Appendix A: Traffic Study

MDOT US 72 Road Improvements

Operational Analysis Report

Marshall County

SP-0007-01(102)/109563-101000

Prepared For:

Mississippi Dept. of Transportation

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1.0 Introduction

The purpose of this study is to evaluate the traffic operations for Existing Conditions, Future No Build Conditions, and Future Build Conditions for a new interchange on US 72 with a connector road west of the SR 302 interchange in Marshall County. The study area extends along US 72 from Knox Road to Coopwood Road and along SR 302 from US 72 to west of Red Banks Road. The new interchange would be located along US 72 to the west of the SR 302 interchange, and the connector would intersect SR 302 at Red Banks Road. *Synchro* and *SimTraffic* software were used to analyze the study intersections according to the latest *Highway Capacity Manual* (*HCM*) methodology and *SimTraffic* microsimulation methodology. For alternatives with roundabout control, *Sidra* software was also utilized for evaluation. *Highway Capacity Software* (*HCS*) Freeway Facilities module was used to analyze the merging and diverging segments within the interchanges according to the latest *HCM* methodology. While US 72 and SR 302 are not technically freeways, the sections analyzed using Freeway Facilities behave like a freeway due to their controlled access, merging and diverging ramps, and high free flow speeds. Multilane highway segment capacity and ramp capacity were also checked against demand to verify the performance within the ramps and interchange. The following subsections of this report show the results for each scenario.

2.0 Existing Conditions

US 72 and SR 302 are both multilane divided facilities with posted speed limits of 65 miles per hour. All intersections along these corridors are stop controlled along the minor approaches. The intersections within the study area were analyzed under existing conditions using *Synchro* and *SimTraffic* software according to *HCM* and *SimTraffic* methodologies. The volumes used for this analysis were provided by MDOT and are shown in **Appendix A – Design Volumes**. The results are provided in **Appendix B – Existing Operational Analysis** and are summarized in **Tables 1 and 2** based on *HCM* and *SimTraffic* methodologies, respectively. As shown in **Tables 1 and 2**, the through movements along the main corridors operate acceptably. The stop-controlled minor approach movements also operate acceptably except at Coopwood Road which shows unacceptable LOS E conditions according to the *HCM* methodology. The 95th percentile queue lengths are minimal with all movements throughout the study area having queues under 200 feet.

Table 1: Intersection LOS and Queue Lengths – 2023 Existing-*HCM* Methodology

Intersection	Control	Time Period	MOE	EB Movement			WB Movement			NB Movement			SB Movement			Overall
				U/Left	Thru	Right	U/Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
US 72 at Knox Rd	One-Way Stop	AM	LOS	C	A		A	A	A				D		C	A
			Delay	15.9	0		9.7	0	0				26.5		16.8	0.6
			Queue (ft)	2.5	0		0	0	0				0		0	
		PM	LOS	B	A		B	A	A				C		B	A
			Delay	11.9	0		12.2	0	0				24		11.8	0.2
			Queue (ft)	2.5	0		0	0	0				0		0	
US 72 at Curl Rd/Red Banks Rd	Two-Way Stop	AM	LOS	B	A	A	B	A	A	C		B	B		A	A
			Delay	13	0	0	11.1	0	0	24.5		11.5	11.1		0	2.0
			Queue (ft)	12.5	0	0	2.5	0	0	25		12.5	2.5		0	
		PM	LOS	B	A	A	C	A	A	D		C	C		A	A
			Delay	10.1	0	0	16.8	0	0	28		17.9	16.8		0	0.9
			Queue (ft)	5	0	0	0	0	0	15		10	0		0	
US 72 at Kings Mountain Dr	One-Way Stop	AM	LOS	C	A		A	A	A				C		B	A
			Delay	15.1	0		9.7	0	0				23.1		13.4	0.6
			Queue (ft)	2.5	0		0	0	0				5		5	
		PM	LOS	B	A		B	A	A				C		B	A
			Delay	12.5	0		11.8	0	0				22.8		11	0.4
			Queue (ft)	2.5	0		2.5	0	0				5		2.5	
US 72 at Coopwood Rd	Two-Way Stop	AM	LOS	C	A	A	B	A	A	E		B	D		C	A
			Delay	22.5	0	0	13.2	0	0	36		13.5	32.4		19.2	3.8
			Queue (ft)	45	0	0	10	0	0	70		25	15		5	
		PM	LOS	C	A	A	D	A	A	E		D	E		B	A
			Delay	15.3	0	0	26.2	0	0	45.7		30.4	40.5		14.3	4.3
			Queue (ft)	25	0	0	22.5	0	0	100		75	27.5		5	
MS 302 at Red Banks Rd	Two-Way Stop	AM	LOS	A	A	A	A	A	A	B			B			A
			Delay	8.1	0	0	7.7	0	0	13.1			10.9			4.1
			Queue (ft)	0	0	0	0	0	0	27.5			5			
		PM	LOS	A	A	A	A	A	A	B			B			A
			Delay	7.8	0	0	8.2	0	0	14.1			14.5			3.2
			Queue (ft)	0	0	0	0	0	0	15			20			

Table 2: Intersection LOS and Queue Lengths – 2023 Existing-*SimTraffic* Methodology

Intersection	Control	Time Period	MOE	EB Movement				WB Movement				NB Movement			SB Movement			Overall
				U	Left	Thru	Right	U	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
US 72 at Knox Rd	One-Way Stop	AM	LOS	A	A	A		A		A	A				C		A	A
			Delay	6.2	8.2	1.5		0		2.2	4.9				17		2.8	2.1
			Queue (ft)	24		0		9		0	0				19		10	
		PM	LOS	A	A	A		A		A	A				B		A	A
			Delay	0	7.4	3.4		0		0.9	0				14		2.8	2.7
			Queue (ft)	29		0		15		0	0				32		17	
US 72 at Curl Rd/Red Banks Rd	Two-Way Stop	AM	LOS	A	A	A	A	A	A	A	A	C	C	A	A	A	A	A
			Delay	0	8.7	1.1	5.1	0	4.9	1.6	0	17.9	19.3	6.1	0	0	0	2.8
			Queue (ft)	64		0	0	33		0	0	134	134	70	33	33	0	
		PM	LOS	A	A	A	A	A	A	A	A	C	A	A	A	A	A	A
			Delay	0	0	2.4	6.3	0	5.7	0.7	0	18.8	0	6	0	0	0	2.8
			Queue (ft)	55		0	0	18		0	0	122	122	67	18	18	0	
US 72 at Kings Mountain Dr	One-Way Stop	AM	LOS	A	A	A		A		A	A				B		A	A
			Delay	6.1	7.7	1.5		5		1.1	0.5				11.9		4.1	1.4
			Queue (ft)	31		0		36		0	0				87		51	
		PM	LOS	A	A	A		A		A	A				B		A	A
			Delay	7.1	6.2	2.1		6.8		0.7	0.4				11.8		3.2	1.7
			Queue (ft)	27		0		35		0	0				85		50	
US 72 at Coopwood Rd	Two-Way Stop	AM	LOS	B	B	A	A	A	A	A	A	C	C	A	C	C	A	A
			Delay	11.1	12.3	1.7	3.6	7.5	8.1	3.2	1.8	20.5	21.7	4.3	15.5	16.1	3.6	4.5
			Queue (ft)	81		0	0	55		0		169	169	91	92	92	40	
		PM	LOS	B	B	A	A	C	C	A	A	D	D	A	D	D	A	A
			Delay	11.8	12.3	5.5	6.1	23.5	16.2	2.3	0.9	33.7	34.2	4.3	32.7	25.4	4.4	6.6
			Queue (ft)	80		13	27	75		0	0	190	190	117	121	121	57	
MS 302 at Red Banks Rd	Two-Way Stop	AM	LOS	A	A	A	A	A	A	A	A	B	B	A	A	C	B	A
			Delay	4.3	3.4	1.9	5.3	0	1.9	1.6	5.7	14.5	13.7	5.1	0	18.7	12.7	5.7
			Queue (ft)	12		0	0	9		3	0	107			58			
		PM	LOS	A	A	A	A	A	A	A	A	B	B	A	C	D	B	A
			Delay	0	3.2	5.1	7	0	2.7	1.1	0	14.6	12.3	4.4	17.6	26.1	14.7	7.5
			Queue (ft)	3		0	0	8		0	0	77			88			

The performance of the ramps within the US 72 at MS 302 interchange were analyzed using *HCS*. The results are provided in **Appendix B – Existing Operational Analysis** and are summarized in **Table 3**. As

shown, all ramps operate well under 2023 Existing conditions. In addition, *HCM Exhibit 14-11* for high-speed ramp junctions on multilane highways and *HCM Exhibit 14-12* for one- and two-lane ramps were utilized to compare the maximum peak hour demand versus capacity within this interchange. As shown, the demand is well within the capacity for all ramps within this interchange. It should be noted that the number of lanes on the ramps within this interchange were analyzed as built, and this configuration will not change under Build conditions. The only changes anticipated at this existing interchange will be shifts in volume due to the addition of the new adjacent interchange to the west.

Table 3: Ramp LOS – 2023 Existing- *HCM* Methodology

Segment	type	MOE	AM	PM	Flow and Capacity		Excceeds Capacity?
US 72 WB off-ramp to MS 302	diverge (two lane ramp)	LOS	A	A	max Flow (pc/h)	268	no
		density (pc/mi/ln)	3.2	0	capacity (pc/h)	4000	
US 72 WB on-ramp from MS 302	merge (single lane ramp)	LOS	A	A	max Flow (pc/h)	3	no
		density (pc/mi/ln)	3.2	0.7	capacity (pc/h)	1900	
US 72 EB off-ramp to MS 302	diverge (single lane ramp)	LOS	A	A	max Flow (pc/h)	7	no
		density (pc/mi/ln)	5.2	9.8	capacity (pc/h)	1900	
US 72 EB on-ramp from MS 302	merge (two lane ramp)	LOS	A	A	max Flow (pc/h)	374	no
		density (pc/mi/ln)	0.1	5.8	capacity (pc/h)	4000	
MS 302 WB on-ramp from US 72 EB	merge (single lane ramp with FFS>30 mph)	LOS	A	A	max Flow (pc/h)	7	no
		density (pc/mi/ln)	2.3	2.0	capacity (pc/h)	2000	
MS 302 EB off-ramp to US 72 WB	diverge (single lane ramp)	LOS	A	A	max Flow (pc/h)	3	no
		density (pc/mi/ln)	3.9	5.7	capacity (pc/h)	1900	

3.0 2050 No Build Conditions

A new battery plant and multiple developments are anticipated to be developed to the north of US 72 near Curl Road. These developments will generate new trips in addition to the background growth of existing volumes. The anticipated 2050 volumes were provided by MDOT for both the No Build and the Build conditions. The 2050 No Build volumes are provided in **Appendix A – Design volumes**. These volumes were analyzed assuming no roadway improvements. The results of this analysis are provided in **Appendix C – No Build Operational Analysis** and are summarized in **Tables 4 and 5**. These results demonstrate that all of the study intersections will experience one or more turning movements with unacceptable delays and failing LOS E/F conditions as well as lengthy queues with the anticipated 2050 traffic demand. The intersections of US 72 at Knox Road, US 72 at Curl Road/Red Banks Road, and US 72 at Coopwood Road also experience overall intersection LOS F. The analysis of the ramps within the existing interchange is also provided in **Appendix C – No Build Operational Analysis** and is summarized in **Table 6**. As shown, these merge and diverge segments will operate acceptably; however, the failing conditions at the intersections within the study area demonstrate a need for roadway improvements to accommodate the anticipated 2050 traffic demand.

