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I-40 Level of Service Analysis

To: Daniel Nguyen, Project Manager, Division 4
From: GARVER
RE: EC-1457A I-40 Corridor Study, LOS for Grant Application
Date: March 24, 2016

Daniel:

Level of Service (LOS) analysis was performed on Interstate 40 from east of Douglas Boulevard to east of I-240 using the 2015/2045 design traffic volumes from EC 1457A – I-40 Corridor Study. The analysis included an examination of the LOS for the current four-lane freeway configuration for 2015 and 2045 traffic demand. In addition, the analysis included LOS determination for a scenario that widened I-40 to a six-lane freeway (three lanes in each direction).

The HCS Freeway Facility module was used to determine the freeway mainline and ramp merge/diverge LOS. No weaving maneuvers are located along this segment of the I-40 corridor. In addition to the volumes, the following parameters were used in the analysis:

- Level Terrain
- Free flow speed of 70 mph
- Peak Hour Factor of 0.92
- Actual merge and diverge distances

Existing and No Build Results

As shown in Table A-1 and A-2, the I-40 corridor has segments that operate at LOS D in the AM and LOS E in the PM under 2015 traffic demand. By 2045, LOS F conditions will occur along multiple basic segments or ramps during both the AM and PM peak periods.

Build Results

Tables A-3 and **A-4** depict the expected 2015/2045 LOS with the additional third lane in each direction on I-40. Aside from the additional lane, no other modifications were assumed at any of the ramps at the Anderson Road or I-240 interchanges. As shown, operations for the six-lane freeway will improve with the widening with most segments operating at LOS D or better through 2045. However, the EB ramp merge movement at I-240 will operate at LOS E conditions in the PM peak period due to the heavy 2045 design volumes. Additionally, the 2045 design volumes indicate the I-240 ramps (westbound off ramp, eastbound on ramp) will approach or exceed the capacity of a single ramp itself (not specific merge/diverge areas), which is 2,100 passenger cars per hour per lane (pcphpl). **Table A-5** depicts the ramp demand volumes in pcphpl.

To alleviate the LOS E condition and resolve the issue of the ramps being over capacity, two lane ramps at I-240 are needed. **Tables A-6** and **A-7** depict the resulting LOS for a six-lane freeway with 2-lane ramps at I-240 that assume merge and diverge conditions as presently exist. Note that with this configuration, operation could be improved beyond the LOS D conditions shown if one of the I-240 ramp lanes is extended and treated as an auxiliary lane between I-240 and the nearest interchange to the east, Choctaw Road.

Table A-1: Existing Configuration Freeway Analysis - Eastbound

Location	Segment Type	AM						PM					
		2015			2045			2015			2045		
		Density (pc/mi/ln)	v/c ratio	LOS	Density (pc/mi/ln)	v/c ratio	LOS	Density (pc/mi/ln)	v/c ratio	LOS	Density (pc/mi/ln)	v/c ratio	LOS
Between Douglas Boulevard and Anderson Road	Basic Segment	8.8	0.26	A	13.6	0.4	B	27.7	0.76	D	44.9	1.08	F
Anderson Road Exit Ramp	Off-Ramp	9.8	0.26	A	15.2	0.4	B	29.5	0.76	D	42.1	1.08	F
Between Anderson Road Ramps	Basic Segment	7.3	0.21	A	11.1	0.32	B	21.1	0.61	C	29.1	0.84	D
Anderson Road Entrance Ramp	On-Ramp	8.9	0.23	A	13.6	0.35	B	25.4	0.63	C	34.3	0.87	D
Between Anderson Road and I-240	Basic Segment	7.8	0.23	A	11.9	0.35	B	21.9	0.63	C	36.6	0.87	E
I-240 Entrance Ramp	On-Ramp	15.9	0.43	B	26.7	0.7	C	36.9	0.89	E	43.3	1.29	F
Between I-240 and Choctaw Road	Basic Segment	14.8	0.43	B	25.0	0.7	C	35.8	0.89	E	44.5	1.29	F

