraction is the now-closed Englewood Theater, which has no immediate plan to reopen.

The sidewalks and northern curb line between Sterling Road and Appleton Avenue have been recently improved by the City of Independence. This project also included new crosswalks and pedestrian signs at key intersections. There are no immediate Capital Improvement Projects planned on E. Winner Road.

2 Roadway system

2.1 Crash analysis

Crash data from 2010 to July 2013 was obtained from the City of Independence and analyzed to detect any unsafe conditions. The crash data was on E. Winner Road between Northern Avenue and Sterling Avenue. The data is summarized in Exhibit 3 below.

The following observations were noted:

- 36-percent (4 of 11) of the crashes resulted in injuries.
- There were no pedestrian – vehicle crashes in the corridor.
- Failing to yield resulted in 45% (5 of 11) crashes.
- In the last three years, the Northern Avenue intersection has seen no crashes. The closest crash occurred 50 feet east of Northern Avenue as a car was merging into traffic.
- The Appleton Avenue intersection experienced 45% (5 of 11) crashes in the corridor.
    - o Police reports indicated that two of the crashes resulted from obscured vision due to a parked car on the west side of the intersection.

Looking east at Appleton Avenue

Exhibit 2: Sight distance challenges due to parked vehicles at Appleton Avenue

Further review of the Appleton Avenue intersection reveals the following:

- Sight distance restrictions – Sight distance restrictions are primarily due to the angled parking along on-street medians. Since sight triangles are not strictly observed at this location, cars in the median are not able to view traffic on E. Winner Road during the turn. An example of these restrictions is shown in Exhibit 2.

Year	Location	Severity	Number of vehicles	Type	Cause	Notes
2010	50 feet east of Northern	PDO	2	Sideswipe	Failure to yield	
	Winner Road - mid-block	INJ	2	Head on	Too fast	
	Appleton at Winner	PDO	2	Right angle	Failure to yield	Vision obscured by parked car on west side
	Appleton at Winner	INJ	2	Right angle	Failure to yield	Vision obscured by parked car on west side
	45 feet east of Harris	PDO	2	Parked car	Improper backing	Bad pull out from parking stall
2011	Appleton at Winner	PDO	2	Angle	Improper signal + inattention	
	Appleton at Winner	PDO	2	Sideswipe	Improper passing	
2012	Harvard at Winner	INJ	2	Angle	Failure to yield	
	Winner Road at alley near Englewood Café	PDO	1	Drive into construction zone	Inattention	
	Appleton at Winner	INJ	2	Angle	Failure to yield	
2013	50 feet west of Harvard	PDO	2	Parked car	Poor lane use	

Notes:
1. PDO = Property damage only reported
2. INJ = Injury crash
3. Crash reports between January 1, 2010 and July 22, 2013 summarized

Exhibit 3: Crash analysis on E. Winner Road

2.2 On-street median parking

A very unique feature of the Englewood Arts District, specifically E. Winner Road, is the on-street angled median parking. Business owners on E. Winner Road consider this long-standing feature sacred and strongly oppose any change to this parking pattern. However, significant challenges are posed by the on-street median parking.

Exhibit 4: On-street median parking

- Adjoining lane width: The 60-degree angled parking results in a very wide lane width for vehicular traffic. In some locations, each lane on E. Winner Road is about 22 feet wide. Even though this section of the roadway is posted at 20 miles per hour (mph), the excessive pavement increases the comfort of the driver, and higher speeds tend to prevail.
- Sight distance: The median parking restricts the sight triangle particularly for vehicles turning onto the side streets. This is one of the primary factors for the higher crash rate at the Appleton Avenue intersection. The crash rates are discussed in a prior section.
- Crossing E. Winner Road: Business patrons park in the median and conveniently cross the street in front of their car at mid-block locations. Oncoming drivers must be unduly cautious of pedestrians stepping out from behind a parked car in the median.

Because of the wide lane width, a suggestion was presented to the steering committee to reduce the angle of the parking from the current 60 degrees to 45 degrees. This angle reduction also reduces the required lane width to 12 feet, with a stall width of 8 feet, a depth of 18.5 feet and skew width of 11.3 feet. However, it should be noted that the current city standard for parking stall width is 9 feet.

By reducing the parking angle and lane widths pedestrian safety is improved because of the shorter walking distance and exposure time in mid-block locations. Significantly, the spatial restrictions perceived by drivers will assist in slowing the vehicular traffic.

While this solution does not address the concerns listed above, it does maintain the desired on-street parking while providing some safety enhancements.

2.3 Sight distance

A significant cause for concern and safety is the sight distance challenges posed by large vehicles parking in the median near side street intersections. The plane of the sight triangle is encroached upon, causing vision challenges for traffic crossing E. Winner Road. This vision challenge must be recognized by those implementing future roadway improvements, and appropriate guidelines must be followed. These are provided in the "A Policy on Geometric Design of Highways and Street," published by the American Association of State Highway and

Transportation Officials (AASHTO), 2004 (commonly referred to as the green book). The criteria are as follows:

- Left turn from stop (Exhibit 9-55 of the green book) –
  - 280-feet for 25 mph
  - 225 feet for 20 mph
- Crossing maneuver (Exhibit 9-58 of the green book) –
  - 240-feet for 25 mph
  - 195 feet for 20 mph

During concept plan development, the guidelines were used to determine the triangle at each crossing point. Because business owners were unwilling to give up three or four parking spots at each crossing, an alternative plan was developed to minimize the sight triangle encroachment. This plan utilized green space and parking spaces specifically designated to compact cars and bicycles. . Exhibit 5 shows the final concept developed for the Appleton Avenue intersection.