Table 4: Intersection LOS and Queue Lengths – 2050 No Build – *HCM* Methodology

Intersection	Control	Time Period	MOE	EB Movement			WB Movement			NB Movement			SB Movement			Overall
				U/Left	Thru	Right	U/Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
US 72 at Knox Rd	One-Way Stop	AM	LOS	E	A		D	A	A				F		E	A
			Delay	44.8	0		26.3	0	0				72.1		45.8	0.7
			Queue (ft)	17.5	0		2.5	0	0				7.5		5	
		PM	LOS	F	A		C	A	A				F		F	A
			Delay	236.7	0		23.3	0	0				186.9		163.6	1.8
			Queue (ft)	57.5	0		5	0	0				32.5		27.5	
US 72 at Curl Rd/Red Banks Rd	Two-Way Stop	AM	LOS	F	A	A	F	A	A	F		F	F		F	F
			Delay	7795.9	0	0	29077	0	0	46430.3		38634.4	29615.4		538.4	7934.0
			Queue (ft)	5132.5	0	0	822.5	0	0	6615		1482.5	1940		1117.5	
		PM	LOS	F	A	A	F	A	A	F		F	F		F	F
			Delay	1403.5	0	0	9226.9	0	0	4212.3		2808.8	11444.5		2217.6	2365.2
			Queue (ft)	1750	0	0	2260	0	0	2347.5		597.5	7435		5175	
US 72 at Kings Mountain Dr	One-Way Stop	AM	LOS	E	A		B	A	A				E		D	A
			Delay	39.1	0		13.7	0	0				46.5		32.8	0.8
			Queue (ft)	10	0		5	0	0				25		20	
		PM	LOS	D	A		C	A	A				E		C	A
			Delay	30.8	0		20.4	0	0				43.3		22.9	0.5
			Queue (ft)	12.5	0		5	0	0				15		10	
US 72 at Coopwood Rd	Two-Way Stop	AM	LOS	F	A	A	F	A	A	F		F	F		F	F
			Delay	5628.9	0	0	687.8	0	0	6718.8		1089.9	1045.7		357.9	1280.2
			Queue (ft)	2340	0	0	285	0	0	2845		505	662.5		377.5	
		PM	LOS	F	A	A	F	A	A	F		F	F		F	F
			Delay	363.5	0	0	1879.9	0	0	2572.3		2208.8	2550.3		670.4	331.8
			Queue (ft)	547.5	0	0	632.5	0	0	1155		607.5	2172.5		1540	
MS 302 at Red Banks Rd	Two-Way Stop	AM	LOS	A	A	A	A	A	A	F			C			F
			Delay	9.1	0	0	8.1	0	0	306.1			15.2			76.1
			Queue (ft)	17.5	0	0	0	0	0	542.5			32.5			
		PM	LOS	A	A	A	A	A	A	F			F			E
			Delay	9	0	0	9.1	0	0	120.3			118			39.3
			Queue (ft)	7.5	0	0	0	0	0	190			435			

Table 5: Intersection LOS and Queue Lengths – 2050 No Build – *SimTraffic* Methodology

Intersection	Control	Time Period	MOE	EB Movement				WB Movement				NB Movement			SB Movement			Overall
				U	Left	Thru	Right	U	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
US 72 at Knox Rd	One-Way Stop	AM	LOS	F	F	F		F		A	A				F		A	F
			Delay	2219.4	2231.6	2227.8		134.9		5	7.8				149.1		2.6	1286.4
			Queue (ft)	265		10280		32		4	0				56		24	
		PM	LOS	F	F	F		F		A	A				F		A	F
			Delay	259.6	259.6	255.9		54.6		4.1	7.4				67.2		2.5	121.2
			Queue (ft)	329		5451		40		0	0				76		36	
US 72 at Curl Rd/Red Banks Rd	Two-Way Stop	AM	LOS	F	F	F	F	A	B	A	A	F	F	F	F	F	F	F
			Delay	1648.7	1657.2	227.8	488	9.2	11.2	6.3	6.3	2475.2	2483.7	2332.1	1057.6	1059.6	1058.4	468.7
			Queue (ft)	561		3353	4291	69		12	43	4905	4905	4826	1420	1420	1357	
		PM	LOS	F	F	F	F	C	D	A	A	F	F	F	F	F	F	F
			Delay	918	918.2	94.5	83.7	15.2	26.9	4.3	2.5	1896.9	1897.1	1311.7	1993.1	2004.8	1985.3	823.2
			Queue (ft)	599		3969	4029	89		5	23	4173	4173	4094	1273	1273	1193	
US 72 at Kings Mountain Dr	One-Way Stop	AM	LOS	A	C	A		A		A	A				C		B	A
			Delay	5.2	16.1	2.3		6.4		2.3	1.5				24.7		10.5	2.6
			Queue (ft)	22		0		39		8	22				109		70	
		PM	LOS	C	B	A		A		A	A				C		A	A
			Delay	21.2	14.7	3.3		8		1.6	0.8				19.4		6.8	2.8
			Queue (ft)	37		0		44		9	3				86		51	
US 72 at Coopwood Rd	Two-Way Stop	AM	LOS	F	F	F	F	B	B	A	A	F	F	F	F	F	F	F
			Delay	3277.2	3285.5	1502	1406.1	12.5	14.3	10	7.5	1852.1	1860.4	1634.4	360.1	361.9	330.9	983.9
			Queue (ft)	424		4200	4219	64		8	24	4191	4191	4099	1153	1153	1093	
		PM	LOS	F	F	C	C	F	F	A	A	F	F	F	F	F	F	F
			Delay	66.9	72.2	23.9	20.3	1024.6	1063.4	9.1	4.1	1822.4	1827.7	1709.2	4338.1	4376.9	3980.7	799.4
			Queue (ft)	293		517	514	468		453	392	4352	4352	4256	5444	5444	5351	
MS 302 at Red Banks Rd	Two-Way Stop	AM	LOS	F	F	F	F	A	A	C	B	F	F	F	F	F	F	F
			Delay	526.3	557.7	115.6	88.8	3.4	3.4	16.1	13.6	1124.4	1122	1072.4	298.2	298.2	147.9	401.8
			Queue (ft)	366		2262	1507	28		103	145	5303			439			
		PM	LOS	D	D	A	A	A	A	A	A	F	F	F	E	F	E	E
			Delay	34.3	34.3	7.9	8.8	5.4	5.4	2.4	0	227.8	207.3	125.2	43.2	105.8	36.7	36.1
			Queue (ft)	117		56	25	13		3	0	578			305			

Table 6: Ramp LOS – 2050 No Build – *HCM* Methodology

Segment	type	MOE	AM	PM	Flow and Capacity		Excceeds Capacity?
US 72 WB off-ramp to MS 302	diverge (two lane ramp)	LOS	B	A	max Flow (pc/h)	435	no
		density (pc/mi/ln)	10.7	8.7	capacity (pc/h)	4000	
US 72 WB on-ramp from MS 302	merge (single lane ramp)	LOS	A	A	max Flow (pc/h)	5	no
		density (pc/mi/ln)	9.3	6.8	capacity (pc/h)	1900	
US 72 EB off-ramp to MS 302	diverge (single lane ramp)	LOS	B	B	max Flow (pc/h)	5	no
		density (pc/mi/ln)	11.4	17.9	capacity (pc/h)	1900	
US 72 EB on-ramp from MS 302	merge (two lane ramp)	LOS	A	B	max Flow (pc/h)	582	no
		density (pc/mi/ln)	6.7	14.9	capacity (pc/h)	4000	
MS 302 WB on-ramp from US 72 EB	merge (single lane ramp with FFS>30 mph)	LOS	A	A	max Flow (pc/h)	5	no
		density (pc/mi/ln)	3.1	3.7	capacity (pc/h)	2000	
MS 302 EB off-ramp to US 72 WB	diverge (single lane ramp)	LOS	A	A	max Flow (pc/h)	5	no
		density (pc/mi/ln)	5.0	7.7	capacity (pc/h)	1900	

4.0 Build Conditions

As mentioned earlier, the new Connector Road will tie into Red Banks Road to intersect MS 302 and will provide a new interchange at US 72. Since Red Banks Road is currently a two-lane road, operational analysis was initially conducted with a two-lane typical section along the new Connector Road. Single lane ramps in a basic diamond interchange configuration and stop control on the minor approaches were utilized throughout. Areas that performed inadequately were examined to determine what additional improvements are needed. Operational analysis was performed using the 2050 Build volumes shown in **Appendix A – Design Volumes** which are based on data provided by MDOT. These volumes are conservatively high and account for several possible future developments in addition to the Battery Plant.

During the initial operational analysis, one intersection was identified as not operating adequately overall with stop control in 2050 and would likely require signalization: MS 302 at Connector Road/Red Banks Road. Signal Warrant 3 was checked based on the 2030 peak hour Build volumes provided in **Appendix A – Design Volumes**. The intersection of MS 302 at Connector Road met Warrant 3 even with right turn reductions applied to the minor approaches. It should be noted that only Warrant 3 was tested due to lack of data to test the 12-hour larger set of signal warrants. Since this intersection met Warrant 3 with 2030 Build volumes, stop-controlled performance was tested at this intersection with 2030 Build volumes, and both *HCM* and *SimTraffic* methodologies showed adequate overall intersection LOS during both peaks with two-way stop control. Based on the initial operational analysis and signal warrant results, this intersection should operate adequately with stop control in the opening year but should be monitored for future signalization when delays on the minor approaches become unacceptable. The 2050 Build models assumed signalization at this intersection.

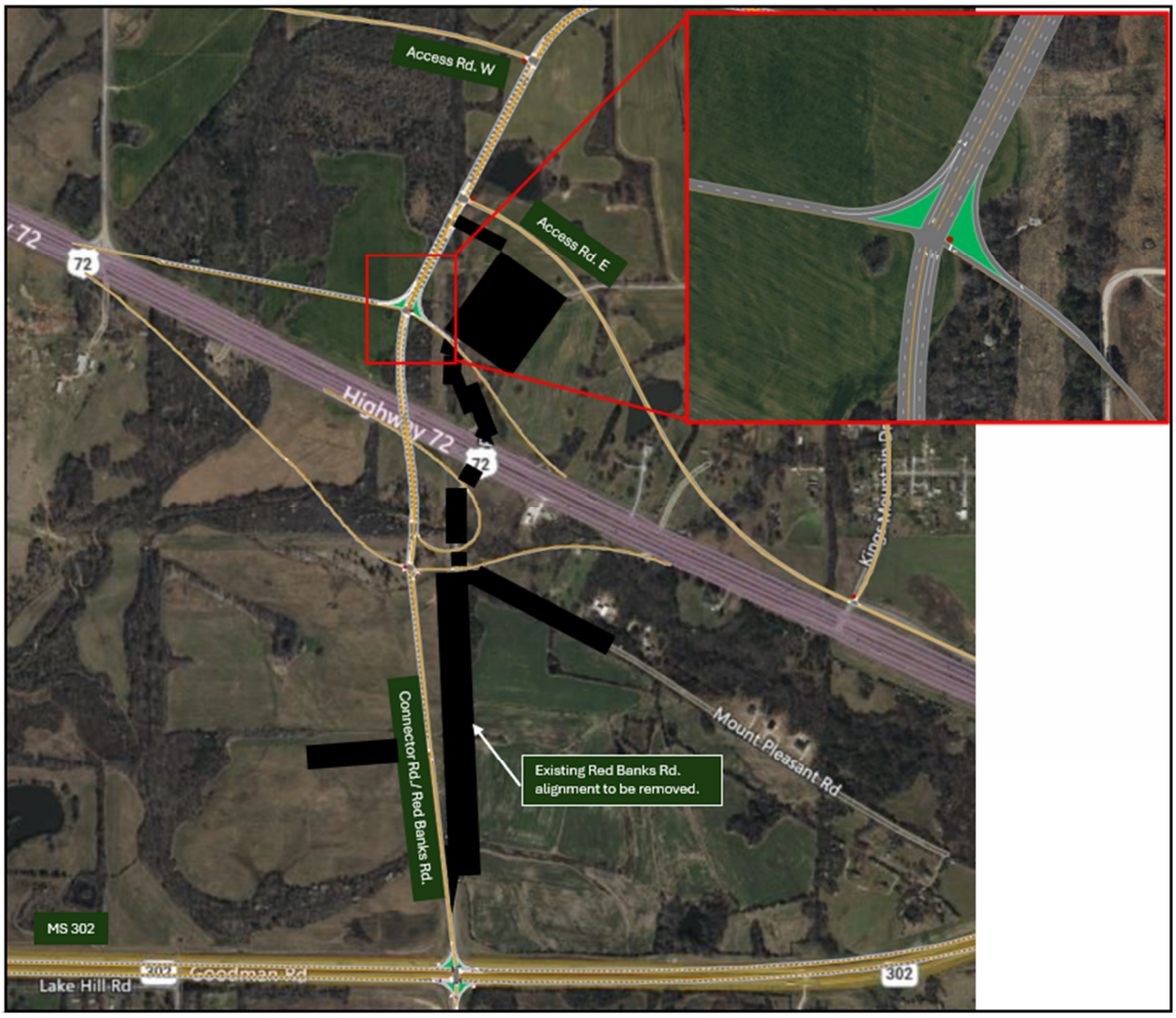
After the initial, iterative testing of various build configurations, two build options with stop control at the ramp intersections, two build options with a roundabout at the westbound ramp intersection, and one build option with roundabouts at both ramp intersections were selected for complete operational analysis as discussed in the following subsections. Access roads from the east and west will tie to Connector Road as two T-intersections with stop control on the minor approaches for all build options. It should be noted that the intersection of US 72 at Coopwood Road was not included in the Build analysis since this intersection is not impacted by the new interchange or the new Connector Road. While operational issues

exist and will worsen at this intersection, improvements at this location will be evaluated in a separate future study.

