Technical Memo

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TO: Project Team

FR: Mark T. Johnson, PE (AZ) – MTJ Roundabout Engineering

RE: **D R A F T** Roundabout Analysis & Concept SKETCH Design Alternative Development
Fourth & Cedar/Lockett, City of Flagstaff, AZ

DT: December 14, 2020

Please find the attached summary memo of our Operational Analysis and Concept Design Development for this intersection. This memo includes additional analysis and concept design layouts to avoid/minimize residential impacts as requested during review meetings held on Nov. 23 and Dec. 7, 2020.

This memo provides a summary of this operational analysis and the concept designs we've developed for project team review and discussion. This memo is organized as outlined below:

Outline:

1. **Operational Analysis**
   - A. 2019 Peak Hour Traffic Evaluation (Street Light and FMPO flipped)
   - B. Sketch Laneage Options Analyzed
   - C. Rodel operational output
   - D. Analysis Summary

2. **Concept Design Summary**

3. **Summary**

Attachments:

- Appendix A: 11x17 Concept Design Exhibits – Gray Scale Alts: A-F
- Appendix B: 11x17 Design Exhibits – Colorized Alts: A, B, B1, B4, C, C4

1. OPERATIONAL ANALYSIS

The operational analysis is a foundational element of roundabout performance, and was conducted with the roundabout-specific analysis program Rodel (v.1.96). Rodel is well suited to provide an understanding of the expected performance of this roundabout (please see Rodel summary attached).

Introduction

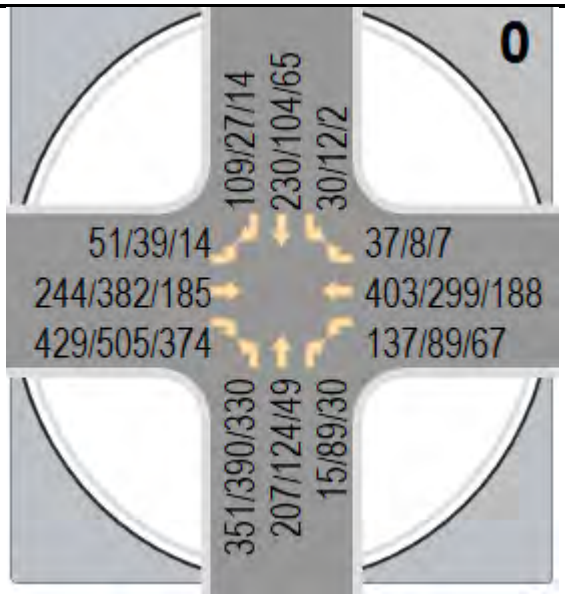
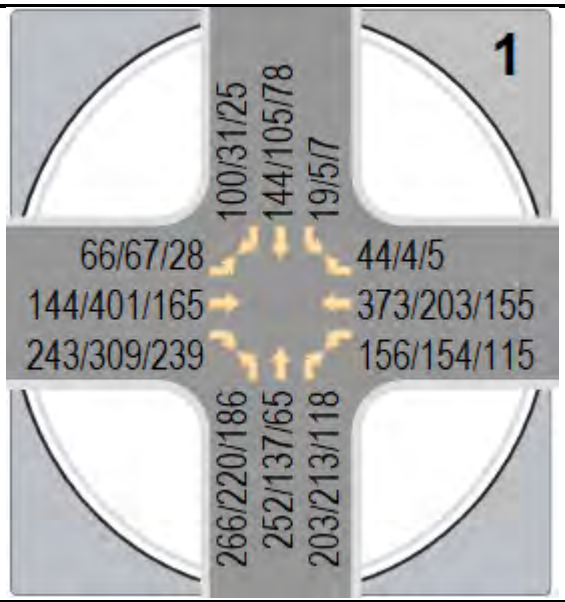
Operational performance is foundational, providing an understanding of laneage alternatives to meet operational objectives. The operational analysis is used to inform selection of geometric design alternatives that may be possible for a given project and the associated performance and impacts.

We have reviewed the provided Peak Hour turning movement counts for 2019 AM/PM/Off Peak for both the Street Light and FMPO flipped data. Please see discussion below.
We utilized higher flows of each set of data for our Rodel analysis. Additionally, we performed a sensitivity test (constrained capacity), allowing for an understanding of potential sensitive entries that may fail prior to others for a given layout.

LOS	Signalized Intersection	Unsignalized Intersection
A	≤10 sec	≤10 sec
B	10–20 sec	10–15 sec
C	20–35 sec	15–25 sec
D	35–55 sec	25–35 sec
E	55–80 sec	35–50 sec
F	≥80 sec	≥50 sec

The Peak Hour Traffic Data evaluated are shown below in Figure 1.

Fig. 1: 2019 AM/PM/MID Traffic
(Source: City of Flagstaff)

Fourth & Cedar/Lockett – Streetlight	Fourth & Cedar/Lockett – 2019 FMPO Count Flipped 180 deg
	

A. 2019 Peak Hour Traffic Evaluation

To ascertain a conservative analysis we have identified the highest flow for each movement and each peak from the provided traffic data (2019 Street Light and 2019 FMPO Flipped).

This new turning movement diagram is shown to the right in Figure 2 for 4-Leg configuration and Figure 3 for Double Roundabout configuration. For our initial operational analysis purposes we have developed two primary layouts and they include:

- 4-Leg Alternative
- Double Roundabout Alternative.

The 4-Leg ties all legs into a singular roundabout.

The Double Roundabout provides two separate smaller 3-Leg roundabouts at each intersection with a short connection between them.

One key analysis issue for the Double Roundabout is providing adequate capacity for the connecting leg entries based on available queue storage between them.

Operational Analysis was conducted on two scenarios for each layout (4-Leg and Double). The primary difference is the evaluation of the NB entry with a single lane and then with a two-lane entry (LEFT ONLY and THRU).

Fig. 2: 4-Leg Roundabout 2019 highest flows from each set of traffic data

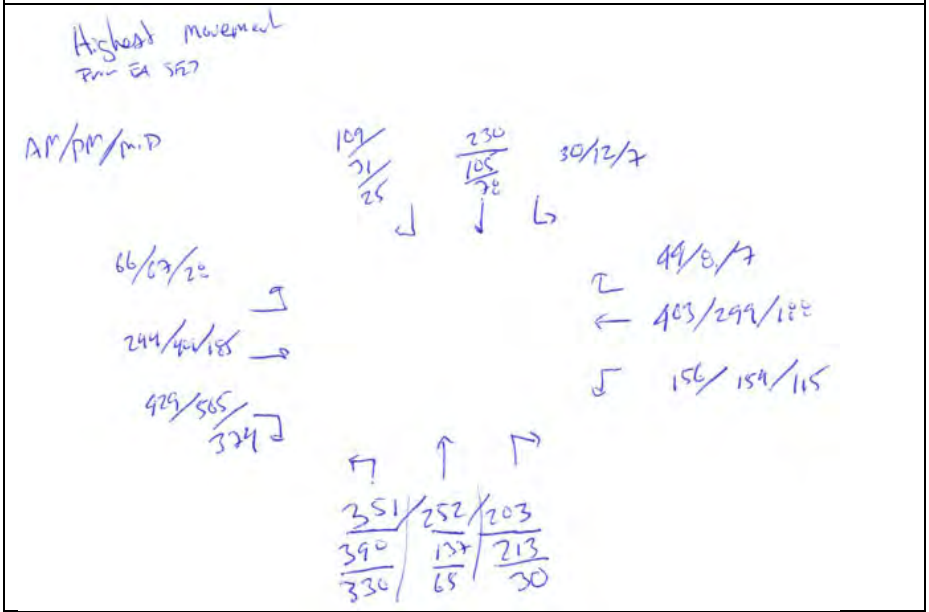
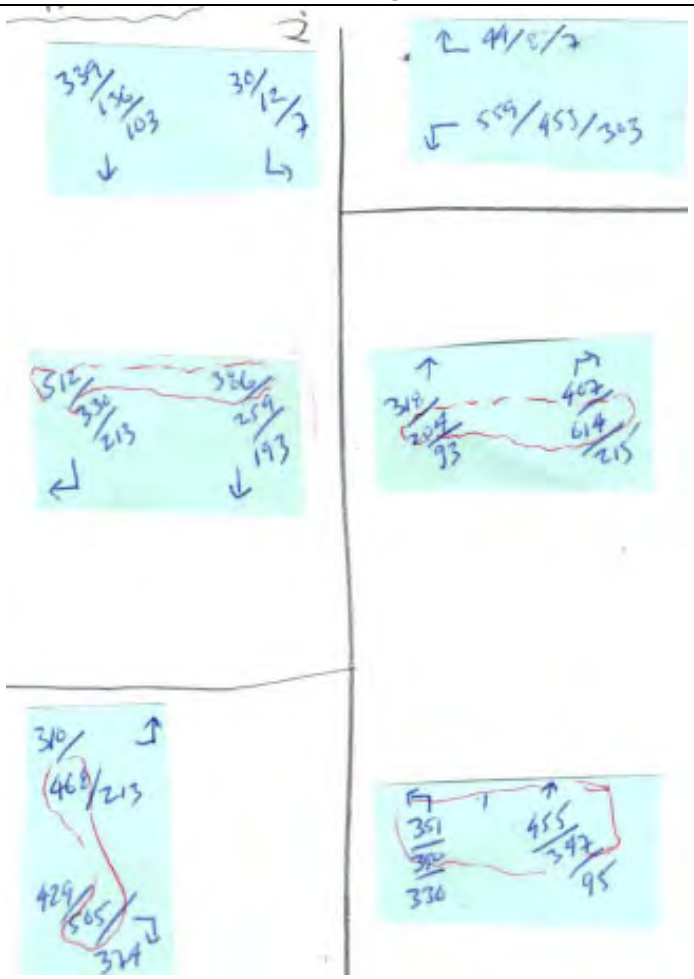


Fig. 3: Double Roundabout 2019 highest flows



B. Sketch Laneage Options Analyzed

Four-Leg Roundabout Analysis includes two laneage scenarios:

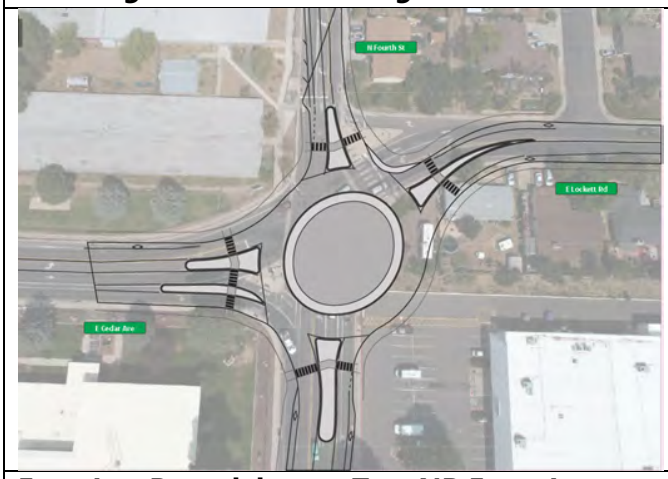
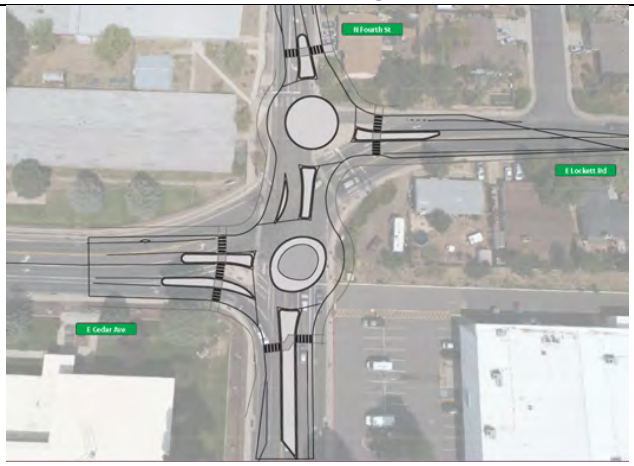
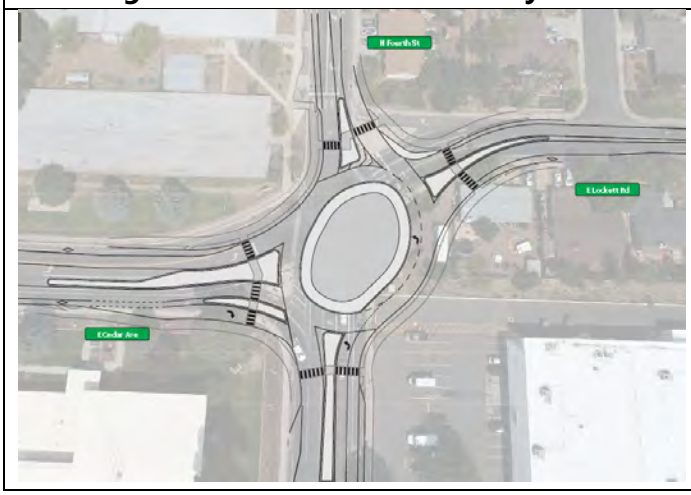
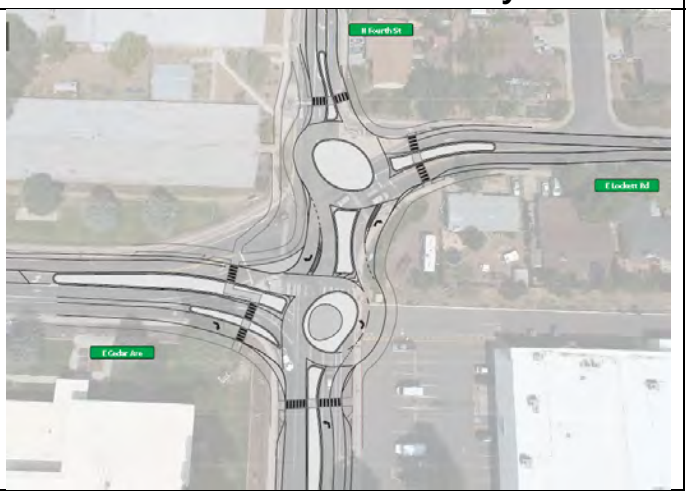
1) Single-Lane Entries for all entries with
   - Yield RT Lane for EB entry
2) Single-Lane Entries for all entries with
   - Yield RT Lane for EB entry
   - *Added Two-Lane NB entry*

Double Roundabouts Analysis includes two laneage scenarios:

1) South roundabout
   - SB entry includes a Yield Right Lane
   - EB entry includes a Yield Right Lane (YRTL)

   North roundabout
   - Single Lane Entries
2) South roundabout
   - *Two NB Entry Lanes*

   North roundabout
   - NB entry includes a Yield Right Lane

Four-Leg Roundabout – Single NB Lane	Double Roundabouts – Single NB Lane
	
Four-Leg Roundabout – Two NB Entry Lanes	**Double Roundabouts – Two NB Entry Lanes**
	

C. Rodel Operational Output

2019: 4 Leg Roundabout - Single NB Entry Lane

2019 Single Lane Roundabout AM

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	401		982		652		0.6151		11.87		11.87	1.48		3.74		B		B
2	EB	Yield	337	466	449	449	912	867	0.3694	0.5468	5.70	8.22	7.16	0.56	1.14	1.46	2.92	A	A	A
3	NB	None	876		369		1066		0.8216		13.73		13.73	3.82		9.11		B		B
4	WB	None	655		723		805		0.8143		16.94		16.94	3.61		8.64		C		C
All	Intersection												12.30							B

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 AM Sensitivity Testing 85% CL (~10% Reduced Capacity)

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	401		930		478		0.8387		28.93		28.93	3.90		9.29		D		D
2	EB	Yield	337	466	435	435	720	671	0.4678	0.7158	8.36	15.09	12.27	0.83	2.16	2.15	5.36	A	C	B
3	NB	None	876		368		868		1.0097		43.07		43.07	14.37		29.69		E		E
4	WB	None	655		701		617		1.0621		68.86		68.86	18.22		36.84		F		F
All	Intersection												38.13							E

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 Single Lane Roundabout PM

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	164		929		678		0.2426		6.31		6.31	0.31		0.81		A		A
2	EB	Yield	520	561	300	300	985	940	0.5278	0.6070	6.77	8.51	7.67	1.06	1.44	2.71	3.66	A	A	A
3	NB	None	811		532		911		0.8906		20.39		20.39	5.69		13.05		C		C
4	WB	None	512		638		848		0.6040		8.99		8.99	1.42		3.60		A		A
All	Intersection												11.86							B

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 PM 85% CL (~10% Reduced Capacity)

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	164		906		490		0.3356		9.71		9.71	0.49		1.27		A		A
2	EB	Yield	520	561	299	299	787	738	0.6608	0.7846	11.09	16.50	13.90	1.78	2.93	4.46	7.14	B	C	B
3	NB	None	811		531		782		1.0370		49.79		49.79	16.58		33.79		E		E
4	WB	None	512		612		662		0.7736		17.42		17.42	2.91		7.09		C		C
All	Intersection												25.66							D

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

Notes: Critical Hr is AM, NB LOS E, WB LOS F, SB LOS D as single lanes, to provide more capacity an aux. NB LT lane can be added, LEFT ONLY, THRU-RIGHT.

2019: 4 Leg Roundabout – Two NB Entry Lanes

2019 AM

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	401		986		650		0.6170		11.96		11.96	1.48		3.75		B		B
2	EB	Yield	337	466	450	450	912	867	0.3695	0.5470	5.70	8.23	7.17	0.56	1.14	1.46	2.92	A	A	A
3	NB	None	876		369		1661		0.5275		7.18		7.18	1.87		4.67		A		A
4	WB	None	655		726		906		0.7234		11.52		11.52	2.33		5.77		B		B
All	Intersection												8.92							A

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 AM 85% CL (~10% Reduced Capacity)

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	401		975		457		0.8785		33.59		33.59	4.77		11.14		D		D
2	EB	Yield	337	466	441	441	717	669	0.4696	0.7189	8.41	15.22	12.36	0.84	2.19	2.17	5.44	A	C	B
3	NB	None	876		368		1463		0.5989		9.34		9.34	2.46		6.06		A		A
4	WB	None	655		725		707		0.9266		30.47		30.47	6.97		15.64		D		D
All	Intersection												18.85							C

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 PM

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	164		932		477		0.3445		10.02		10.02	0.50		1.31		B		B
2	EB	Yield	520	561	300	300	787	738	0.6611	0.7850	11.10	16.53	13.92	1.78	2.94	4.46	7.15	B	C	B
3	NB	None	811		531		1307		0.6205		11.23		11.23	2.82		6.88		B		B
4	WB	None	512		643		737		0.6947		12.72		12.72	2.04		5.09		B		B
All	Intersection												12.58							B

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 PM 85% CL (~10% Reduced Capacity)

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	164		932		477		0.3445		10.02		10.02	0.50		1.31		B		B
2	EB	Yield	520	561	300	300	787	738	0.6611	0.7850	11.10	16.53	13.92	1.78	2.94	4.46	7.15	B	C	B
3	NB	None	811		531		1307		0.6205		11.23		11.23	2.82		6.88		B		B
4	WB	None	512		643		737		0.6947		12.72		12.72	2.04		5.09		B		B
All	Intersection												12.58							B

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 Double Roundabout with Single NB Entry Lane

North Roundabout AM

2019 AM

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	410		618		786		0.5214		8.24		8.24	1.03		2.64		A		A
2	NB	None	806		33		1101		0.7317		9.79		9.79	2.44		6.01		A		A
3	WB	None	670		352		929		0.7208		11.02		11.02	2.31		5.71		B		B
All	Intersection												9.89							A

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 AM 85% CL

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	410		608		593		0.6915		15.29		15.29	2.01		5.00		C		C
2	NB	None	806		33		902		0.8931		21.36		21.36	5.79		13.26		C		C
3	WB	None	670		348		732		0.9148		27.37		27.37	6.46		14.62		D		D
All	Intersection												22.18							C

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

Notes: AM Peak WB entry shows some sensitivity.

North Roundabout PM

2019 PM

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	164		503		793		0.2074		5.06		5.06	0.24		0.64		A		A
2	NB	None	909		13		1049		0.8666		14.59		14.59	4.29		10.12		B		B
3	WB	None	512		226		938		0.5462		6.95		6.95	1.07		2.73		A		A
All	Intersection												11.13							B

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 PM 85% CL

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	164		502		606		0.2715		7.09		7.09	0.35		0.90		A		A
2	NB	None	909		13		861		1.0556		46.43		46.43	16.52		33.68		E		E
3	WB	None	512		215		756		0.6777		11.21		11.21	1.76		4.41		B		B
All	Intersection												30.97							D

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

Notes: Pm peak NB entry is critical entry. This connection leg to south roundabout has Q storage available of ~3 veh. Analysis shows more capacity necessary for this entry to reduce Queueing.

