I-10 DCR Predictive Safety Analysis Appendix

AADT Volumes

Figure 2-20. 2050 Build Alternative 3 Volumes and Lane Configuration
(Sheet 1 of 5)

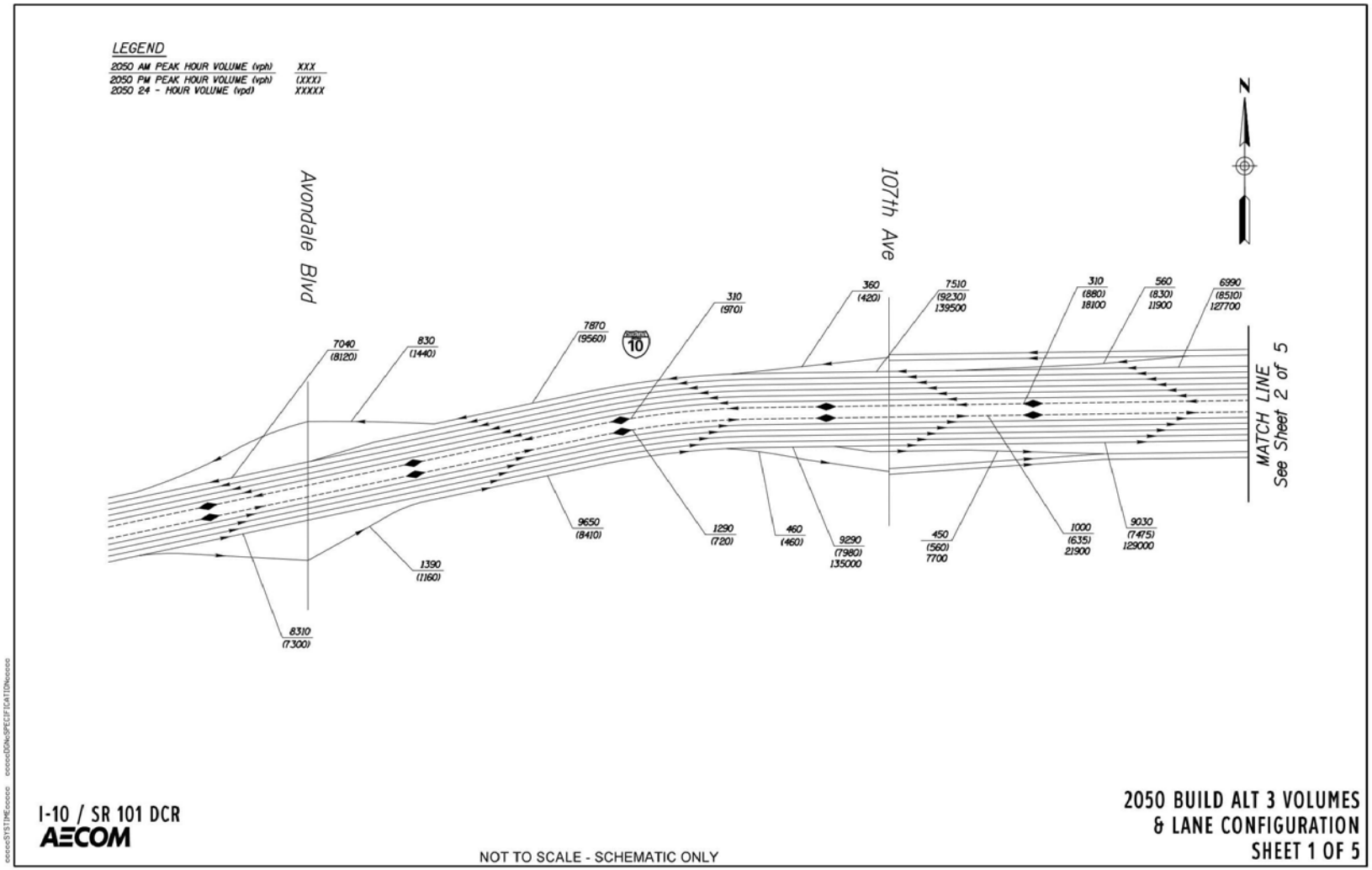

Figure 2-20. 2050 Build Alternative 3 Volumes and Lane Configuration
(Sheet 2 of 5)