4.1 Build Option 1 – Stop Control with SE Loop Ramp

Build Option 1 utilizes a five-lane typical section along the new Connector Road and a single-lane loop ramp in the southeast quadrant of the US 72 interchange. The intersection of Connector Road/Red Banks Road at MS 302 is signalized in 2050; all other intersections are stop-controlled on the minor approaches. Build Option 1 layout is shown in **Figure 1**.

Figure 1: Build Option 1 Layout



Operational analysis was performed for Build Option 1 using *HCM* and *SimTraffic* methodologies; the results are provided in **Appendix D – Build Operational Analysis** and are summarized in **Tables 7 – 9**. These results from both methodologies demonstrate that the Build Option 1 Layout will provide adequate

service for most movements and for all overall intersections within the study area with the 2050 Build volumes provided. However, this analysis reveals three potential problem areas:

- The US 72 Westbound Off-Ramp left turn movement cannot find adequate gaps in northbound and southbound traffic in either the AM or the PM peak. However, this delay is not severe enough to cause the overall intersection to fail since the volume making this movement is relatively small. The *SimTraffic* methodology shows the westbound left movement reaching a 95th percentile queue length of 1,172 feet during the AM peak. Even so, the Westbound Off-Ramp should have adequate storage to contain this queue so spillback onto US 72 will not occur.
- At the intersection of Connector Road and Access Road E, the stop-controlled minor approach movements struggle to find gaps in the northbound and southbound traffic during the AM peak according to *HCM* methodology and during both peaks according to *SimTraffic* methodology. Because the volumes making these movements are small, this delay does not cause the overall intersection to fail. However, this intersection should be monitored and tested for signal warrants when the delays for these movements become problematic.
- At the intersection of Connector Road and Access Road W, the northbound left movement struggles to find adequate gaps in southbound traffic during the PM peak according to both *HCM* and *SimTraffic* methodologies. However, this is a small movement and does not cause the overall intersection to fail. As with the intersection of Connector Road and Access Road E, this intersection should be monitored and tested for signal warrants if delays for these movements become problematic.

The recommended storage lengths for this alternative based on 95th percentile queue lengths are provided in **Table 10**.

Table 7: Intersection LOS and Queue Lengths – 2050 Build Option 1 – *HCM* Methodology

Intersection	Control	Time Period	MOE	EB Movement			WB Movement			NB Movement			SB Movement			Overall
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Access Road at Knox Rd	One-Way Stop	AM	LOS	A	A			A	A				A		A	A
			Delay	0.0	0.0			0.0	0.0				8.8		8.8	4.8
			Queue (ft)	0	0			0	0				2.5		2.5	
		PM	LOS	A	A			A	A				A		A	A
			Delay	0.0	0.0			0.0	0.0				8.7		8.7	2.9
			Queue (ft)	0	0			0	0				0		0	
Access Road at Kings Mountain Dr	One-Way Stop	AM	LOS	A	A			A	A				A		A	A
			Delay	7.3	0.0			0.0	0.0				8.5		8.5	7.8
			Queue (ft)	2.5	0			0	0				2.5		2.5	
		PM	LOS	A	A			A	A				A		A	A
			Delay	7.3	0.0			0.0	0.0				8.5		8.5	7.7
			Queue (ft)	2.5	0			0	0				2.5		2.5	
Connector Road at Access Road W	One-Way Stop	AM	LOS	B		B				B	A			A	A	A
			Delay	11.8		11.8				11.7	0.0			0.0	0.0	0.2
			Queue (ft)	5		5				5	0			0	0	
		PM	LOS	D		D				F	A			A	A	A
			Delay	30.6		30.6				69.1	0.0			0.0	0.0	0.6
			Queue (ft)	5		5				25	0			0	0	
Connector Road at Access Road E	One-Way Stop	AM	LOS				F		F		A	A	A	A		A
			Delay				273.0		273.0		0.0	0.0	0.0	0.0		2.8
			Queue (ft)				80		80		0	0	0	0		
		PM	LOS				D		D		A	A	A	A		A
			Delay				29.3		29.3		0.0	0.0	0.0	0.0		0.2
			Queue (ft)				12.5		12.5		0	0	0	0		
Connector Road at US 72 Westbound Ramps	One-Way Stop	AM	LOS				F		A	A	A			A	A	A
			Delay				238.9		0.0	8.1	0.0			0.0	0.0	4.1
			Queue (ft)				85		0	10	0			0	0	
		PM	LOS				F		A	B	A			A	A	A
			Delay				95.2		0.0	12.0	0.0			0.0	0.0	5.0
			Queue (ft)				82.5		0	42.5	0			0	0	
Connector Road at US 72 Eastbound Ramps	One-Way Stop	AM	LOS	A		A					A	A	A	A		A
			Delay	0.0		9.2					0.0	0.0	9.7	0.0		2.2
			Queue (ft)	0		10					0	0	12.5	0		
		PM	LOS	A		B					A	A	B	A		A
			Delay	0.0		13.3					0.0	0.0	10.6	0.0		5.0
			Queue (ft)	0		57.5					0	0	47.5	0		
Connector Road/Red Banks Rd at MS 302	Signal	AM	LOS	A	A		A	A		A			A	A		A
			Delay	9.5	6.5		6.9	6.5		9.5			7.2			8.4
			Queue (ft)	236	39	n/a[1]	13	40	n/a[1]	261		n/a[1]	55		n/a[1]	
		PM	LOS	A	A		A	A		A			A	A		A
			Delay	8.1	6.1		6.6	6.3		6.8			7.6			6.8
			Queue (ft)	146	83		8	97		66			309			

n/a[1] –HCM methodology does not provide delay for channelized right turns at a signalized intersection

Table 8: Intersection LOS and Queue Lengths – 2050 Build Option 1 – *SimTraffic* Methodology

Intersection	Control	Time Period	MOE	EB Movement			WB Movement			NB Movement			SB Movement			Overall
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Access Road at Knox Rd	One-Way Stop	AM	LOS	A	A			A	A				A		A	A
			Delay	0.0	0.0			0.0	0.6				4.3		0.0	2.8
			Queue (ft)	0	0			0	0				47		47	
		PM	LOS	A	A			A	A				A		A	A
			Delay	0.0	0.0			0.0	2.5				4.1		0.0	3.1
			Queue (ft)	0	0			0	0				38		38	
Access Road at Kings Mountain Dr	One-Way Stop	AM	LOS	A	A			A	A				A		A	A
			Delay	2.3	0.0			0.0	0.0				0.0		2.7	2.5
			Queue (ft)	0	0			0	0				45		45	
		PM	LOS	A	A			A	A				A		A	A
			Delay	2.5	0.1			0.0	0.0				0.0		2.9	2.6
			Queue (ft)	0	0			0	0				48		48	
Connector Road at Access Road W	One-Way Stop	AM	LOS	A		A				A	A			A	A	A
			Delay	3.6		3.6				5.3	2.9			1.0	0.0	2.6
			Queue (ft)	49		49				32	0			0	0	
		PM	LOS	A		A				F	A			A	A	A
			Delay	4.9		4.9				80.0	1.0			8.7	0.0	7.2
			Queue (ft)	32		32				74	8			218	50	
Connector Road at Access Road E	One-Way Stop	AM	LOS				F		F		A	A	A	A		C
			Delay				1589.3		1589.3		1.3	0.3	0.0	0.4		17.9
			Queue (ft)				697		697		37	23	0	0		
		PM	LOS				F		F		A	A	A	C		C
			Delay				825.4		825.4		0.3	0.1	0.0	18.0		20.3
			Queue (ft)				424		424		0	3	0	602		
Connector Road at US 72 Westbound Ramps	One-Way Stop	AM	LOS				F		E	A	A			A	A	C
			Delay				1115.5		45.9	3.6	3.9			0.9	1.9	21.6
			Queue (ft)				1172		371	43	0			0	0	
		PM	LOS				F		A	E	A			D	C	C
			Delay				132.5		1.2	37.6	1.5			26.9	23.4	21.4
			Queue (ft)				192		0	282	12			732	785	
Connector Road at US 72 Eastbound Ramps	One-Way Stop	AM	LOS	A		A					A	A	A	A		A
			Delay	9.6		2.2					2.5	2.0	4.5	0.9		6.9
			Queue (ft)	0		0					27		75	18		
		PM	LOS	A		A					A	A	B	A		A
			Delay	1.1		3.5					4.8	2.6	13.2	5.6		5.2
			Queue (ft)	0		20					76		169	99		
Connector Road/Red Banks Rd at MS 302	Signal	AM	LOS	C	B	A	B	B	A	B	B	A	A	A	A	B
			Delay	24.0	11.8	6.5	10.3	10.2	4.1	17.1	19.3	7.7	9.5	5.8	2.9	13.1
			Queue (ft)	167	54	54	26	39	48		172			63		
		PM	LOS	C	B	A	B	A	A	B	B	A	B	A	A	A
			Delay	22.6	13.5	9.5	10.6	9.9	3.8	10.9	13.2	5.3	12.9	2.1	5.3	9.6
			Queue (ft)	86	62	61	12	67	74		91			132		

Table 9: Ramp LOS – 2050 Build Option 1 – *HCM* Methodology

Segment	type	MOE	AM	PM	Flow and Capacity		Excceeds Capacity?
US 72 WB off-ramp to MS 302	diverge (two lane ramp)	LOS	B	A	max Flow (pc/h)	364	no
		density (pc/mi/ln)	11.7	6.6	capacity (pc/h)	4000	
US 72 WB on-ramp from MS 302	merge (single lane ramp)	LOS	B	A	max Flow (pc/h)	11	no
		density (pc/mi/ln)	10.1	5.6	capacity (pc/h)	1900	
US 72 WB off-ramp to Connector Rd/Red Banks Rd	diverge (single lane ramp with FFS>30)	LOS	A	A	max Flow (pc/h)	478	no
		density (pc/mi/ln)	9.9	4.8	capacity (pc/h)	2000	
US 72 WB on-ramp from Connector Rd/Red Banks Rd	merge (single lane ramp with FFS>30)	LOS	B	C	max Flow (pc/h)	1908	no
		density (pc/mi/ln)	13.4	21.6	capacity (pc/h)	2000	
US 72 EB off-ramp to SB Connector Rd/Red Banks Rd	diverge (single lane ramp with FFS>30)	LOS	B	B	max Flow (pc/h)	337	no
		density (pc/mi/ln)	19.9	18.9	capacity (pc/h)	2000	
US 72 EB off-ramp to NB Connector Rd/Red Banks Rd	diverge (single lane ramp with FFS>30)	LOS	C	B	max Flow (pc/h)	1663	no
		density (pc/mi/ln)	21.6	18.3	capacity (pc/h)	2000	
US 72 EB on-ramp from Connector Rd/Red Banks Rd	merge (single lane ramp with FFS>30)	LOS	A	B	max Flow (pc/h)	484	no
		density (pc/mi/ln)	5.9	15.7	capacity (pc/h)	2000	
US 72 EB on-ramp from MS 302	merge (two lane ramp)	LOS	A	B	max Flow (pc/h)	543	no
		density (pc/mi/ln)	3.0	15.4	capacity (pc/h)	4000	
MS 302 WB on-ramp from US 72 EB	merge (single lane ramp with FFS>30)	LOS	A	A	max Flow (pc/h)	11	no
		density (pc/mi/ln)	3.1	3.7	capacity (pc/h)	2000	
MS 302 EB off-ramp to US 72 WB	diverge (single lane ramp)	LOS	A	A	max Flow (pc/h)	11	no
		density (pc/mi/ln)	5.0	7.7	capacity (pc/h)	1900	

Table 10: Build Option 1 Recommended Storage Lengths

Intersection	Mvmt	Max 95% Queue (ft)	Recommended Min. Storage (ft)
Connector Road at Access Road W	NBL	74	75
	SB Th/Rt	50	50
Connector Road at Access Road E	SBL	0	50
Connector Road at US 72 WB Ramps	WBR	371	375
	NBL	282	300
Connector Road at US 72 EB Ramps	SBL	169	175

4.2 Build Option 2 – Stop Control with SE and NE Loop Ramps

Build Option 2 adds a single lane loop ramp in the northeast quadrant of the US 72 interchange to serve the northbound to westbound movement. This allows the northbound left movement from Option 1 to become a free northbound right movement in Option 2. This change eliminates conflicting movements for the northbound left movement and reduces conflicting movements (and thus delay) for the problematic westbound left movement. The layout of Option 2 is shown in **Figure 2**. The results from operational analysis are provided in **Appendix D** – **Build Operational Analysis** and are summarized in **Tables 11** – **13**.