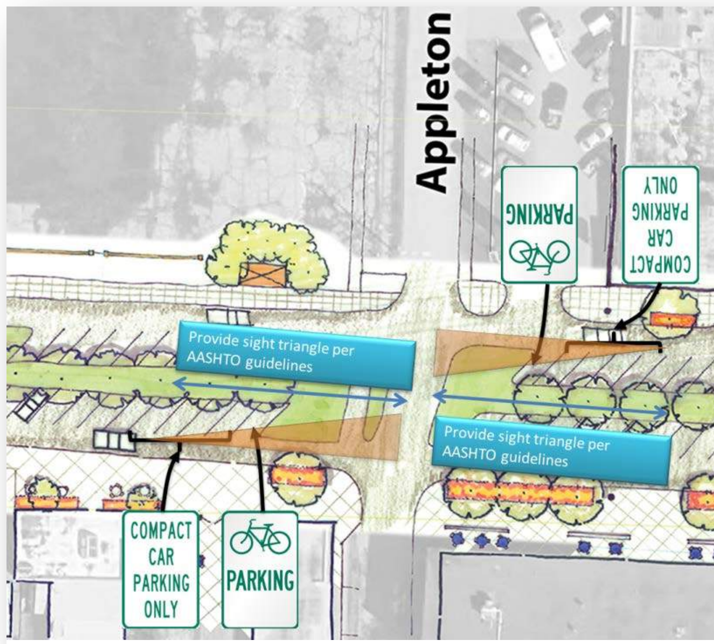


Exhibit 5: Parking concept at Appleton Avenue intersection

3 E. Winner Road at Northern Avenue Intersection

E. Winner Road at Northern Avenue, located on the west edge of the study area, is a non-standard five-legged intersection. An in-depth analysis is being completed for this intersection to determine possible improvements and create a gateway entrance to the arts district.

3.1 Existing traffic counts

Traffic counts were collected in July 2013 during the morning and afternoon peak hours. Pedestrian activity was also recorded during the same time periods. These counts are shown in Exhibit 6 below.

Exhibit 6: Existing traffic counts at E. Winner Road and Northern Boulevard intersection

Exhibit 7: No pedestrian actuation at E. Winner Road and Northern Boulevard

From these traffic counts we observe the following:

- Pedestrian activity is minimal during both peak auto-traffic periods. While the intersection is a non-standard five-legged intersection, it is believed to be relatively simple to access and cross. Although the existing signal has pedestrian indications, no push-buttons are provided for pedestrian actuation.

- Traffic flow is not directional – the volume of traffic east or westbound on E. Winner Road is of the same magnitude during both peak periods.
- Minimal traffic is turning onto E. 18th Street. Most of the E. 18th Street traffic continues as through traffic from the east leg of E. Winner Road.
- During field observations, it was noted that the majority of the traffic to E. 18th Street is turning one block west at S. Ralston Avenue.

3.2 Capacity analysis

When evaluating modifications to an intersection its operational level must be established. Based upon the delays experienced by its users, a baseline is set and improvement ideas are analyzed. Any alternatives developed should exceed this baseline level of operations. The "Highway Capacity Manual", published by the Transportation Research Board (TRB), 2010 provides guidelines for completing an operational analysis at the intersection. The analysis results in a letter grade called the Level of Service (LOS). LOS ranges from A through F where LOS A implies drivers experience no delays while LOS F indicates a complete breakdown at the intersection. For signalized intersections, the criteria for the LOS grade are shown in the adjacent table.

Level of Service (LOS)	Delay (seconds per vehicle)	General description
A	≤ 10	Free flow
B	>10 to 20	Stable flow
C	>20 to 35	Stable flow
D	>35 to 55	Tolerable delay
E	>55 to 80	Intolerable delay
F	>80	Jammed conditions

Exhibit 8: Signal intersection level of service criteria

Because this intersection is five-legged, it should be noted that the HCM 2010 methodology does not analyze it. HCM 2000 methodologies were used to complete the analysis. The criteria used for determining the LOS is the same using both methodologies. However, minor modifications do exist in how the delay is calculated.

The analysis is completed using software called Synchro, released by Trafficware, version 8. The results of the analysis are shown in Exhibit 9. Outputs from the software are included in the appendix. The following conclusions are made from the analysis results.

Existing Capacity Analysis results	Peak hour/ item		Approach					Intersection
			18th St. Eastbound	Winner Rd. Westbound	Northern Northbound	Northern Southbound	Winner Eastbound	
	Morning	Delay*	15.6	11.8	4.4	4.4	16.8	12.1
	Morning	LOS	B	B	A	A	B	B
	Afternoon	Delay*	11.9	9.4	6.9	7.1	15.4	11.4
	Afternoon	LOS	B	A	A	A	B	B

* - delay is measured in seconds per vehicle

Exhibit 9: Existing capacity analysis summary

From Exhibit 9 it is observed that the intersection can meet its present traffic demand. The levels-of-service are indicative of minimal delays. Further, it is believed that sufficient spare capacity is available to accommodate future growth.

3.3 Alternative development

This phase was primarily completed during the charrette on August 5 and 6, 2013. The steering committee and the Transportation Focus Group were presented with the existing conditions. During the discussions, it was noted that the E. 18th Street leg of the intersection was primarily funneling traffic to and from E. Winner Road. Good connectivity within the network allows traffic to turn onto E. 18th Street from S. Ralston Avenue to the west and E. 19th Street to the south.

Simplifying the intersection was a primary desire of the steering committee and a suggestion was made to close E. 18th Street at S. Hedges Avenue. This would force S. Hedges Avenue traffic to use E. 18th Street to the west, using S. Ralston Avenue to connect to E. Winner Road.

The advantages of this approach are:

1. The five legged intersection of S. Northern Boulevard and E. Winner Road becomes a standard four legged intersection.
2. Traffic coming to and from S. Hedges Avenue has a standard four-way intersection at S. Ralston Avenue.

However, a disadvantage is that S. Hedges Avenue traffic must travel an extra distance to get to E. Winner Road. Traffic heading east on E. Winner Road will be the most inconvenienced with this approach.