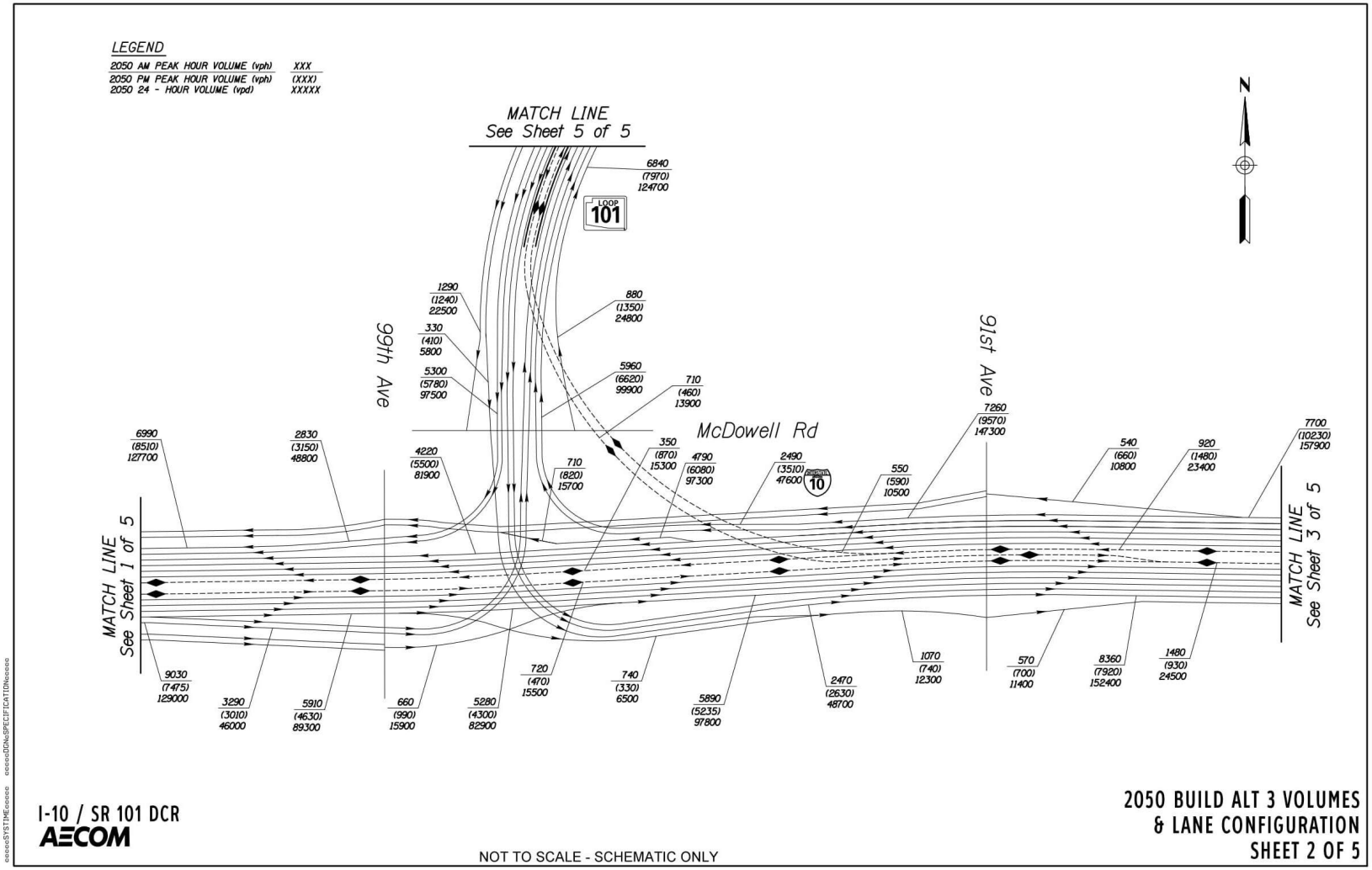

Figure 2-20. 2050 Build Alternative 3 Volumes and Lane Configuration
(Sheet 3 of 5)