South Roundabout AM

2019 AM

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	Yield	429	569	381	381	921	957	0.4657	0.6042	6.47	8.28	7.50	0.83	1.44	2.15	3.64	A	A	A
2	EB	Yield	344	477	428	428	890	858	0.3872	0.5653	5.92	8.49	7.42	0.61	1.22	1.57	3.12	A	A	A
3	NB	None	896		344		935		0.9582		28.56		28.56	9.38		20.33		D		D
All	Intersection												14.42							B

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | Economics | Global Results

2019 AM 85% CL

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	Yield	429	569	320	320	649	707	0.6610	0.8372	13.54	20.45	17.48	1.76	3.68	4.43	8.80	B	C	C
2	EB	Yield	344	477	427	427	691	655	0.4984	0.7506	9.01	16.51	13.37	0.94	2.49	2.41	6.13	A	C	B
3	NB	None	896		343		736		1.2170		144.95		144.95	54.53		106.37		F		F
All	Intersection												58.29							F

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | Economics | Global Results

South Roundabout PM

2019 PM

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	Yield	288	367	412	412	848	907	0.3395	0.4094	5.58	6.18	5.91	0.47	0.67	1.24	1.74	A	A	A
2	EB	Yield	520	561	287	287	906	902	0.5738	0.6337	7.55	9.37	8.49	1.18	1.60	3.02	4.03	A	A	A
3	NB	None	819		519		786		1.0420		42.34		42.34	13.81		28.64		E		E
All	Intersection												18.68							C

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | Economics | Global Results

2019 PM 85% CL

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	Yield	288	367	317	317	709	763	0.4057	0.4894	7.38	8.43	7.97	0.62	0.91	1.61	2.34	A	A	A
2	EB	Yield	520	561	287	287	700	687	0.7432	0.8503	14.06	21.45	17.89	2.29	3.91	5.67	9.30	B	C	C
3	NB	None	819		517		599		1.3666		226.54		226.54	75.44		147.10		F		F
All	Intersection												82.24							F

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | Economics | Global Results

Notes: Critical analysis and Entry is the NB morning am peak... To provide more capacity an aux. LT lane can be added, LEFT ONLY, THRU-RIGHT. See Alt C1

2019 Double Roundabout with Two NB Entry Lanes

South Roundabout

2019 AM

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	Yield	429	569	389	389	917	953	0.4679	0.6071	6.52	8.38	7.58	0.84	1.45	2.16	3.67	A	A	A
2	EB	Yield	344	477	428	428	889	858	0.3873	0.5654	5.93	8.50	7.42	0.61	1.22	1.57	3.12	A	A	A
3	NB	None	896		344		1597		0.5609		7.84		7.84	2.12		5.27		A		A
All	Intersection												7.62							A

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 AM 85% CL

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	Yield	429	569	388	388	614	670	0.6987	0.8874	15.27	24.61	20.60	2.06	4.67	5.13	10.93	C	C	C
2	EB	Yield	344	477	426	426	692	656	0.4980	0.7500	9.00	16.47	13.33	0.94	2.49	2.41	6.12	A	C	B
3	NB	None	896		343		1399		0.6403		10.51		10.51	2.89		7.05		B		B
All	Intersection												15.07							C

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

South Roundabout

2019 PM

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	Yield	288	367	432	432	837	896	0.3438	0.4145	5.67	6.28	6.01	0.48	0.68	1.26	1.77	A	A	A
2	EB	Yield	520	561	287	287	906	902	0.5738	0.6337	7.55	9.37	8.49	1.18	1.60	3.02	4.03	A	A	A
3	NB	None	819		519		1326		0.6176		10.41		10.41	2.62		6.43		B		B
All	Intersection												8.47							A

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 PM 85% CL

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	Yield	288	367	430	430	650	700	0.4427	0.5343	8.32	9.70	9.09	0.72	1.08	1.86	2.76	A	A	A
2	EB	Yield	520	561	287	287	700	687	0.7430	0.8501	14.05	21.42	17.88	2.29	3.91	5.67	9.30	B	C	C
3	NB	None	819		517		1140		0.7183		14.94		14.94	3.88		9.23		B		B
All	Intersection												14.68							B

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

North Roundabout

2019 AM

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	410		620		786		0.5219		8.26		8.26	1.03		2.64		A		A
2	NB	Yield	354	452	33	34	1101	1069	0.3220	0.4279	4.42	5.45	5.00	0.46	0.73	1.20	1.88	A	A	A
3	WB	None	670		353		929		0.7213		11.04		11.04	2.31		5.72		B		B
All	Intersection												7.85							A

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 AM 85% CL

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	410		610		592		0.6926		15.35		15.35	2.02		5.03		C		C
2	NB	Yield	354	452	33	34	902	866	0.3929	0.5307	5.95	7.97	7.08	0.62	1.07	1.61	2.75	A	A	A
3	WB	None	670		353		746		0.8978		24.98		24.98	5.78		13.24		C		C
All	Intersection												15.24							C

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

North Roundabout

2019 PM

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	164		503		793		0.2074		5.06		5.06	0.24		0.64		A		A
2	NB	Yield	227	682	13	13	1049	1049	0.2161	0.6617	3.92	8.74	7.54	0.26	1.81	0.68	4.53	A	A	A
3	WB	None	512		227		954		0.5371		6.73		6.73	1.03		2.64		A		A
All	Intersection												7.02							A

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 PM 85% CL

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	164		502		606		0.2716		7.09		7.09	0.35		0.90		A		A
2	NB	Yield	227	682	13	13	848	848	0.2672	0.8317	5.13	17.22	14.20	0.34	3.73	0.89	8.91	A	C	B
3	WB	None	512		227		766		0.6687		10.80		10.80	1.69		4.26		B		B
All	Intersection												12.37							B

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

D. Analysis Results Summary

4-Leg Roundabout:

- Sensitivity testing with 2019 flows shows both the NB and WB entries LOS degrade more rapidly as single-lane entries.
- NB entry sensitivity is addressed with the addition of a NB LT Only Lane, resulting in a two-lane NB entry. This will conform to the existing two-lane NB lanes.
    - The directional distribution for NB movements is close to 50/50 for LT and THRU-Rights; therefore, adding the LT Only lane substantially improves capacity for this entry as both lanes are equally utilized.
- WB Entry:
    - With the addition of the NB LT Only Lane the WB entry capacity is also increased due to the addition of two circulating lanes past the WB entry.
    - While additional capacity for the WB entry could be achieved with application of a Flared Two-Lane Entry (THRU-RIGHT and THRU-LEFT), this ***adds substantial complexity*** to the design which would require additional design space to address.

Double Roundabouts:

- NB entry shows sensitivity as a single-lane entry, which is addressed with inclusion of two NB entry lanes (LEFT ONLY, THRU).

- WB entry sensitivity is reduced with the two-roundabout application as the NB left turn flows (circulating/opposing) are removed from the WB entry of north roundabout; therefore, increasing capacity for the WB entry.

- Available queue storage between the two closely spaced roundabouts is ~3 vehicles. Providing the YRTLs for the connecting entries provides satisfactory queue storage.

TRAFFIC GROWTH SENSITIVITY ANALYSIS SUMMARY

To ascertain the potential for available traffic growth for each roundabout application, we have analyzed both layout scenarios with two NB entry lanes. With this laneage layout we have grown traffic by 5% increments to understand at what point the roundabouts begin to break down.

Analysis shows each design layout begins to degrade for critical entries with 25% growth for the SB & WB movement and 30% traffic growth for the EB and NB movements. Analysis output with this growth scenario is shown below for each layout (4-Leg, Double). The Double Roundabout provides slightly improved LOS as compared to the 4-Leg layout. However, it is noted that queue storage between the two closely spaced roundabouts will need closer evaluation.

4-Leg Roundabout

25% Growth SB and WB, 30% Growth EB and NB

AM

	Volume Modifiers			Turning Volumes (veh/hr)					Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor			U-Turn	Exit-3	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.25			0	30	230	109	0							0.920
2	EB	2.0	1.30			0	66	244	0	429							0.920
3	NB	2.0	1.30			0	351	252	203	0							0.920
4	WB	2.0	1.25			0	156	403	44	0							0.920

Calibration | Accidents | Economics | Bypass | 1 message | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)		Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	501		1226		533		0.9415		38.12		38.12	7.19		16.07		E		E
2	EB	Yield	438	606	545	545	866	820	0.5061	0.7597	7.45	14.16	11.35	0.97	2.67	2.50	6.55	A	B	B
3	NB	None	1139		476		1558		0.7309		12.11		12.11	4.27		10.08		B		B
4	WB	None	819		941		828		0.9898		38.01		38.01	11.79		24.88		E		E
All	Intersection												21.66							C

PM

	Volume Modifiers			Turning Volumes (veh/hr)					Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor			U-Turn	Exit-3	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.25			0	12	105	31	0							0.900
2	EB	2.0	1.30			0	67	401	0	505							0.900
3	NB	2.0	1.30			0	390	124	216	0							0.900
4	WB	2.0	1.25			0	154	299	8	0							0.900

Calibration | Accidents | Economics | Bypass | 2 messages | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)		Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	206		1184		553		0.3715		8.97		8.97	0.57		1.48		A		A
2	EB	Yield	676	729	375	375	949	904	0.7124	0.8317	10.56	16.11	13.44	2.23	3.80	5.52	9.06	B	C	B
3	NB	None	1054		690		1355		0.7783		16.16		16.16	5.57		12.80		C		C
4	WB	None	640		832		867		0.7382		12.23		12.23	2.49		6.14		B		B
All	Intersection												13.80							B

Double Roundabout

25% Growth SB and WB, 30% Growth EB and NB

North Roundabout AM

	Volume Modifiers			Turning Volumes (veh/hr)				Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor			U-Turn	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.25			0	30	339	0							0.900
2	NB	2.0	1.30			0	318	1	407							0.900
3	WB	2.0	1.25			0	559	44	0							0.900

Calibration | Accidents | Economics | Bypass | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)		Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	513		755		713		0.7189		13.78		13.78	2.28		5.65		B		B
2	NB	Yield	461	588	41	43	1097	1064	0.4202	0.5602	5.11	6.91	6.12	0.69	1.21	1.80	3.09	A	A	A
3	WB	None	838		459		872		0.9604		30.13		30.13	9.34		20.25		D		D
All	Intersection												16.14							C

North Roundabout PM

	Volume Modifiers			Turning Volumes (veh/hr)				Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor				U-Turn	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.25				0	12	136	0							0.900
2	NB	2.0	1.30				0	204	0	614							0.900
3	WB	2.0	1.25				0	453	8	0							0.900

Calibration | Accidents | Economics | Bypass | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	206		628		781		0.2632		5.67		5.67	0.34		0.90		A		A
2	NB	Yield	295	887	17	17	1110	1079	0.2655	0.8458	4.08	14.80	12.13	0.35	4.20	0.92	9.94	A	B	B
3	WB	None	640		295		960		0.6667		9.30		9.30	1.83		4.59		A		A
All	Intersection												10.58							B

South Roundabout AM

	Volume Modifiers			Turning Volumes (veh/hr)				Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor				U-Turn	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.25				0	386	0	512							0.920
2	EB	2.0	1.30				0	310	0	429							0.920
3	NB	2.0	1.30				0	351	455	0							0.920

Calibration | Accidents | Economics | Bypass | 2 messages | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	Yield	524	696	493	493	784	836	0.6690	0.8625	11.45	19.33	15.94	1.84	4.35	4.61	10.26	B	C	C
2	EB	Yield	438	606	522	522	839	807	0.5221	0.7731	7.88	14.89	11.95	1.03	2.82	2.64	6.89	A	B	B
3	NB	None	1139		437		1503		0.7578		13.55		13.55	4.83		11.26		B		B
All	Intersection												13.92							B

South Roundabout PM

	Volume Modifiers			Turning Volumes (veh/hr)				Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor				U-Turn	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.25				0	259	0	330							0.900
2	EB	2.0	1.30				0	468	0	505							0.900
3	NB	2.0	1.30				0	390	347	0							0.900

Calibration | Accidents | Economics | Bypass | 3 messages | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	Yield	360	458	555	555	846	876	0.4250	0.5313	6.55	7.77	7.23	0.71	1.08	1.83	2.77	A	A	A
2	EB	Yield	676	729	359	359	927	895	0.7296	0.8411	11.33	16.77	14.15	2.40	3.97	5.92	9.43	B	C	B
3	NB	None	1065		672		1265		0.8413		21.35		21.35	7.72		17.11		C		C
All	Intersection												14.76							B

4-Leg Roundabout:

2019 + 25% Growth SB and WB, 30% Growth EB and NB

Leg	*Del sec (am/pm)*	*LOS (am/pm)*
SB (N Fourth St)	38 / 9	E / A
EB (E Cedar Ave)	11 / 13	B / B
NB (N Fourth St)	12 / 16	B / C
WB (E Lockett Rd)	38 / 12	E / B

Double Roundabout:

2019 + 25% Growth SB and WB, 30% Growth EB and NB

North 3-Leg Roundabout

Leg	*Del sec (am/pm)*	*LOS (am/pm)*
SB (N Fourth St)	14 / 6	B / A
NB (N Fourth St)	6 / 12	A / B
WB (E Lockett Rd)	30 / 9	D / A

South 3-Leg Roundabout

Leg	*Del sec (am/pm)*	*LOS (am/pm)*
SB (N Fourth St)	16 / 7	C / A
NB (N Fourth St)	12 / 14	B / B
WB (E Lockett Rd)	14 / 21	B / C

Analysis Summary

The operational analysis shows that two NB lanes are necessary to meet operational objectives for either the 4-Leg or Double Roundabout alternatives.

The Double Roundabout layout requires a Yield RT Lane between each roundabout to address queuing between the closely spaced double roundabouts.

2. CONCEPT DESIGN SUMMARY – Primary Roundabout Layout Options Evaluated (see Fig. 3 below)

Design Layouts:

To ascertain viable layout alternatives that minimize adverse impacts to surrounding parcels we have developed several iterations for both the 4-Leg and the Double layout alternatives and these are summarized below, shown in Figure 3, and attached in the appendix B as full exhibits.

4-LEG ALTERNATIVES

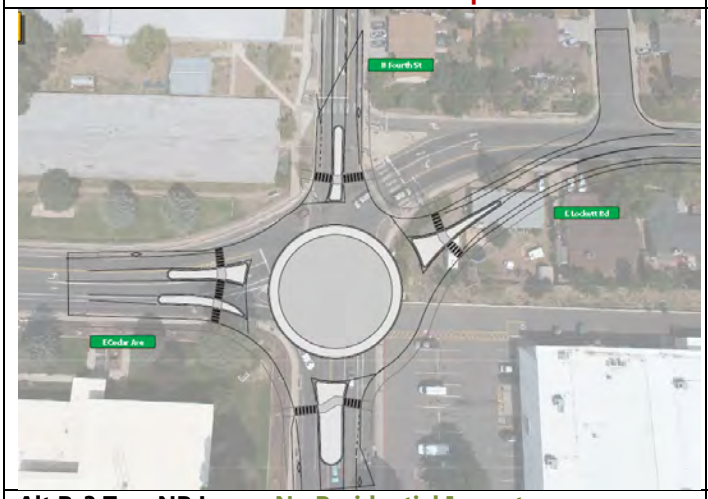
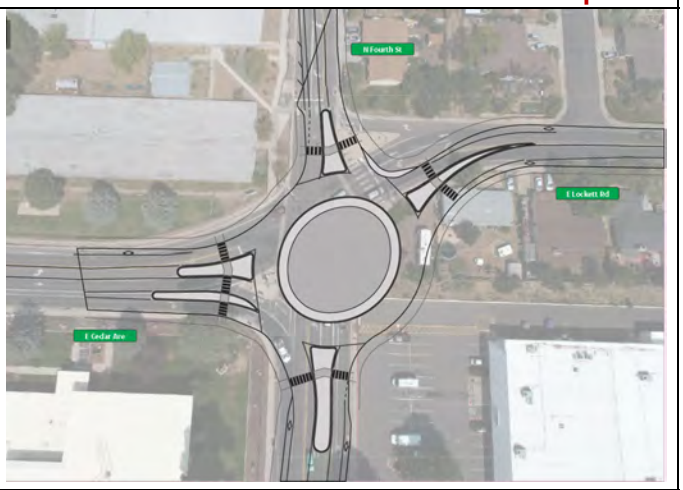
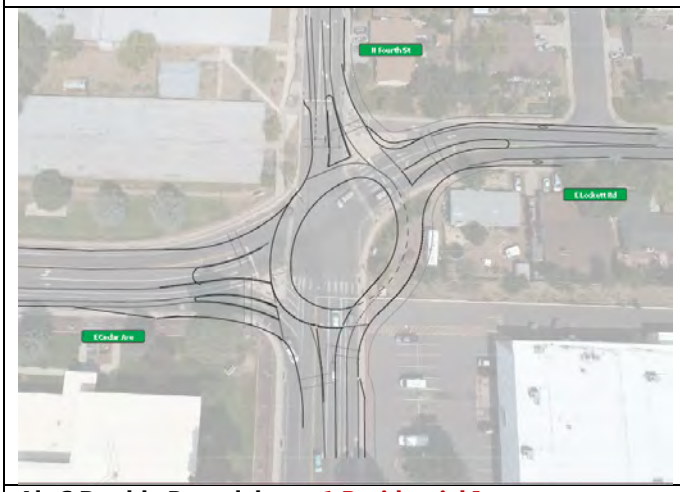
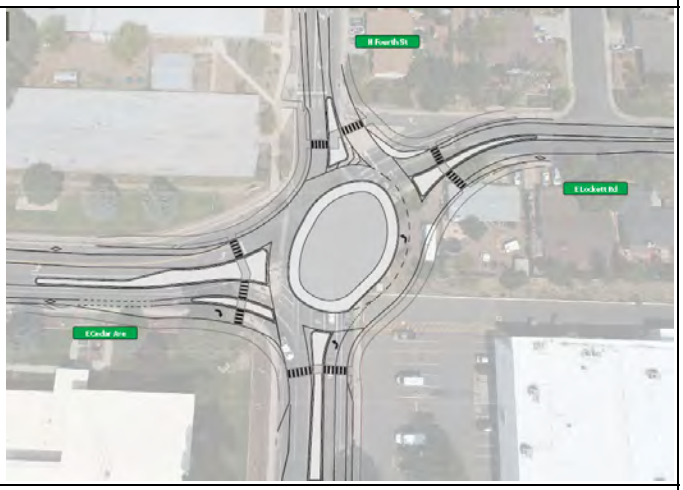
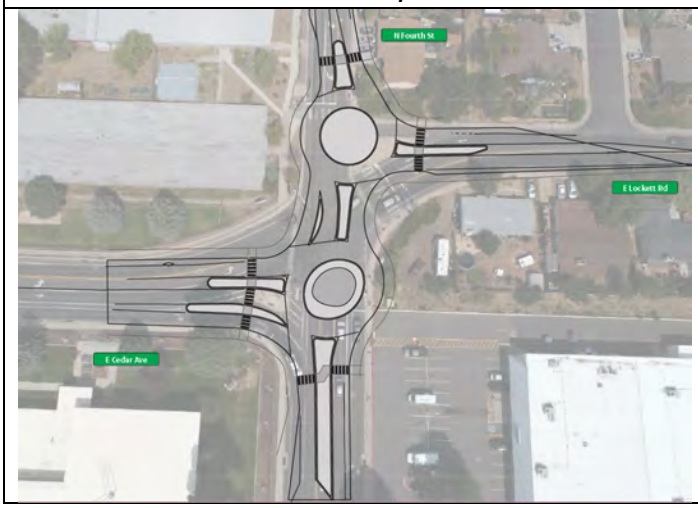
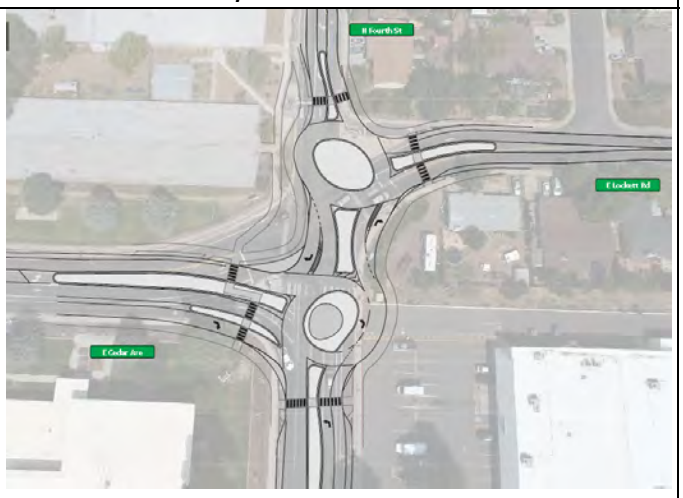
- **Alt A – 170' Circular ICD:**
  - Single-Lane Entries for all entries with Yield RT Lane (YRTL) for west leg (EB entry)
  - Description:
    - Impacts two residential properties along E. Lockett Rd.
- **Alt B – 190' x 160' Non Circular ICD:** Auxiliary NB Left Turn Lane
  - Single-Lane Entries for all entries with Yield RT Lane for west leg (EB entry).
  - Description:
    - Impacts one residential property along E. Lockett Rd.
    - Reduces impacts to the S-W quadrant
- **Alt B1 – 180' x 160' Non Circular ICD:** Auxiliary NB Yield Right Lane
  - Single-Lane Entries for all entries with Yield RT Lane for west leg (EB entry)
  - Description:
    - Alt C is similar to Alt B but it is shifted east
    - Reduces impacts to both NW and the SW quadrant
    - Impacts one residential property along E. Lockett Rd.
- **Alt B4 – 176' x 138' No Residential Structure Impacts**
  - Yield RT Lane for west leg (EB entry).
  - Two-Lane NB Entry
  - Description:
    - Alt B-1 strives to *minimize adverse impacts to residential property* along E. Lockett Rd.