The *HCM* and *SimTraffic* results from this analysis demonstrate that the addition of the loop ramp in the northeast quadrant provides improvements for the Westbound Ramp intersection problem areas observed in Option 1. Both methodologies show acceptable overall intersection LOS for all intersections within the study area during both 2050 peaks. However, the following movements still show some potential issues:

- The Westbound Off-Ramp left turn movement still experiences LOS F during the AM peak according to both the *HCM* and *SimTraffic* methodologies; however, the delay for this movement is reduced significantly compared to Option 1. The *SimTraffic* results show a maximum 95th percentile queue length of 258 feet for the westbound left movement. This ramp will have adequate storage to contain this queue, so spillback onto US 72 will not occur.
- The Access Road intersections with the Connector Road are the same between Option 1 and Option 2 and show similar issues with the minor approach movements experiencing lengthy delays. The overall intersection performance remains adequate since the turning movement volumes are small.

The recommended storage lengths for this alternative, shown in **Table 14**, were determined based on 95th percentile queues observed during the peak periods.

Figure 2: Build Option 2 Layout

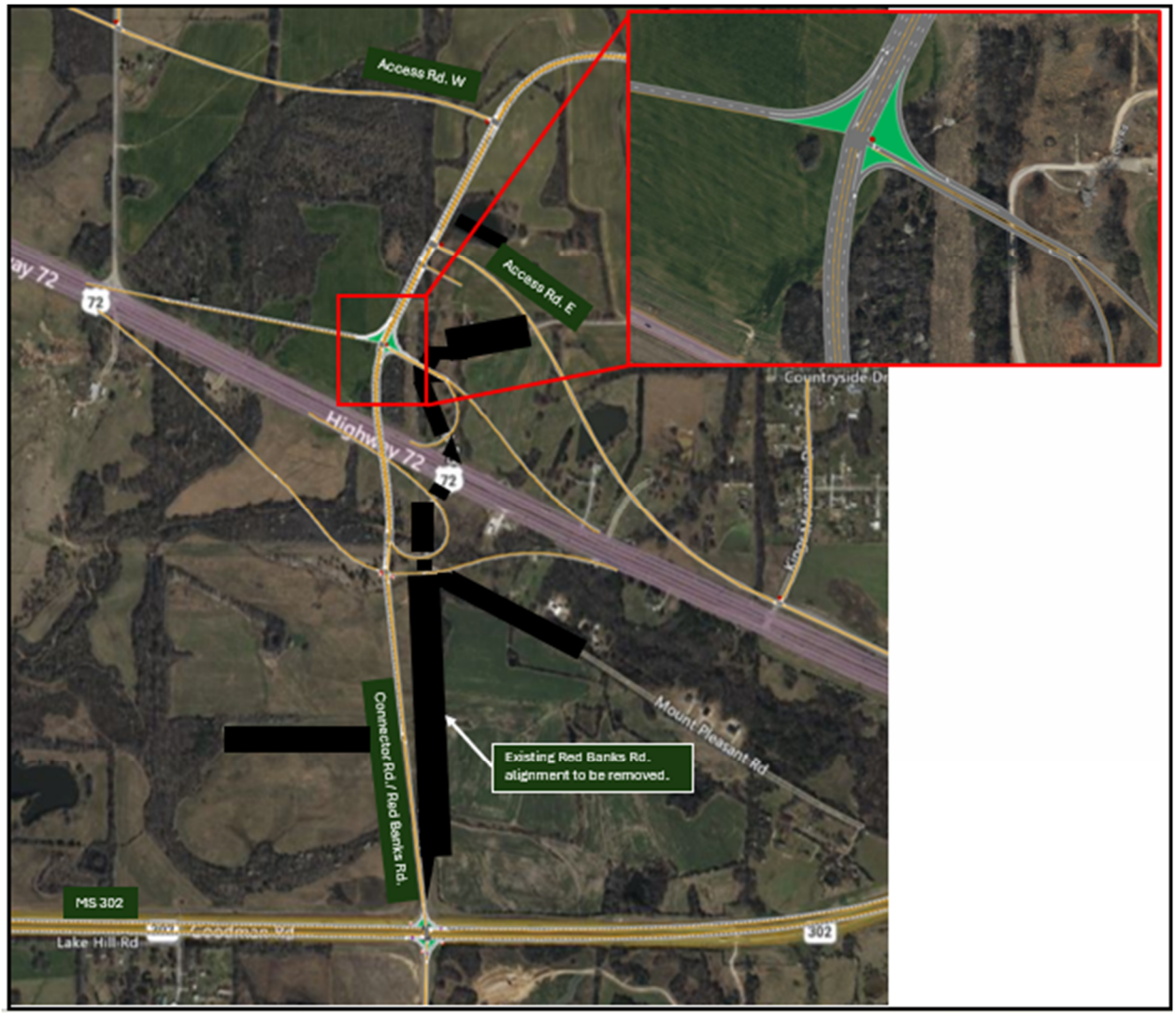


Table 11: Intersection LOS and Queue Lengths – 2050 Build Option 2 – *HCM* Methodology

Intersection	Control	Time Period	MOE	EB Movement			WB Movement			NB Movement			SB Movement			Overall
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Access Road at Knox Rd	One-Way Stop	AM	LOS	A	A			A	A				A		A	A
			Delay	0.0	0.0			0.0	0.0				8.8		8.8	4.8
			Queue (ft)	0	0			0	0				2.5		2.5	
		PM	LOS	A	A			A	A				A		A	A
			Delay	0.0	0.0			0.0	0.0				8.7		8.7	4.8
			Queue (ft)	0	0			0	0				2.5		2.5	
Access Road at Kings Mountain Dr	One-Way Stop	AM	LOS	A	A			A	A				A		A	A
			Delay	7.3	0.0			0.0	0.0				8.5		8.5	7.8
			Queue (ft)	2.5	0			0	0				2.5		2.5	
		PM	LOS	A	A			A	A				A		A	A
			Delay	7.3	0.0			0.0	0.0				8.5		8.5	7.7
			Queue (ft)	2.5	0			0	0				2.5		2.5	
Connector Road at Access Road W	One-Way Stop	AM	LOS	B		B				B	A			A	A	A
			Delay	11.8		11.8				11.7	0.0			0.0	0.0	0.2
			Queue (ft)	5		5				5	0			0	0	
		PM	LOS	D		D				F	A			A	A	A
			Delay	30.6		30.6				69.1	0.0			0.0	0.0	0.6
			Queue (ft)	5		5				25	0			0	0	
Connector Road at Access Road E	One-Way Stop	AM	LOS				F		F		A	A	A	A		A
			Delay				273.0		273.0		0.0	0.0	0.0	0.0		2.8
			Queue (ft)				80		80		0	0	0	0		
		PM	LOS				D		D		A	A	A	A		A
			Delay				29.3		29.3		0.0	0.0	0.0	0.0		0.2
			Queue (ft)				12.5		12.5		0	0	0	0		
Connector Road at US 72 Westbound Ramps	Two-Way Stop	AM	LOS				F		A	A	A			A	A	A
			Delay				95.7		0.0	0.0	0.0			0.0	0.0	1.5
			Queue (ft)				52.5		0	0	0			0	0	
		PM	LOS				C		A	A	A			A	A	A
			Delay				19.9		0.0	0.0	0.0			0.0	0.0	0.8
			Queue (ft)				20		0	0	0			0	0	
Connector Road at US 72 Eastbound Ramps	Two-Way Stop	AM	LOS	A		A					A	A	A	A		A
			Delay	0.0		9.2					0.0	0.0	9.7	0.0		2.2
			Queue (ft)	0		10					0	0	12.5	0		
		PM	LOS	A		B					A	A	B	A		A
			Delay	0.0		13.3					0.0	0.0	10.6	0.0		5.0
			Queue (ft)	0		57.5					0	0	47.5	0		
Connector Road/Red Banks Rd at MS 302	Signal	AM	LOS	A	A		A	A		A			A	A		A
			Delay	9.5	6.5		6.9	6.5		9.5			7.2			8.4
			Queue (ft)	236	39	n/a[1]	13	40	n/a[1]	261		n/a[1]	55		n/a[1]	
		PM	LOS	A	A		A	A		A			A	A		A
			Delay	8.1	6.1		6.6	6.3		6.8			7.6			6.8
			Queue (ft)	146	83		8	97		66			309			

n/a[1] – HCM methodology does not provide delay for channelized right turns at a signalized intersection

Table 12: Intersection LOS and Queue Lengths – 2050 Build Option 2 – *SimTraffic* Methodology

Intersection	Control	Time Period	MOE	EB Movement			WB Movement			NB Movement			SB Movement			Overall
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Access Road at Knox Rd	One-Way Stop	AM	LOS	A	A			A	A				A		A	A
			Delay	0.0	0.0			0.0	1.0				4.2		0.0	2.8
			Queue (ft)	0	0			0	0				48		48	
		PM	LOS	A	A			A	A				A		A	A
			Delay	0.0	0.0			0.0	1.3				4.2		0.0	2.8
			Queue (ft)	0	0			0	0				42		42	
Access Road at Kings Mountain Dr	One-Way Stop	AM	LOS	A	A			A	A				A		A	A
			Delay	1.9	0.0			0.0	0.0				0.0		2.9	2.4
			Queue (ft)	0	0			0	0				43		43	
		PM	LOS	A	A			A	A				A		A	A
			Delay	2.3	0.1			0.0	0.0				0.0		2.7	2.5
			Queue (ft)	0	0			0	0				47		47	
Connector Road at Access Road W	One-Way Stop	AM	LOS	A		A				A	A			A	A	A
			Delay	3.5		3.5				3.6	1.7			1.1	0.0	1.6
			Queue (ft)	46		46				34	0			0	0	
		PM	LOS	A		A				F	A			A	A	A
			Delay	5.7		5.7				73.0	0.8			6.2	0.0	5.1
			Queue (ft)	25		25				53	0			3	0	
Connector Road at Access Road E	One-Way Stop	AM	LOS				F		F		A	A	A	A		C
			Delay				1522.3		1522.3		0.5	0.1	0.0	0.5		16.4
			Queue (ft)				669		669		0	0	0	0		
		PM	LOS				F		F		A	A	A	A		A
			Delay				545.3		545.3		0.2	0.1	0.0	1.7		5.6
			Queue (ft)				223		223		0	0	0	0		
Connector Road at US 72 Westbound Ramps	Two-Way Stop	AM	LOS				F		A	A	A			A	A	A
			Delay				477.5		1.0	7.0	5.8			0.4	1.7	9.6
			Queue (ft)				258		0	0	3			0	0	
		PM	LOS				C		A	A	A			A	A	A
			Delay				18.9		0.5	4.8	3.5			1.5	3.9	3.5
			Queue (ft)				66		0	0	3			5	0	
Connector Road at US 72 Eastbound Ramps	Two-Way Stop	AM	LOS	A		A					A	A	A	A		A
			Delay	9.7		2.2					2.6	2.2	4.5	1.0		7.0
			Queue (ft)	0		0					36		78	0		
		PM	LOS	A		A					A	A	A	A		A
			Delay	1.3		3.6					5.3	2.6	9.1	3.0		4.1
			Queue (ft)	0		23					86		139	40		
Connector Road/Red Banks Rd at MS 302	Signal	AM	LOS	C	B	A	B	A	A	B	B	A	A	A	A	B
			Delay	23.6	11.8	6.6	11.2	9.8	4.3	15.8	18.0	6.7	9.8	3.5	3.1	12.5
			Queue (ft)	162	47	53	28	44	53		182			65		
		PM	LOS	C	B	A	B	A	A	B	B	A	B	A	A	B
			Delay	27.2	15.1	9.4	10.3	9.9	4.0	11.7	12.0	3.9	15.2	2.2	5.3	10.8
			Queue (ft)	124	73	67	15	70	73		99			142		

