



MEMORANDUM

DATE: August 27, 2017 (Revised 7/16/18)

TO: Roberta Dwyer, PE

FROM: Bob Green, PE, PTOE

SUBJECT: Twin Ports Interchange Crash Analysis – 2011 to 2015

A crash analysis was conducted based on five years of crash data from 2011 through 2015. Data was obtained from Minnesota Crash Mapping Analysis Tool (MnCMAT). The study area included I-35 from 27th Avenue to TH 194; I-535 from Garfield to the Twin Ports Interchange (TPI), and US-53 from the 20th Avenue West/21st Avenue West interchange to TPI.

Interchange element maps were obtained from MnDOT that provide coding for the different ramps and segments within an interchange, which identifies the location of the crash. The interchange element sketches are included as Exhibits 69-1-35-255.2 and 69-1-35-255.5 in Appendix A. Table A-1 in Appendix A provides a summary of crashes by location. There have been 394 crashes within the study area in the last five years, for an average of 79 crashes per year. 275 of these crashes occurred within the TPI boundaries. TPI has the 5th highest crash rate in the state, at 2.08 Crashes per Million Entering Vehicles (MEV).

Table 1 provides a breakdown by location and severity.

Table 1
Crash Summary by Area and Severity

Area and Routes	Limits	Severity					
		Total (2011-2015)	Fatality (K)	Incapacitating Injury (A)	Non-Incapacitating Injury (B)	Possible Injury (C)	Property Damage (N)
Twin Ports Interchange (TPI)	Mainline and Ramps	275	0	1	14	45	213
I-35	27 th Avenue to TPI	15	0	0	0	2	13
I-35	TPI to TH 194	44	0	0	6	6	34
I-535	Garfield to TPI	27	0	0	1	3	23
US-53	TPI to 20 th /21 st	33	0	0	3	4	26
TOTAL		394	0	1	24	60	309
AVERAGE PER YEAR		79	0	1	4	12	62

Exhibit 1 illustrates the approximate location of the crashes, and highlights five locations that have averaged over five crashes per year:

- Area 1 – SB US-53 Ramp to SB I-35 (including junction with the I-535 Ramp to I-35) – 63 crashes related to blind merges, difficult vertical ramp profiles, and impacts of queuing from the traffic signal.
- Area 2 – SB I-35 Ramp to US-53, including the junction with I-535 NB and I-35 NB entrance ramps – 36 crashes related to multiple merge points and blind merges.
- Area 3 – SB I-35 from TH 194 to I-535 SB exit ramp – 33 crashes related to difficult weaving section between TH 194 and TPI, left exit to I-535.
- Area 4 – Traffic signal at I-35 NB Ramp to US-53 / US-53 SB to I-535 – 27 crashes related to unexpected location and difficult geometry.
- Area 5 – I-535 NB Ramp to I-35 NB – 26 crashes evenly spaced between exit from I-535, ramp, and entrance to I-35 NB.

As part of the preliminary design process, several concepts have been developed that replace aging infrastructure and improve safety within the interchange by eliminating left exits and blind merges, while providing improved areas for weaving and merging. In addition, large portions of mainline I-35 will be converted from bridge structure to fill. These improvements will reduce the potential for crashes within the study area. Alternative C is the preferred alternative being carried forward in the environmental analysis.

The Highway Safety Manual and the FHWA's Crash Modification Factors Clearinghouse were utilized to estimate the expected crash reductions that are possible if Alternative C is implemented. The Crash Modification Factors (CMF) Clearinghouse provides a searchable online database of CMFs along with guidance and resources on using CMFs in road safety practice.

Table 2 on the next page summarizes the estimated crash reduction anticipated in Year 2020 and Year 2040. CMFs were identified for each key interchange area to estimate crash reductions. Crashes within the interchange area are anticipated to be reduced by more than 30%, or 400 fewer crashes over 20 years. It is believed that the 30% reduction is a conservative estimate, and additional benefits may be achieved.