DOUBLE ROUNDABOUT ALTERNATIVES

- **Alt C – Two Closely Spaced 'Compact' Roundabouts**:
  - South roundabout
    - EB entry includes a Yield Right Lane (YRTL)
    - SB entry includes a Yield Right Lane to accommodate the higher flows for that entry in this layout configuration
  - Description:
    - Impacts residential property along North Leg of N. Fourth St.
    - Reduced overall impacts
- **Alt C-4 – Two Closely Spaced 'Compact' Roundabouts**:
  - South roundabout
    - EB entry includes a Yield Right Turn Lane (YRTL)
    - SB entry includes YRTL
    - NB entry includes two entry lanes
  - North roundabout
    - Includes a fully mountable central island (aka mini-roundabout)
    - NB entry includes a Yield Right Turn Lane
  - Description:
    - Strives to *minimize adverse impacts to residential properties*
    - Reduces impacts to west side of northern roundabout

Fig. 3

Alternatives B3 and C4 both strive to avoid impacts to residential structures and are shown below.

Alt A: 170′ Circular ICD 2 Residential Impacts	Alt B: 190′ x 160′ Non-Circular ICD 1 Residential Impact
	
Alt B-3 Two NB Lanes: No Residential Impacts **178′ x 140′ Non-Circular ICD**	**Alt. B-4 Two NB Lanes: 1 Residential Impact** **178′ x 140′ Non-Circular ICD**
	
Alt C Double Roundabout: 1 Residential Impacts **South 100′ x 90′ Non-Circular ICD, North 90′ ICD**	**Alt C-4: Double Roundabout – No Residential Impacts** **South 100′ x 90′ ICD, North 100′ x 80′ ICD**
	

Additional Alternatives Developed:

Alt D

Alt D leaves N. Fourth Street as a Side Street stop-controlled condition. This configuration will require operational analysis to determine its feasibility. The ¾ access configuration at N. Fourth St. requires the minor SB Left from N. Fourth St. to make a RT and utilize the U-Turn capability at the roundabout to go east on E. Lockett Rd.

Alt E

Alt E is a variation of the previous Double roundabout layout but T's N. Fourth Street into E. Lockett. This layout creates challenges to meet safety design principles such as speed control for one or more movements. This may be mitigated with other design features such as raised pedestrian crossings. Therefore, the benefits of this layout do not appear favorable as a viable alternative. If City desires to pursue this further for feasibility, this layout will require additional design work.

Alt D	Alt E
	

Please see attached 11 x 17 exhibits for Alts A, B, C, D, E.

3. Summary

Operational Analysis

Traffic Flows: To ascertain a conservative 2019 condition we combined the highest flows for each movement from both sets of provided 2019 traffic data (Streetlight and FMPO adjusted).

The operational analysis results indicate that two NB lanes are necessary to meet operational objectives for both the Double and 4-leg layouts. Two NB lanes utilize the existing 2-lane approach lanes of the south leg Fourth St., with the NB lane #1 assigned as a LEFT ONLY lane, and lane #2 as a Thru-Right lane for both layouts.

The updated analysis with highest flows from each set of traffic also indicates that the Double Roundabout layout requires Yield Right Turn Lane for each direction of the connecting leg to ensure minimal queuing between the two roundabouts. This is a key consideration for closely spaced roundabouts. This updated analysis with highest flows from each set of data shows that initial Alternative layouts with single NB entry lane do not meet operational objectives.

Future Traffic Growth

To ascertain the potential for available traffic growth accommodation for each viable roundabout application (4 Leg and Double) we conducted sensitivity testing for each scenario. We utilized 5% traffic growth increments to understand at what growth rate the roundabouts begin to break down.

Sensitivity testing analysis shows each design layout begins to degrade for critical entries at 25% growth for the SB & WB movements and 30% growth for the EB & NB movements. It noted that once growth rates are developed (by others) based on regional modeling this future analysis can be updated to reflect differing future growth rates as deemed necessary.

Concept Designs

The existing roadway alignments, cross sections, existing constraints and operational analysis inform the design layouts we've developed. Based on the context of this application we have developed two primary layout alternatives: 4-Leg and Double Roundabout. Both of these layouts are developed for evaluation to ascertain viable alternatives that strive to minimize adverse impacts to surrounding parcels, meet operational objectives, and adhere to foundational safety principles for all modes.

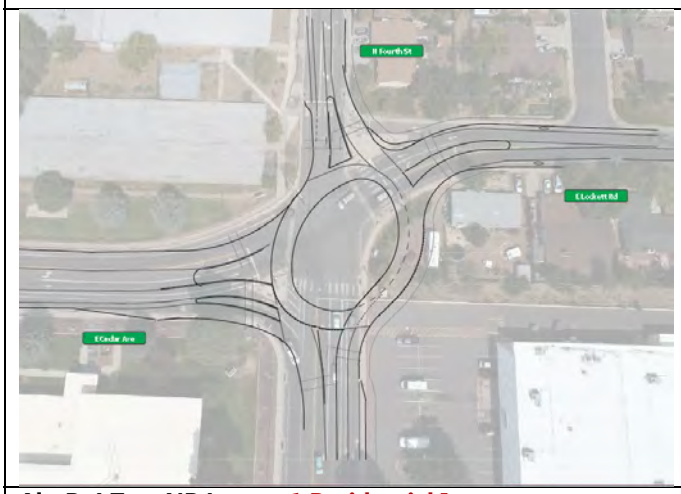
For both of the primary 4-Leg and Double layouts we developed a number of concept iterations aimed at exploring for best fit and adherence to design safety principles, including large truck accommodations. Both layouts accommodate WB-62 for all movements.

The three most viable alternatives are shown below with a brief summary of each. All Alternatives developed are included in the appendices.

Alt B-3:
The residential structure in the east quadrant is a significant design constraint for the 4-Leg layout.

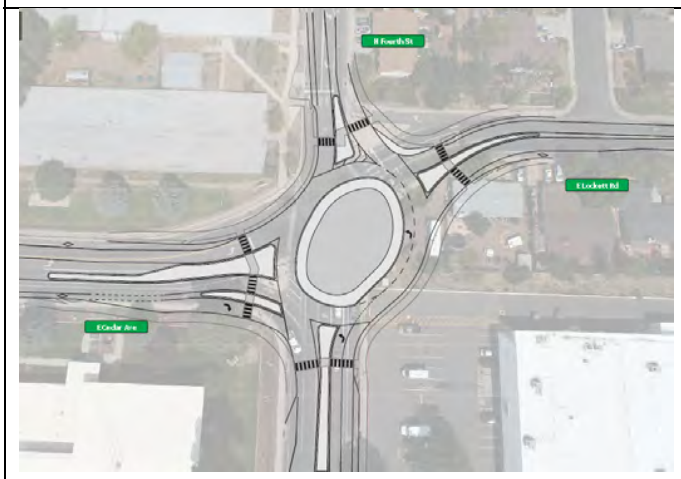
This constraint makes achieving all design principles more challenging with the geometrics of the east leg necessary to avoid the residential structure impact. In particular, the safety principle of striving to achieve as close to 90 degree angles as possible between legs and design accommodations for large trucks (WB-62) is somewhat diminished.

Alt B-3 Two NB Lanes: No Residential Impacts
178′ x 140′ Non Circular ICD



Alt. B-4 Two NB Lanes: 1 Residential Impact
178′ x 140′ Non Circular ICD

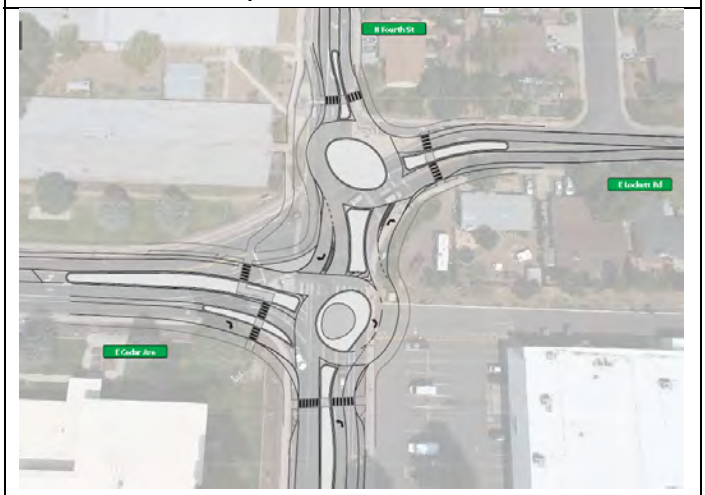
Alt B-4:
This concept is similar to B3 but realigns the east leg and impacts the residential structure in the east quadrant. By opening up this design space for the east leg the east leg alignment improves the angle between legs and improves large truck accommodations as compared to B3.



Alt C-4: Double Roundabout – No Residential Impacts
South 100′ x 90′ ICD, North 100′ x 80′ ICD

Alt C-4:
C4 builds on earlier versions of the Double Roundabout concept and has been further developed to a higher level of design refinement to understand its potential for best fit for the intersection and to avoid adverse impacts.

C4 avoids impacts to residential structures and strives to minimize other adverse impacts. The north roundabout has been shifted south and west to minimize impacts adjacent to the middle school.



Comparison:
Based on the alternatives analysis, Alts B4 and C4 are the most viable alternatives. Colorized versions of Alt B4 and C4 are shown to the right with brief summary of each describing primary differences between each. 11x17 colorized exhibits of each are attached in Appendix C.

Alt B-4:
The 4 leg roundabout and associated size and shape allows for large central island landscaping plan.

Alt. B-4: Residential Structure Impacts
178' x 140' Non Circular ICD

Alt C-4: Double Roundabout –
No Residential Structure Impacts

Alt C-4:
The closely spaced compact double roundabout layout utilizes a full mountable central island for the north roundabout to accommodate the WB 62 design vehicle, thus precluding the ability to landscape the central island.

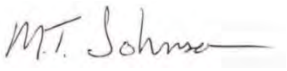
The southern compact roundabout allows for a small area of the central island to be landscaped while still accommodating the WB-62 design vehicles movements.

Alternative	*Number or Residential Impacts*	*# of veh/veh conflict points*	*# of pedestrian crossing lanes*	**Bike Accommodations*	*Speed Control*	*Central Island Landscaping*
4 Leg (B4)	1	7	10	Implements bike ramps	Higher circulating speeds	Much larger area for landscaping
Double (C4)	0	10	10	Implements bike ramps	Slower circulating speeds	Small landscaping area - south roundabout only

*Both alternatives incorporate bike ramps on approach and exits to allow cyclists the choice to exit the roadway to the 8'-10' shared-use pathway, or stay on the roadway and take a lane as a vehicle.

I look forward to discussing this analysis and the associated concept sketch level designs with the project team.

Sincerely,



Mark T. Johnson, PE (AZ)
MTJ Roundabout Engineering

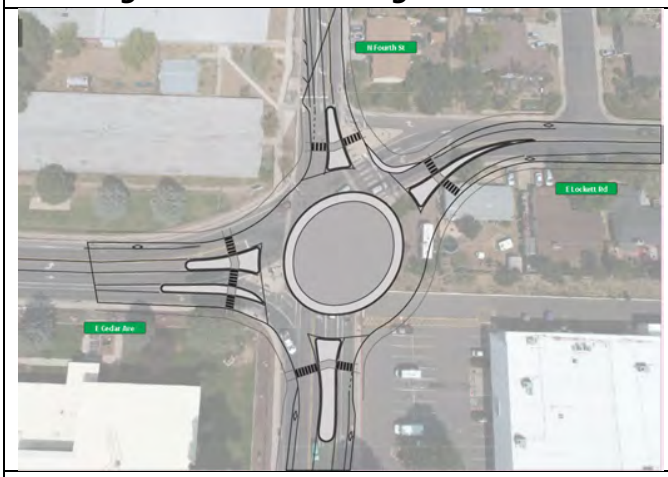
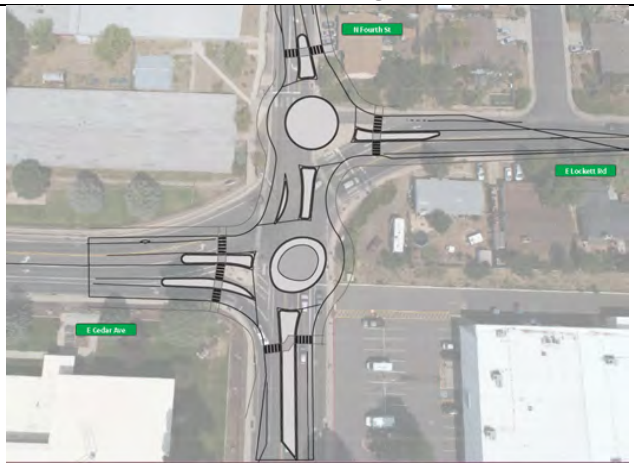
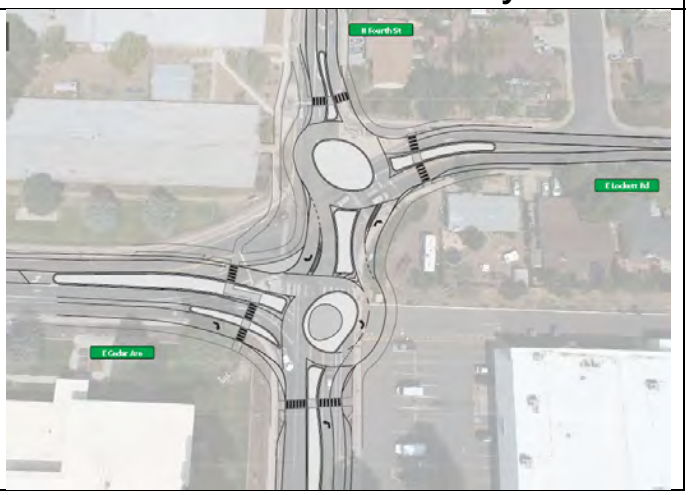
Attachments:

Appendix A: Rodel Output and overview of Rodel
Appendix B: Black & White Concept Design Exhibits Alts A-E
Appendix C: Colorized Concept Design Exhibits Alts A, B-C

APPENDIX A –

Rodel Output
& Summary of Program

A. RODEL OPERATIONAL ANALYSIS

Four Leg Roundabout – Single NB Lane	Double Roundabouts – Single NB Lane
	
Four Leg Roundabout – Two NB Entry Lanes	**Double Roundabouts – Two NB Entry Lanes**
	

Rodel Roundabout Analysis Software

Rodel provides an excellent foundation from which to understand expected operations, allowing for confidence in the design decisions with respect to acceptable delay, queuing and ultimately feasibility for an associated geometric layout.

Rodel is fully compliant with HCM methodologies and provides the following features:

- **Accurate Operational Analysis for All Types of Roundabouts**
  - ***Seamless integration of HCM model & lane-based geometric model***
  - ***Facilitates sound decision-making for Intersection Control Evaluations (ICE)***
  - ***Validated by U.S. capacity data (see p. 2)***
  - ***Facilitates selection of safe geometrics for all modes***
    - Flared entries
    - Exclusive right turn modeling
  - ***Safety/economic analysis***

- **Compliant with HCM procedures for roundabout analysis**
  - ***15-min. analysis, PHF, Right Hand Drive, standard units***
  - ***Time Dependent Queuing Theory***
  - ***High Definition Queuing Theory Equations provide accurate prediction at higher v/c ratios to avoid over-design (see p. 2)***

- **Support**
  - ***Online Tutorial Modules:*** *http://rodel-interactive.com/support/tutorials.html*
  - ***Simple-to-follow case studies*** to accelerate learning
  - ***On-site training available***

Highlighted Features of Rodel

High Definition Queuing Theory

Rodel is fully compliant with HCM methodologies and implements 'Time Dependent Queuing Theory' (developed by U.S. researcher P.M. Morse). Delay is derived from queuing theory equations, so nothing in this respect is different from HCM methodology to Rodel. However, Rodel uniquely incorporates 'High Definition' queuing theory equations vs. low definition equation. 'High definition' queuing theory equations allow for accurate and stable predictions for Queue and Delay at high v/c ratio conditions up to and exceeding 1.0. This allows for a thorough understanding of expected operations at end of traffic horizons, upon which lane and geometric decisions are typically based.

Rodel's high definition models use seven "time-dependent" equations to predict queue lengths and delays. Each equation is selected depending on whether the v/c ratio is less than or greater than 1.0, and if the queues are growing, reducing, or stable (TRL Report 909).

Gap-based methodologies utilize a "low definition" model that incorporates a single average v/c ratio in a single queuing equation. The simplified time-dependent model gives good queue and delay predictions at lower v/c ratios. But as v/c ratios exceed 0.9, equations become more pessimistic in capacity estimation and predicted queue and delay can become unstable. This often results in a call for additional laneage, which may reduce safety and/or feasibility.

Validated Accuracy

Rodel's accurate predictive capabilities have been field-verified on recent FHWA (US) capacity data. Rodel's capacity prediction output allows for a direct comparison to U.S. capacity data, providing a level of understanding and confidence not found in other analysis methods and/or programs. Rodel includes both a Lane-Based Geometric model (Kimber's) and the HCM 2010 and HCM 6 Capacity Models. Please see the paper recently published by Transportation Research Record (TRR) which validates Rodel's geometric model for U.S. conditions: *Impact of Geometric Factors-Johnson, Lin-TRR Publication*.

Sensitivity Analysis

Rodel's sensitivity testing tools include: flow factor adjustments (to allow for annual percentage increases), confidence level (CL), and capacity adjustments. These tools improve understanding of the expected operational performance based on the geometric design, to include: LOS, Delay, and Queuing.