Table A-2: Existing Configuration Freeway Analysis - Westbound

Location	Segment Type	AM						PM					
		2015			2045			2015			2045		
		Density (pc/mi/ln)	v/c ratio	LOS	Density (pc/mi/ln)	v/c ratio	LOS	Density (pc/mi/ln)	v/c ratio	LOS	Density (pc/mi/ln)	v/c ratio	LOS
Between Choctaw Road and I-240	Basic Segment	32.8	0.85	D	44.9	1.24	F	15.5	0.45	B	28.4	0.77	D
I-240 Exit Ramp	Off-ramp	33.6	0.85	D	44	1.24	F	17.8	0.45	B	31.2	0.77	D
Between I-240 and Anderson Road	Basic Segment	20.4	0.59	C	22.3	0.8	C	8.2	0.24	A	14.2	0.42	B
Anderson Road Exit Ramp	Off-ramp	22.4	0.59	C	25.8	0.8	C	9.1	0.24	A	15.8	0.42	B
Between Anderson Road Ramps	Basic Segment	19.8	0.57	C	21.9	0.77	C	7.6	0.22	A	13.2	0.38	B
Anderson Road Entrance Ramp	Off-ramp	30.1	0.73	D	37.7	1.03	F	10.5	0.27	B	18.2	0.46	B
Between Anderson Road and Douglas Boulevard	Basic Segment	26.6	0.73	D	35.2	1.03	F	9.3	0.27	A	15.9	0.46	B

Table A-3: Six-Lane Freeway Analysis - Eastbound

Location	Segment Type	AM						PM					
		2015			2045			2015			2045		
		Density (pc/mi/ln)	v/c ratio	LOS	Density (pc/mi/ln)	v/c ratio	LOS	Density (pc/mi/ln)	v/c ratio	LOS	Density (pc/mi/ln)	v/c ratio	LOS
Between Douglas Boulevard and Anderson Road	Basic Segment	5.9	0.17	A	9.1	0.26	A	17.3	0.5	B	26.0	0.72	C
Anderson Road Exit Ramp	Off-Ramp	6.3	0.17	A	9.7	0.26	A	18.5	0.5	B	26.9	0.72	C
Between Anderson Road Ramps	Basic Segment	4.9	0.14	A	7.4	0.21	A	13.9	0.41	B	19.3	0.56	C
Anderson Road Entrance Ramp	On-Ramp	5.6	0.15	A	8.6	0.23	A	15.9	0.42	B	22.4	0.58	C
Between Anderson Road and I-240	Basic Segment	5.2	0.15	A	7.9	0.23	A	14.4	0.42	B	20.1	0.58	C
I-240 Entrance Ramp	On-Ramp	10.4	0.29	B	17.1	0.47	B	22.1	0.59	C	35.8	0.86	E
Between I-240 and Choctaw Road	Basic Segment	9.9	0.29	A	16.1	0.47	B	20.5	0.59	C	33.7	0.86	D

Table A-4: Six-Lane Freeway Analysis - Westbound

Location	Segment Type	AM						PM					
		2015			2045			2015			2045		
		Density (pc/mi/ln)	v/c ratio	LOS	Density (pc/mi/ln)	v/c ratio	LOS	Density (pc/mi/ln)	v/c ratio	LOS	Density (pc/mi/ln)	v/c ratio	LOS
Between Choctaw Road and I-240	Basic Segment	19.4	0.56	C	31.6	0.83	D	10.3	0.3	A	17.6	0.51	B
I-240 Exit Ramp	Off-ramp	21.1	0.56	C	31.9	0.83	D	11.4	0.3	B	19.8	0.51	B
Between I-240 and Anderson Road	Basic Segment	13.5	0.39	B	18.3	0.53	C	5.5	0.16	A	9.5	0.28	A
Anderson Road Exit Ramp	Off-ramp	14.1	0.39	B	19.1	0.53	B	5.8	0.16	A	10.0	0.28	A
Between Anderson Road Ramps	Basic Segment	13.1	0.38	B	17.7	0.51	B	5.0	0.15	A	8.8	0.26	A
Anderson Road Entrance Ramp	Off-ramp	18.6	0.49	B	27.0	0.69	C	6.7	0.18	A	11.6	0.31	B
Between Anderson Road and Douglas Boulevard	Basic Segment	16.8	0.49	B	24.3	0.69	C	6.2	0.18	A	10.6	0.31	A