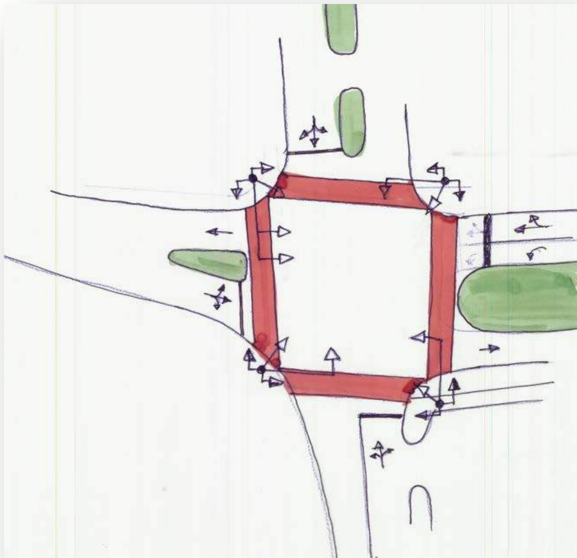
The overall approach of closing E. 18th Street between S. Hedges Avenue and E. Winner Road was very well received by the steering committee. This modified intersection is shown in Exhibit 10.

Exhibit 10: Proposed four-legged intersection

Because the intersection is now converted to a standard four-way intersection, options for traffic control are discussed. A desire of the focus group is to convert this intersection into a gateway to the Englewood Arts District. The two options that present themselves are:

1. Improve the signal layout at the intersection or
2. Install a single-lane roundabout at the intersection.

These are shown in Exhibit 11. Because of the overwhelming support for standardizing the intersection by closing the E. 18th Street leg, further analysis and alternative testing is being completed using each of these two alternatives.



Note: these drawings are conceptual and are not to scale.

Exhibit 11: Alternatives for the E. Winner Road and Northern Boulevard intersection

Advantages and disadvantages for each method of traffic control were briefly presented during the charrette. A few of these are summarized in Exhibit 12. Despite the disadvantages of a roundabout, the steering group and the charrette attendees unanimously prefer a roundabout for this intersection.

Signal intersection		**Roundabout**	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
	32 points of conflict between vehicles and pedestrians	Safer • Reduced vehicle speed • Reduction in conflict points	
Shorter walking distance for the pedestrian	Increased exposure for pedestrians	Reduced exposure for pedestrians	Increased walking distance for a pedestrian
	Increased congestion	Reduced congestion	
	Maintenance for life of signal	Reduced maintenance costs – primarily landscaping	
	Increased fuel use and pollution	Reduced fuel use and pollution	
Users are used to signals – no learning required.			Not used to a roundabout – learning curve required

Exhibit 12: Advantages and disadvantages of intersection control

3.4 Alternative testing

Alternative testing uses current counts to determine operational performance levels. These are compared to the existing levels-of-service, from Exhibit 9, and a suitable approach for traffic control at the intersection is selected. The two tested alternatives are:

1. Standard four-way intersection with a signal
2. Standard four-way intersection with a single lane roundabout.

Results of this analysis are summarized in Exhibit 13. For both scenarios, the results indicate the intersection will operate at a high level of service. The intersection is projected to operate at LOS B with a signal control and LOS A with a roundabout.

To ensure that the intersection option will fulfill demand needs for the design life of 20 years, the two scenarios are tested by increasing existing traffic volumes at a two-percent (2%) annual growth rate. This increases the traffic by about 50% over the 20-years. These results are summarized in Exhibit 14. In 20 years the intersection is projected to continue operating at LOS B with signal control and LOS A with a roundabout in place.

Roundabout parameters used for analysis are as follows:

- Because the available diagonal pavement at the intersection is approximately 95 feet, the outside diameter of the roundabout was set at 90-feet.
- The circulatory lane width is set at 15 feet.
- The inside circle diameter is 60 feet.
- All approach radii are set at a 50 feet radius.
- Lane width for approaching and exiting lanes is set at 12 feet, due to Kansas City Area Transportation Authority (KCATA) busses that use E. Winner Road.
- Pedestrian crosswalks are set 25 feet behind the yield line for each approach.
- Roundabout analysis was completed using the software SIDRA, released by Ackelick and Associates, version 6.

18th Street removed Capacity Analysis results Signal intersection Existing traffic counts	Peak hour/ item		Approach				Intersection
			Winner Rd. Westbound	Northern Northbound	Northern Southbound	Winner Rd. Eastbound	
	Morning	Delay*	13.4	4.2	4.3	15.2	12.3
	Morning	LOS	B	A	A	B	B
	Afternoon	Delay*	12.7	7.4	7.4	14.8	12.7
	Afternoon	LOS	B	A	A	B	B

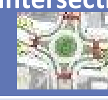
18th Street removed Capacity Analysis results Roundabout intersection Existing traffic counts	Peak hour/ item		Approach				Intersection
			Winner Rd. Westbound	Northern Northbound	Northern Southbound	Winner Rd. Eastbound	
	Morning	Delay*	4.5	4.0	4.0	4.5	4.4
	Morning	LOS	A	A	A	A	A
	Afternoon	Delay*	5.7	5.4	4.8	6.9	6.1
	Afternoon	LOS	A	A	A	A	A

Exhibit 13: Proposed four-legged intersection capacity analysis summary

18th Street removed Capacity Analysis results Signal intersection 20-year traffic volumes		Approach				Intersection
Peak hour/ item		Winner Rd. Westbound	Northern Northbound	Northern Southbound	Winner Rd. Eastbound	
Morning	Delay*	13.0	5.1	5.2	15.3	12.4
Morning	LOS	B	A	A	B	B
Afternoon	Delay*	13.4	10.1	10.1	17.0	14.4
Afternoon	LOS	B	B	B	B	B

18th Street removed Capacity Analysis results Roundabout intersection 20-year traffic volumes		Approach				Intersection
Peak hour/ item		Winner Rd. Westbound	Northern Northbound	Northern Southbound	Winner Rd. Eastbound	
Morning	Delay*	5.1	4.4	4.4	5.1	4.9
Morning	LOS	A	A	A	A	A
Afternoon	Delay*	6.9	5.7	6.6	9.4	7.9
Afternoon	LOS	A	A	A	A	A

Exhibit 14: 20-year capacity analysis summary

4 Priorities

The existing transportation conditions analysis for the Englewood Arts District was completed by the R^3C Design Group, LLC. The focus was on the existing roadway conditions, crash rates, median parking and the sight distance restrictions caused by the on-street parking. However, the primary charge was to develop alternatives for the five-legged intersection at E. Winner Road and Northern Boulevard.