2019: 4 Leg Roundabout - Single NB Entry Lane

2019 Single Lane Roundabout AM

Project: 4th Cedar Flagstaff AZ | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: AM | Feet | RHD
Name: Single Lane w YRTLs | Flows: 2030 | Delay: Queuing | Results: Veh / Peak60/15m | PHF Flow Profile | Conf: 50 | Light | 80

	Approach Geometry						Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	12.00	1	13.00	1	50.00	40.00	25.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
2	EB	Y	90	0	12.00	1	13.00	1	50.00	40.00	25.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
3	NB	Y	180	0	12.00	1	14.00	1	50.00	60.00	20.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
4	WB	Y	270	0	12.00	1	13.00	1	50.00	50.00	20.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)					Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor			U-Turn	Exit-3	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.00			0	30	230	109	0							0.920
2	EB	2.0	1.00			0	66	244	0	429							0.920
3	NB	2.0	1.00			0	351	252	203	0							0.920
4	WB	2.0	1.00			0	156	403	44	0							0.920

Calibration | Accidents | Economics | Bypass | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	401		982		652		0.6151		11.87		11.87	1.48		3.74		B		B
2	EB	Yield	337	466	449	449	912	867	0.3694	0.5468	5.70	8.22	7.16	0.56	1.14	1.46	2.92	A	A	A
3	NB	None	876		369		1066		0.8216		13.73		13.73	3.82		9.11		B		B
4	WB	None	655		723		805		0.8143		16.94		16.94	3.61		8.64		C		C
All	Intersection												12.30							B

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 AM Sensitivity Testing 85% CL (~10% Reduced Capacity)

Project: 4th Cedar Flagstaff AZ | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: AM | Feet | RHD
Name: Single Lane w YRTLs | Flows: 2030 | Delay: Queuing | Results: Veh / Peak60/15m | PHF Flow Profile | Conf: 85 | Light | 81

	Approach Geometry						Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	12.00	1	13.00	1	50.00	40.00	25.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
2	EB	Y	90	0	12.00	1	13.00	1	50.00	40.00	25.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
3	NB	Y	180	0	12.00	1	14.00	1	50.00	60.00	20.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
4	WB	Y	270	0	12.00	1	13.00	1	50.00	50.00	20.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)					Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor			U-Turn	Exit-3	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.00			0	30	230	109	0							0.920
2	EB	2.0	1.00			0	66	244	0	429							0.920
3	NB	2.0	1.00			0	351	252	203	0							0.920
4	WB	2.0	1.00			0	156	403	44	0							0.920

Calibration | Accidents | Economics | Bypass | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	401		930		478		0.8387		28.93		28.93	3.90		9.29		D		D
2	EB	Yield	337	466	435	435	720	671	0.4678	0.7158	8.36	15.09	12.27	0.83	2.16	2.15	5.36	A	C	B
3	NB	None	876		368		868		1.0097		43.07		43.07	14.37		29.69		E		E
4	WB	None	655		701		617		1.0621		68.86		68.86	18.22		36.84		F		F
All	Intersection												38.13							E

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 Single Lane Roundabout PM

Project: 4th Cedar Flagstaff AZ | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: PM | Feet | RHD
Name: Single Lane w YRTLs | Flows: 2030 | Delay: Queuing | Results: Veh / Peak60/15m | PHF Flow Profile | Conf: 50 | Light | 75

	Approach Geometry					Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	12.00	1	13.00	1	50.00	40.00	25.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
2	EB	Y	90	0	12.00	1	13.00	1	50.00	40.00	25.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
3	NB	Y	180	0	12.00	1	13.00	1	50.00	60.00	20.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
4	WB	Y	270	0	12.00	1	13.00	1	50.00	50.00	20.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)					Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor			U-Turn	Exit-3	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.00			0	12	105	31	0							0.900
2	EB	2.0	1.00			0	67	401	0	505							0.900
3	NB	2.0	1.00			0	390	124	216	0							0.900
4	WB	2.0	1.00			0	154	299	8	0							0.900

Calibration | Accidents | Economics | Bypass | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)		Max Q (veh)			Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	164		929		678		0.2426		6.31		6.31	0.31		0.81		A		A
2	EB	Yield	520	561	300	300	985	940	0.5278	0.6070	6.77	8.51	7.67	1.06	1.44	2.71	3.66	A	A	A
3	NB	None	811		532		911		0.8906		20.39		20.39	5.69		13.05		C		C
4	WB	None	512		638		848		0.6040		8.99		8.99	1.42		3.60		A		A
All	Intersection												11.86							B

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 PM 85% CL (~10% Reduced Capacity)

Project: 4th Cedar Flagstaff AZ | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: PM | Feet | RHD
Name: Single Lane w YRTLs | Flows: 2030 | Delay: Queuing | Results: Veh / Peak60/15m | PHF Flow Profile | Conf: 85 | Light | 83

	Approach Geometry					Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	12.00	1	13.00	1	50.00	40.00	25.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
2	EB	Y	90	0	12.00	1	13.00	1	50.00	40.00	25.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
3	NB	Y	180	0	12.00	1	14.00	1	50.00	60.00	20.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
4	WB	Y	270	0	12.00	1	13.00	1	50.00	50.00	20.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)					Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor			U-Turn	Exit-3	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.00			0	12	105	31	0							0.900
2	EB	2.0	1.00			0	67	401	0	505							0.900
3	NB	2.0	1.00			0	390	124	216	0							0.900
4	WB	2.0	1.00			0	154	299	8	0							0.900

Calibration | Accidents | Economics | Bypass | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)		Max Q (veh)			Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	164		906		490		0.3356		9.71		9.71	0.49		1.27		A		A
2	EB	Yield	520	561	299	299	787	738	0.6608	0.7846	11.09	16.50	13.90	1.78	2.93	4.46	7.14	B	C	B
3	NB	None	811		531		782		1.0370		49.79		49.79	16.58		33.79		E		E
4	WB	None	512		612		662		0.7736		17.42		17.42	2.91		7.09		C		C
All	Intersection												25.66							D

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

Notes: Critical Hr is AM, NB LOS E, WB LOS F, SB LOS D as single lanes, to provide more capacity an aux. NB LT lane can be added, LEFT ONLY, THRU-RIGHT.

2019: 4 Leg Roundabout – Two NB Entry Lanes

2019 AM

Project: 4th Cedar Flagstaff AZ | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: AM | Feet | RHD
Name: Single Lane w YRTLs | Flows: 2030 | Delay: Queuing | Results: Veh / Peak60/15m | PHF Flow Profile | Conf: 50 | Light | 87

	Approach Geometry					Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	12.00	1	13.00	1	50.00	40.00	25.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
2	EB	Y	90	0	12.00	1	13.00	1	50.00	40.00	25.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
3	NB	Y	180	0	22.00	2	22.00	2	50.00	60.00	20.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
4	WB	Y	270	0	12.00	1	13.00	1	50.00	50.00	20.00	170.00	30.00	2	14.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)					Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor			U-Turn	Exit-3	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.00			0	30	230	109	0							0.920
2	EB	2.0	1.00			0	66	244	0	429							0.920
3	NB	2.0	1.00			0	351	252	203	0							0.920
4	WB	2.0	1.00			0	156	403	44	0							0.920

Calibration | Accidents | Economics | Bypass | 1 message | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	401		986		650		0.6170		11.96		11.96	1.48		3.75		B		B
2	EB	Yield	337	466	450	450	912	867	0.3695	0.5470	5.70	8.23	7.17	0.56	1.14	1.46	2.92	A	A	A
3	NB	None	876		369		1661		0.5275		7.18		7.18	1.87		4.67		A		A
4	WB	None	655		726		906		0.7234		11.52		11.52	2.33		5.77		B		B
All	Intersection												8.92							A

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 AM 85% CL (~10% Reduced Capacity)

Project: 4th Cedar Flagstaff AZ | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: AM | Feet | RHD
Name: Single Lane w YRTLs | Flows: 2030 | Delay: Queuing | Results: Veh / Peak60/15m | PHF Flow Profile | Conf: 85 | Light | 86

	Approach Geometry					Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	12.00	1	13.00	1	50.00	40.00	25.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
2	EB	Y	90	0	12.00	1	13.00	1	50.00	40.00	25.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
3	NB	Y	180	0	22.00	2	22.00	2	50.00	60.00	20.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
4	WB	Y	270	0	12.00	1	13.00	1	50.00	50.00	20.00	170.00	30.00	2	14.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)					Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor			U-Turn	Exit-3	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.00			0	30	230	109	0							0.920
2	EB	2.0	1.00			0	66	244	0	429							0.920
3	NB	2.0	1.00			0	351	252	203	0							0.920
4	WB	2.0	1.00			0	156	403	44	0							0.920

Calibration | Accidents | Economics | Bypass | 1 message | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	401		975		457		0.8785		33.59		33.59	4.77		11.14		D		D
2	EB	Yield	337	466	441	441	717	669	0.4696	0.7189	8.41	15.22	12.36	0.84	2.19	2.17	5.44	A	C	B
3	NB	None	876		368		1463		0.5989		9.34		9.34	2.46		6.06		A		A
4	WB	None	655		725		707		0.9266		30.47		30.47	6.97		15.64		D		D
All	Intersection												18.85							C

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 PM

Project: 4th Cedar Flagstaff AZ | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: PM | Feet | RHD
Name: Single Lane w YRTLs | Flows: 2030 | Delay: Queuing | Results: Veh / Peak60/15m | PHF Flow Profile | Conf: 50 | Light | 85

	Approach Geometry					Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	12.00	1	13.00	1	50.00	40.00	25.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
2	EB	Y	90	0	12.00	1	13.00	1	50.00	40.00	25.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
3	NB	Y	180	0	22.00	2	22.00	2	50.00	60.00	20.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
4	WB	Y	270	0	12.00	1	13.00	1	50.00	50.00	20.00	170.00	30.00	2	14.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)					Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor			U-Turn	Exit-3	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.00			0	12	105	31	0							0.900
2	EB	2.0	1.00			0	67	401	0	505							0.900
3	NB	2.0	1.00			0	390	124	216	0							0.900
4	WB	2.0	1.00			0	154	299	8	0							0.900

Calibration | Accidents | Economics | Bypass | 2 messages | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	164		932		477		0.3445		10.02		10.02	0.50		1.31		B		B
2	EB	Yield	520	561	300	300	787	738	0.6611	0.7850	11.10	16.53	13.92	1.78	2.94	4.46	7.15	B	C	B
3	NB	None	811		531		1307		0.6205		11.23		11.23	2.82		6.88		B		B
4	WB	None	512		643		737		0.6947		12.72		12.72	2.04		5.09		B		B
All	Intersection												12.58							B

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 PM 85% CL (~10% Reduced Capacity)

Project: 4th Cedar Flagstaff AZ | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: PM | Feet | RHD
Name: Single Lane w YRTLs | Flows: 2030 | Delay: Queuing | Results: Veh / Peak60/15m | PHF Flow Profile | Conf: 85 | Light | 85

	Approach Geometry					Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	12.00	1	13.00	1	50.00	40.00	25.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
2	EB	Y	90	0	12.00	1	13.00	1	50.00	40.00	25.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
3	NB	Y	180	0	22.00	2	22.00	2	50.00	60.00	20.00	170.00	20.00	1	14.00	1	12.00	1	0	1.000
4	WB	Y	270	0	12.00	1	13.00	1	50.00	50.00	20.00	170.00	30.00	2	14.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)					Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor			U-Turn	Exit-3	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.00			0	12	105	31	0							0.900
2	EB	2.0	1.00			0	67	401	0	505							0.900
3	NB	2.0	1.00			0	390	124	216	0							0.900
4	WB	2.0	1.00			0	154	299	8	0							0.900

Calibration | Accidents | Economics | Bypass | 2 messages | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	164		932		477		0.3445		10.02		10.02	0.50		1.31		B		B
2	EB	Yield	520	561	300	300	787	738	0.6611	0.7850	11.10	16.53	13.92	1.78	2.94	4.46	7.15	B	C	B
3	NB	None	811		531		1307		0.6205		11.23		11.23	2.82		6.88		B		B
4	WB	None	512		643		737		0.6947		12.72		12.72	2.04		5.09		B		B
All	Intersection												12.58							B

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 Double Roundabout with Single NB Entry Lane

North Roundabout AM

2019 AM

Project: Project-1 | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: AM | Feet | RHD
Name: Double - North mdbt Alt C | Flows: 2030 | Delay: Queuing | Results: Veh | Peak60/15m | PHF Flow Profile | Conf: 50 | Light | 37

	Approach Geometry					Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	11.00	1	13.00	1	33.00	45.00	25.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000
2	NB	Y	180	0	11.00	1	13.00	1	33.00	45.00	25.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000
3	WB	Y	270	0	11.00	1	13.00	1	33.00	45.00	25.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)				Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor				U-Turn	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.00				0	30	339	0							0.900
2	NB	2.0	1.00				0	318	407	0							0.900
3	WB	2.0	1.00				0	559	44	0							0.900

Calibration | Accidents | Economics | Bypass | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	410		618		786		0.5214		8.24		8.24	1.03		2.64		A		A
2	NB	None	806		33		1101		0.7317		9.79		9.79	2.44		6.01		A		A
3	WB	None	670		352		929		0.7208		11.02		11.02	2.31		5.71		B		B
All	Intersection												9.89							A

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 AM 85% CL

Project: Project-1 | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: AM | Feet | RHD
Name: Double - North mdbt Alt C | Flows: 2030 | Delay: Queuing | Results: Veh | Peak60/15m | PHF Flow Profile | Conf: 85 | Light | 36

	Approach Geometry					Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	11.00	1	13.00	1	33.00	45.00	25.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000
2	NB	Y	180	0	11.00	1	13.00	1	33.00	45.00	25.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000
3	WB	Y	270	0	11.00	1	13.00	1	33.00	45.00	25.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)				Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor				U-Turn	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.00				0	30	339	0							0.900
2	NB	2.0	1.00				0	318	407	0							0.900
3	WB	2.0	1.00				0	559	44	0							0.900

Calibration | Accidents | Economics | Bypass | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	410		608		593		0.6915		15.29		15.29	2.01		5.00		C		C
2	NB	None	806		33		902		0.8931		21.36		21.36	5.79		13.26		C		C
3	WB	None	670		348		732		0.9148		27.37		27.37	6.46		14.62		D		D
All	Intersection												22.18							C

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

Notes: AM Peak WB entry shows some sensitivity.

North Roundabout PM

2019 PM

Project: Project-1 | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: PM | Feet | RHD
Name: Double - North rndbt Alt C | Flows: 2030 | Delay: Queuing | Results: Veh / Peak60/15m | PHF Flow Profile | Conf: 50 | Light | 34

	Approach Geometry					Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	11.00	1	13.00	1	33.00	45.00	25.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000
2	NB	Y	180	0	11.00	1	13.00	1	33.00	45.00	25.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000
3	WB	Y	270	0	11.00	1	13.00	1	33.00	45.00	25.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)				Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor				U-Turn	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	5.0	1.00				0	12	136	0							0.900
2	NB	5.0	1.00				0	204	614	0							0.900
3	WB	5.0	1.00				0	453	8	0							0.900

Calibration | Accidents | Economics | Bypass | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	164		503		793		0.2074		5.06		5.06	0.24		0.64		A		A
2	NB	None	909		13		1049		0.8666		14.59		14.59	4.29		10.12		B		B
3	WB	None	512		226		938		0.5462		6.95		6.95	1.07		2.73		A		A
All	Intersection												11.13							B

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 PM 85% CL

Project: Project-1 | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: PM | Feet | RHD
Name: Double - North rndbt Alt C | Flows: 2030 | Delay: Queuing | Results: Veh / Peak60/15m | PHF Flow Profile | Conf: 85 | Light | 32

	Approach Geometry					Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	11.00	1	13.00	1	33.00	45.00	25.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000
2	NB	Y	180	0	11.00	1	13.00	1	33.00	45.00	25.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000
3	WB	Y	270	0	11.00	1	13.00	1	33.00	45.00	25.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)				Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor				U-Turn	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	5.0	1.00				0	12	136	0							0.900
2	NB	5.0	1.00				0	204	614	0							0.900
3	WB	5.0	1.00				0	453	8	0							0.900

Calibration | Accidents | Economics | Bypass | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	164		502		606		0.2715		7.09		7.09	0.35		0.90		A		A
2	NB	None	909		13		861		1.0556		46.43		46.43	16.52		33.68		F		F
3	WB	None	512		215		756		0.6777		11.21		11.21	1.76		4.41		B		B
All	Intersection												30.97							D

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

Notes: Pm peak NB entry is critical entry. This connection leg to south roundabout has Q storage available of ~3 veh. Analysis shows more capacity necessary for this entry to reduce Queueing.

South Roundabout AM

2019 AM

Project: Project-1 | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: AM | Feet | RHD
Name: Double - South Rndbt Alt C | Flows: 2030 | Delay: Queuing | Results: Veh / Peak60/15m | PHF Flow Profile | Conf: 50 | Light | 33

	Approach Geometry						Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	11.00	1	13.00	1	33.00	50.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000
2	EB	Y	90	0	11.00	1	13.00	1	33.00	45.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000
3	NB	Y	180	0	11.00	1	13.00	1	33.00	45.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)				Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor				U-Turn	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.00				0	386	0	512							0.900
2	EB	2.0	1.00				0	310	0	429							0.900
3	NB	2.0	1.00				0	351	455	0							0.900

Calibration | Accidents | Economics | Bypass | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)		Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	Yield	429	569	381	381	921	957	0.4657	0.6042	6.47	8.28	7.50	0.83	1.44	2.15	3.64	A	A	A
2	EB	Yield	344	477	428	428	890	858	0.3872	0.5653	5.92	8.49	7.42	0.61	1.22	1.57	3.12	A	A	A
3	NB	None	896		344		935		0.9582		28.56		28.56	9.38		20.33		D		D
All	Intersection												14.42							B

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 AM 85% CL

Project: Project-1 | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: AM | Feet | RHD
Name: Double - South Rndbt Alt C | Flows: 2030 | Delay: Queuing | Results: Veh / Peak60/15m | PHF Flow Profile | Conf: 85 | Light | 32

	Approach Geometry						Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	11.00	1	13.00	1	33.00	50.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000
2	EB	Y	90	0	11.00	1	13.00	1	33.00	45.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000
3	NB	Y	180	0	11.00	1	13.00	1	33.00	45.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)				Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor				U-Turn	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.00				0	386	0	512							0.900
2	EB	2.0	1.00				0	310	0	429							0.900
3	NB	2.0	1.00				0	351	455	0							0.900

Calibration | Accidents | Economics | Bypass | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)		Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	Yield	429	569	320	320	649	707	0.6610	0.8372	13.54	20.45	17.48	1.76	3.68	4.43	8.80	B	C	C
2	EB	Yield	344	477	427	427	691	655	0.4984	0.7506	9.01	16.51	13.37	0.94	2.49	2.41	6.13	A	C	B
3	NB	None	896		343		736		1.2170		144.95		144.95	54.53		106.37		F		F
All	Intersection												58.29							F

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

South Roundabout PM

2019 PM

Project: Project-1 | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: PM | Feet | RHD
Name: Double - South Rndbt Alt C | Flows: 2030 | Delay: Queuing | Results: Veh / Peak60/15m | PHF Flow Profile | Conf: 50 | Light | 35

	Approach Geometry					Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	11.00	1	13.00	1	33.00	50.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000
2	EB	Y	90	0	11.00	1	13.00	1	33.00	45.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000
3	NB	Y	180	0	11.00	1	13.00	1	33.00	45.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)				Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor				U-Turn	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	5.0	1.00				0	259	0	330							0.900
2	EB	5.0	1.00				0	468	0	505							0.900
3	NB	5.0	1.00				0	390	347	0							0.900

Calibration | Accidents | Economics | Bypass | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	Yield	288	367	412	412	848	907	0.3395	0.4094	5.58	6.18	5.91	0.47	0.67	1.24	1.74	A	A	A
2	EB	Yield	520	561	287	287	906	902	0.5738	0.6337	7.55	9.37	8.49	1.18	1.60	3.02	4.03	A	A	A
3	NB	None	819		519		786		1.0420		42.34		42.34	13.81		28.64		E		E
All	Intersection												18.68							C

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 PM 85% CL

Project: Project-1 | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: PM | Feet | RHD
Name: Double - South Rndbt Alt C | Flows: 2030 | Delay: Queuing | Results: Veh / Peak60/15m | PHF Flow Profile | Conf: 85 | Light | 36

	Approach Geometry					Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	11.00	1	13.00	1	33.00	50.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000
2	EB	Y	90	0	11.00	1	13.00	1	33.00	45.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000
3	NB	Y	180	0	11.00	1	13.00	1	33.00	45.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)				Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor				U-Turn	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	5.0	1.00				0	259	0	330							0.900
2	EB	5.0	1.00				0	468	0	505							0.900
3	NB	5.0	1.00				0	390	347	0							0.900

Calibration | Accidents | Economics | Bypass | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	Yield	288	367	317	317	709	763	0.4057	0.4894	7.38	8.43	7.97	0.62	0.91	1.61	2.34	A	A	A
2	EB	Yield	520	561	287	287	700	687	0.7432	0.8503	14.06	21.45	17.89	2.29	3.91	5.67	9.30	B	C	C
3	NB	None	819		517		599		1.3666		226.54		226.54	75.44		147.10		F		F
All	Intersection												82.24							F

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

Notes: Critical analysis and Entry is the NB morning am peak... To provide more capacity an aux. LT lane can be added, LEFT ONLY, THRU-RIGHT. See Alt C1

2019 Double Roundabout with Two NB Entry Lanes

South Roundabout

2019 AM

Project: Project-1 | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: AM | Feet | RHD
Name: Double - South rndbt | Flows: 2030 | Delay: Queuing | Results: Veh / Peak60/15m | PHF Flow Profile | Conf: 50 | Light | 31

	Approach Geometry						Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	11.00	1	13.00	1	33.00	50.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000
2	EB	Y	90	0	11.00	1	13.00	1	33.00	45.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000
3	NB	Y	180	0	22.00	2	22.00	2	33.00	45.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)				Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor				U-Turn	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.00				0	386	0	512							0.900
2	EB	2.0	1.00				0	310	0	429							0.900
3	NB	2.0	1.00				0	351	455	0							0.900

Calibration | Accidents | Economics | Bypass | 2 messages | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	Yield	429	569	389	389	917	953	0.4679	0.6071	6.52	8.38	7.58	0.84	1.45	2.16	3.67	A	A	A
2	EB	Yield	344	477	428	428	889	858	0.3873	0.5654	5.93	8.50	7.42	0.61	1.22	1.57	3.12	A	A	A
3	NB	None	896		344		1597		0.5609		7.84		7.84	2.12		5.27		A		A
All	Intersection												7.62							A

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 AM 85% CL

Project: Project-1 | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: AM | Feet | RHD
Name: Double - South rndbt | Flows: 2030 | Delay: Queuing | Results: Veh / Peak60/15m | PHF Flow Profile | Conf: 85 | Light | 30