Table 13: Ramp LOS – 2050 Build Option 2 – *HCM* Methodology

Segment	type	MOE	AM	PM	Flow and Capacity		Excceeds Capacity?
US 72 WB off-ramp to MS 302	diverge (two lane ramp)	LOS	B	A	max Flow (pc/h)	364	no
		density (pc/mi/ln)	11.7	6.6	capacity (pc/h)	4000	
US 72 WB on-ramp from MS 302	merge (single lane ramp)	LOS	B	A	max Flow (pc/h)	11	no
		density (pc/mi/ln)	10.1	5.6	capacity (pc/h)	1900	
US 72 WB off-ramp to Connector Rd/Red Banks Rd	diverge (single lane ramp with FFS>30)	LOS	A	A	max Flow (pc/h)	478	no
		density (pc/mi/ln)	9.9	4.8	capacity (pc/h)	2000	
US 72 WB on-ramp from NB Connector Rd/Red Banks Rd	merge (single lane ramp)	LOS	B	B	max Flow (pc/h)	304	no
		density (pc/mi/ln)	11.5	10.3	capacity (pc/h)	1900	
US 72 WB on-ramp from SB Connector Rd/Red Banks Rd	merge (single lane ramp with FFS>30)	LOS	B	C	max Flow (pc/h)	1603	no
		density (pc/mi/ln)	13.5	21.8	capacity (pc/h)	2000	
US 72 EB off-ramp to SB Connector Rd/Red Banks Rd	diverge (single lane ramp with FFS>30)	LOS	B	B	max Flow (pc/h)	337	no
		density (pc/mi/ln)	19.9	18.9	capacity (pc/h)	2000	
US 72 EB off-ramp to NB Connector Rd/Red Banks Rd	diverge (single lane ramp with FFS>30)	LOS	C	B	max Flow (pc/h)	1663	no
		density (pc/mi/ln)	21.6	18.3	capacity (pc/h)	2000	
US 72 EB on-ramp from Connector Rd/Red Banks Rd	merge (single lane ramp with FFS>30)	LOS	A	B	max Flow (pc/h)	484	no
		density (pc/mi/ln)	5.9	15.7	capacity (pc/h)	2000	
US 72 EB on-ramp from MS 302	merge (two lane ramp)	LOS	A	B	max Flow (pc/h)	543	no
		density (pc/mi/ln)	3.0	15.4	capacity (pc/h)	4000	
MS 302 WB on-ramp from US 72 EB	merge (single lane ramp with FFS>30)	LOS	A	A	max Flow (pc/h)	11	no
		density (pc/mi/ln)	3.1	3.7	capacity (pc/h)	2000	
MS 302 EB off-ramp to US 72 WB	diverge (single lane ramp)	LOS	A	A	max Flow (pc/h)	11	no
		density (pc/mi/ln)	5.0	7.7	capacity (pc/h)	1900	

Table 14: Build Option 2 Recommended Storage Lengths

Intersection	Mvmt	Max 95% Queue (ft)	Recommended Min. Storage (ft)
Connector Road at Access Road W	NBL	53	75
	SB Th/Rt	0	50
Connector Road at Access Road E	SBL	0	50
Connector Road at US 72 WB Ramps	WBR	0	275 [1]
Connector Road at US 72 EB Ramps	SBL	139	150

[1] Extra storage length is recommended for this lane due to blockage from the westbound left lane.

4.3 Build Option 3 - Roundabout Options at the WB Ramps Intersection

Build Option 3 explores the feasibility of installing a roundabout at the Westbound Ramps intersection. For the roundabout intersections, *Sidra* software was also used to check operations due to its ability to more accurately analyze this type of intersection control.

4.3.1 *Sidra* Analysis

Initially, a basic two-lane roundabout was analyzed in *Sidra* using the 2050 PM peak volumes, as shown in **Figure 3**. These results demonstrate that slip lanes will be necessary. Therefore, a roundabout with slip lanes was tested as shown in **Figure 4**. To improve safety, only a single lane flows southbound through the roundabout in this iteration. The northbound direction maintains two lanes. The roundabout uses one single lane slip lane each for the westbound to northbound movement and the southbound to westbound movement. In this model, 50% of the southbound to westbound volume was assumed to utilize the outside circulating lane. This configuration did not provide adequate service during the 2050 PM peak.

Next, the roundabout was tested with the assumption that 100% of the southbound right movement used the slip lane. As shown in **Figure 5**, this configuration experiences LOS F for the southbound right movement during the PM peak due to being over capacity but still provides acceptable approach and overall LOS during both the 2050 AM and 2050 PM peaks. This configuration was analyzed with Option 3a, and the results based on *Sidra* for this intersection configuration are summarized in **Table 15**.

Next, a roundabout configuration with two circulating lanes southbound through the roundabout plus single-lane slip lanes was evaluated as shown in **Figure 6**. This configuration assumes that 90% of the southbound to westbound traffic will utilize the slip lane and 10% will use the outside southbound circulating lane. The evaluation demonstrated acceptable performance for all movements. Therefore, this configuration was analyzed with Option 3b. The results based on *Sidra* analysis for this intersection configuration are summarized in **Table 16**. Complete results are provided in **Appendix D – Build Operational Analysis.**

Figure 3: WB Ramps – Roundabout Trial 1

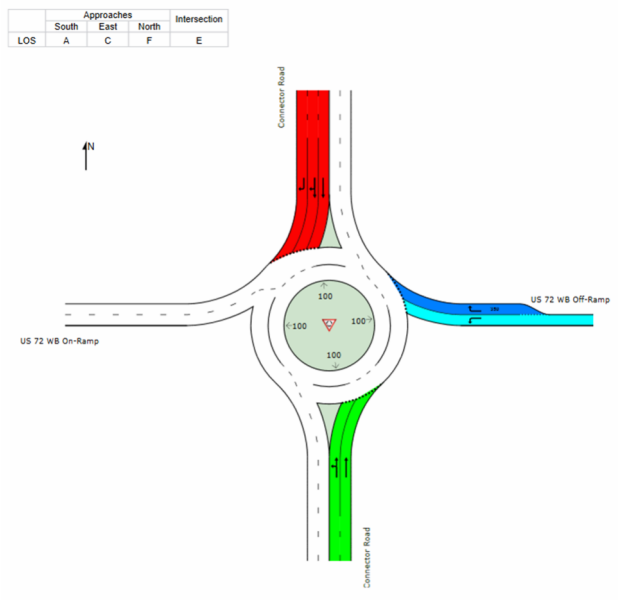


Figure 4: WB Ramps – Roundabout Trial 2

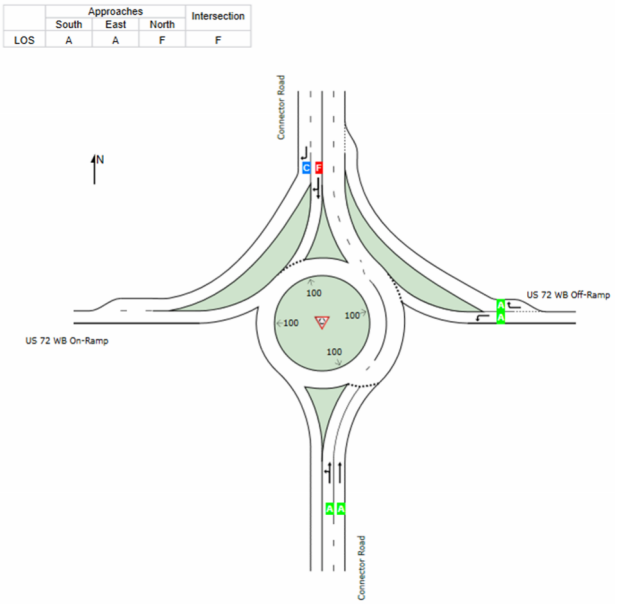
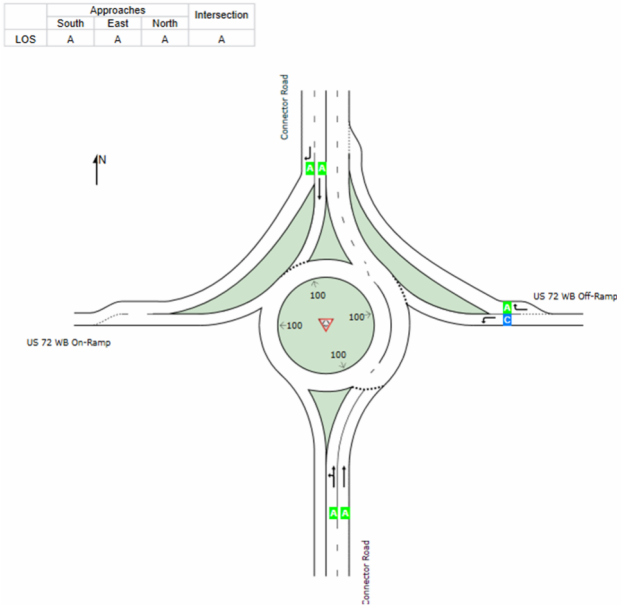


Figure 5: WB Ramps – Roundabout Trial 3 (used in Option 3a)

2050 AM



2050 PM

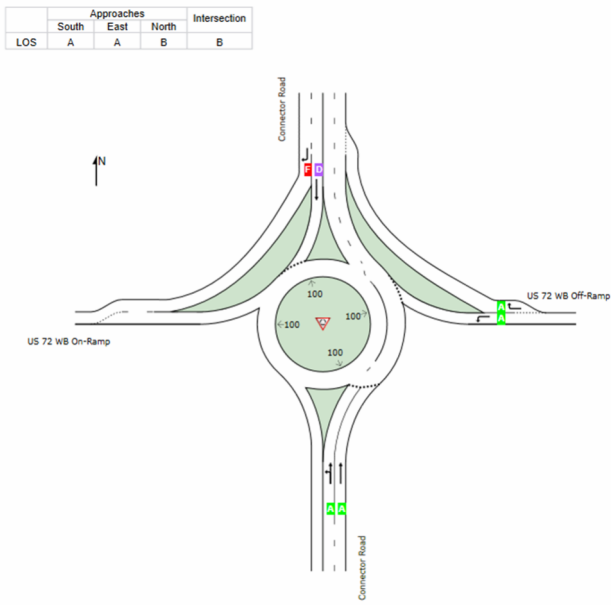


Table 15: WB Ramps Roundabout LOS and Queue Lengths – 2050 Build Option 3a – *Sidra* Methodology

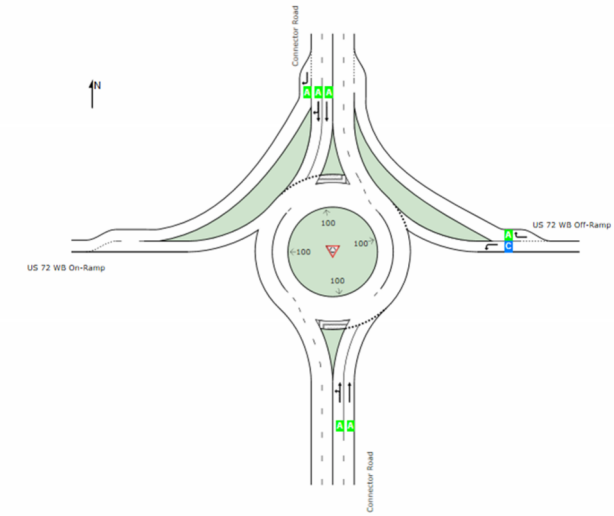
Intersection	Control	Time Period	MOE	EB Movement			WB Movement			NB Movement			SB Movement			Overall
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Connector Road at US 72 Westbound Ramps	Roundabout	AM	LOS				C		A	B	A			A	A	A
			Delay				24.0		8.8	10.1	6.8			6.6	0.1	6.5
			Queue (ft)				14		0	0	0			30	0	
		PM	LOS				A		A	B	A			D	F[1]	B
			Delay				8.6		4.2	12.5	5.1			29.4	7.3	12.0
			Queue (ft)				11		0	0	0			615	0	

[1] Volume to Capacity ratio is 1.01, resulting in LOS F for this movement.