4.1 Roadway system

Field observations and the analysis indicate an excessive amount of pavement for accommodating one lane of traffic in each direction. At some locations the pavement was as wide as 22 feet, where a 12-feet lane width is adequate for traffic movement.

A cause of this wide pavement is the angled median parking. Because the entry angle is 60-degrees, wider pavement width is required to negotiate the parking spot. By reducing this parking angle to 45-degrees, a narrower lane width is used by the through vehicles. An added benefit is the shorter distance and time that it takes for the pedestrians to cross E. Winner Road.

As part of this section, the crash rates and the predominant causes of crashes on E. Winner Road are examined. The high crash location is at Appleton Avenue and the main cause of the crashes is a lack of sight distance for traffic turning onto Appleton Avenue from E. Winner Road. When cars are parked in the median parking spots, the sight triangle is penetrated and turning vehicles are unable to see approaching traffic.

4.2 E. Winner Road and Northern Boulevard intersection

The data reveals that the traffic proceeds through this intersection because of the complicated nature of making a turn. The preferred turning location is S. Ralston Street, one block to the west. After considering the data and input from the steering committee and charrette participants, the E. 18th Street connection between S. Hodges Road and E. Winner Road is eliminated.

This change improves the intersection to a standard four-way intersection, while causing only a minor inconvenience to the traffic on S. Hodges Avenue, as they are routed along S. Ralston Avenue to get to E. Winner Road.

Using the four-legged intersection as a basis, two alternatives for traffic control are evaluated and discussed in the charrette. A capacity analysis for both alternatives reveals that the intersection would operate with no delays regardless of the intersection control. However, charrette participants overwhelmingly approved the roundabout concept because of the inherent safety features.

5 Appendix

5.1 Existing

5.1.1 Morning peak hour

HCM Signalized Intersection Capacity Analysis
4:
8/25/2013

Movement	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	SBL	SBT	SEL2
Lane Configurations	✣		↰	↑	↱			✣			✣	
Volume (vph)	26	1	9	10	92	25	5	10	13	20	11	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0			4.0			4.0	
Lane Util. Factor	1.00		1.00	1.00	1.00			1.00			1.00	
Frt	1.00		1.00	1.00	0.85			0.94			1.00	
Flt Protected	1.00		0.95	1.00	1.00			0.99			0.97	
Satd. Flow (prot)	1854		1770	1863	1583			1731			1804	
Flt Permitted	1.00		0.74	1.00	1.00			0.98			0.90	
Satd. Flow (perm)	1854		1375	1863	1583			1710			1672	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	28	1	10	11	100	27	5	11	14	22	12	1
RTOR Reduction (vph)	1	0	0	0	81	0	0	6	0	0	0	0
Lane Group Flow (vph)	28	0	10	11	46	0	0	24	0	0	34	0
Turn Type	NA		pm+pt	NA	Perm		Perm	NA		Perm	NA	Perm
Protected Phases	4!		3	8!				2			6	
Permitted Phases			8		8		2			6		4!
Actuated Green, G (s)	6.2		10.9	10.9	10.9			22.9			22.9	
Effective Green, g (s)	6.2		10.9	10.9	10.9			22.9			22.9	
Actuated g/C Ratio	0.15		0.26	0.26	0.26			0.55			0.55	
Clearance Time (s)	4.0		4.0	4.0	4.0			4.0			4.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	274		365	485	412			936			916	
v/s Ratio Prot	0.02		0.00	0.01								
v/s Ratio Perm			0.01		c0.03			0.01			c0.02	
v/c Ratio	0.10		0.03	0.02	0.11			0.03			0.04	
Uniform Delay, d1	15.4		11.5	11.5	11.8			4.3			4.4	
Progression Factor	1.00		1.00	1.00	1.00			1.00			1.00	
Incremental Delay, d2	0.2		0.0	0.0	0.1			0.0			0.1	
Delay (s)	15.6		11.5	11.5	11.9			4.4			4.4	
Level of Service	B		B	B	B			A			A	
Approach Delay (s)	15.6			11.8				4.4			4.4	
Approach LOS	B			B				A			A	

Intersection Summary			
HCM 2000 Control Delay	12.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.11		
Actuated Cycle Length (s)	41.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	26.8%	ICU Level of Service	A
Analysis Period (min)	15		

! Phase conflict between lane groups.
c Critical Lane Group

8/25/2013 Baseline

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HCM Signalized Intersection Capacity Analysis
4: 8/25/2013

Movement	SEL	SER	SER2
Lane Configurations			
Volume (vph)	79	7	0
Ideal Flow (vphpl)	1900	1900	1900
Total Lost time (s)	4.0		
Lane Util. Factor	1.00		
Frt	0.99		
Flt Protected	0.96		
Satd. Flow (prot)	1759		
Flt Permitted	1.00		
Satd. Flow (perm)	1832		
Peak-hour factor, PHF	0.92	0.92	0.92
Adj. Flow (vph)	86	8	0
RTOR Reduction (vph)	0	0	0
Lane Group Flow (vph)	95	0	0
Turn Type	NA		Perm
Protected Phases	4!		
Permitted Phases			4
Actuated Green, G (s)	6.2		
Effective Green, g (s)	6.2		
Actuated g/C Ratio	0.15		
Clearance Time (s)	4.0		
Vehicle Extension (s)	3.0		
Lane Grp Cap (vph)	271		
v/s Ratio Prot			
v/s Ratio Perm	c0.05		
v/c Ratio	0.35		
Uniform Delay, d1	16.0		
Progression Factor	1.00		
Incremental Delay, d2	0.8		
Delay (s)	16.8		
Level of Service	B		
Approach Delay (s)	16.8		
Approach LOS	B		
Intersection Summary			

8/25/2013 Baseline

Synchro 8 Report
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5.1.2 Afternoon peak hour