	Approach Geometry						Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	11.00	1	13.00	1	33.00	50.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000
2	EB	Y	90	0	11.00	1	13.00	1	33.00	45.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000
3	NB	Y	180	0	22.00	2	22.00	2	33.00	45.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)				Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor				U-Turn	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.00				0	386	0	512							0.900
2	EB	2.0	1.00				0	310	0	429							0.900
3	NB	2.0	1.00				0	351	455	0							0.900

Calibration | Accidents | Economics | Bypass | 2 messages | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	Yield	429	569	388	388	614	670	0.6987	0.8874	15.27	24.61	20.60	2.06	4.67	5.13	10.93	C	C	C
2	EB	Yield	344	477	426	426	692	656	0.4980	0.7500	9.00	16.47	13.33	0.94	2.49	2.41	6.12	A	C	B
3	NB	None	896		343		1399		0.6403		10.51		10.51	2.89		7.05		B		B
All	Intersection												15.07							C

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

South Roundabout

2019 PM

Project: Project-1 | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: PM | Feet | RHD
Name: Double - South rndbt | Flows: 2030 | Delay: Queuing | Results: Veh | Peak60/15m | PHF Flow Profile | Conf: 50 | Light | 28

	Approach Geometry						Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	11.00	1	13.00	1	33.00	50.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000
2	EB	Y	90	0	11.00	1	13.00	1	33.00	45.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000
3	NB	Y	180	0	22.00	2	22.00	2	33.00	45.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)				Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor				U-Turn	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	5.0	1.00				0	259	0	330							0.900
2	EB	5.0	1.00				0	468	0	505							0.900
3	NB	5.0	1.00				0	390	347	0							0.900

Calibration | Accidents | Economics | Bypass | 3 messages | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	Yield	288	367	432	432	837	896	0.3438	0.4145	5.67	6.28	6.01	0.48	0.68	1.26	1.77	A	A	A
2	EB	Yield	520	561	287	287	906	902	0.5738	0.6337	7.55	9.37	8.49	1.18	1.60	3.02	4.03	A	A	A
3	NB	None	819		519		1326		0.6176		10.41		10.41	2.62		6.43		B		B
All	Intersection												8.47							A

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 PM 85% CL

Project: Project-1 | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: PM | Feet | RHD
Name: Double - South rndbt | Flows: 2030 | Delay: Queuing | Results: Veh | Peak60/15m | PHF Flow Profile | Conf: 85 | Light | 29

	Approach Geometry						Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	11.00	1	13.00	1	33.00	50.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000
2	EB	Y	90	0	11.00	1	13.00	1	33.00	45.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000
3	NB	Y	180	0	22.00	2	22.00	2	33.00	45.00	25.00	100.00	16.00	1	13.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)				Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor				U-Turn	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	5.0	1.00				0	259	0	330							0.900
2	EB	5.0	1.00				0	468	0	505							0.900
3	NB	5.0	1.00				0	390	347	0							0.900

Calibration | Accidents | Economics | Bypass | 3 messages | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)			Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	Yield	288	367	430	430	650	700	0.4427	0.5343	8.32	9.70	9.09	0.72	1.08	1.86	2.76	A	A	A
2	EB	Yield	520	561	287	287	700	687	0.7430	0.8501	14.05	21.42	17.88	2.29	3.91	5.67	9.30	B	C	C
3	NB	None	819		517		1140		0.7183		14.94		14.94	3.88		9.23		B		B
All	Intersection												14.68							B

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

North Roundabout

2019 AM

Project: Project-1 | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: AM | Feet | RHD
Name: Double - North rndbt | Flows: 2030 | Delay: Queuing | Results: Veh / Peak60/15m | PHF Flow Profile | Conf: 50 | Light | 27

	Approach Geometry					Entry Geometry					Circ Geom			Exit Geometry			Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	11.00	1	13.00	1	33.00	45.00	25.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000
2	NB	Y	180	0	11.00	1	13.00	1	33.00	45.00	25.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000
3	WB	Y	270	0	11.00	1	13.00	1	33.00	45.00	25.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)				Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor				U-Turn	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.00				0	30	339	0							0.900
2	NB	2.0	1.00				0	318	1	407							0.900
3	WB	2.0	1.00				0	559	44	0							0.900

Calibration | Accidents | Economics | Bypass | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)		Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	410		620		786		0.5219		8.26		8.26	1.03		2.64		A		A
2	NB	Yield	354	452	33	34	1101	1069	0.3220	0.4279	4.42	5.45	5.00	0.46	0.73	1.20	1.88	A	A	A
3	WB	None	670		353		929		0.7213		11.04		11.04	2.31		5.72		B		B
All	Intersection												7.85							A

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | Economics | Global Results

2019 AM 85% CL

Project: Project-1 | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: AM | Feet | RHD
Name: Double - North rndbt | Flows: 2030 | Delay: Queuing | Results: Veh / Peak60/15m | PHF Flow Profile | Conf: 85 | Light | 29

	Approach Geometry					Entry Geometry					Circ Geom			Exit Geometry			Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	11.00	1	13.00	1	33.00	45.00	25.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000
2	NB	Y	180	0	11.00	1	13.00	1	33.00	45.00	25.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000
3	WB	Y	270	0	11.00	1	13.00	1	33.00	45.00	20.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)				Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor				U-Turn	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	2.0	1.00				0	30	339	0							0.900
2	NB	2.0	1.00				0	318	1	407							0.900
3	WB	2.0	1.00				0	559	44	0							0.900

Calibration | Accidents | Economics | Bypass | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)		Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	410		610		592		0.6926		15.35		15.35	2.02		5.03		C		C
2	NB	Yield	354	452	33	34	902	866	0.3929	0.5307	5.95	7.97	7.08	0.62	1.07	1.61	2.75	A	A	A
3	WB	None	670		353		746		0.8978		24.98		24.98	5.78		13.24		C		C
All	Intersection												15.24							C

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | Economics | Global Results

North Roundabout

2019 PM

Project: Project-1 | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: PM | Feet | RHD
Name: Double - North rndbt | Flows: 2030 | Delay: Queuing | Results: Veh | Peak60/15m | PHF Flow Profile | Conf: 50 | Light | 32

	Approach Geometry						Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	11.00	1	13.00	1	33.00	45.00	25.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000
2	NB	Y	180	0	11.00	1	13.00	1	33.00	45.00	25.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000
3	WB	Y	270	0	11.00	1	13.00	1	33.00	45.00	20.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)				Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor				U-Turn	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	5.0	1.00				0	12	136	0							0.900
2	NB	5.0	1.00				0	204	0	614							0.900
3	WB	5.0	1.00				0	453	8	0							0.900

Calibration | Accidents | Economics | Bypass | Run

	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)		Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	164		503		793		0.2074		5.06		5.06	0.24		0.64		A		A
2	NB	Yield	227	682	13	13	1049	1049	0.2161	0.6617	3.92	8.74	7.54	0.26	1.81	0.68	4.53	A	A	A
3	WB	None	512		227		954		0.5371		6.73		6.73	1.03		2.64		A		A
All	Intersection												7.02							A

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

2019 PM 85% CL

Project: Project-1 | Date: 27-Nov-2020 | Model: Rodel 2017 | Timeslice: 15 | Full Geometry | Peak: PM | Feet | RHD
Name: Double - North rndbt | Flows: 2030 | Delay: Queuing | Results: Veh | Peak60/15m | PHF Flow Profile | Conf: 85 | Light | 31

	Approach Geometry						Entry Geometry					Circ Geom			Exit Geometry				Entry Capacity Mods	
	Leg Name	•	Bearing	G	V	n	E	n	L'	R	Φ	D	C	n	Ex	n	Vx	n	-+ Cap (v/h)	Xwalk Fact
1	SB	Y	0	0	11.00	1	13.00	1	33.00	45.00	25.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000
2	NB	Y	180	0	11.00	1	13.00	1	33.00	45.00	25.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000
3	WB	Y	270	0	11.00	1	13.00	1	33.00	45.00	20.00	90.00	16.00	1	13.00	1	12.00	1	0	1.000

	Volume Modifiers			Turning Volumes (veh/hr)				Arrival Volume Ratios			Arrival Volume Times (min)			PHF
	Leg Name	%Truck	Factor				U-Turn	Exit-2	Exit-1	Bypass	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	
1	SB	5.0	1.00				0	12	136	0							0.900
2	NB	5.0	1.00				0	204	0	614							0.900
3	WB	5.0	1.00				0	453	8	0							0.900

Calibration | Accidents | Economics | Bypass | Run

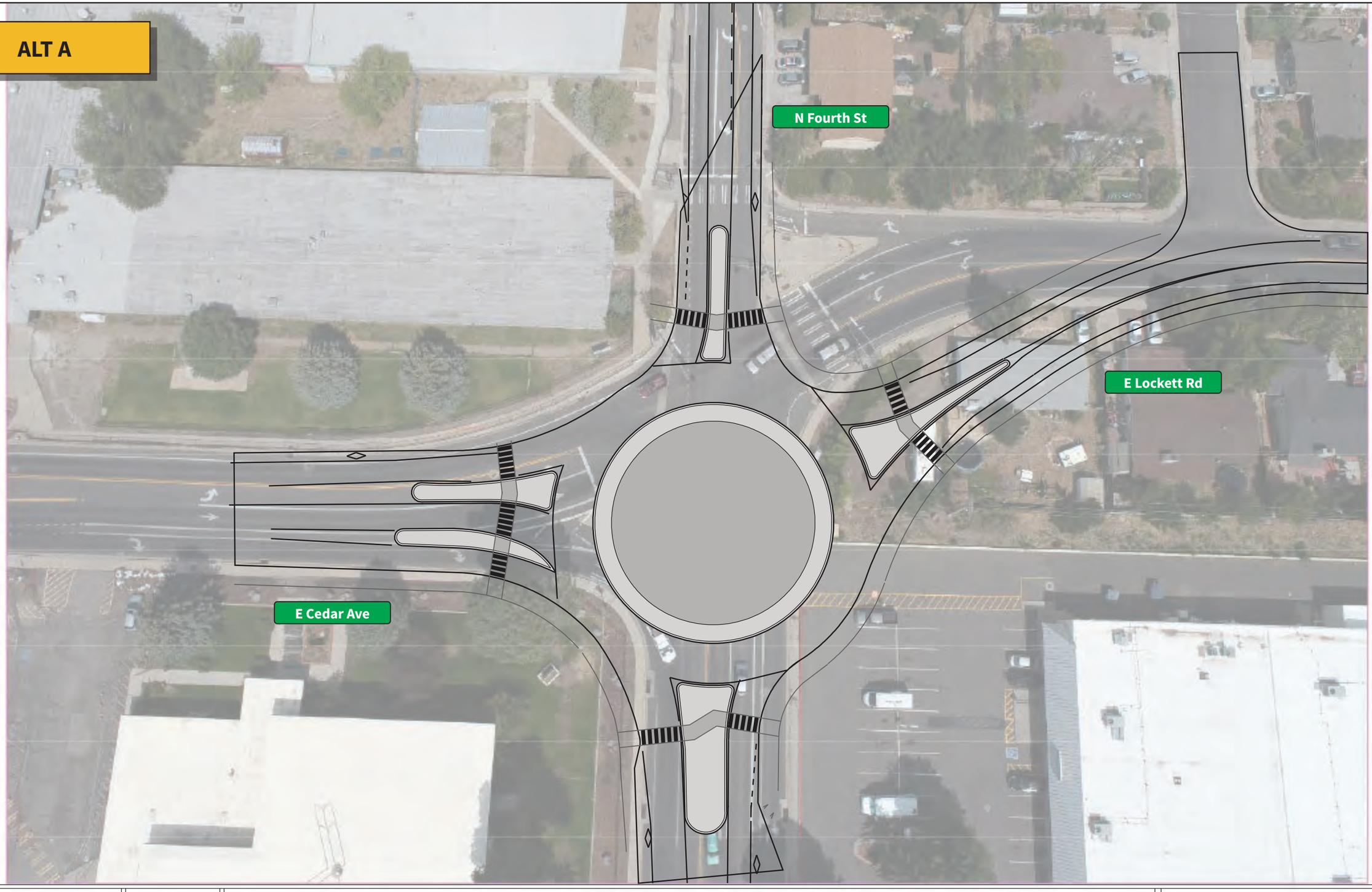
	Peak 15min Results	Bypass Type	Flow Rate (veh/hr)		Opp Rate (veh/hr)		Capacity (veh/hr)		Ave VCR		Ave Del (sec/veh)		Max Q (veh)		Max Q95% (veh)		LOS A-F		
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Entry	Byp	Leg
1	SB	None	164		502		606		0.2716		7.09		7.09	0.35		0.90		A		A
2	NB	Yield	227	682	13	13	848	848	0.2672	0.8317	5.13	17.22	14.20	0.34	3.73	0.89	8.91	A	C	B
3	WB	None	512		227		766		0.6687		10.80		10.80	1.69		4.26		B		B
All	Intersection												12.37							B

Results 60 | Results 15 | Int / Slope - 60 | Int / Slope - 15 | $ Economics | Global Results

APPENDIX B

11x17 Concept Design Layouts:
Alts A-E (Grey Scale)

ALT A



N Fourth St. @
E Cedar Ave. & E Lockett Rd.
Flagstaff, AZ

12.01.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT A: WITH AERIAL

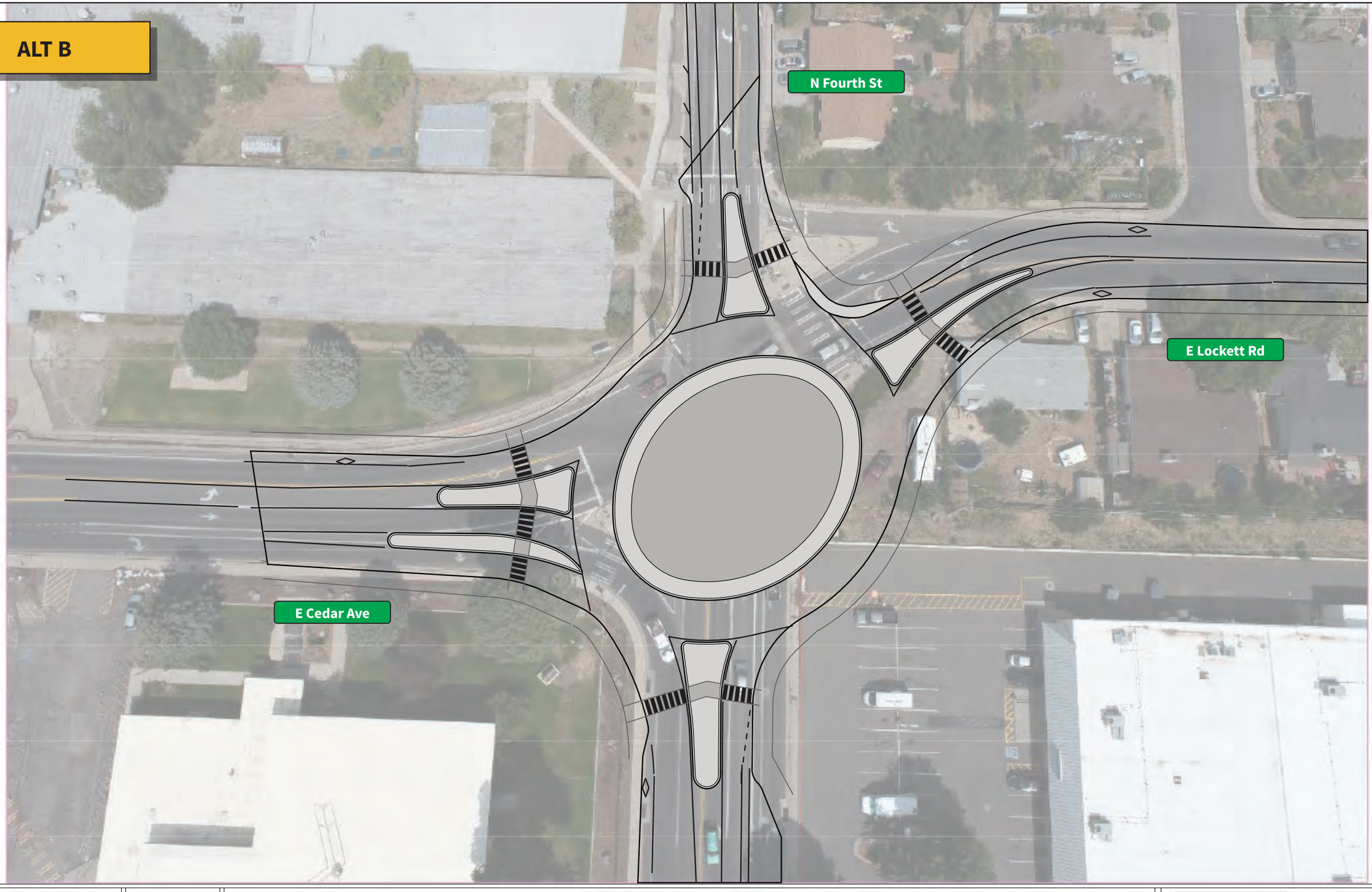
MTJ ROUNDABOUT engineering

313 Price Place, Suite #11
Madison, WI 53705

608.238.5000
info@mtjengineering.com

www.mtjengineering.com

ALT B



N Fourth St. @
E Cedar Ave. & E Lockett Rd.
Flagstaff, AZ

12.01.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT B: WITH AERIAL

MTJ ROUNDABOUT engineering

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ALT B1

N Fourth St. @
E Cedar Ave. & E Lockett Rd.
Flagstaff, AZ

12.01.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT B1: WITH AERIAL

MTJ ROUNDABOUT engineering

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info@mtjengineering.com

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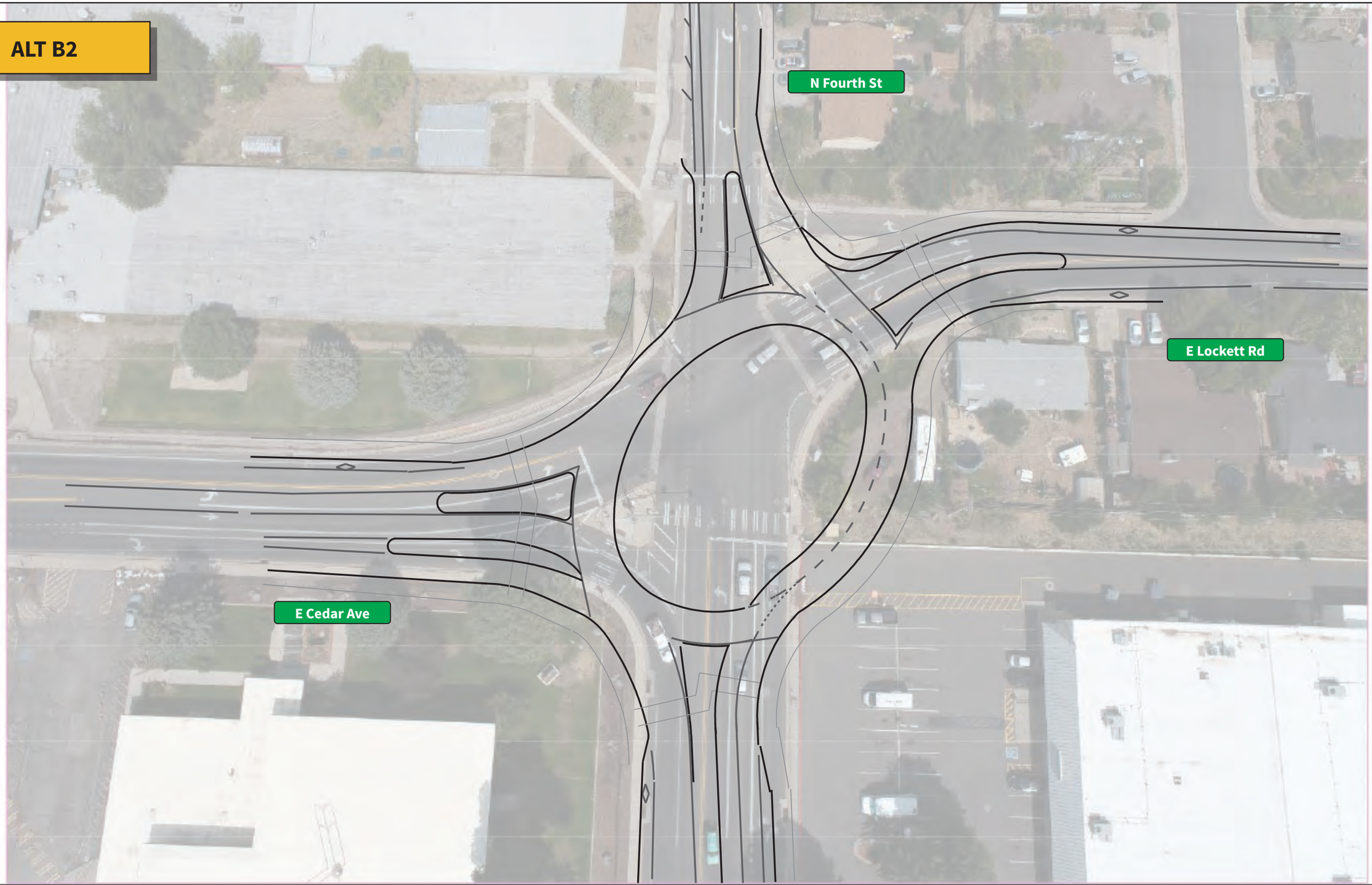
ALT B2