Figure 6: Westbound Ramps – Roundabout Trial 4 (used in Option 3b)

2050 AM

	Approaches			Intersection
	South	East	North	
LOS	A	A	A	A



2050 PM

	Approaches			Intersection
	South	East	North	
LOS	A	A	B	B

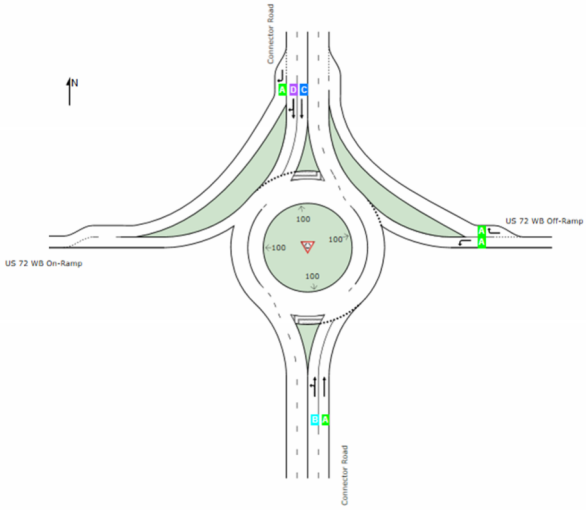


Table 16: WB Ramps Roundabout LOS and Queue Lengths – 2050 Build Option 3b – *Sidra* Methodology

Intersection	Control	Time Period	MOE	EB Movement			WB Movement			NB Movement			SB Movement			Overall
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Connector Road at US 72 Westbound Ramps	Roundabout	AM	LOS				C		A	B	A			A	A	A
			Delay				24.0		8.8	11.0	6.8			5.9	3.3	6.9
			Queue (ft)				14		0	0	0			23	23	
		PM	LOS				A		A	C	A			C	B	B
			Delay				8.6		4.2	21.7	5.1			15.7	10.2	12.1
			Queue (ft)				11		0	0	0			244	244	

4.3.2 Build Option 3a analysis with *Synchro/SimTraffic – One SB Circulating Lane*

Based on the results from the *Sidra* analysis, Build Option 3a utilizes the roundabout shown in **Figure 5** at the westbound ramps. The Eastbound Ramps intersection maintains stop control with the same configurations as were used in Options 1 and 2. The layout of Build Option 3a is shown in **Figure 7**. The results from the operational analysis of the study area using *Synchro/SimTraffic* are provided in **Appendix D – Build Operational Analysis** and are summarized in **Tables 17 – 18**. The US 72 on and off ramp performance is identical to Option 1 (See **Table 9**). The recommended storage lengths for this alternative, shown in **Table 19**, are based on the maximum 95th percentile queue lengths observed during the peak hour operational analyses.

The *HCM* and *SimTraffic* results show Option 3a performing adequately for most movements with delays generally similar to Options 1 throughout the network. Option 3a shows the following potential problem areas:

- According to the *SimTraffic* methodology, the northbound and westbound movements at the Westbound Off-Ramp show unacceptable LOS E/F conditions during the AM peak due to the

continuous heavy flow of northbound traffic through the roundabout at the reduced speed necessary to traverse a roundabout. These issues result in an overall intersection LOS E. Even so, the westbound movements at the Westbound Off-Ramp show a maximum 95th percentile queue length of 420 feet, so adequate storage to prevent spillback onto US 72 will not be an issue. During the PM peak, the *SimTraffic* methodology shows LOS F for the southbound through movement due to having only one circulating lane for this movement. The *HCM* methodology does now show operational issues for any movements at this intersection during either peak.

- Similar to Options 1 and 2, Option 3a shows the turning movements at the Access Road intersections with Connector Road having difficulty finding adequate gaps in the free-flowing northbound/southbound traffic which results in unacceptable delays for these movements. It should be noted that the volumes making these movements are small and the delays do not cause the overall intersection to fail. However, the *SimTraffic* methodology shows overall LOS F for the two Access Road intersections during the PM peak.

SimTraffic can produce unrealistically high delay estimates at roundabout intersections during the peak periods. Delays perceived by the model at these locations show spill back and impact upstream intersection performance. Hence, the delays and queue lengths of certain movements vary notably between the simulation-based *SimTraffic* results and deterministic-based *Sidra* and *HCM* results. *Sidra* is considered the most reliable of the three methodologies for roundabout analysis. It should be noted that even with the higher delays shown in *SimTraffic*, the maximum 95th percentile queues for the Westbound Off-Ramp movements do not exceed 420 feet, and the maximum 95th percentile queues for the Eastbound Off-Ramp movements do not exceed 233 feet, which are less than the length of the proposed ramps

As mentioned earlier, at the roundabout for Option 3a *Sidra* showed some delays with unacceptable LOS F conditions for the southbound right movement during the PM peak. This is because the volume slightly exceeded capacity with a volume-to-capacity ratio of 1.01. However, *Sidra* still shows that the overall roundabout intersection LOS is acceptable at LOS B or better during both peaks.

Figure 7: Build Option 3a Layout

Table 17: Intersection LOS and Queue Lengths – 2050 Build Option 3a – *HCM* Methodology

Intersection	Control	Time Period	MOE	EB Movement			WB Movement			NB Movement			SB Movement			Overall
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Access Road at Knox Rd	One-Way Stop	AM	LOS	A	A			A	A				A		A	A
			Delay	0.0	0.0			0.0	0.0				8.8		8.8	4.8
			Queue (ft)	0	0			0	0				2.5		2.5	
		PM	LOS	A	A			A	A				A		A	A
			Delay	0.0	0.0			0.0	0.0				8.7		8.7	2.9
			Queue (ft)	0	0			0	0				0		0	
Access Road at Kings Mountain Dr	One-Way Stop	AM	LOS	A	A			A	A				A		A	A
			Delay	7.3	0.0			0.0	0.0				8.5		8.5	7.8
			Queue (ft)	2.5	0			0	0				2.5		2.5	
		PM	LOS	A	A			A	A				A		A	A
			Delay	7.3	0.0			0.0	0.0				8.5		8.5	7.7
			Queue (ft)	2.5	0			0	0				2.5		2.5	
Connector Road at Access Road W	One-Way Stop	AM	LOS	B		B				A	A			A	A	A
			Delay	10.7		10.7				9.1	0.0			0.0	0.0	0.2
			Queue (ft)	5		5				2.5	0			0	0	
		PM	LOS	D		D				D	A			A	A	A
			Delay	26.7		26.7				26.0	0.0			0.0	0.0	0.3
			Queue (ft)	5		5				10	0			0	0	
Connector Road at Access Road E	One-Way Stop	AM	LOS				F		F		A	A	A	A		A
			Delay				276.2		276.2		0.0	0.0	0.0	0.0		2.8
			Queue (ft)				80		80		0	0	0	0		
		PM	LOS				E		E		A	A	A	A		A
			Delay				35.9		35.9		0.0	0.0	0.0	0.0		0.3
			Queue (ft)				17.5		17.5		0	0	0	0		
Connector Road at US 72 Westbound Ramps	Roundabout	AM	LOS				C		A	C	C			A	A	C
			Delay				24.2		0.0	18.0	21.9			6.2	0.0	18.8
			Queue (ft)				25		0	250	325			25	0	
		PM	LOS				A		A	A	A			C	A	B
			Delay				8.6		0.0	7.1	7.2			24.4	0.0	14.4
			Queue (ft)				0		0	50	50			275	0	
Connector Road at US 72 Eastbound Ramps	Two-Way Stop	AM	LOS	A		A					A	A	A	A		A
			Delay	0.0		9.7					0.0	0.0	9.6	0.0		2.2
			Queue (ft)	0		10					0	0	12.5	0		
		PM	LOS	A		C					A	A	B	A		A
			Delay	0.0		18.8					0.0	0.0	10.5	0.0		6.1
			Queue (ft)	0		90					0	0	47.5	0		
Connector Road/Red Banks Rd at MS 302	Signal	AM	LOS	A	A	n/a[1]	A	A	n/a[1]	A		n/a[1]	A	A	n/a[1]	A
			Delay	9.5	6.5		6.9	6.5		9.5			7.2			8.4
			Queue (ft)	236	39		13	40		261			55			
		PM	LOS	A	A		A	A		A			A	A		A
			Delay	8.1	6.1		6.6	6.3		6.8			7.6			6.8
			Queue (ft)	146	83		8	97		66			309			

n/a[1] –HCM methodology does not provide delay for channelized right turns at a signalized intersection

Table 18: Intersection LOS and Queue Lengths – 2050 Build Option 3a – *SimTraffic* Methodology

Intersection	Control	Time Period	MOE	EB Movement			WB Movement			NB Movement			SB Movement			Overall
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Access Road at Knox Rd	One-Way Stop	AM	LOS	A	A			A	A				A		A	A
			Delay	0.0	0.0			0.0	0.5				4.4		0.0	2.4
			Queue (ft)	0	0			0	0				46		46	
		PM	LOS	A	A			A	A				A		A	A
			Delay	0.0	0.0			0.0	2.1				4.5		0.0	2.8
			Queue (ft)	0	0			0	0				33		33	
Access Road at Kings Mountain Dr	One-Way Stop	AM	LOS	A	A			A	A				A		A	A
			Delay	2.0	0.0			0.0	0.0				0.0		2.9	2.5
			Queue (ft)	0	0			0	0				46		46	
		PM	LOS	A	A			A	A				A		A	A
			Delay	2.2	0.1			0.0	0.0				0.0		2.8	2.4
			Queue (ft)	0	0			0	0				47		47	
Connector Road at Access Road W	One-Way Stop	AM	LOS	A		A				A	A			A	A	A
			Delay	4.7		4.7				3.3	1.6			1.1	0.0	1.5
			Queue (ft)	48		48				30	0			0	0	
		PM	LOS	F		F				F	A			F	A	F
			Delay	112.8		112.8				145.5	1.2			99.2	0.0	72.6
			Queue (ft)	44		44				93	102			2672	2673	
Connector Road at Access Road E	One-Way Stop	AM	LOS				F		F		A	A	A	A		C
			Delay				1369.9		1369.9		0.8	0.1	0.0	0.7		16.8
			Queue (ft)				701		701		0	0	0	0		
		PM	LOS				F		F		A	A	A	F		F
			Delay				1205.1		1205.1		0.2	0.1	0.0	71.3		61.3
			Queue (ft)				480		480		0	0	0	1507		
Connector Road at US 72 Westbound Ramps	Roundabout	AM	LOS				F		E	E	E			A	A	E
			Delay				557.9		36.2	42.8	38.3			6.6	1.3	36.8
			Queue (ft)				296		420	936	931			73	0	
		PM	LOS				B		A	A	A			F	B	D
			Delay				11.0		1.1	7.1	8.5			101.7	12.2	30.1
			Queue (ft)				56		0	62	6			389	324	
Connector Road at US 72 Eastbound Ramps	Two-Way Stop	AM	LOS	B		A					A	A	A	A		A
			Delay	11.2		2.3					8.0	8.3	6.0	1.6		9.3
			Queue (ft)	233		17					36		78	0		
		PM	LOS	A		A					A	A	A	A		A
			Delay	1.3		5.1					6.9	5.1	9.3	3.5		4.9
			Queue (ft)	0		123					86		126	30		
Connector Road/Red Banks Rd at MS 302	Signal	AM	LOS	C	B	A	B	A	A	B	B	A	A	A	A	B
			Delay	23.2	12.7	6.8	11.5	9.9	4.2	15.7	17.3	7.0	9.8	1.7	4.2	12.0
			Queue (ft)	162	59	60	26	42	48		175			68		
		PM	LOS	C	B	A	B	A	A	B	A	A	B	A	A	A
			Delay	20.5	13.0	9.3	11.1	9.0	4.0	10.2	7.1	5.2	14.7	3.9	7.6	9.9
			Queue (ft)	83	46	58	16	67	68		95			118		

Table 19: Build Option 3a Recommended Storage Lengths

Intersection	Mvmt	Max 95% Queue (ft)	Recommended Min. Storage (ft)
Connector Road at Access Road W	NBL	93	100
Connector Road at Access Road E	SBL	0	50
Connector Road at US 72 EB Ramps	SBL	126	150

4.3.3 Build Option 3b with *Synchro/SimTraffic* – Two SB Circulating Lanes

Build Option 3b utilizes the roundabout shown in **Figure 6** at the westbound ramps. This configuration carries two lanes southbound through the roundabout. The Eastbound Ramps intersection maintains stop control with the same configurations as were used in Options 1 and 2. The layout of Build Option 3b is shown in **Figure 8**. The results from the operational analysis of the study area using *Synchro/SimTraffic* are provided in **Appendix D – Build Operational Analysis** and are summarized in **Tables 20 – 21**. The US 72 on and off ramp performance is identical to Option 1 (See **Table 9**). The recommended storage lengths for this alternative, shown in **Table 22**, are based on the maximum 95th percentile queue lengths observed during the peak hour operational analyses.

The *HCM* and *SimTraffic* results show Option 3b performing adequately for nearly all movements. Both methodologies show acceptable overall intersection LOS for all intersections during both 2050 peaks. However, a few potential problem areas were identified:

- According to the *SimTraffic* methodology, the northbound through and westbound left movements at the Westbound Off-Ramp show unacceptable LOS E/F conditions during the AM peak due to the continuous heavy flow of northbound traffic through the roundabout at the reduced speed necessary to traverse a roundabout. Nevertheless, the overall intersection performance is acceptable and the 95th percentile queue length for the westbound left movement is only 224 feet, so spillback onto US 72 will not be an issue. The *HCM* methodology does now show operational issues for any movements at this intersection.
- Some of the turning movements at the Access Road intersections north of the interchange experience unacceptable delays due to lack of gaps in traffic along the Connector Road according to both *HCM* and *SimTraffic* methodologies. However, these turning movement volumes are small and do not cause the overall intersection performance to fail. These intersections should be monitored and checked for signal warrants in the future when these movements become problematic.