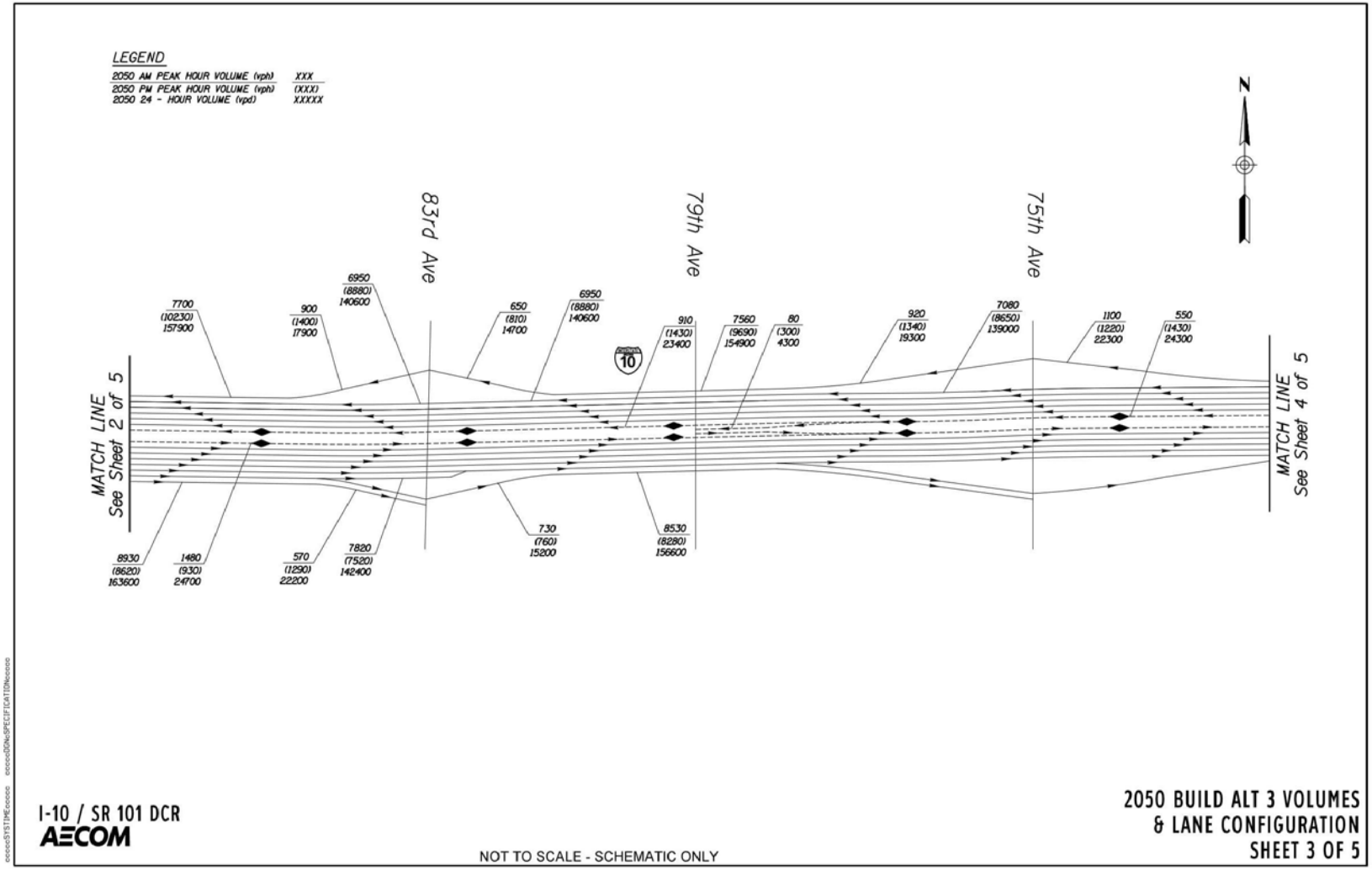

Figure 2-20. 2050 Build Alternative 3 Volumes and Lane Configuration
(Sheet 4 of 5)