N Fourth St. @
E Cedar Ave. & E Lockett Rd.
Flagstaff, AZ

12.01.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT B2: WITH AERIAL

MTJ ROUNDABOUT engineering

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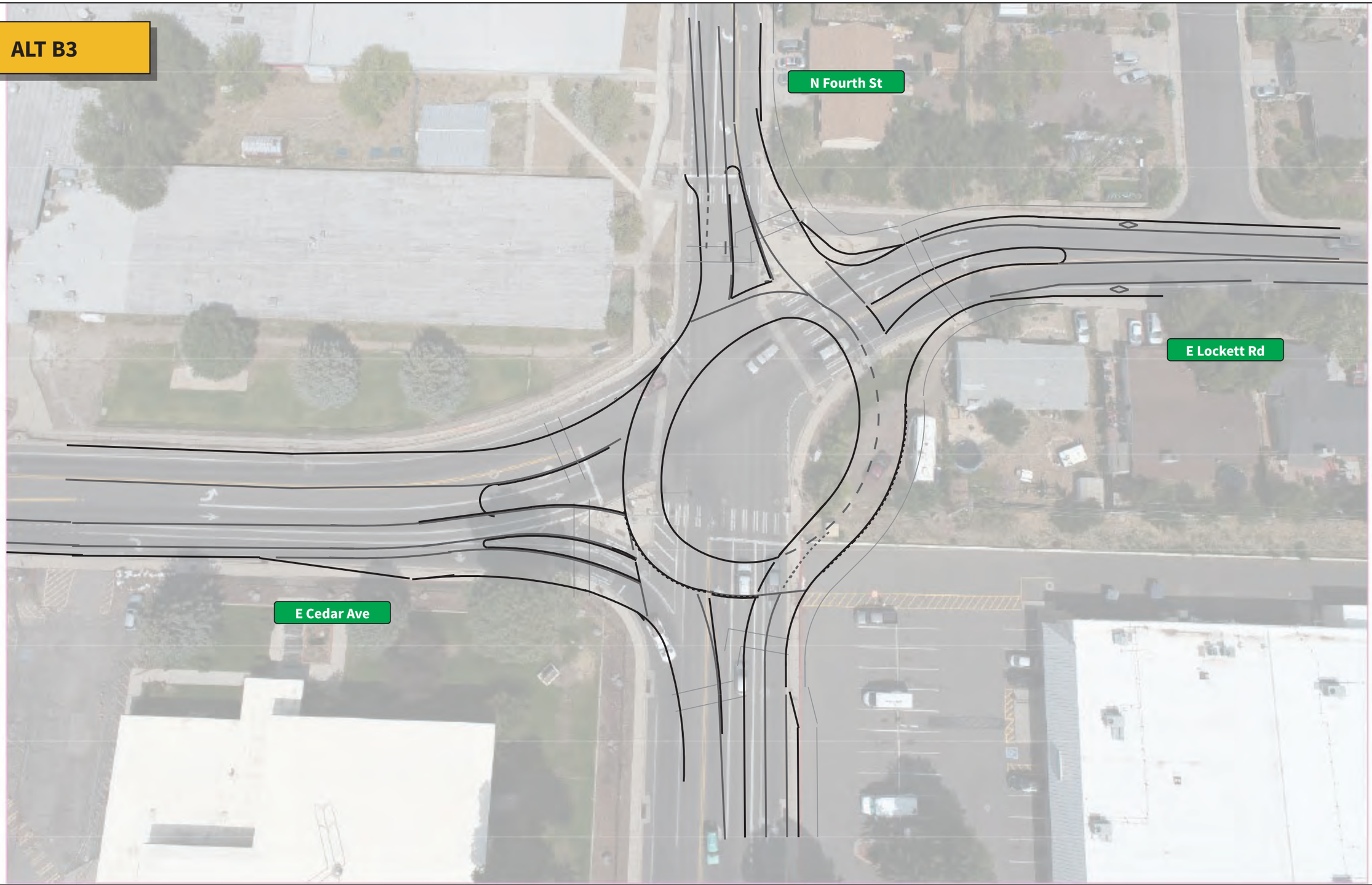
ALT B3



N Fourth St. @
E Cedar Ave. & E Lockett Rd.
Flagstaff, AZ

12.01.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT B3: WITH AERIAL

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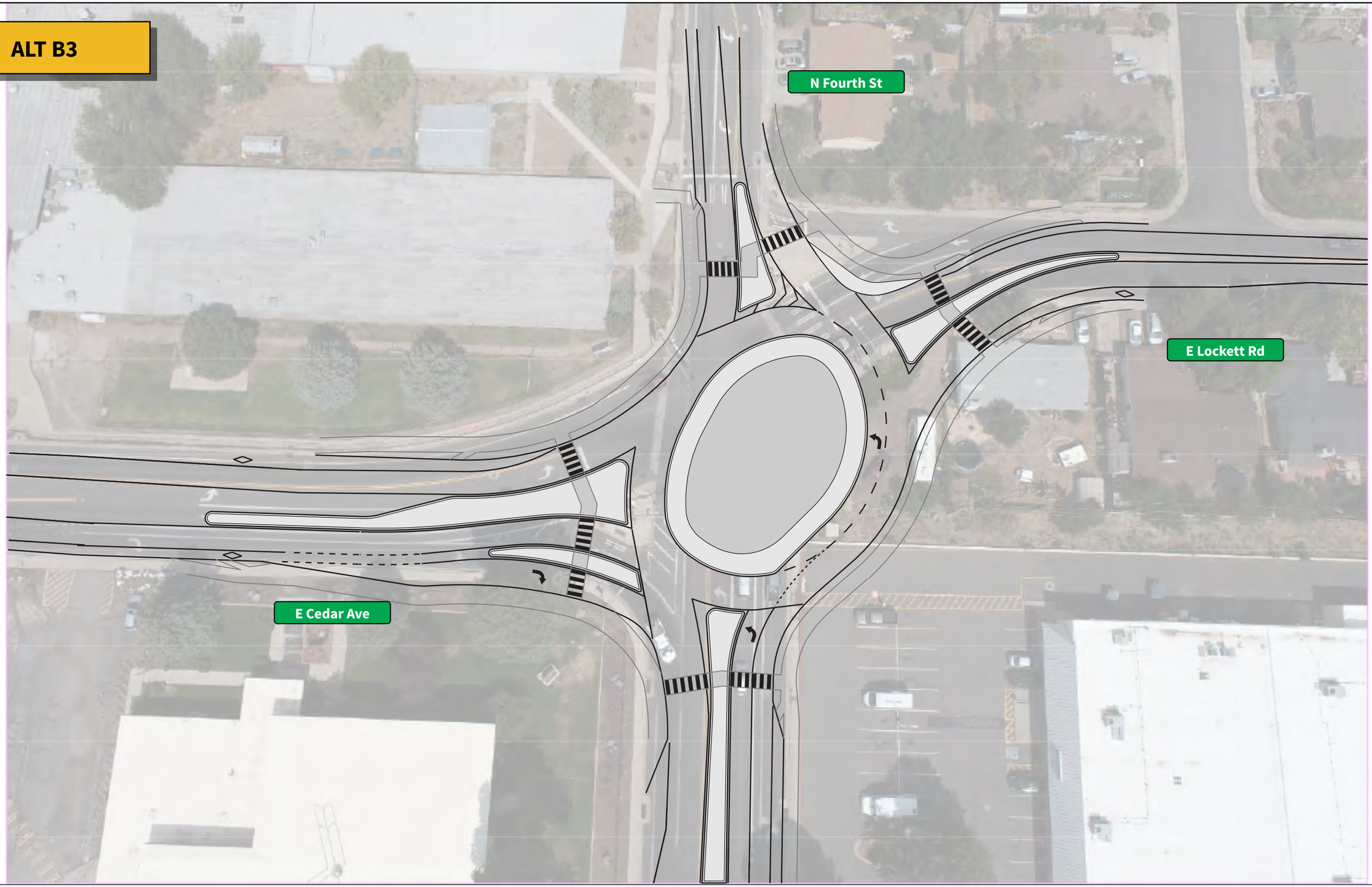
ALT B3



N Fourth St. @
E Cedar Ave. & E Lockett Rd.
Flagstaff, AZ

12.10.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT B4: WITH AERIAL

MTJ ROUNDABOUT engineering

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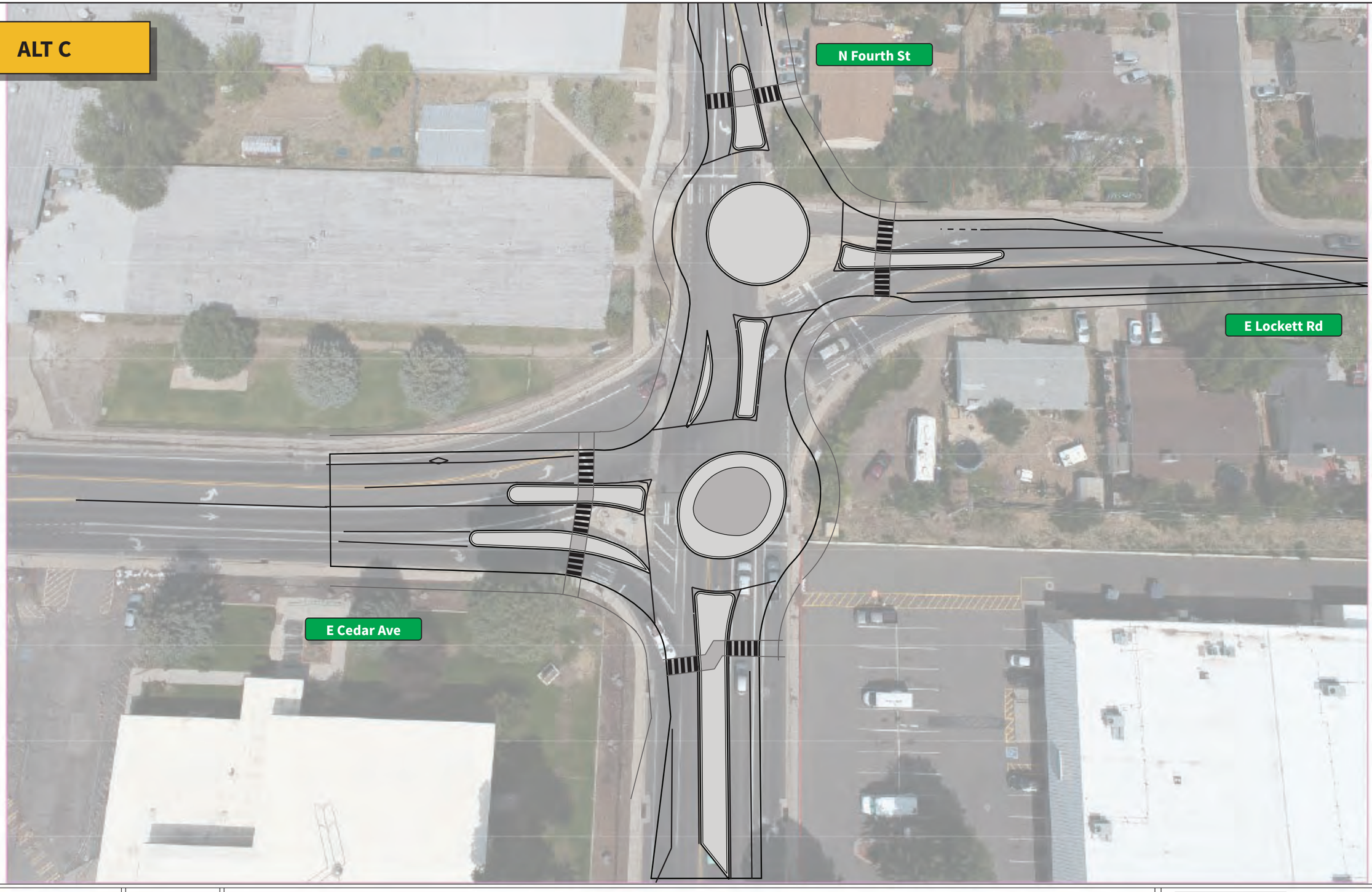
ALT C



N Fourth St. @
E Cedar Ave. & E Lockett Rd.
Flagstaff, AZ

12.01.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT C: WITH AERIAL

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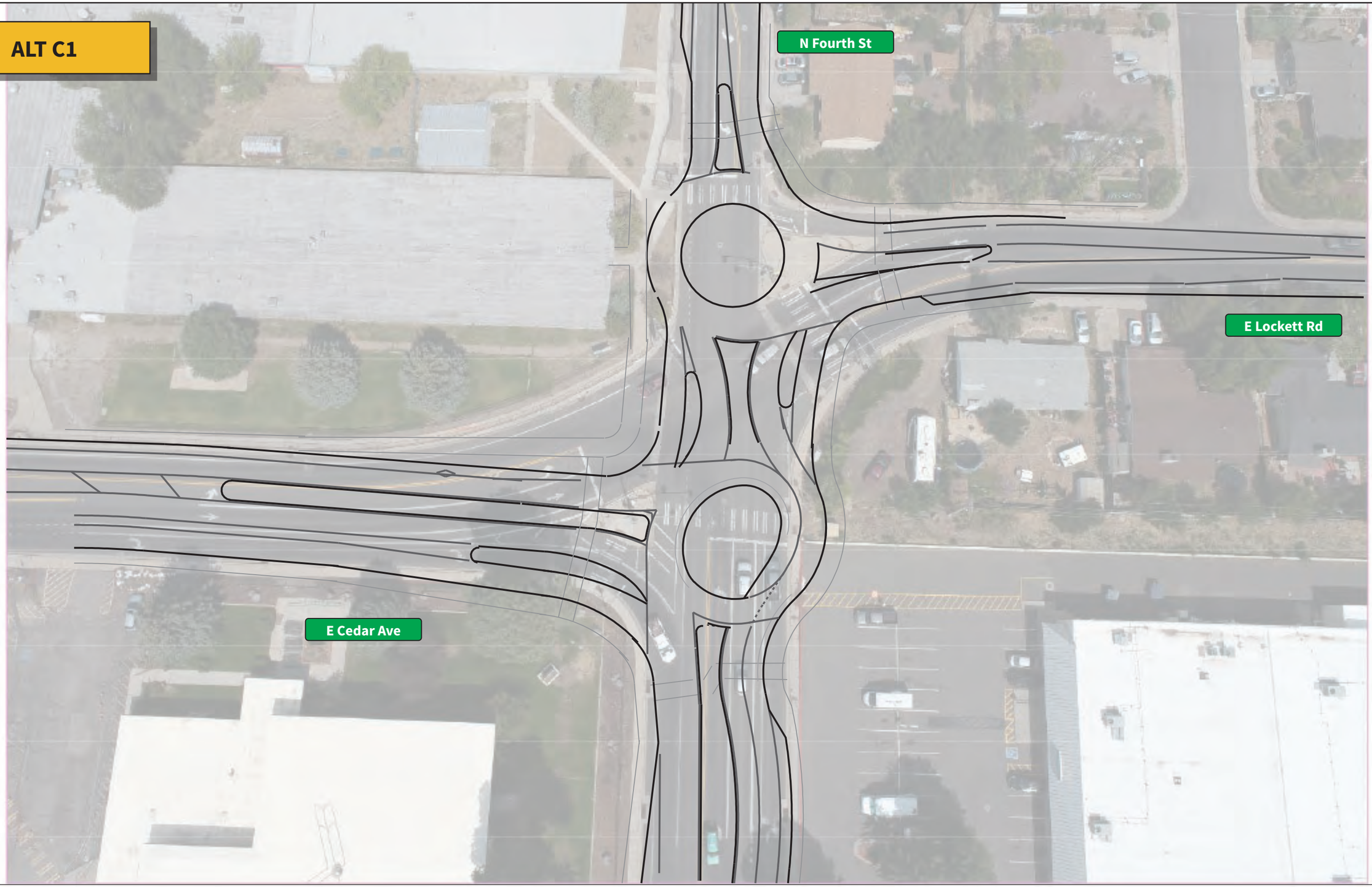
ALT C1



N Fourth St. @
E Cedar Ave. & E Lockett Rd.
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12.01.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT C1: WITH AERIAL

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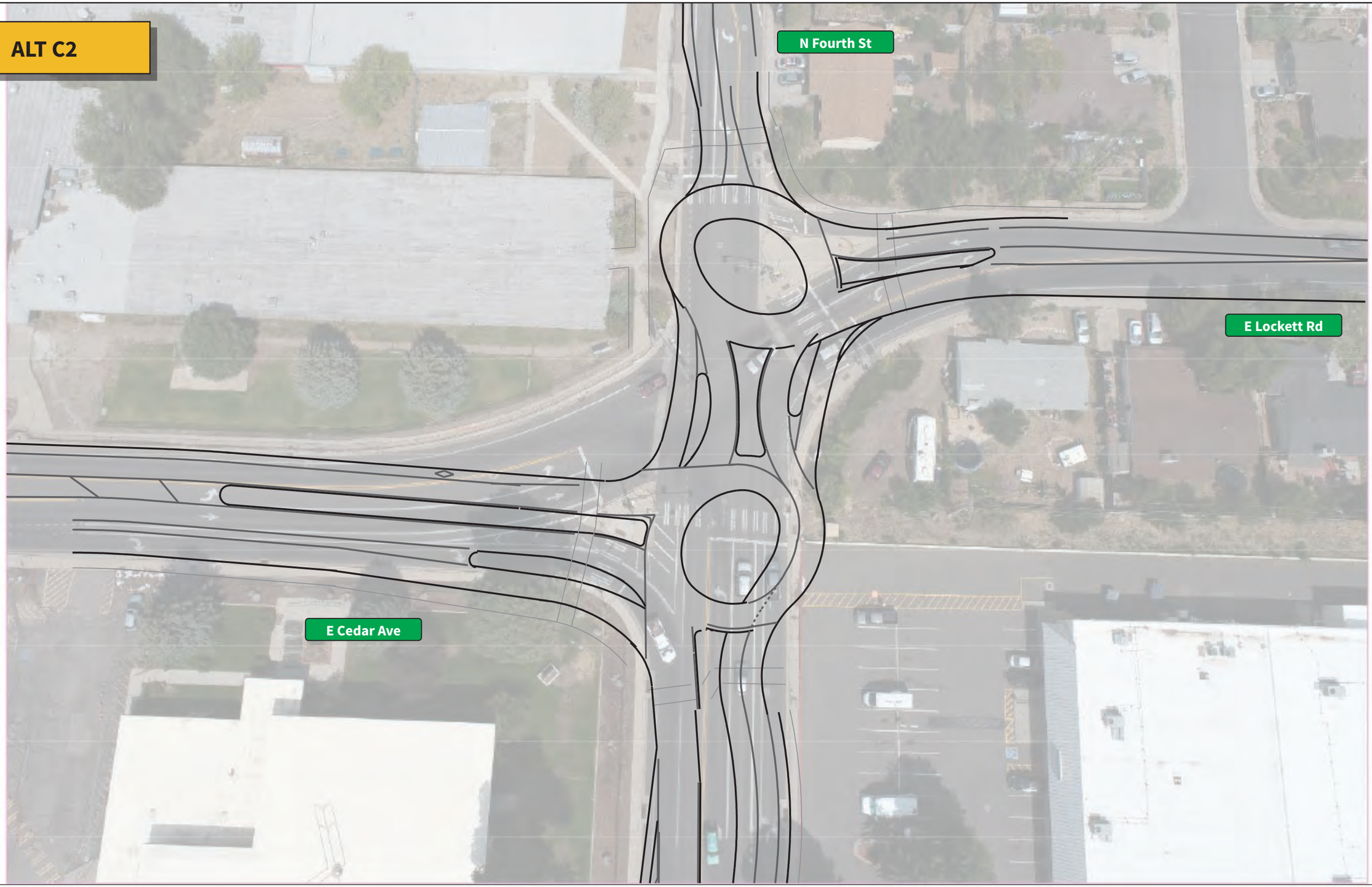
ALT C2



N Fourth St. @
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12.01.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT C2: WITH AERIAL