HCM Signalized Intersection Capacity Analysis
4: 8/23/2013

Movement	EBT	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	SBL	SBT	SBR	SBR2
Lane Configurations	✥	↰	↑	↱			✥			✥		
Volume (vph)	26	19	26	159	34	10	20	28	38	20	1	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0			4.0			4.0		
Lane Util. Factor	1.00	1.00	1.00	1.00			1.00			1.00		
Frt	1.00	1.00	1.00	0.85			0.94			0.99		
Flt Protected	1.00	0.95	1.00	1.00			0.99			0.97		
Satd. Flow (prot)	1863	1770	1863	1583			1728			1796		
Flt Permitted	1.00	0.74	1.00	1.00			0.97			0.86		
Satd. Flow (perm)	1863	1377	1863	1583			1686			1586		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	28	21	28	173	37	11	22	30	41	22	1	2
RTOR Reduction (vph)	0	0	0	69	0	0	17	0	0	1	0	0
Lane Group Flow (vph)	28	21	28	141	0	0	46	0	0	65	0	0
Turn Type	NA	pm+pt	NA	Perm		Perm	NA		Perm	NA		
Protected Phases	4!	3	8!				2			6		
Permitted Phases		8		8		2			6			
Actuated Green, G (s)	10.9	15.5	15.5	15.5			18.8			18.8		
Effective Green, g (s)	10.9	15.5	15.5	15.5			18.8			18.8		
Actuated g/C Ratio	0.26	0.37	0.37	0.37			0.44			0.44		
Clearance Time (s)	4.0	4.0	4.0	4.0			4.0			4.0		
Vehicle Extension (s)	3.0	3.0	3.0	3.0			3.0			3.0		
Lane Grp Cap (vph)	480	510	682	580			749			704		
v/s Ratio Prot	0.02	0.00	0.02									
v/s Ratio Perm		0.01		c0.09			0.03			c0.04		
v/c Ratio	0.06	0.04	0.04	0.24			0.06			0.09		
Uniform Delay, d1	11.8	8.6	8.6	9.3			6.7			6.8		
Progression Factor	1.00	1.00	1.00	1.00			1.00			1.00		
Incremental Delay, d2	0.1	0.0	0.0	0.2			0.2			0.3		
Delay (s)	11.9	8.7	8.6	9.5			6.9			7.1		
Level of Service	B	A	A	A			A			A		
Approach Delay (s)	11.9		9.4				6.9			7.1		
Approach LOS	B		A				A			A		

Intersection Summary			
HCM 2000 Control Delay	11.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.29		
Actuated Cycle Length (s)	42.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	41.0%	ICU Level of Service	A
Analysis Period (min)	15		

! Phase conflict between lane groups.
c Critical Lane Group

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HCM Signalized Intersection Capacity Analysis
4: 8/23/2013

Movement	SEL2	SEL	SER	SER2
Lane Configurations				
Volume (vph)	2	228	19	0
Ideal Flow (vphpl)	1900	1900	1900	1900
Total Lost time (s)		4.0		
Lane Util. Factor		1.00		
Frt		0.99		
Flt Protected		0.96		
Satd. Flow (prot)		1760		
Flt Permitted		1.00		
Satd. Flow (perm)		1837		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2	248	21	0
RTOR Reduction (vph)	0	0	0	0
Lane Group Flow (vph)	0	271	0	0
Turn Type	Perm	NA		Perm
Protected Phases		4!		
Permitted Phases	4!			4
Actuated Green, G (s)		10.9		
Effective Green, g (s)		10.9		
Actuated g/C Ratio		0.26		
Clearance Time (s)		4.0		
Vehicle Extension (s)		3.0		
Lane Grp Cap (vph)		473		
v/s Ratio Prot				
v/s Ratio Perm		c0.15		
v/c Ratio		0.57		
Uniform Delay, d1		13.7		
Progression Factor		1.00		
Incremental Delay, d2		1.7		
Delay (s)		15.4		
Level of Service		B		
Approach Delay (s)		15.4		
Approach LOS		B		
Intersection Summary				

Baseline

Synchro 8 Report
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5.2 18th Street removed with current year traffic counts

5.2.1 Signal control

5.2.1.1 Morning peak hour

HCM 2010 Signalized Intersection Summary

4: 8/25/2013

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥		↰	↑			✥			✥	
Volume (veh/h)	1	105	7	19	92	25	5	10	13	20	11	0
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), 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 veh/h/ln	190.0	186.3	190.0	186.3	186.3	190.0	190.0	186.3	190.0	190.0	186.3	190.0
Lanes	0	1	0	1	1	0	0	1	0	0	1	0
Cap, veh/h	105	206	14	37	362	98	198	382	403	645	318	0
Arrive On Green	0.12	0.12	0.12	0.02	0.26	0.26	0.52	0.52	0.52	0.52	0.52	0.00
Sat Flow, veh/h	8	1711	120	1774	1414	382	151	742	781	923	617	0
Grp Volume(v), veh/h	123	0	0	21	0	127	30	0	0	34	0	0
Grp Sat Flow(s),veh/h/ln	1838	0	0	1774	0	1795	1675	0	0	1540	0	0
Q Serve(g_s), s	0.2	0.0	0.0	0.4	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	2.2	0.0	0.0	0.4	0.0	2.0	0.3	0.0	0.0	0.3	0.0	0.0
Prop In Lane	0.01		0.07	1.00		0.21	0.17		0.47	0.65		0.00
Lane Grp Cap(c), veh/h	325	0	0	37	0	460	983	0	0	963	0	0
V/C Ratio(X)	0.38	0.00	0.00	0.56	0.00	0.28	0.03	0.00	0.00	0.04	0.00	0.00
Avail Cap(c_a), veh/h	944	0	0	203	0	1233	983	0	0	963	0	0
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)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	14.5	0.0	0.0	16.9	0.0	10.4	4.2	0.0	0.0	4.2	0.0	0.0
Incr Delay (d2), s/veh	0.7	0.0	0.0	12.5	0.0	0.3	0.1	0.0	0.0	0.1	0.0	0.0
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
%ile Back of Q (50%), veh/ln	0.9	0.0	0.0	0.3	0.0	0.7	0.1	0.0	0.0	0.1	0.0	0.0
Lane Grp Delay (d), s/veh	15.2	0.0	0.0	29.4	0.0	10.7	4.2	0.0	0.0	4.3	0.0	0.0
Lane Grp LOS	B			C		B	A			A		
Approach Vol, veh/h		123			148			30			34	
Approach Delay, s/veh		15.2			13.4			4.2			4.3	
Approach LOS		B			B			A			A	
Timer												
Assigned Phs		4		3	8			2			6	
Phs Duration (G+Y+Rc), s		8.2		4.7	12.9			22.0			22.0	
Change Period (Y+Rc), s		4.0		4.0	4.0			4.0			4.0	
Max Green Setting (Gmax), s		16.0		4.0	24.0			18.0			18.0	
Max Q Clear Time (g_c+I1), s		4.2		2.4	4.0			2.3			2.3	
Green Ext Time (p_c), s		0.4		0.1	0.7			0.2			0.2	
Intersection Summary												
HCM 2010 Ctrl Delay			12.3									
HCM 2010 LOS			B									
Notes												