Based on MnDOT's historical crash data (2011-2015), the average crash rate for an Urban Freeway Interchange is 1.15 Crashes/MEV. The proposed interchange improvements will address current design deficiencies, and it is anticipated that the crashes at the proposed interchange will trend down from the current 2.08 Crashes/MEV toward the average crash rate for urban freeway interchanges. If the interchange's crash rate meets the average rate, the **reduction in crashes in the interchange could reach over 40%**.

It should be noted that the crash reduction focused on the TPI interchange, and not the approaching roadway segments on I-35, I-535, and US-53 shown previously in Table 1. It is anticipated that crashes will be reduced at a lower rate in these areas, since the geometric changes are not as significant and closer to matching existing conditions.

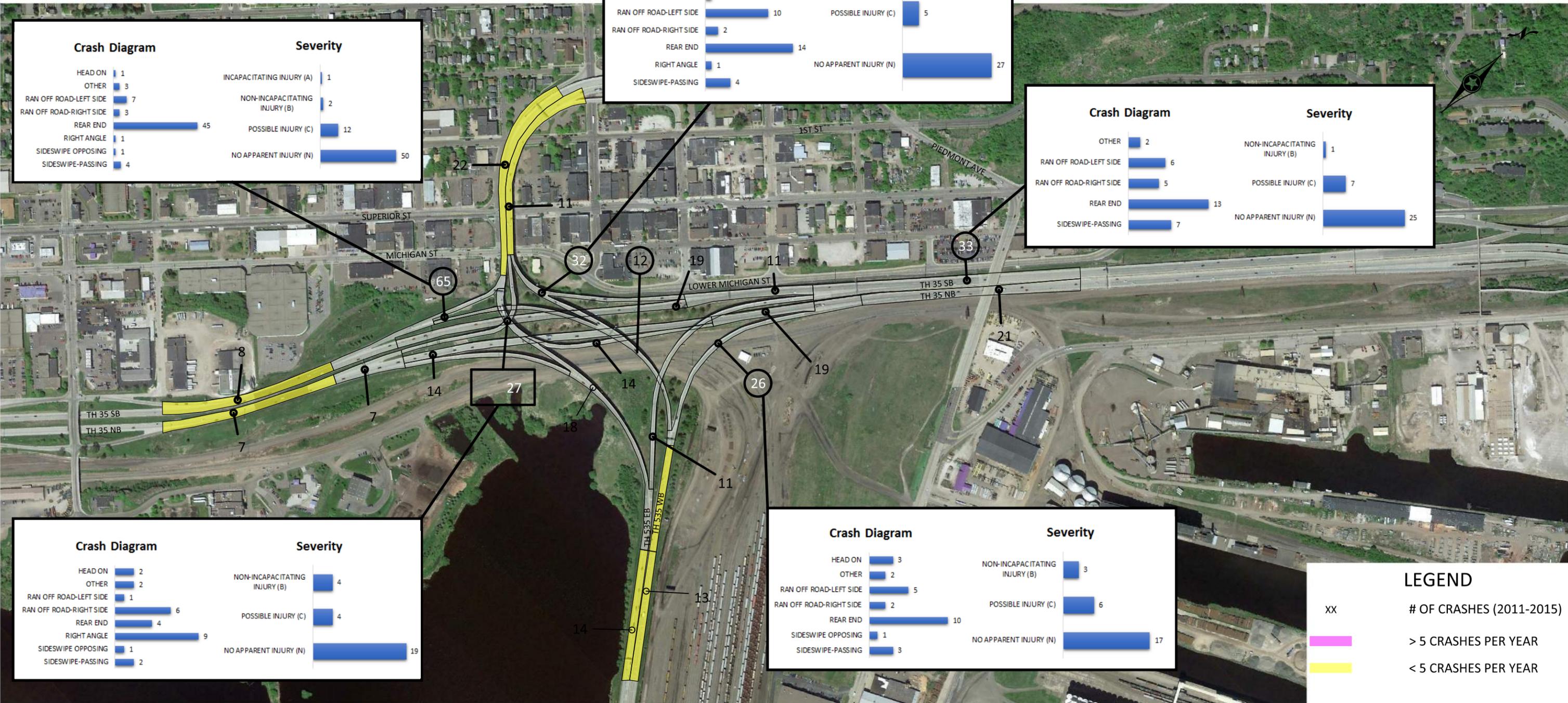


Table 2
Estimated Crash Reduction

Area No.	Location	Total Crashes (2011-2015)	Average Yearly Crashes	Alternative C Improvement	Alt. C Crash Modification Factor	2020 Estimated Total Crashes No-Build	2020 Estimated Crashes, Alt. C	Estimated Crash Reduction	2040 Total Crashes No-Build	2040 Estimated Crashes, Alt. C	Estimated Crash Reduction