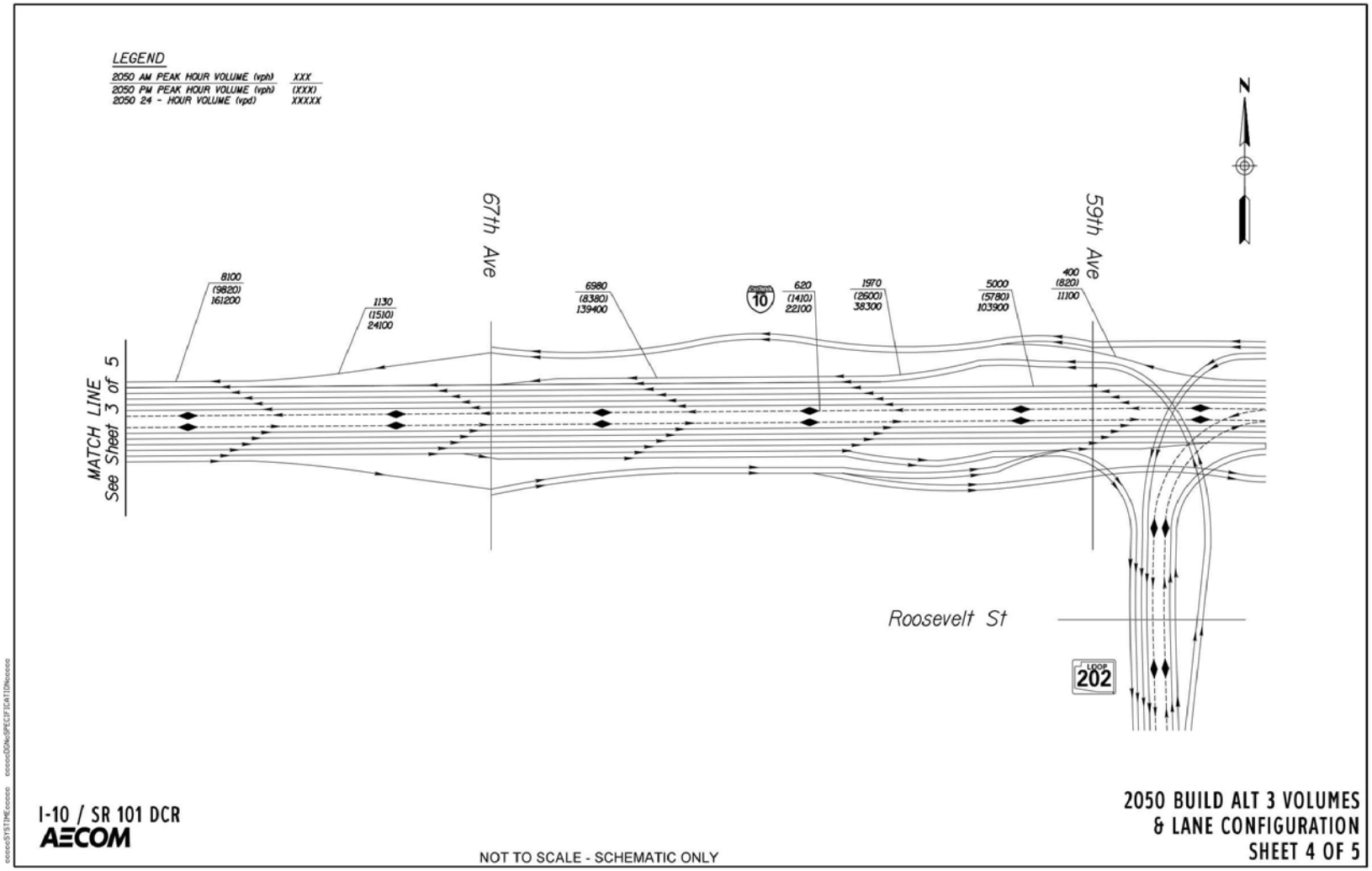

Figure 2-20. 2050 Build Alternative 3 Volumes and Lane Configuration
(Sheet 5 of 5)