8/25/2013 Baseline

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5.2.1.2 Afternoon peak hour

HCM 2010 Signalized Intersection Summary
4: 8/24/2013

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	3	264	20	45	159	34	10	20	28	38	20	3
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), 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 veh/h/ln	190.0	186.3	190.0	186.3	186.3	190.0	190.0	186.3	190.0	190.0	186.3	190.0
Lanes	0	1	0	1	1	0	0	1	0	0	1	0
Cap, veh/h	90	423	32	74	578	124	169	298	330	501	245	29
Arrive On Green	0.25	0.25	0.25	0.04	0.39	0.39	0.42	0.42	0.42	0.42	0.42	0.42
Sat Flow, veh/h	5	1702	130	1774	1488	318	157	717	794	862	589	69
Grp Volume(v), veh/h	312	0	0	49	0	210	63	0	0	66	0	0
Grp Sat Flow(s),veh/h/ln	1837	0	0	1774	0	1807	1668	0	0	1520	0	0
Q Serve(g_s), s	0.0	0.0	0.0	1.1	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	6.3	0.0	0.0	1.1	0.0	3.3	0.9	0.0	0.0	0.9	0.0	0.0
Prop In Lane	0.01		0.07	1.00		0.18	0.17		0.48	0.62		0.05
Lane Grp Cap(c), veh/h	546	0	0	74	0	701	797	0	0	775	0	0
V/C Ratio(X)	0.57	0.00	0.00	0.66	0.00	0.30	0.08	0.00	0.00	0.09	0.00	0.00
Avail Cap(c_a), veh/h	807	0	0	217	0	1105	797	0	0	775	0	0
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)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	13.9	0.0	0.0	19.3	0.0	8.7	7.2	0.0	0.0	7.2	0.0	0.0
Incr Delay (d2), s/veh	0.9	0.0	0.0	9.6	0.0	0.2	0.2	0.0	0.0	0.2	0.0	0.0
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
%ile Back of Q (50%), veh/ln	2.6	0.0	0.0	0.6	0.0	1.2	0.3	0.0	0.0	0.4	0.0	0.0
Lane Grp Delay (d), s/veh	14.8	0.0	0.0	28.9	0.0	8.9	7.4	0.0	0.0	7.4	0.0	0.0
Lane Grp LOS	B			C		A	A			A		
Approach Vol, veh/h		312			259			63			66	
Approach Delay, s/veh		14.8			12.7			7.4			7.4	
Approach LOS		B			B			A			A	
Timer												
Assigned Phs		4		3	8			2			6	
Phs Duration (G+Y+Rc), s		14.2		5.7	19.9			21.0			21.0	
Change Period (Y+Rc), s		4.0		4.0	4.0			4.0			4.0	
Max Green Setting (Gmax), s		16.0		5.0	25.0			17.0			17.0	
Max Q Clear Time (g_c+I1), s		8.3		3.1	5.3			2.9			2.9	
Green Ext Time (p_c), s		1.9		0.0	3.1			0.5			0.5	
Intersection Summary												
HCM 2010 Ctrl Delay			12.7									
HCM 2010 LOS			B									
Notes												

Baseline

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5.2.2 Roundabout control

5.2.2.1 Morning peak hour

MOVEMENT SUMMARY

Site: Winner at Northern, proposed AM

Winner at Northern
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Northern Blvd.											
3	L	5	2.0	0.032	4.0	LOS A	0.1	2.7	0.25	0.79	23.7
8	T	11	2.0	0.032	4.0	LOS A	0.1	2.7	0.25	0.28	26.0
18	R	14	2.0	0.032	4.0	LOS A	0.1	2.7	0.25	0.42	25.5
Approach		30	2.0	0.032	4.0	LOS A	0.1	2.7	0.25	0.44	25.3
East: Winner Road											
1	L	21	2.0	0.136	4.5	LOS A	0.5	13.1	0.08	0.67	17.8
6	T	100	2.0	0.136	4.5	LOS A	0.5	13.1	0.08	0.02	18.6
16	R	27	2.0	0.136	4.5	LOS A	0.5	13.1	0.08	0.04	18.5
Approach		148	2.0	0.136	4.5	LOS A	0.5	13.1	0.08	0.12	18.4
North: Northern Blvd.											
7	L	22	2.0	0.036	4.0	LOS A	0.1	3.1	0.24	0.73	24.2
4	T	12	2.0	0.036	4.0	LOS A	0.1	3.1	0.24	0.34	26.6
14	R	1	2.0	0.036	4.0	LOS A	0.1	3.1	0.24	0.45	26.0
Approach		35	2.0	0.036	4.0	LOS A	0.1	3.1	0.24	0.59	25.0
West: Winner Road											
5	L	1	2.0	0.117	4.5	LOS A	0.4	11.0	0.16	0.94	25.7
2	T	114	2.0	0.117	4.5	LOS A	0.4	11.0	0.16	0.36	28.7
12	R	8	2.0	0.117	4.5	LOS A	0.4	11.0	0.16	0.51	28.0
Approach		123	2.0	0.117	4.5	LOS A	0.4	11.0	0.16	0.38	28.6
All Vehicles		336	2.0	0.136	4.4	LOS A	0.5	13.1	0.14	0.29	22.8

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Model used. Geometric Delay not included.