1	SB US-53 Ramp to SB I-35 (including jct. w/I-535 ramp)	65	13	Remove Blind Merge, Fix Vertical Grade, But Add 2nd entrance to freeway	0.77	14	11	3	16	12	4
2	SB I-35 Ramp to US-53, and Jct with I-535 NB and I-35 NB ent. Ramps	36	7	Revise lane geometry, remove merge condition	0.64	8	5	3	9	6	3
3	I-35 Southbound from TH 194 to I-535 SB exit ramp to US-53 off-ramp	33	7	Move Exit from Left to Right, improve weaving and merging	0.70	7	5	2	8	6	2
4	Traffic Signal I-35 NB ramp to US-53 NB / US-53SB to I-535	27	5	Install Signal in Expected Location, Use Avg. Crash Rate for improvement	0.35	6	2	4	7	2	5
5	I-535 NB Ramp to I-35 NB	26	5	Improve accel/decel lanes	0.64	6	4	2	6	4	2
6	I-35 NB from 27th Avenue to US-53/I-535 Exit	14	3	Move Exit from Left to Right	0.70	3	2	1	3	2	1
7	NB I-35 and SB US-53 ramps to I-535	18	4	Remove Blind Merge	0.80	4	3	1	4	3	1
8	I-35 Mainline	31	6	Mainline moves from Structures to Fill, improved performance under wet conditions	0.80	7	6	1	8	6	2
9	Other Ramps	25	5	Improved Grades, Accel, Decel, sight distance	0.80	5	4	1	6	5	1
	TOTALS	275	55			60	42	18	67	46	21
<i>Estimated Reduction in Crashes in these areas</i>											31%