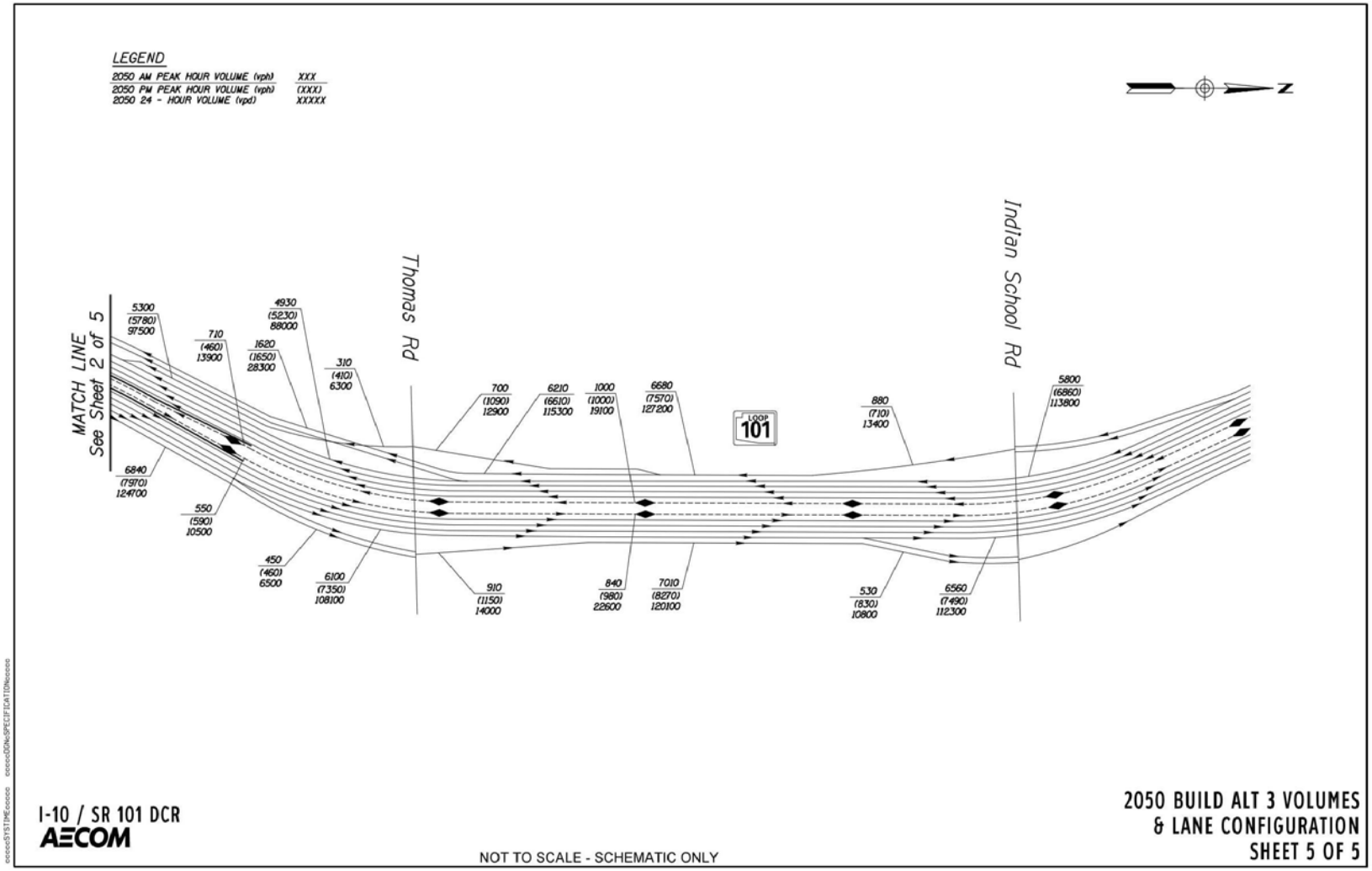

Figure 2-21. 2050 Build Alternative 4 Volumes and Lane Configuration
(Sheet 1 of 5)