Processed: Sunday, August 25, 2013 4:08:31 PM
SIDRA INTERSECTION 5.1.13.2093
Project: C:\Users\R3C\Desktop\Winner at Northern proposed AM.sip
8000824, R 3C DESIGN GROUP, SINGLE

SIDRA INTERSECTION

5.2.2.2 Afternoon peak hour

LANE SUMMARY

Site: Winner at Northern, proposed PM

Winner at Northern
Roundabout

Lane Use and Performance

	Demand Flows L veh/h	Demand Flows T veh/h	Demand Flows R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Lane Length ft	SL Type	Cap. Adj. %	Prob. Block. %
South: Northern Blvd.																
Lane 1	11	22	30	63	2.0	790	0.080	100	5.4	LOS A	0.3	6.9	1600	–	0.0	0.0
Approach	11	22	30	63	2.0		0.080		5.4	LOS A	0.3	6.9				
East: Winner Road																
Lane 1	49	173	37	259	2.0	1068	0.242	100	5.7	LOS A	1.0	26.3	1600	–	0.0	0.0
Approach	49	173	37	259	2.0		0.242		5.7	LOS A	1.0	26.3				
North: Northern Blvd.																
Lane 1	41	22	3	66	2.0	875	0.076	100	4.8	LOS A	0.3	6.7	1600	–	0.0	0.0
Approach	41	22	3	66	2.0		0.076		4.8	LOS A	0.3	6.7				
West: Winner Road																
Lane 1	3	287	22	312	2.0	988	0.316	100	6.9	LOS A	1.4	36.3	1600	–	0.0	0.0
Approach	3	287	22	312	2.0		0.316		6.9	LOS A	1.4	36.3				
Intersection				700	2.0		0.316		6.1	LOS A	1.4	36.3				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Model used. Geometric Delay not included.

Processed: Saturday, August 24, 2013 7:06:31 AM
SIDRA INTERSECTION 5.1.13.2093
Project: C:\Users\R3C\Desktop\Winner at Northern proposed PM.sip
8000824, R 3C DESIGN GROUP, SINGLE

SIDRA INTERSECTION

5.3 18th Street removed and 20 year traffic projections

5.3.1 Signal control

5.3.1.1 Morning peak hour

HCM 2010 Signalized Intersection Summary
4: 8/25/2013

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	1	105	7	19	92	25	5	10	13	20	11	0
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), 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 veh/h/ln	190.0	186.3	190.0	186.3	186.3	190.0	190.0	186.3	190.0	190.0	186.3	190.0
Lanes	0	1	0	1	1	0	0	1	0	0	1	0
Cap, veh/h	99	278	18	52	421	115	195	351	378	605	297	0
Arrive On Green	0.16	0.16	0.16	0.03	0.30	0.30	0.49	0.49	0.49	0.49	0.49	0.00
Sat Flow, veh/h	8	1721	110	1774	1409	385	166	723	779	916	613	0
Grp Volume(v), veh/h	184	0	0	31	0	191	45	0	0	51	0	0
Grp Sat Flow(s),veh/h/ln	1839	0	0	1774	0	1795	1669	0	0	1529	0	0
Q Serve(g_s), s	0.0	0.0	0.0	0.6	0.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	3.4	0.0	0.0	0.6	0.0	3.1	0.5	0.0	0.0	0.5	0.0	0.0
Prop In Lane	0.01		0.06	1.00		0.21	0.18		0.47	0.65		0.00
Lane Grp Cap(c), veh/h	395	0	0	52	0	536	924	0	0	902	0	0
V/C Ratio(X)	0.47	0.00	0.00	0.59	0.00	0.36	0.05	0.00	0.00	0.06	0.00	0.00
Avail Cap(c_a), veh/h	890	0	0	191	0	1162	924	0	0	902	0	0
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)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	14.5	0.0	0.0	17.8	0.0	10.2	5.0	0.0	0.0	5.0	0.0	0.0
Incr Delay (d2), s/veh	0.9	0.0	0.0	10.2	0.0	0.4	0.1	0.0	0.0	0.1	0.0	0.0
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
%ile Back of Q (50%), veh/ln	1.5	0.0	0.0	0.4	0.0	1.2	0.2	0.0	0.0	0.2	0.0	0.0
Lane Grp Delay (d), s/veh	15.3	0.0	0.0	28.0	0.0	10.6	5.1	0.0	0.0	5.2	0.0	0.0
Lane Grp LOS	B			C		B	A			A		
Approach Vol, veh/h		184			222			45			51	
Approach Delay, s/veh		15.3			13.0			5.1			5.2	
Approach LOS		B			B			A			A	
Timer												
Assigned Phs		4		3	8			2			6	
Phs Duration (G+Y+Rc), s		10.0		5.1	15.1			22.0			22.0	
Change Period (Y+Rc), s		4.0		4.0	4.0			4.0			4.0	
Max Green Setting (Gmax), s		16.0		4.0	24.0			18.0			18.0	
Max Q Clear Time (g_c+I1), s		5.4		2.6	5.1			2.5			2.5	
Green Ext Time (p_c), s		0.7		0.1	1.1			0.4			0.4	
Intersection Summary												
HCM 2010 Ctrl Delay			12.4									
HCM 2010 LOS			B									
Notes												