Table A-5: Ramp Demand Volumes in PCPHPL

Location	Cross Street	Year	DDHV	TRUCK %	PHF	PCPHPL
EB Off Ramp	Anderson Road	2015 AM	200	2%	0.92	220
		2015 PM	650			714
		2045 AM	325			357
		2045 PM	1050			1153
EB On Ramp	Anderson Road	2015 AM	65	2%	0.92	71
		2015 PM	90			99
		2045 AM	105			115
		2045 PM	140			154
EB On Ramp	I-240	2015 AM	880	5%	0.92	980
		2015 PM	1130			1259
		2045 AM	1530			1705
		2045 PM	1795			2000
WB Off Ramp	I-240	2015 AM	1100	5%	0.92	1226
		2015 PM	910			1014
		2045 AM	1905			2122
		2045 PM	1530			1705
WB Off Ramp	Anderson Road	2015 AM	75	2%	0.92	82
		2015 PM	85			93
		2045 AM	120			132
		2045 PM	140			154
WB On Ramp	Anderson Road	2015 AM	700	2%	0.92	768
		2015 PM	220			242
		2045 AM	1130			1241
		2045 PM	355			390

Table A-6: Six-Lane Freeway Analysis with I-240 Ramp Improvements - Eastbound

Location	Segment Type	AM						PM					
		2015			2045			2015			2045		
		Density (pc/mi/ln)	v/c ratio	LOS	Density (pc/mi/ln)	v/c ratio	LOS	Density (pc/mi/ln)	v/c ratio	LOS	Density (pc/mi/ln)	v/c ratio	LOS
Between Douglas Boulevard and Anderson Road	Basic Segment	5.9	0.17	A	9.1	0.26	A	17.3	0.5	B	26.0	0.72	C
Anderson Road Exit Ramp	Off-Ramp	6.3	0.17	A	9.7	0.26	A	18.5	0.5	B	26.9	0.72	C
Between Anderson Road Ramps	Basic Segment	4.9	0.14	A	7.4	0.21	A	13.9	0.41	B	19.3	0.56	C
Anderson Road Entrance Ramp	On-Ramp	5.6	0.15	A	8.6	0.23	A	15.9	0.42	B	22.4	0.58	C
Between Anderson Road and I-240	Basic Segment	5.2	0.15	A	7.9	0.23	A	14.4	0.42	B	20.1	0.58	C
I-240 Entrance Ramp ¹	On-Ramp	10.4	0.29	B	17.1	0.47	B	22.0	0.59	C	34.8	0.86	D
Between I-240 and Choctaw Road ¹	Basic Segment	9.9	0.29	A	16.1	0.47	B	20.5	0.59	C	33.7	0.86	D

¹Analysis assumes two lane ramp at I-240 with merge movement and no add lanes. Auxiliary lanes between I-240 and Choctaw Road Interchange could be provided for better operation.

Table A-7: Six-Lane Freeway Analysis with I-240 Ramp Improvements - Westbound

Location	Segment Type	AM						PM					
		2015			2045			2015			2045		
		Density (pc/mi/ln)	v/c ratio	LOS	Density (pc/mi/ln)	v/c ratio	LOS	Density (pc/mi/ln)	v/c ratio	LOS	Density (pc/mi/ln)	v/c ratio	LOS
Between Choctaw Road and I-240 ¹	Basic Segment	19.4	0.56	C	31.6	0.83	D	10.3	0.3	A	17.6	0.51	B
I-240 Exit Ramp ¹	Off-ramp	20.8	0.56	C	31.8	0.83	D	11.1	0.3	B	19.4	0.51	B
Between I-240 and Anderson Road	Basic Segment	13.5	0.39	B	18.3	0.53	C	5.5	0.16	A	9.5	0.28	A
Anderson Road Exit Ramp	Off-ramp	14.1	0.39	B	19.1	0.53	B	5.8	0.16	A	10.0	0.28	A
Between Anderson Road Ramps	Basic Segment	13.1	0.38	B	17.7	0.51	B	5.0	0.15	A	8.8	0.26	A
Anderson Road Entrance Ramp	Off-ramp	18.6	0.49	B	27.0	0.69	C	6.7	0.18	A	11.6	0.31	B
Between Anderson Road and Douglas Boulevard	Basic Segment	16.8	0.49	B	24.3	0.69	C	6.2	0.18	A	10.6	0.31	A

¹Analysis assumes two lane ramps with diverge movement and no drop lanes. Auxiliary lanes between I-240 and Choctaw Road Interchange could be provided for better operation.