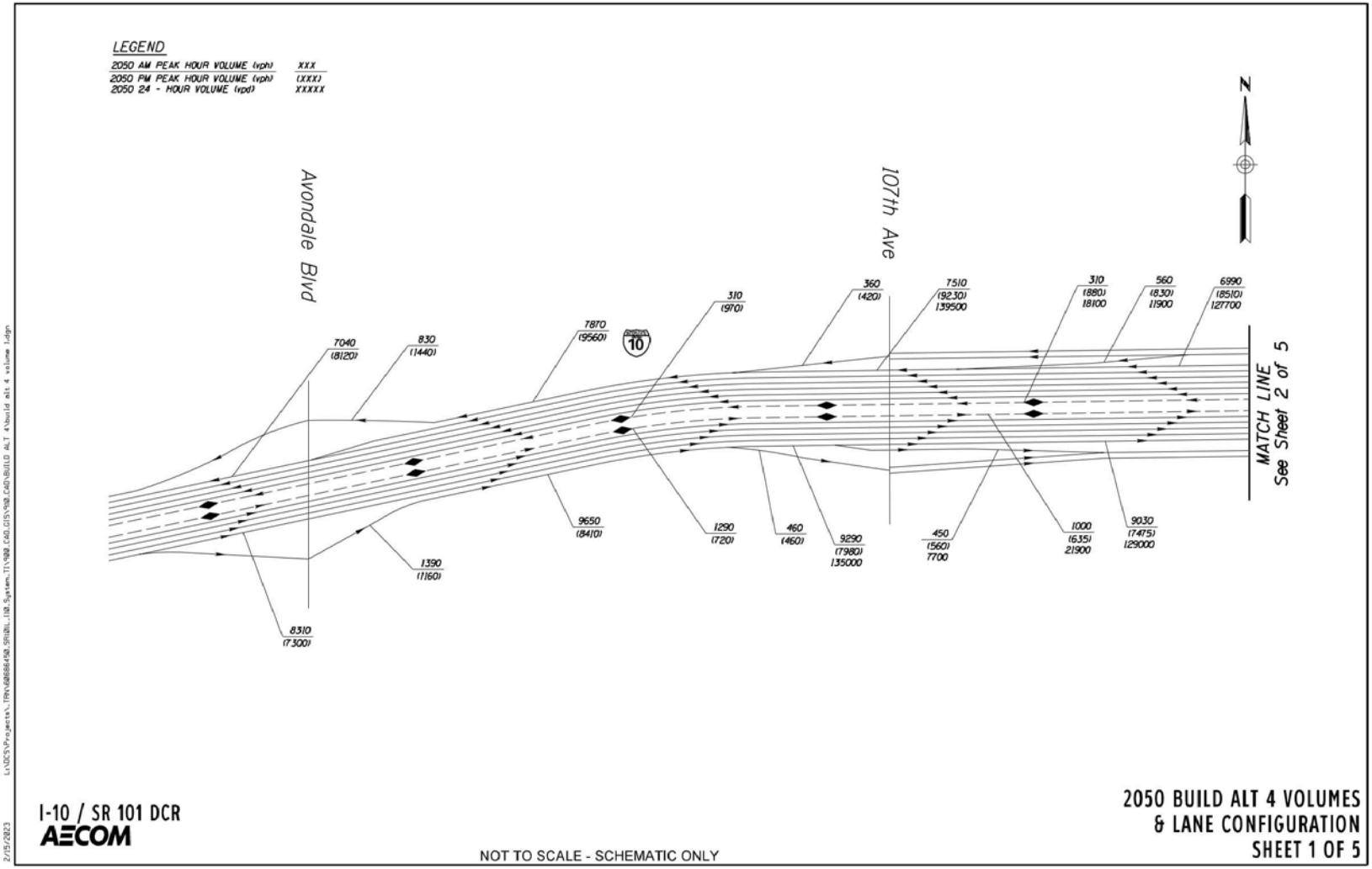

Figure 2-21. 2050 Build Alternative 4 Volumes and Lane Configuration
(Sheet 2 of 5)