8/25/2013 Baseline

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5.3.1.2 Afternoon peak hour

HCM 2010 Signalized Intersection Summary

4: 8/24/2013

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥		↰	↑			✥			↰↑	
Volume (veh/h)	3	264	20	45	159	34	10	20	28	38	20	3
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), 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 veh/h/ln	190.0	186.3	190.0	186.3	186.3	190.0	190.0	186.3	190.0	190.0	186.3	190.0
Lanes	0	1	0	1	1	0	0	1	0	0	1	0
Cap, veh/h	81	540	41	94	681	145	146	263	298	441	214	28
Arrive On Green	0.32	0.32	0.32	0.05	0.46	0.46	0.37	0.37	0.37	0.37	0.37	0.37
Sat Flow, veh/h	5	1701	129	1774	1490	316	148	712	807	852	580	75
Grp Volume(v), veh/h	468	0	0	73	0	314	95	0	0	100	0	0
Grp Sat Flow(s),veh/h/ln	1836	0	0	1774	0	1807	1666	0	0	1508	0	0
Q Serve(g_s), s	0.2	0.0	0.0	1.9	0.0	5.3	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	10.7	0.0	0.0	1.9	0.0	5.3	1.7	0.0	0.0	1.7	0.0	0.0
Prop In Lane	0.01		0.07	1.00		0.18	0.17		0.48	0.62		0.05
Lane Grp Cap(c), veh/h	662	0	0	94	0	826	706	0	0	683	0	0
V/C Ratio(X)	0.71	0.00	0.00	0.78	0.00	0.38	0.13	0.00	0.00	0.15	0.00	0.00
Avail Cap(c_a), veh/h	756	0	0	154	0	981	706	0	0	683	0	0
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)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	14.4	0.0	0.0	21.6	0.0	8.2	9.7	0.0	0.0	9.7	0.0	0.0
Incr Delay (d2), s/veh	2.6	0.0	0.0	13.1	0.0	0.3	0.4	0.0	0.0	0.5	0.0	0.0
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
%ile Back of Q (50%), veh/ln	4.8	0.0	0.0	1.1	0.0	1.9	0.7	0.0	0.0	0.8	0.0	0.0
Lane Grp Delay (d), s/veh	17.0	0.0	0.0	34.6	0.0	8.5	10.1	0.0	0.0	10.1	0.0	0.0
Lane Grp LOS	B			C		A	B			B		
Approach Vol, veh/h		468			387			95			100	
Approach Delay, s/veh		17.0			13.4			10.1			10.1	
Approach LOS		B			B			B			B	
Timer												
Assigned Phs		4		3	8			2			6	
Phs Duration (G+Y+Rc), s		18.6		6.4	25.1			21.0			21.0	
Change Period (Y+Rc), s		4.0		4.0	4.0			4.0			4.0	
Max Green Setting (Gmax), s		17.0		4.0	25.0			17.0			17.0	
Max Q Clear Time (g_c+I1), s		12.7		3.9	7.3			3.7			3.7	
Green Ext Time (p_c), s		1.9		0.0	4.8			0.8			0.8	
Intersection Summary												
HCM 2010 Ctrl Delay			14.4									
HCM 2010 LOS			B									
Notes												

Baseline

Synchro 8 Report
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5.3.2 Roundabout control

5.3.2.1 Morning peak hour

MOVEMENT SUMMARY — **Site: Winner at Northern, future AM**

Winner at Northern
Roundabout
Design Life Analysis (Practical Capacity): Results for 20 years

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Northern Blvd.											
3	L	8	2.0	0.047	4.4	LOS A	0.2	4.0	0.30	0.79	23.5
8	T	15	2.0	0.047	4.4	LOS A	0.2	4.0	0.30	0.33	25.8
18	R	20	2.0	0.047	4.4	LOS A	0.2	4.0	0.30	0.45	25.3
Approach		43	2.0	0.047	4.4	LOS A	0.2	4.0	0.30	0.47	25.1
East: Winner Road											
1	L	29	2.0	0.192	5.1	LOS A	0.8	19.6	0.11	0.66	17.6
6	T	140	2.0	0.192	5.1	LOS A	0.8	19.6	0.11	0.03	18.4
16	R	38	2.0	0.192	5.1	LOS A	0.8	19.6	0.11	0.05	18.3
Approach		207	2.0	0.192	5.1	LOS A	0.8	19.6	0.11	0.12	18.3
North: Northern Blvd.											
7	L	30	2.0	0.053	4.4	LOS A	0.2	4.6	0.29	0.74	24.1
4	T	17	2.0	0.053	4.4	LOS A	0.2	4.6	0.29	0.38	26.4
14	R	2	2.0	0.053	4.4	LOS A	0.2	4.6	0.29	0.48	25.8
Approach		49	2.0	0.053	4.4	LOS A	0.2	4.6	0.29	0.61	24.8
West: Winner Road											
5	L	2	2.0	0.168	5.1	LOS A	0.7	16.5	0.20	0.92	25.5
2	T	160	2.0	0.168	5.1	LOS A	0.7	16.5	0.20	0.38	28.4
12	R	11	2.0	0.168	5.1	LOS A	0.7	16.5	0.20	0.52	27.7
Approach		172	2.0	0.168	5.1	LOS A	0.7	16.5	0.20	0.40	28.3
All Vehicles		470	2.0	0.192	4.9	LOS A	0.8	19.6	0.18	0.30	22.6

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Model used. Geometric Delay not included.

5.3.2.2 Afternoon peak hour

LANE SUMMARY

Site: Winner at Northern, future PM

Winner at Northern
Roundabout
Design Life Analysis (Practical Capacity): Results for 20 years

Lane Use and Performance

	Demand Flows L veh/h	Demand Flows T veh/h	Demand Flows R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Lane Length ft	SL Type	Cap. Adj. %	Prob. Block. %
South: Northern Blvd.																
Lane 1	15	30	43	88	2.0	690	0.128	100	6.6	LOS A	0.4	11.2	1600	–	0.0	0.0
Approach	15	30	43	88	2.0		0.128		6.6	LOS A	0.4	11.2				
East: Winner Road																
Lane 1	68	242	52	362	2.0	1053	0.344	100	6.9	LOS A	1.7	42.4	1600	–	0.0	0.0
Approach	68	242	52	362	2.0		0.344		6.9	LOS A	1.7	42.4				
North: Northern Blvd.																
Lane 1	58	30	5	93	2.0	795	0.117	100	5.7	LOS A	0.4	10.4	1600	–	0.0	0.0
Approach	58	30	5	93	2.0		0.117		5.7	LOS A	0.4	10.4				
West: Winner Road																
Lane 1	5	402	30	437	2.0	944	0.462	100	9.4	LOS A	2.5	62.6	1600	–	0.0	0.0
Approach	5	402	30	437	2.0		0.462		9.4	LOS A	2.5	62.6				
Intersection				980	2.0		0.462		7.9	LOS A	2.5	62.6				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Model used. Geometric Delay not included.

Processed: Saturday, August 24, 2013 7:17:41 AM
SIDRA INTERSECTION 5.1.13.2093
Project: C:\Users\R3C\Desktop\Winner at Northern future PM.sip
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