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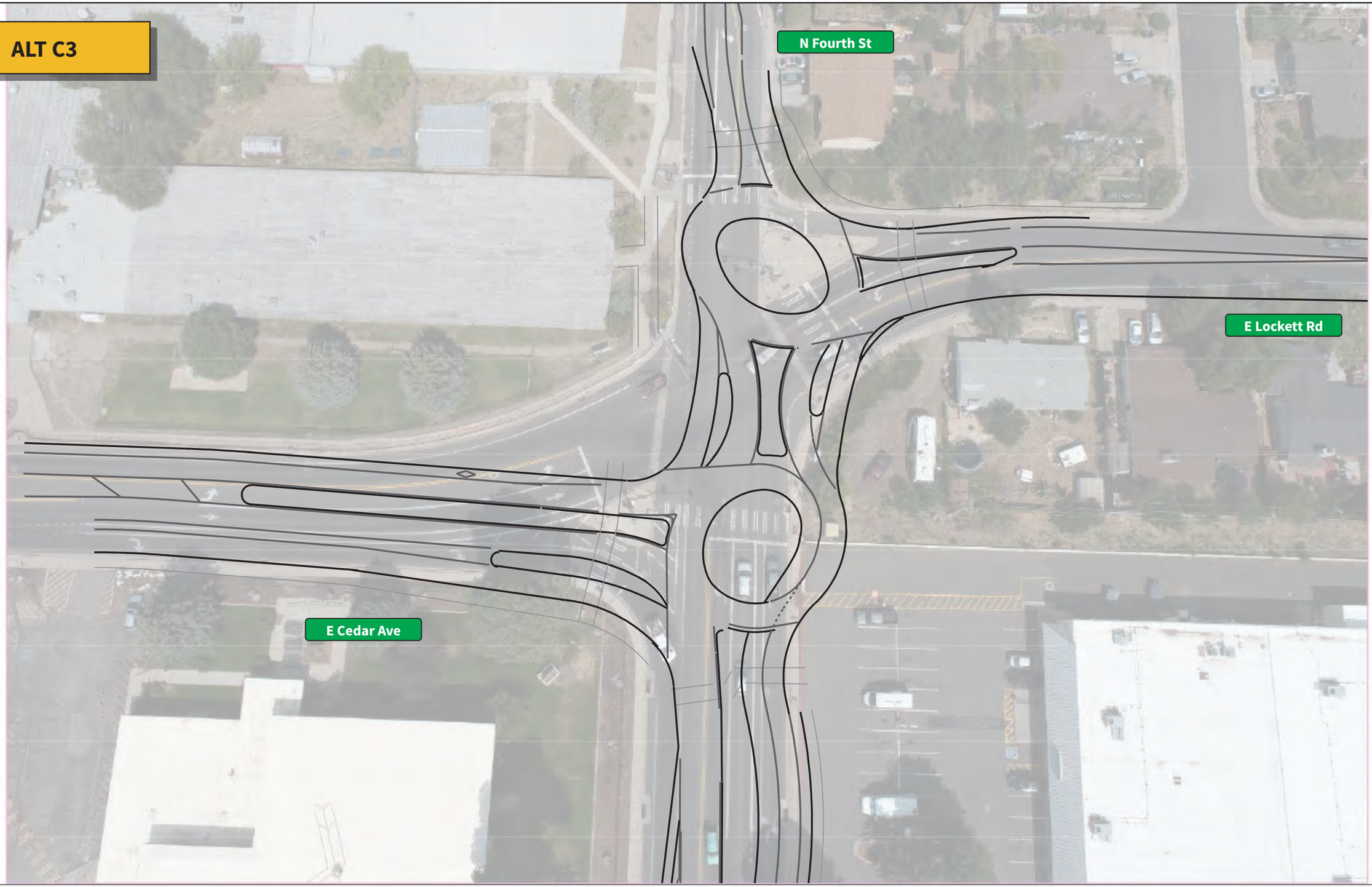
ALT C3



N Fourth St. @
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N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT C3: WITH AERIAL

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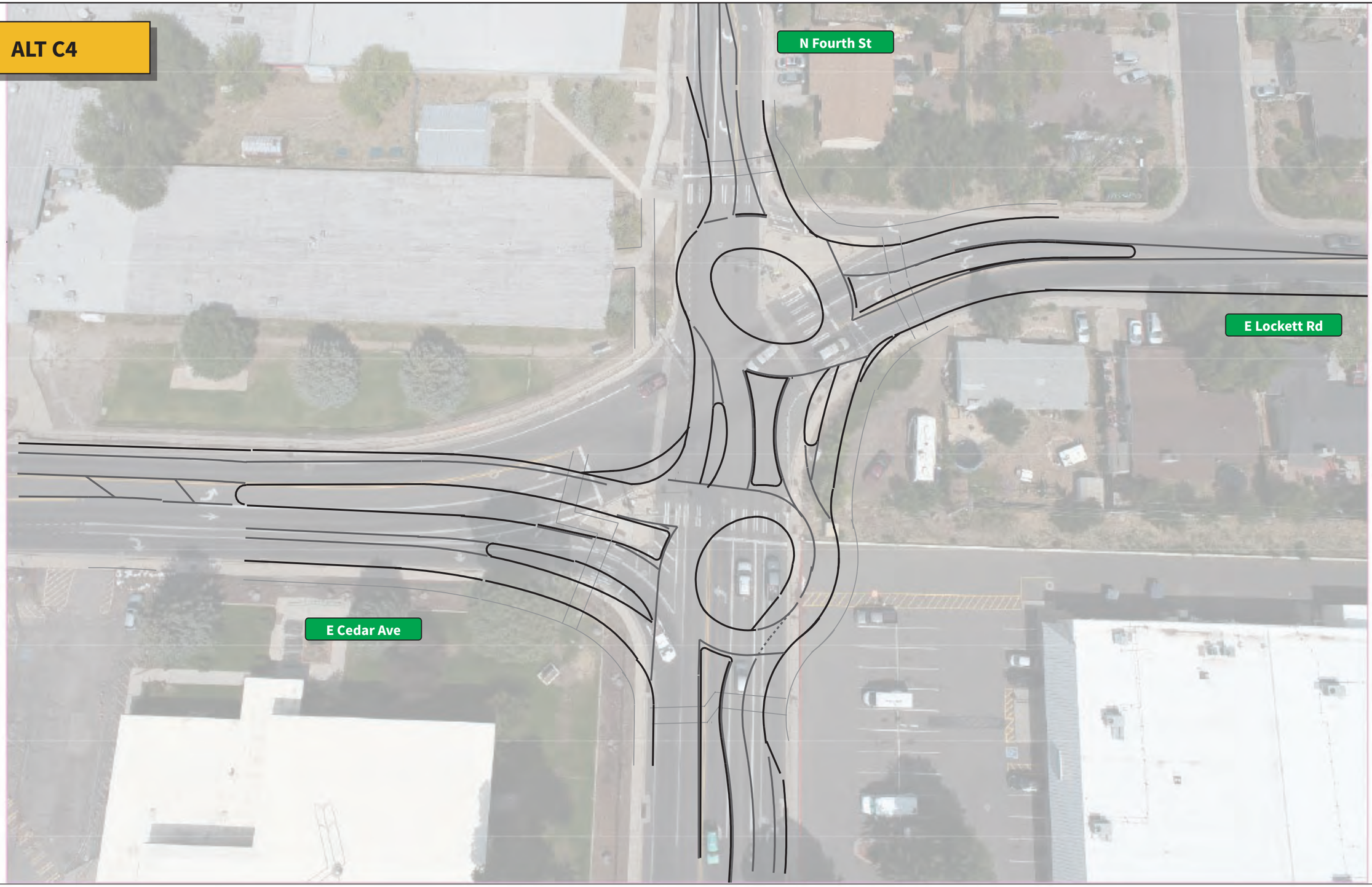
ALT C4



N Fourth St. @
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Flagstaff, AZ

12.01.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT C4: WITH AERIAL

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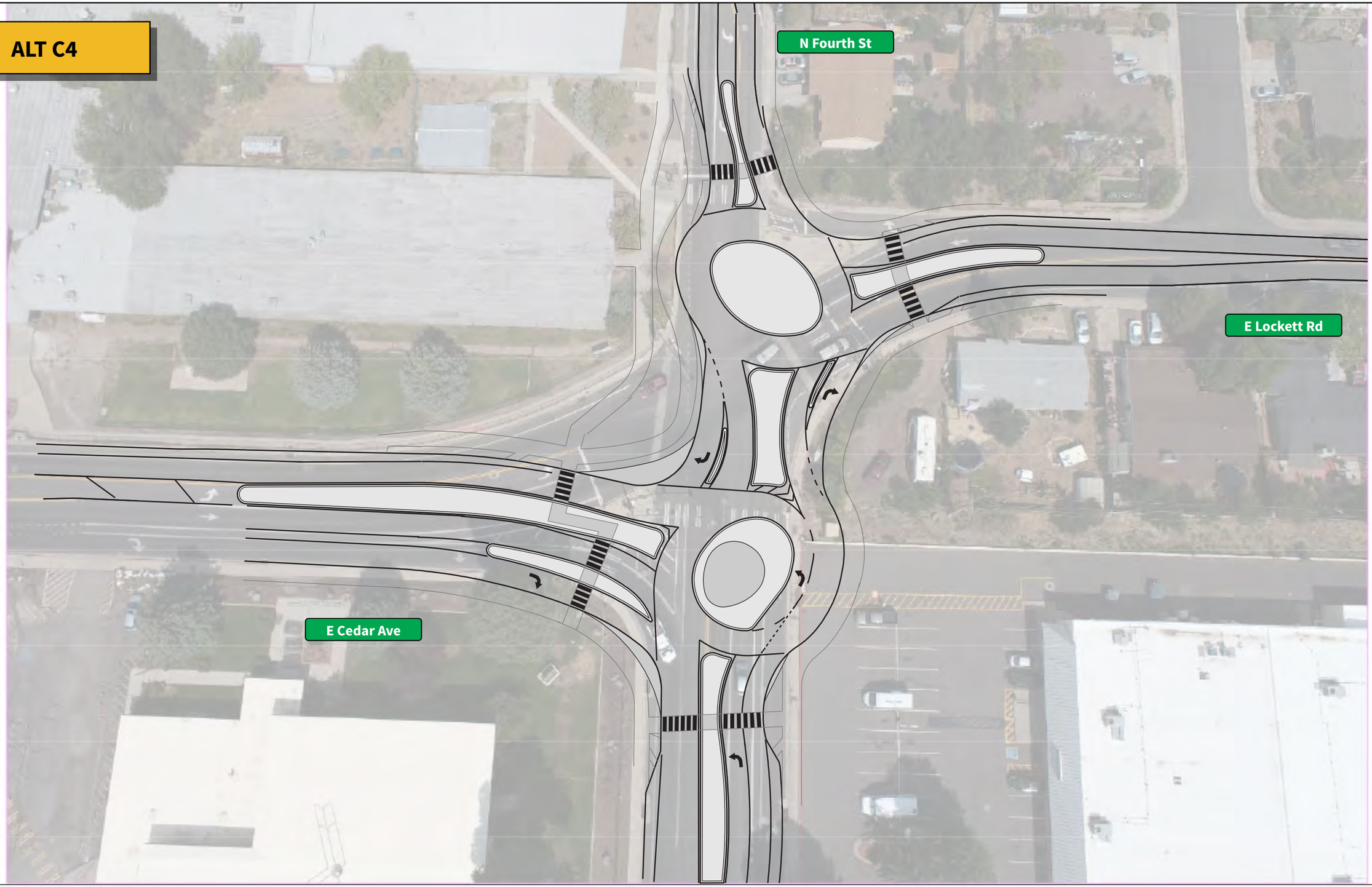
ALT C4



N Fourth St. @
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Flagstaff, AZ

12.10.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT C4: WITH AERIAL

MTJ ROUNDABOUT engineering

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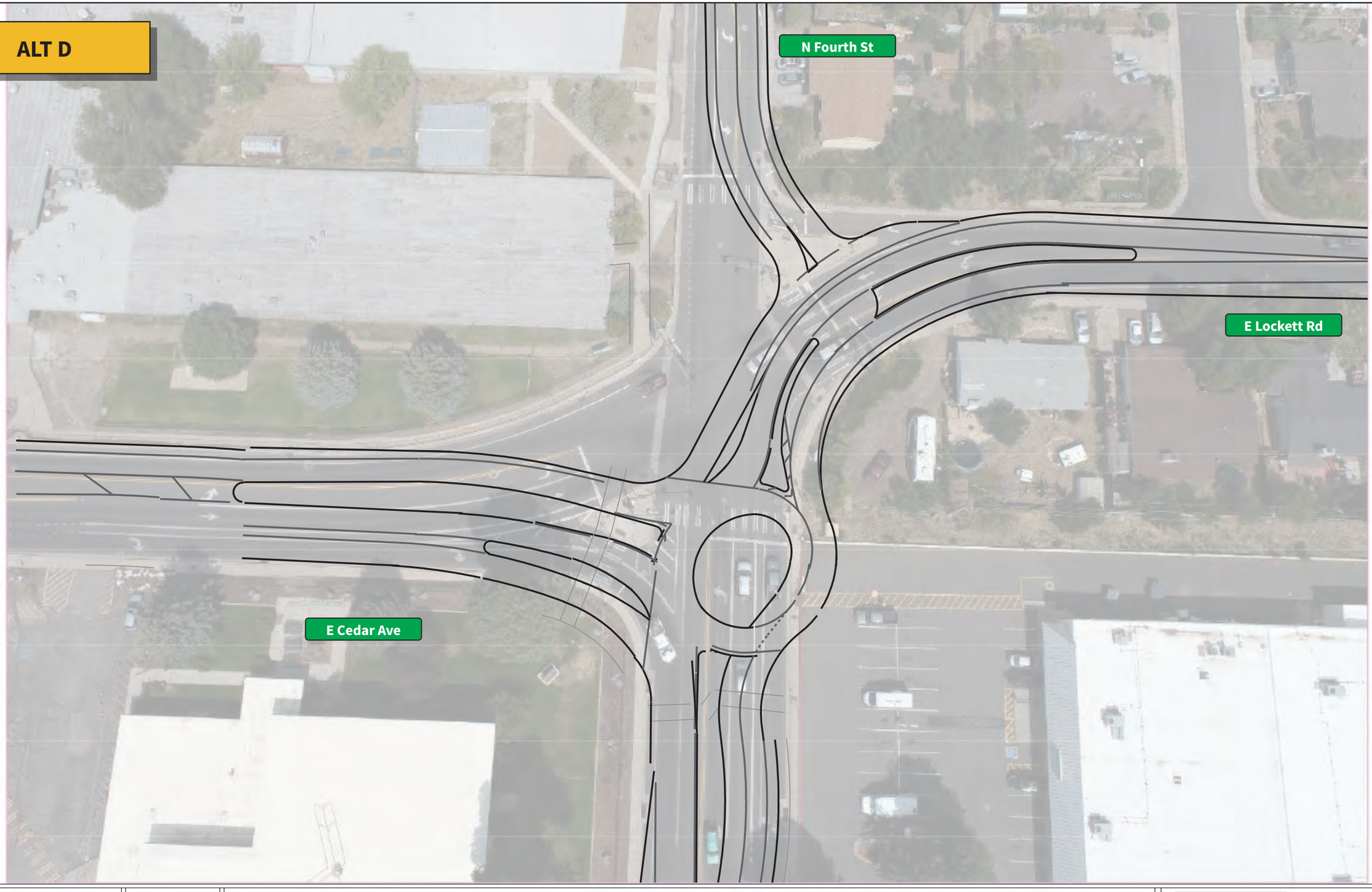
ALT D



N Fourth St. @
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Flagstaff, AZ

12.01.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT D: WITH AERIAL

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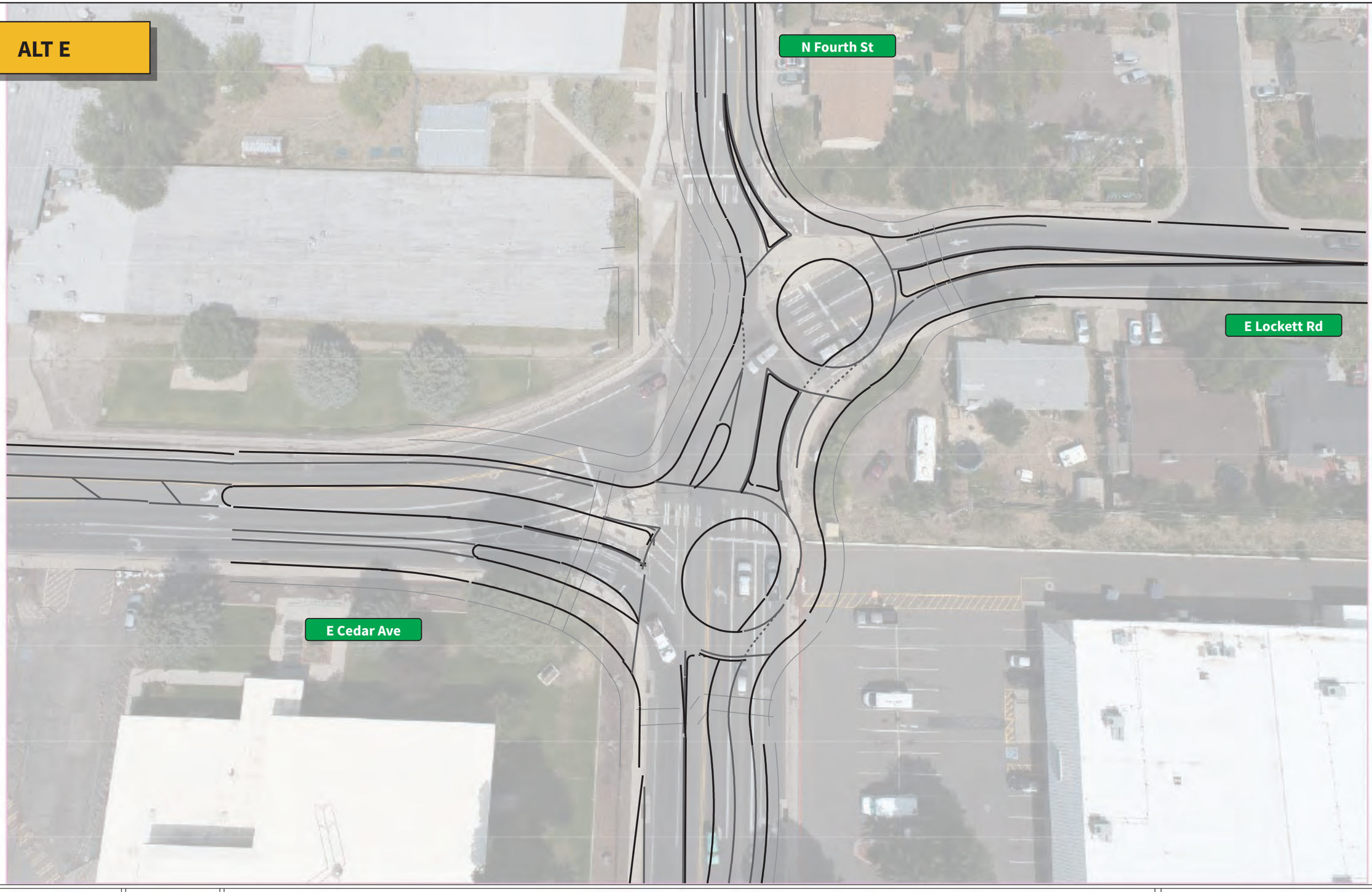
ALT E



N Fourth St. @
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Flagstaff, AZ

12.01.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT E: WITH AERIAL

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APPENDIX C

11x17 Concept Design Exhibits: Alts A, B, B1, B4, C, C4 (Colorized)

ALT A

N Fourth St. @
E Cedar Ave. & E Lockett Rd.
Flagstaff, AZ

12.10.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT A: COLOR WITH AERIAL