The maximum 95th percentile queues for the Westbound Off-Ramp movements do not exceed 224 feet, and the maximum 95th percentile queues for the Eastbound Off-Ramp movements do not exceed 58 feet. These queues will easily be stored within the ramps and will not spill back onto US 72.

Figure 8: Build Option 3b Layout

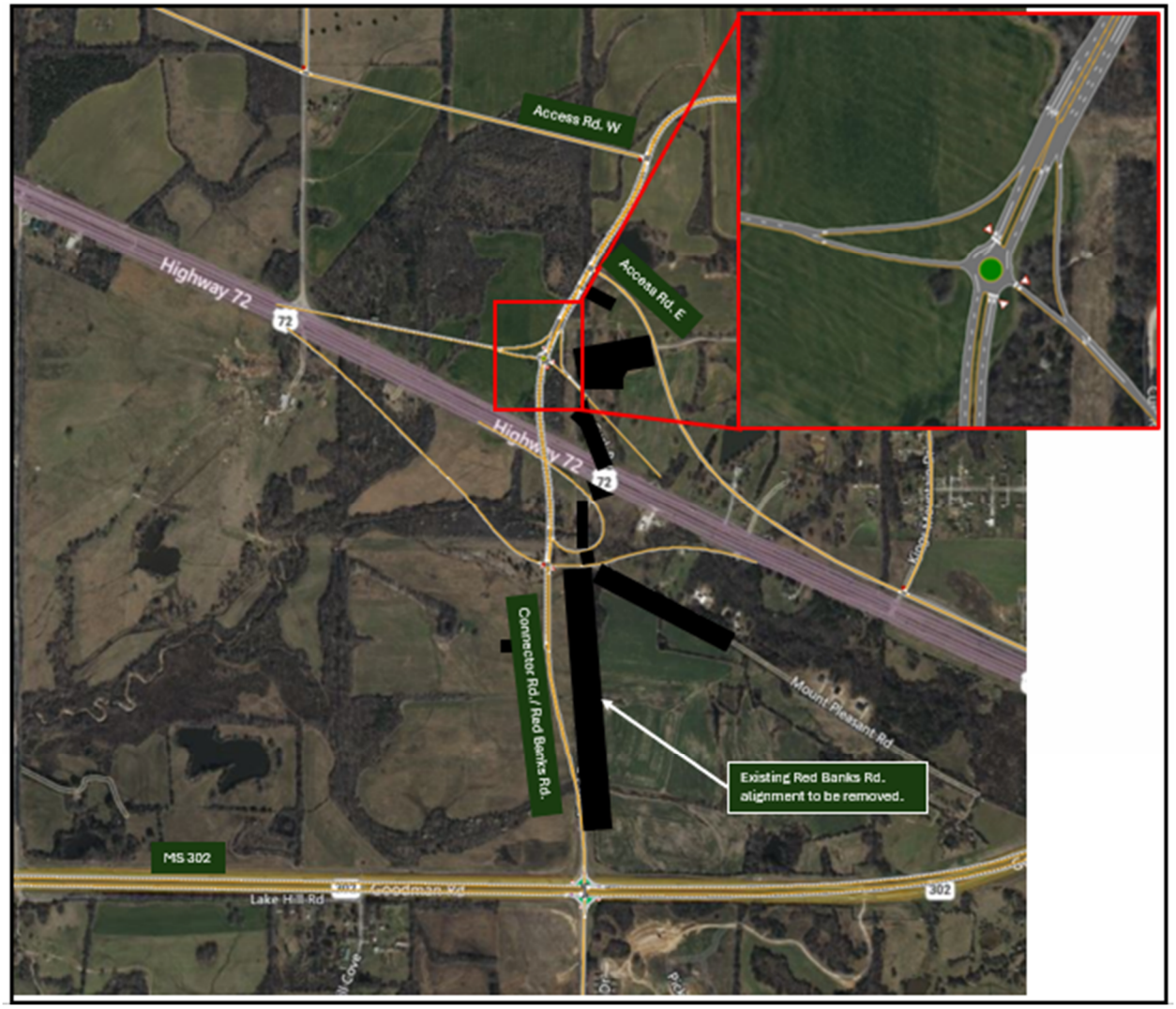


Table 20: Intersection LOS and Queue Lengths – 2050 Build Option 3b – *HCM* Methodology

Intersection	Control	Time Period	MOE	EB Movement			WB Movement			NB Movement			SB Movement			Overall
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Access Road at Knox Rd	One-Way Stop	AM	LOS	A	A			A	A				A		A	A
			Delay	0.0	0.0			0.0	0.0				8.8		8.8	4.8
			Queue (ft)	0	0			0	0				2.5		2.5	
		PM	LOS	A	A			A	A				A		A	A
			Delay	0.0	0.0			0.0	0.0				8.7		8.7	2.9
			Queue (ft)	0	0			0	0				0		0	
Access Road at Kings Mountain Dr	One-Way Stop	AM	LOS	A	A			A	A				A		A	A
			Delay	7.3	0.0			0.0	0.0				8.5		8.5	7.8
			Queue (ft)	2.5	0			0	0				2.5		2.5	
		PM	LOS	A	A			A	A				A		A	A
			Delay	7.3	0.0			0.0	0.0				8.5		8.5	7.7
			Queue (ft)	2.5	0			0	0				2.5		2.5	
Connector Road at W Access Road	One-Way Stop	AM	LOS	B		B				A	A			A	A	A
			Delay	10.7		10.7				9.1	0.0			0.0	0.0	0.2
			Queue (ft)	5		5				2.5	0			0	0	
		PM	LOS	D		D				D	A			A	A	A
			Delay	26.7		26.7				26.0	0.0			0.0	0.0	0.3
			Queue (ft)	5		5				10	0			0	0	
Connector Road at E Access Road	One-Way Stop	AM	LOS				F		F		A	A	A	A		A
			Delay				276.2		276.2		0.0	0.0	0.0	0.0		2.8
			Queue (ft)				80		80		0	0	0	0		
		PM	LOS				E		E		A	A	A	A		A
			Delay				35.9		35.9		0.0	0.0	0.0	0.0		0.3
			Queue (ft)				17.5		17.5		0	0	0	0		
Connector Road at US 72 Westbound Ramps	Roundabout	AM	LOS				C		A	C	C			A	A	C
			Delay				24.2		0.0	18.0	21.9			5.1	4.9	18.3
			Queue (ft)				25		0	250	325			0	0	
		PM	LOS				A		A	A	A			A	A	A
			Delay				8.6		0.0	7.1	7.2			9.1	8.9	7.4
			Queue (ft)				0		0	50	50			50	50	
Connector Road at US 72 Eastbound Ramps	Two-Way Stop	AM	LOS	A		A					A	A	A	A		A
			Delay	0.0		9.2					0.0	0.0	9.7	0.0		2.2
			Queue (ft)	0		10					0	0	12.5	0		
		PM	LOS	A		B					A	A	B	A		A
			Delay	0.0		13.3					0.0	0.0	10.6	0.0		5.0
			Queue (ft)	0		57.5					0	0	47.5	0		
Connector Road/Red Banks Rd at MS 302	Signal	AM	LOS	A	A		A	A		A			A	A		A
			Delay	9.5	6.5		6.9	6.5		9.5			7.2			8.4
			Queue (ft)	236	39	n/a[1]	13	40	n/a[1]	261		n/a[1]	55		n/a[1]	
		PM	LOS	A	A		A	A		A			A	A		A
			Delay	8.1	6.1		6.6	6.3		6.8			7.6			6.8
			Queue (ft)	146	83		8	97		66			309			

n/a[1] –HCM methodology does not provide delay for channelized right turns at a signalized intersection

Table 21: Intersection LOS and Queue Lengths – 2050 Build Option 3b – *SimTraffic* Methodology

Intersection	Control	Time Period	MOE	EB Movement			WB Movement			NB Movement			SB Movement			Overall
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Access Road at Knox Rd	One-Way Stop	AM	LOS	A	A			A	A				A		A	A
			Delay	0.0	0.0			0.0	0.6				4.3		0.0	2.6
			Queue (ft)	0	0			0	0				49		49	
		PM	LOS	A	A			A	A				A		A	A
			Delay	0.0	0.0			0.0	3.6				4.0		0.0	3.8
			Queue (ft)	0	0			0	0				36		36	
Access Road at Kings Mountain Dr	One-Way Stop	AM	LOS	A	A			A	A				A		A	A
			Delay	2.4	0.0			0.0	0.0				0.0		2.6	2.4
			Queue (ft)	0	0			0	0				46		46	
		PM	LOS	A	A			A	A				A		A	A
			Delay	2.4	0.1			0.0	0.0				0.0		2.9	2.5
			Queue (ft)	0	0			0	0				49		49	
Connector Road at W Access Road	One-Way Stop	AM	LOS	A		A				A	A			A	A	A
			Delay	5.0		5.0				3.5	2.0			1.1	0.0	1.9
			Queue (ft)	47		47				33	0			0	0	
		PM	LOS	F		F				F	A			B	A	B
			Delay	263.9		263.9				330.1	1.4			13.2	0.0	13.2
			Queue (ft)	74		74				134	131			202	210	
Connector Road at E Access Road	One-Way Stop	AM	LOS				F		F		A	A	A	A		C
			Delay				1528.4		1528.4		1.1	0.3	0.0	0.7		16.0
			Queue (ft)				664		664		7	5	0	0		
		PM	LOS				F		F		A	A	A	C		D
			Delay				1885.0		1885.0		0.4	0.1	0.0	17.0		27.2
			Queue (ft)				614		614		0	0	0	669		
Connector Road at US 72 Westbound Ramps	Roundabout	AM	LOS				F		A	D	E			A	A	D
			Delay				776.0		2.7	33.8	35.7			6.4	1.2	32.9
			Queue (ft)				224		0	850	859			61	17	
		PM	LOS				C		A	C	A			C	D	C
			Delay				17.1		1.1	18.0	8.6			17.4	28.2	17.2
			Queue (ft)				77		0	91	38			217	225	
Connector Road at US 72 Eastbound Ramps	Two-Way Stop	AM	LOS	A		A					A	A	A	A		A
			Delay	9.9		2.2					2.2	1.8	5.0	1.3		7.1
			Queue (ft)	15		0					23		75	16		
		PM	LOS	A		A					A	A	B	A		A
			Delay	1.3		3.4					4.8	2.4	10.1	4.0		4.4
			Queue (ft)	0		8					92		146	61		
Connector Road/Red Banks Rd at MS 302	Signal	AM	LOS	C	B	A	A	B	A	B	B	A	A	A	A	B
			Delay	22.6	11.8	6.4	9.6	10.1	4.5	16.0	17.1	8.3	9.2	0.7	3.1	11.7
			Queue (ft)	173	61	61	36	49	70		181			62		
		PM	LOS	C	B	A	B	A	A	B	A	A	B	A	A	A
			Delay	20.8	14.1	9.2	16.9	9.9	4.2	10.9	9.5	4.1	12.8	2.5	5.5	9.6
			Queue (ft)	90	65	73	18	72	74		103			120		

Table 22: Build Option 3b Recommended Storage Lengths

Intersection	Mvmt	Max 95% Queue (ft)	Recommended Min. Storage (ft)
Connector Road at Access Road W	NBL	93	100
Connector Road at Access Road E	SBL	0	50
Connector Road at US 72 WB Ramps	SBR	225	225
	WBR	0	50
Connector Road at US 72 EB Ramps	SBL	146	150

4.4 Build Option 4 - Roundabout Options at the EB Ramps Intersection

4.4.1 *Sidra* Analysis for Roundabout at the Eastbound Ramps Intersection

Several lane configurations were tested for the roundabout at Connector Road and US 72 Eastbound Ramps with the 2050 AM peak volumes. The results of the *Sidra* analyses are summarized in **Figures 9 – 13**. Complete results are provided in **Appendix D – Build Operational Analysis.** These results demonstrate that a roundabout will not perform adequately at the Eastbound Ramps intersection with the eastbound to northbound left turn movement. This movement would need to be serviced by a separate loop ramp. **Figure 13** shows the roundabout configuration without the eastbound to northbound movement, which has been replaced by the loop ramp. This roundabout performs adequately for all movements during both 2050 AM and 2050 PM peaks as shown in **Table 23**. With the loop ramp in place, all of the eastbound left turn traffic is diverted to the loop ramp which is physically separate from the eastbound to southbound off-ramp. Therefore, the queues from the two eastbound movements will not interact with each other and should both have plenty of storage so that spillback onto US 72 is not an issue.