Appendix A

- Table A-1 Crash Summary by Element
- Element Maps for Twin Ports Interchange

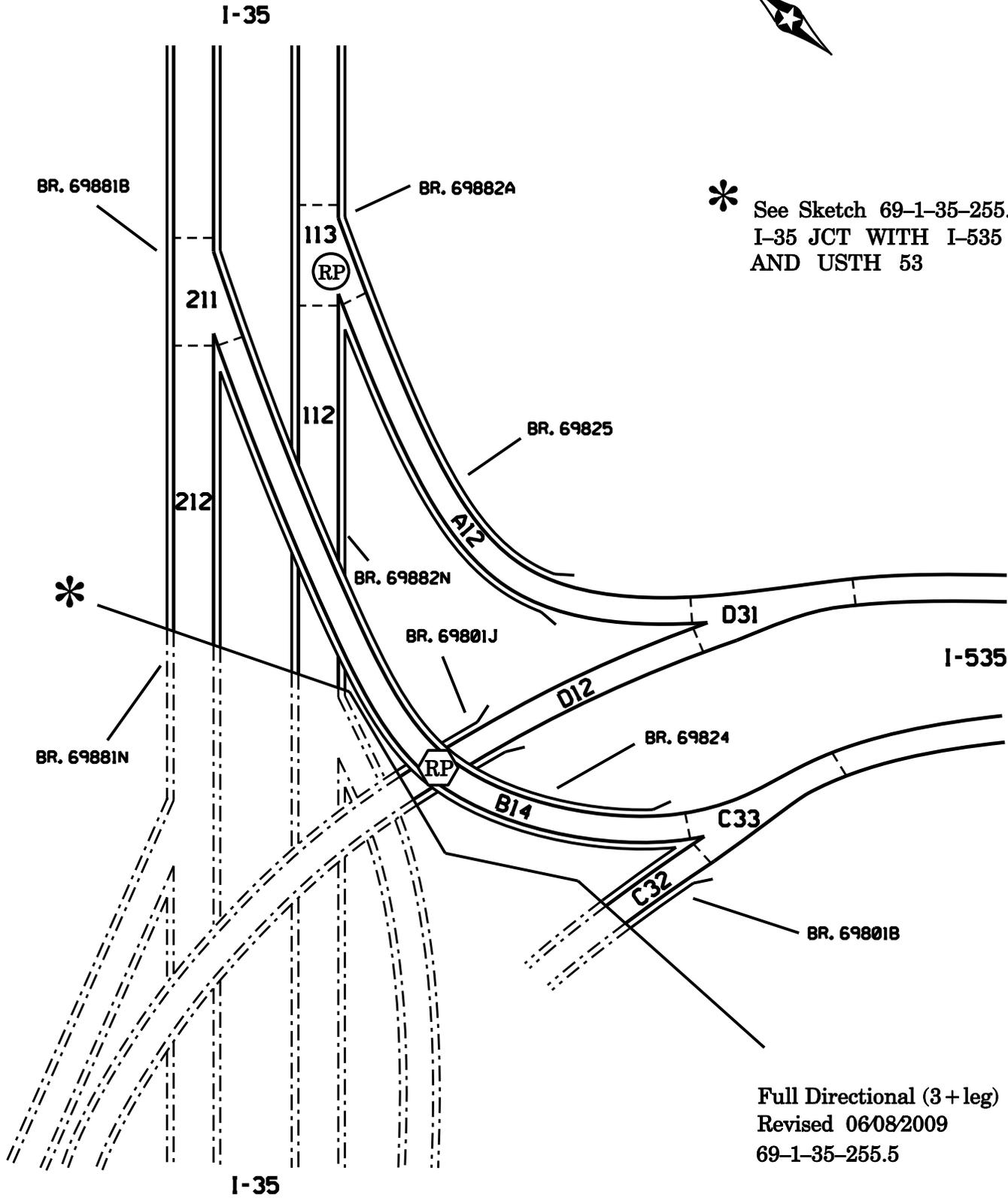
Table A-1
Crash Summary by Interchange Element