MTJ ROUNDABOUT engineering

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Madison, WI 53705

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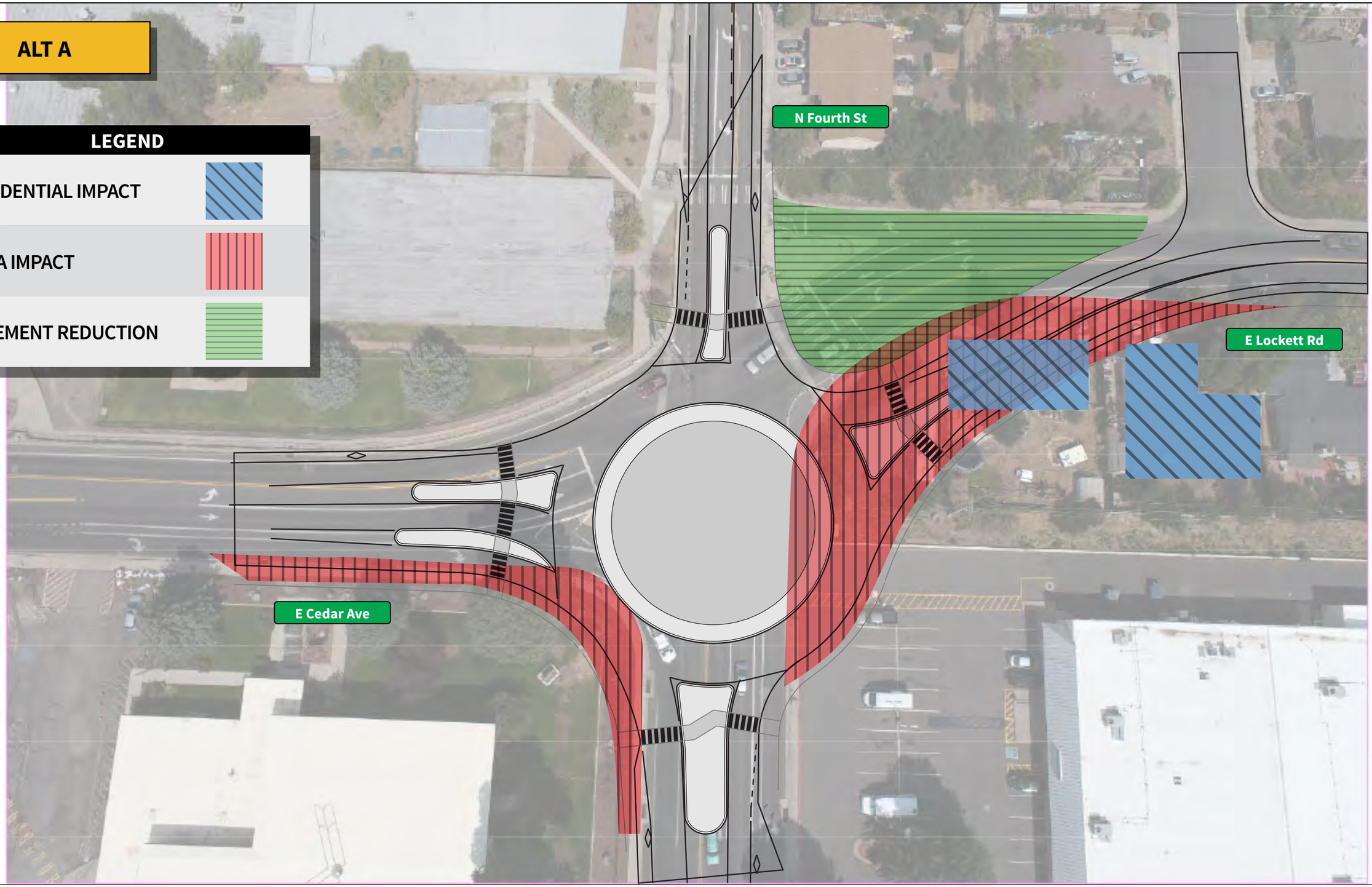
ALT A

LEGEND

- RESIDENTIAL IMPACT
- AREA IMPACT
- PAVEMENT REDUCTION



N Fourth St. @
E Cedar Ave. & E Lockett Rd.
Flagstaff, AZ

12.10.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT A: IMPACTS

MTJ ROUNDABOUT engineering

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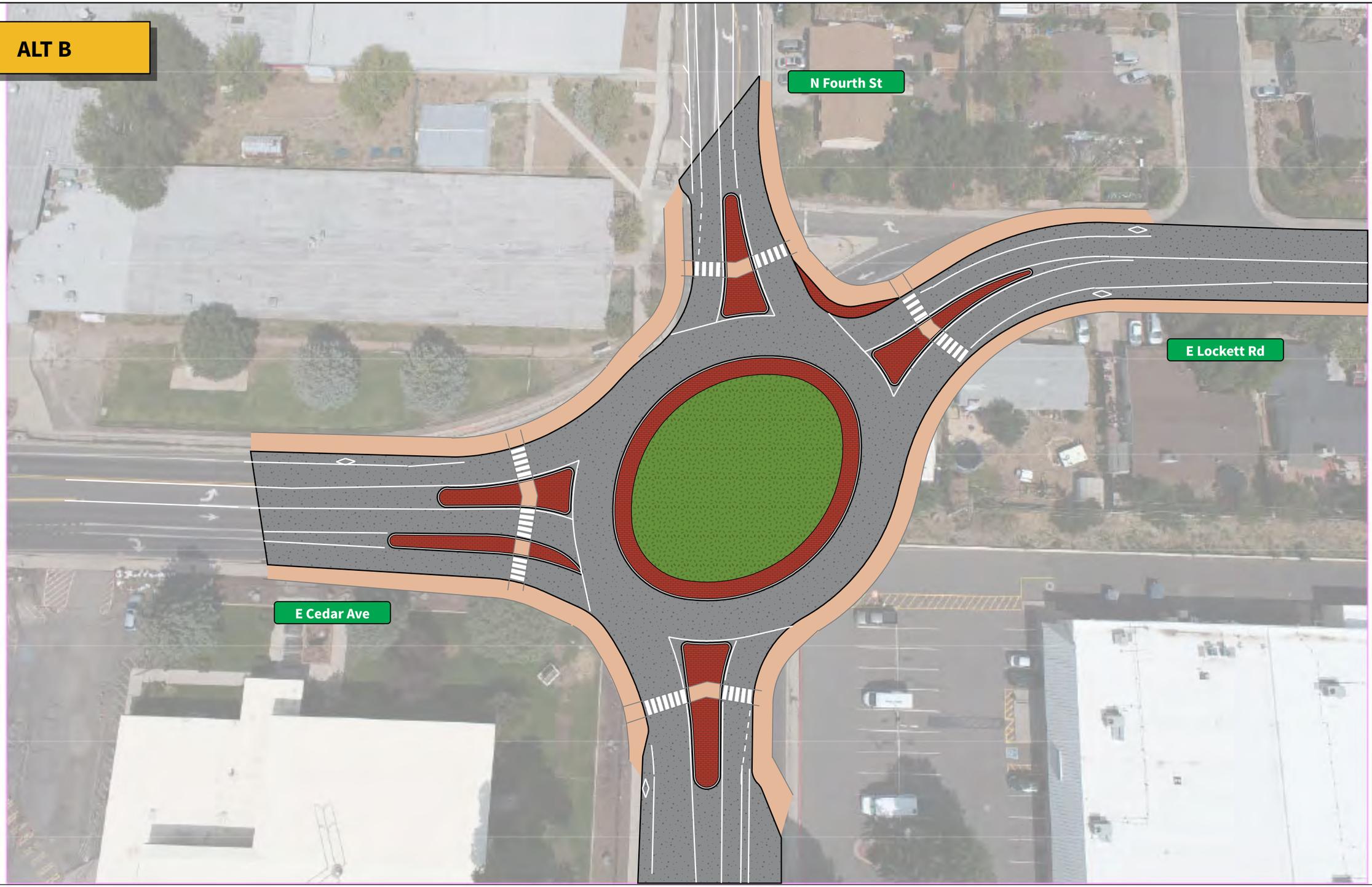
ALT B



N Fourth St. @
E Cedar Ave. & E Lockett Rd.
Flagstaff, AZ

12.10.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT B: COLOR WITH AERIAL

MTJ ROUNDABOUT engineering

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Madison, WI 53705

608.238.5000
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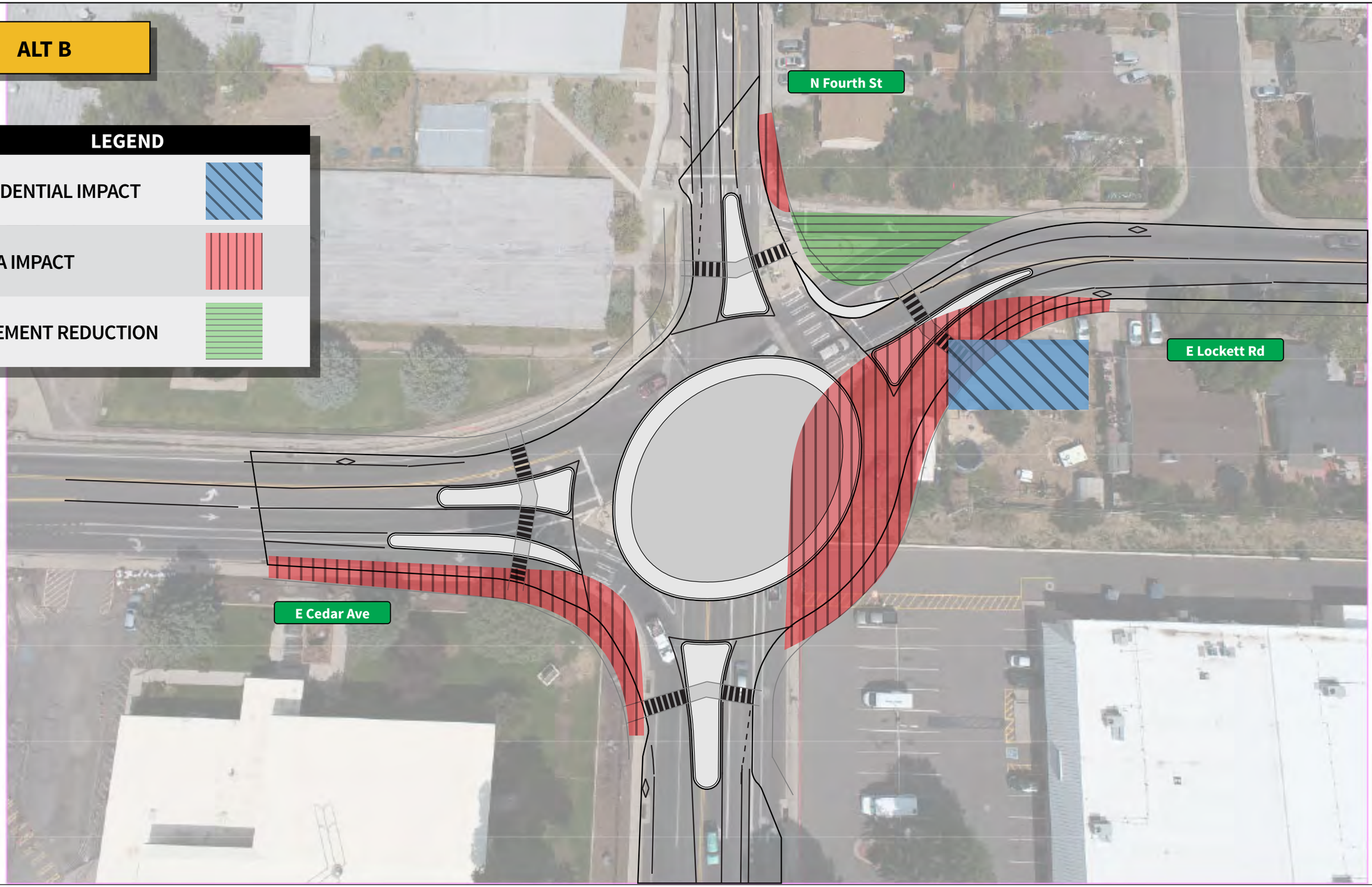
ALT B

LEGEND

- RESIDENTIAL IMPACT
- AREA IMPACT
- PAVEMENT REDUCTION



N Fourth St. @
E Cedar Ave. & E Lockett Rd.
Flagstaff, AZ

12.10.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT B: IMPACTS

MTJ ROUNDABOUT engineering

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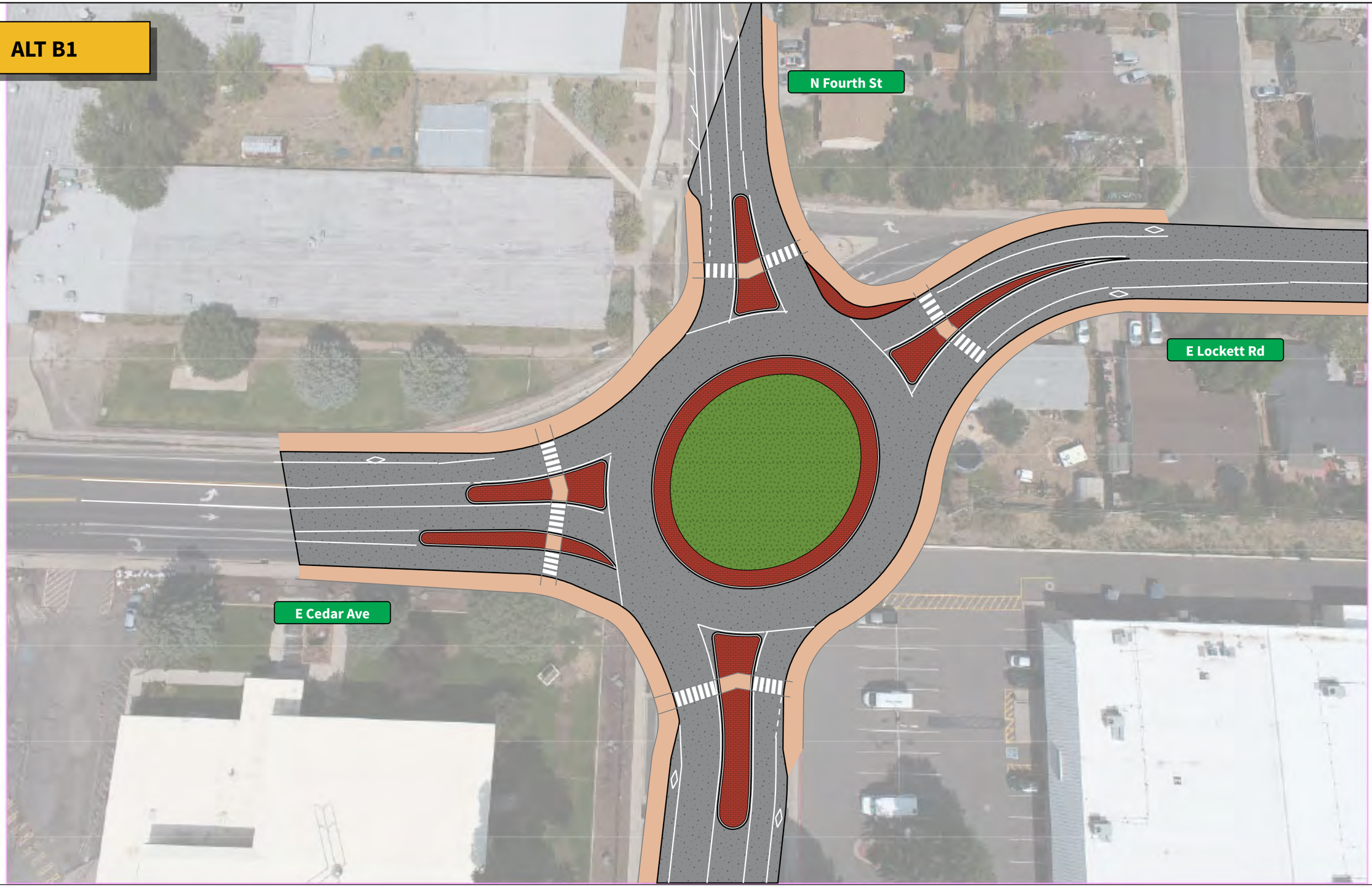
ALT B1



N Fourth St. @
E Cedar Ave. & E Lockett Rd.
Flagstaff, AZ

12.10.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT B1: COLOR WITH AERIAL

MTJ ROUNDABOUT engineering

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Madison, WI 53705

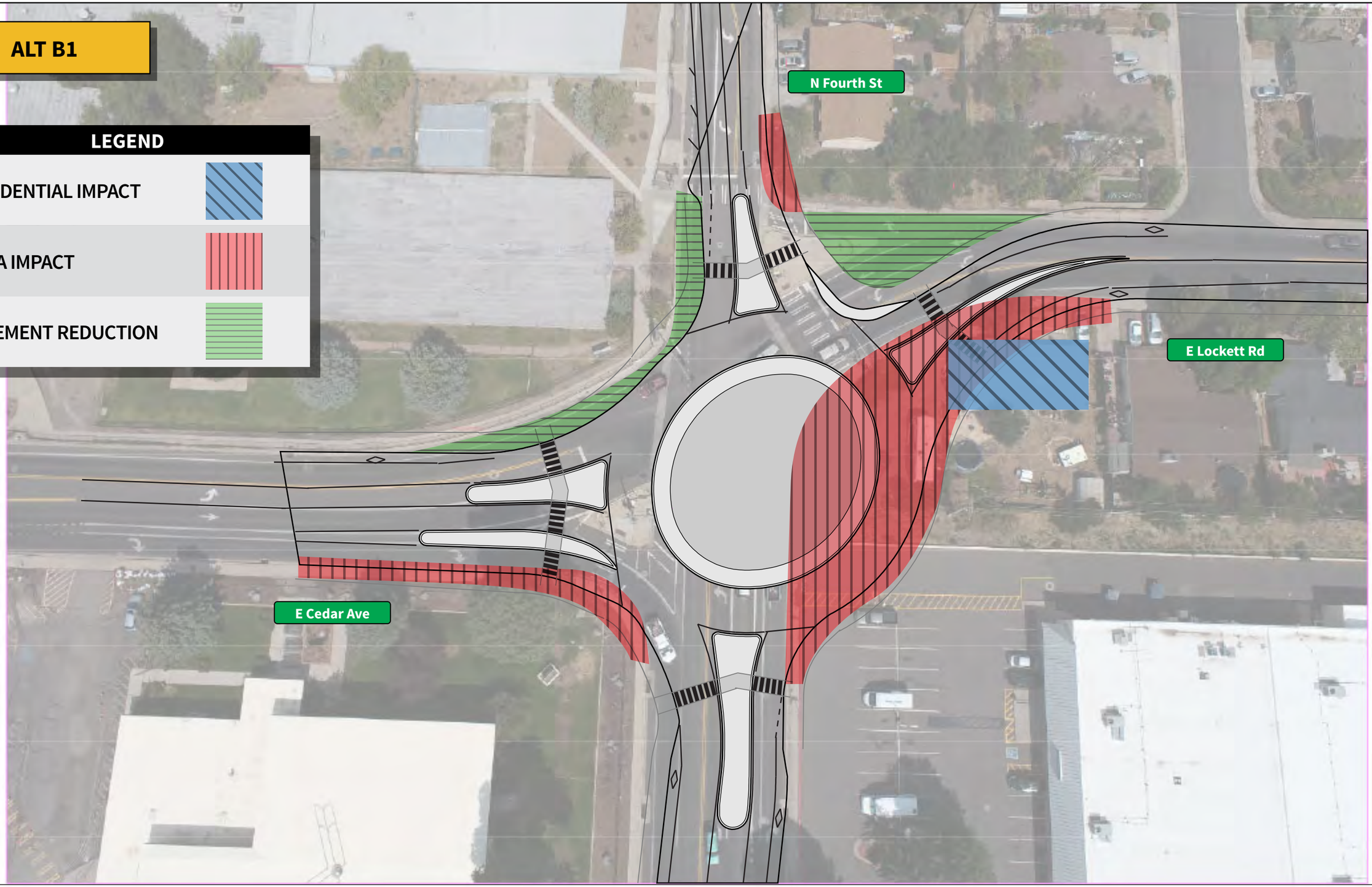
608.238.5000
info@mtjengineering.com

www.mtjengineering.com

ALT B1

LEGEND

RESIDENTIAL IMPACT	
AREA IMPACT	
PAVEMENT REDUCTION	



N Fourth St. @
E Cedar Ave. & E Lockett Rd.
Flagstaff, AZ

12.10.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT B1: IMPACTS

MTJ ROUNDABOUT engineering

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Madison, WI 53705

608.238.5000
info@mtjengineering.com

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ALT B4: COLOR

N Fourth St. @
E Cedar Ave. & E Lockett Rd.
Flagstaff, AZ

12.10.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT B4: COLOR WITH AERIAL

MTJ ROUNDABOUT engineering

313 Price Place, Suite #11
Madison, WI 53705

608.238.5000
info@mtjengineering.com

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ALT C

N Fourth St. @
E Cedar Ave. & E Lockett Rd.
Flagstaff, AZ

12.10.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT C: COLOR WITH AERIAL

MTJ ROUNDABOUT engineering

313 Price Place, Suite #11
Madison, WI 53705

608.238.5000
info@mtjengineering.com

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ALT C

LEGEND

- RESIDENTIAL IMPACT
- AREA IMPACT
- PAVEMENT REDUCTION

N Fourth St

E Lockett Rd

E Cedar Ave

N Fourth St. @
E Cedar Ave. & E Lockett Rd.
Flagstaff, AZ

12.10.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT C: IMPACTS

MTJ ROUNDABOUT engineering

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Madison, WI 53705

608.238.5000
info@mtjengineering.com

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ALT C4: COLOR

N Fourth St. @
E Cedar Ave. & E Lockett Rd.
Flagstaff, AZ

12.10.20

N

Scale= 1:50

MTJ CONCEPT DESIGN

ALT C4: COLOR WITH AERIAL

MTJ ROUNDABOUT engineering

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Madison, WI 53705

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