Figure 9: EB Ramps – Roundabout Trial 1

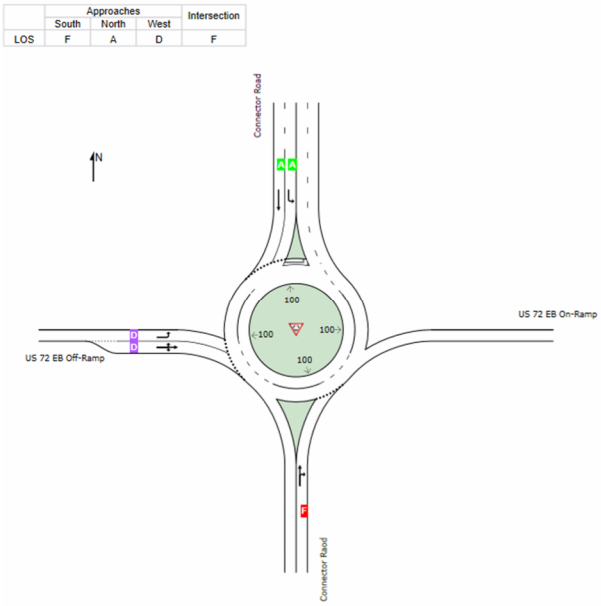


Figure 10: EB Ramps – Roundabout Trial 2

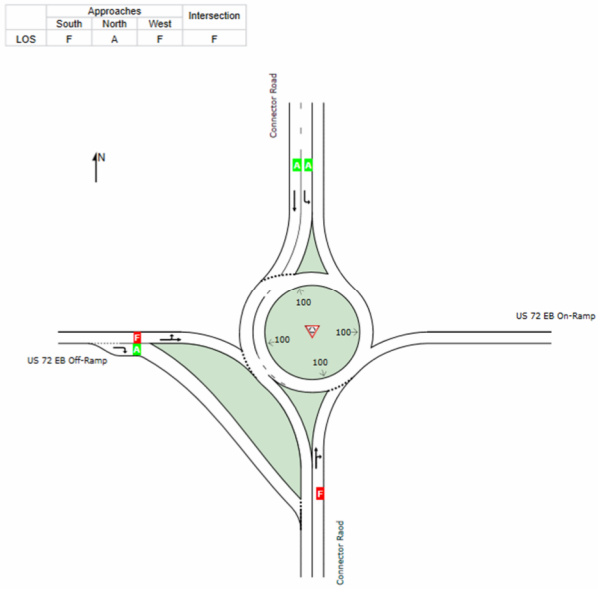


Figure 11: EB Ramps – Roundabout Trial 3

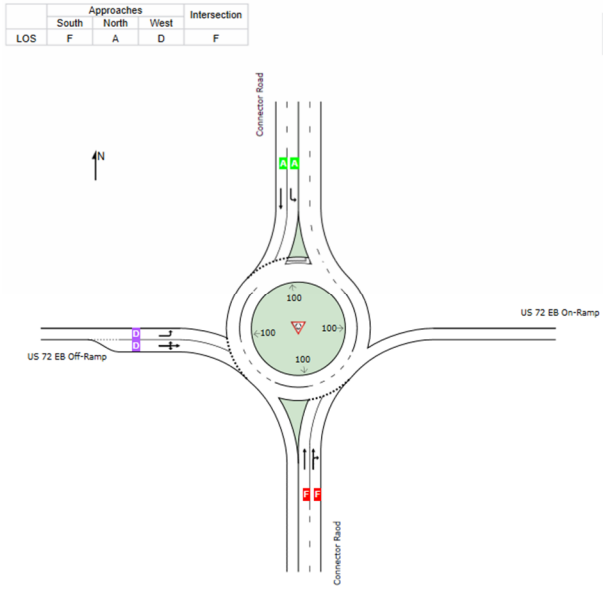


Figure 12: EB Ramps – Roundabout Trial 4

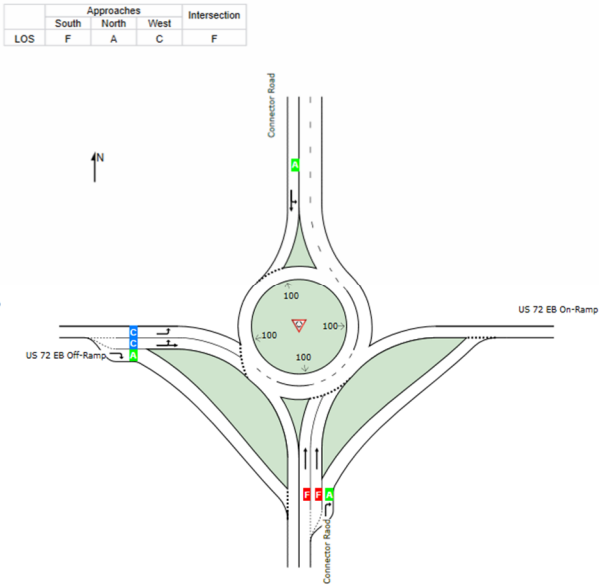
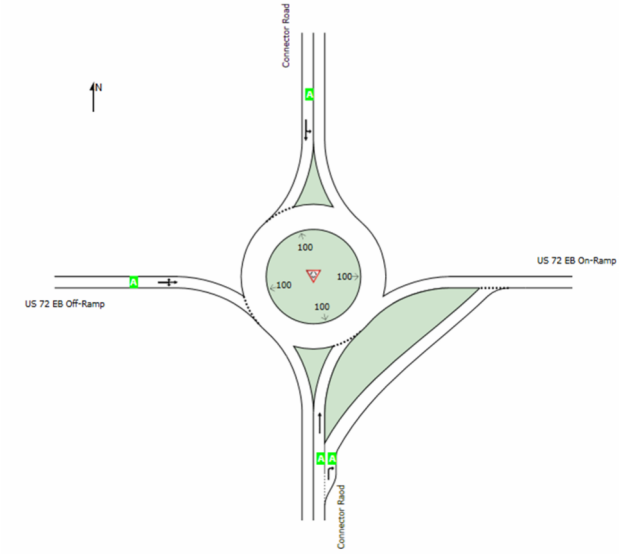


Figure 13: EB Ramps with EB to NB Loop Ramp – Roundabout Trial 5 (used in Option 4)

2050 AM:

	Approaches			Intersection
	South	North	West	
LOS	A	A	A	A



2050 PM:

	Approaches			Intersection
	South	North	West	
LOS	B	A	C	B

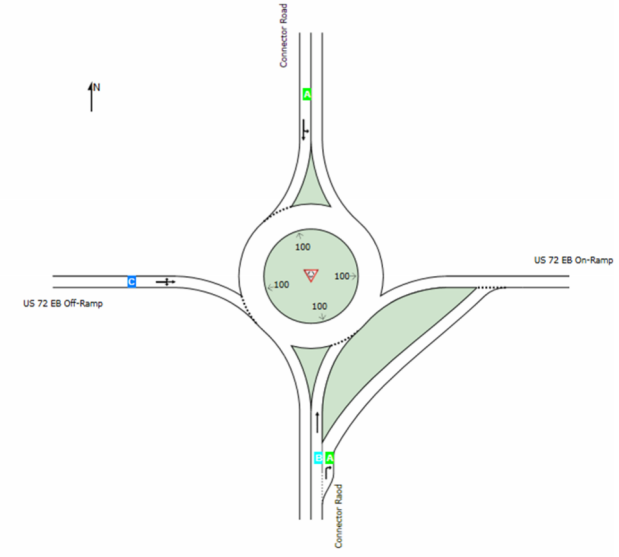


Table 23: EB Ramps Roundabout LOS and Queue Lengths – 2050 Build Option 4 – *Sidra* Methodology

Intersection	Control	Time Period	MOE	EB Movement			WB Movement			NB Movement			SB Movement			Overall
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Connector Road at US 72 Eastbound Ramps	Roundabout with EB to NB Loop Ramp	AM	LOS	n/a[1]		A					A	A	A	A		A
			Delay			5.1					8.4	3.2	4.4	4.4		6.8
			Queue (ft)			5					32	1	0	0		
		PM	LOS	n/a[1]		C					B	A	A	A		B
			Delay			23.8					14.0	4.9	6.3	6.2		11.6
			Queue (ft)			49					55	3	0	0		

n/a[1]: EB to NB Loop Ramp not captured in *Sidra* Roundabout Intersection Analysis

4.4.2 Build Option 4 analysis with *Synchro/SimTraffic* – Roundabouts at both Ramps

Option 4 is identical to Option 3a except that the Eastbound Ramps intersection is a single lane roundabout with the lane configuration shown in **Figure 14**. Since only this intersection changed, **Tables 24 – 25** show the operations only at this intersection. All other intersections would operate the same as Option 3a, and the US 72 on and off ramps would operate the same as Option 1, Option 3a, and Option 3b. No turn lane storage would be provided at the Eastbound Ramps roundabout, and storages at the other intersections would be identical to Option 3a. The *HCM* and *SimTraffic* results demonstrate that the roundabout with the eastbound to northbound loop ramp will perform adequately for all movements during both the 2050 AM and 2050 PM peaks, and Option 4 will perform similarly to Option 3a.

Figure 14: Build Option 4 Layout

Table 24: Intersection LOS and Queue Lengths – 2050 Build Option 4 – *HCM* Methodology

Intersection	Control	Time Period	MOE	EB Movement			WB Movement			NB Movement			SB Movement			Overall
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Connector Road at US 72 Eastbound Ramps	Roundabout with EB to NB Loop Ramp	AM	LOS	n/a[1]		A					A	A	A			A
			Delay			5.0					9.1	3.0	5.6			7.6
			Queue (ft)			0					75	0	25			
		PM	LOS	n/a[1]		C					B	A	B			B
			Delay			22.8					14.5	4.1	12.2			15.0
			Queue (ft)			125					100	0	150			

n/a[1]: EB to NB Loop Ramp not captured in *HCM* Roundabout Intersection Analysis

Table 25: Intersection LOS and Queue Lengths – 2050 Build Option 4 – *SimTraffic* Methodology

Intersection	Control	Time Period	MOE	EB Movement			WB Movement			NB Movement			SB Movement			Overall
				Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Connector Road at US 72 Eastbound Ramps	Roundabout with EB to NB Loop Ramp	AM	LOS	B		A					B	A	A	A		B
			Delay	14.2		3.3					14.8	9.2	4.8	7.3		13.0
			Queue (ft)	428		39					81	8	0			
		PM	LOS	A		B					B	A	A	B		A
			Delay	1.3		11.2					13.3	7.8	9.5	11.7		8.7
			Queue (ft)	0		118					122	34	43			

5.0 Summary

The *SimTraffic* simulations provide a summary of the average delay per vehicle (sec/veh) experienced by vehicles from entry to exit of the network. These delays, shown in **Table 26**, were compared across the Build Options as one method of comparing performance between the alternatives. While Option 2 shows the lowest network delay, this option was not chosen because its construction cost would be prohibitively high. Option 3b had the next lowest total delay.

Table 26: Total Network Delays per Build Option – S*imTraffic* Methodology

Total Delay/Veh (sec/veh)	Opt 1	Opt 2	Opt 3a	Opt 3b	Opt 4
AM	53.4	50.9	72.4	63.6	85.2
PM	80.6	24.1	123.8	64.2	93.7
AM + PM	134.0	75.0	196.2	127.8	178.9

The benefits and problem areas were considered for each of the build options using *HCM*, *SimTraffic*, and *Sidra* methodologies. Options 3a and 3b evaluate roundabout configurations at the US 72 Westbound Ramps intersections with the Connector Road. Option 3a utilizes a single circulating lane plus a slip lane for the southbound approach. This alternative shows the slip lane exceeding capacity in the PM peak and does not perform as well as Option 3b which utilizes an additional southbound circulating lane. The Option 3b roundabout configuration operates within capacity and provides acceptable overall intersection level of service during both peaks according to all three methodologies.

Option 4 evaluates a roundabout at the US 72 Eastbound Ramp intersection with the Connector Road. Results of this analysis demonstrate that a loop ramp for eastbound to northbound traffic will be required. A single lane roundabout or stop control will provide acceptable performance for all movements. Since all movements perform well at this intersection under two-way stop control and the roundabout configuration does not eliminate the need for the loop ramp for the eastbound to northbound traffic, the two-way stop control option is preferred over the roundabout option at this intersection.

Based on the analyses detailed in this Traffic Study, Option 3b is selected as the preferred alternative. As volumes increase over time, the two intersections of Connector Road and Access Road should be monitored. If operations become problematic, the intersections may be evaluated to determine if a signal is warranted.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