Route	Direction	Location	Element	Total Crashes (2011-2015)	Severity				
					K	A	B	C	N
Mainline Segments Outside of TPI									
35	NB	Mainline - 27th Avenue to TPI	n/a	7				1	6
35	NB	Mainline - TPI to TH 194	n/a	21			6	2	13
35	SB	Mainline - TH 194 to TPI	n/a	25				4	21
35	SB	Mainline - TPI to 27th Avenue	n/a	8				1	7
53	SB	Mainline - 20th Ave W/21st Ave West to TPI	n/a	22			2	2	18
53	NB	Mainline - TPI to 20th Ave W/21st Ave West	n/a	11			1	2	8
535	SB	Mainline - TPI to Garfield	n/a	14				2	12
535	NB	Mainline - Garfield to TPI	n/a	13			1	1	11
TPI Interchange - Northbound Elements									
35	NB	TPI - Mainline Jct. with exit ramps to US-53 NB and I-535 SB	101	7				1	6
35	NB	TPI - Mainline	102	14			2	1	11
35	NB	TPI - Mainline Jct. with US-53 SB entrance ramp	103	4				1	3
35	NB	TPI - Mainline	112	7			1		6
35	NB	TPI - Mainline Jct. with I-535 NB entrance ramp	113	9			1	2	6
35	NB	TPI Ramp - I-35 NB to US-53 NB	A14	1					1
35	NB	TPI Ramp - I-35 NB to US-53 NB	A24	0					
35	NB	TPI Ramp - I-35 NB to I-535 SB	A04	2					2
535	NB	TPI - Mainline Jct. with exits to I-35 and US-53 NB	D31	10			1	3	6
535	NB	TPI Ramp - I-535 NB to I-35 NB	A12	7			1	1	5
535	NB	TPI Ramp - I-535 NB to US-53 NB and I-35 SB	D12	2				1	1
535	NB	TPI Ramp - I-535 NB to US-53 NB and I-35 SB	D21	7					7
535	NB	TPI Ramp - I-535 NB to I-35 SB	B05	4					4
53	NB	TPI - Mainline Jct with I-35SB, I-535 NB and I-35 NB ent. Ramps	D23	18				4	14
TPI Interchange - Southbound Elements									
35	SB	TPI - Mainline Jct. with I-535 SB exit ramp	211	8			1	3	4
35	SB	TPI - Mainline	212	7				2	5
35	SB	TPI - Mainline Jct. with US-53 NB exit ramp	201	4					4
35	SB	TPI - Mainline	202	19				2	17
35	SB	TPI - Mainline Jct. with US-53 SB entrance ramp	203	12			1	3	8
35	SB	TPI Ramp - I-35 SB to I-535 SB	B14	11				3	8
35	SB	TPI Ramp - I-35 SB to US-53 NB	B04	14				1	13
53	SB	TPI - Mainline Jct. with I-535 SB and I-35 SB exit ramps	C21	12			1	2	9
53	SB	TPI Ramp - US-53 SB to I-35 SB	C05	18		1		3	14
53	SB	TPI Ramp - US-53 SB to I-35 SB Jct. with I-535 NB	B23	23				4	19
53	SB	TPI Ramp - US-53 SB to I-535 SB	C12	3			1		2
53	SB	TPI Ramp - US-53 SB to I-535 SB	C22	1					1
53	SB	TPI Ramp - Jct. withh NB I-35 exit	C31	4					4
53	SB	TPI Ramp - US-53 SB to I-35 NB	A05	6			1	2	3
535	SB	TPI Mainline - Merge I-35 NB and US 53 SB	C23	6				2	4
535	SB	TPI Mainline	C32	7					7
535	SB	TPI Mainline Jct. with I-35 SB entr. Ramp	C33	3					3
N/A	n/a	Traffic Signal I-35 NB ramp to US-53 NB / US-53SB to I-535	C52	23			3	4	16
TOTALS									
TOTAL CRASHES (2011-2015)				394	0	1	24	60	309
AVERAGE PER YEAR				79	0	1	4	12	62
ESTIMATED CRASHES 2020 (1.07 FACTOR)				85	0	1	4	13	67
ESTIMATED CRASHES 2040 (1.24 FACTOR)				98	0	1	5	15	77

I-35 JCT WITH I-535

ST. LOUIS CO. 69
 DULUTH 1040
 PS 2730

I-35 100's USE $\textcircled{\text{RP}}$ = 255 + 00.541
 I-535 C&D's USE $\textcircled{\text{RP}}$ = 001 + 00.490



* See Sketch 69-1-35-255.2
 I-35 JCT WITH I-535
 AND USTH 53

Full Directional (3 + leg)
 Revised 06/08/2009
 69-1-35-255.5

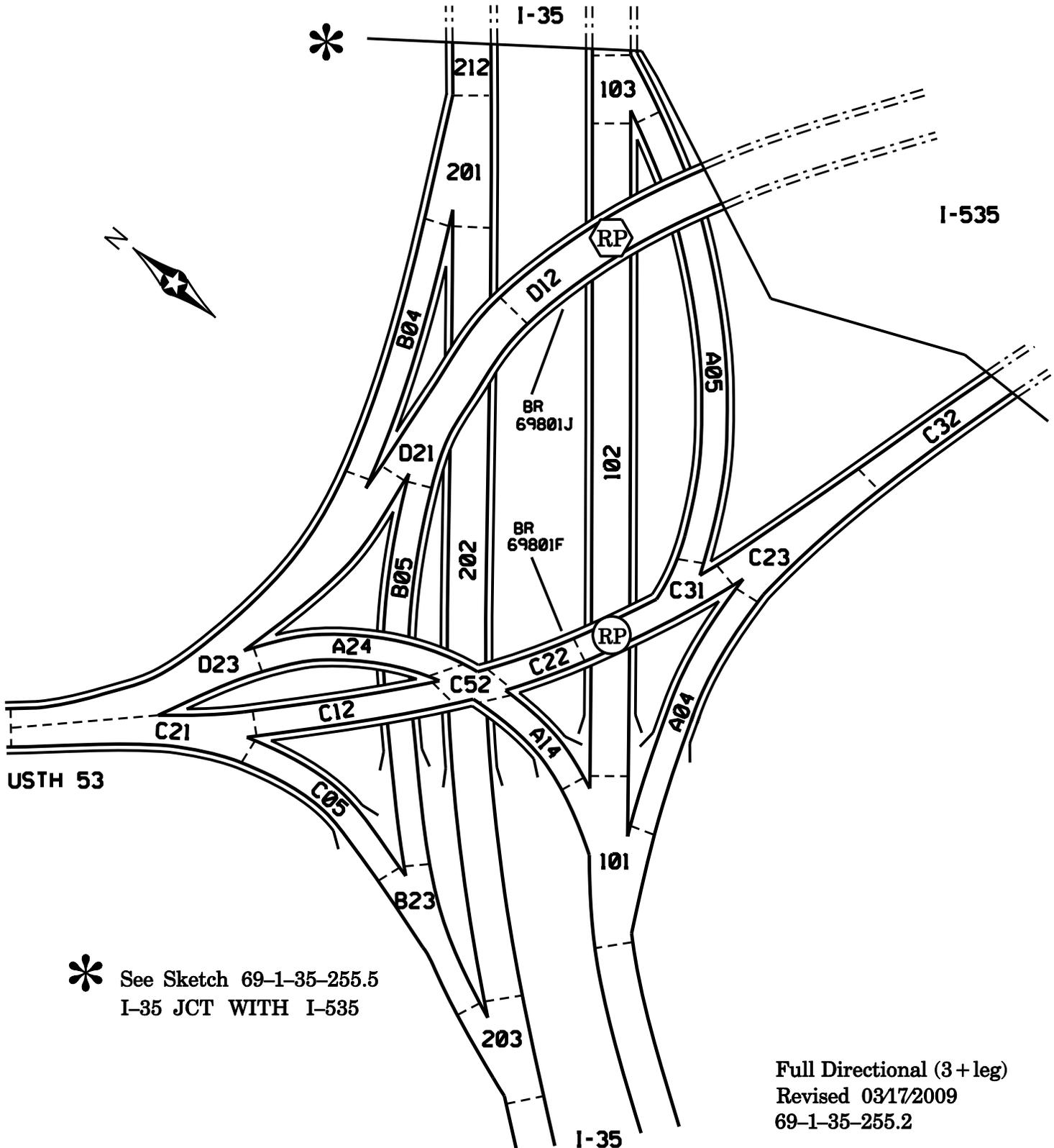
I-35 JCT WITH I-535 AND USTH 53

ST LOUIS CO 69
 DULUTH 1040
 PS 2730

I-35 100's USE $\textcircled{\text{RP}}$ = 255+00.236 $\text{\textcircled{RP}}$ = 255+00.318
 200's
 A&B's

USTH 53 C&D's USE $\textcircled{\text{RP}}$ = 001+00.541

I-535 C's USE $\text{\textcircled{RP}}$ = 001+00.571



* See Sketch 69-1-35-255.5
 I-35 JCT WITH I-535

Full Directional (3 + leg)
 Revised 03/17/2009
 69-1-35-255.2