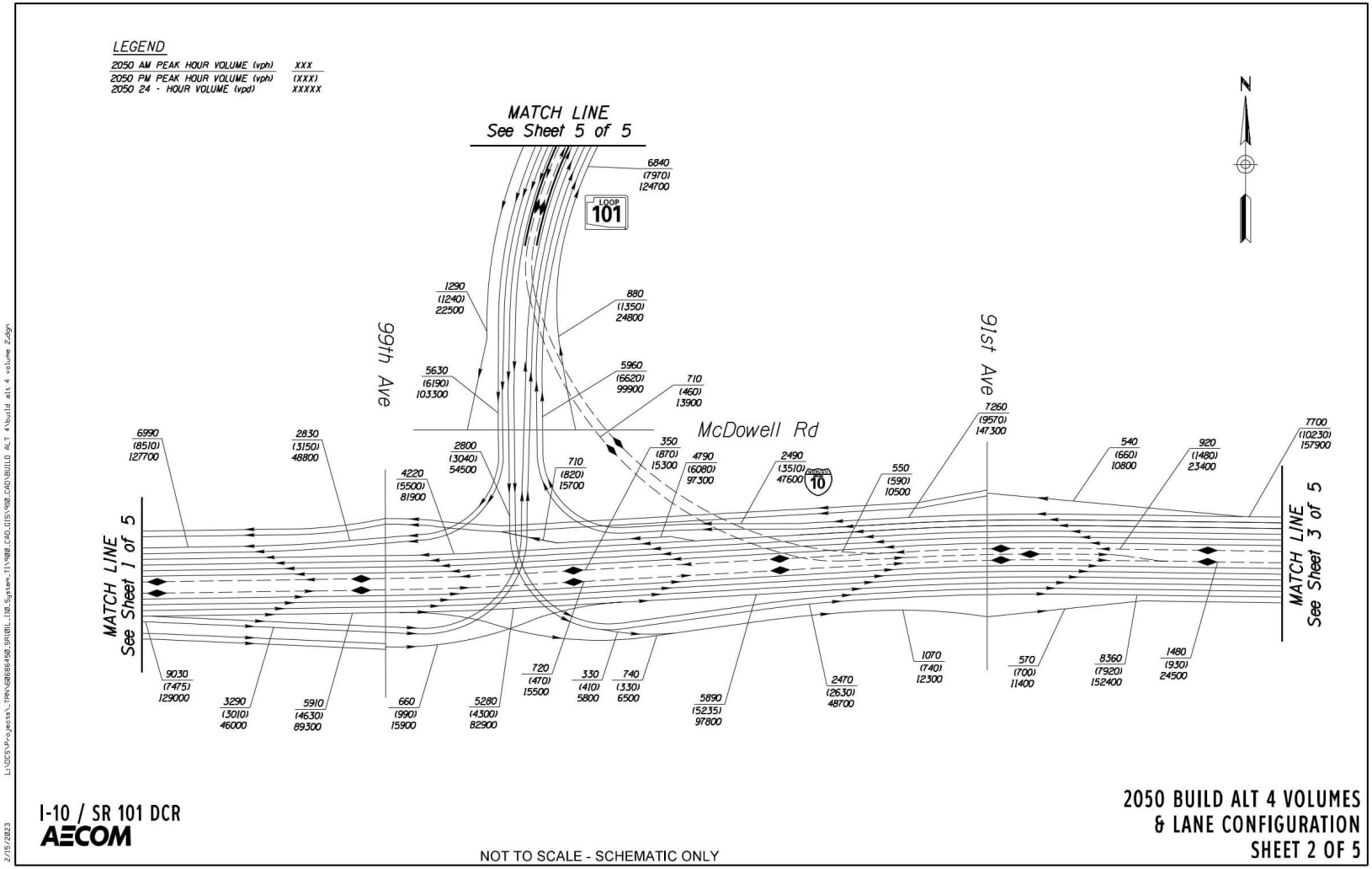

Figure 2-21. 2050 Build Alternative 4 Volumes and Lane Configuration
(Sheet 3 of 5)

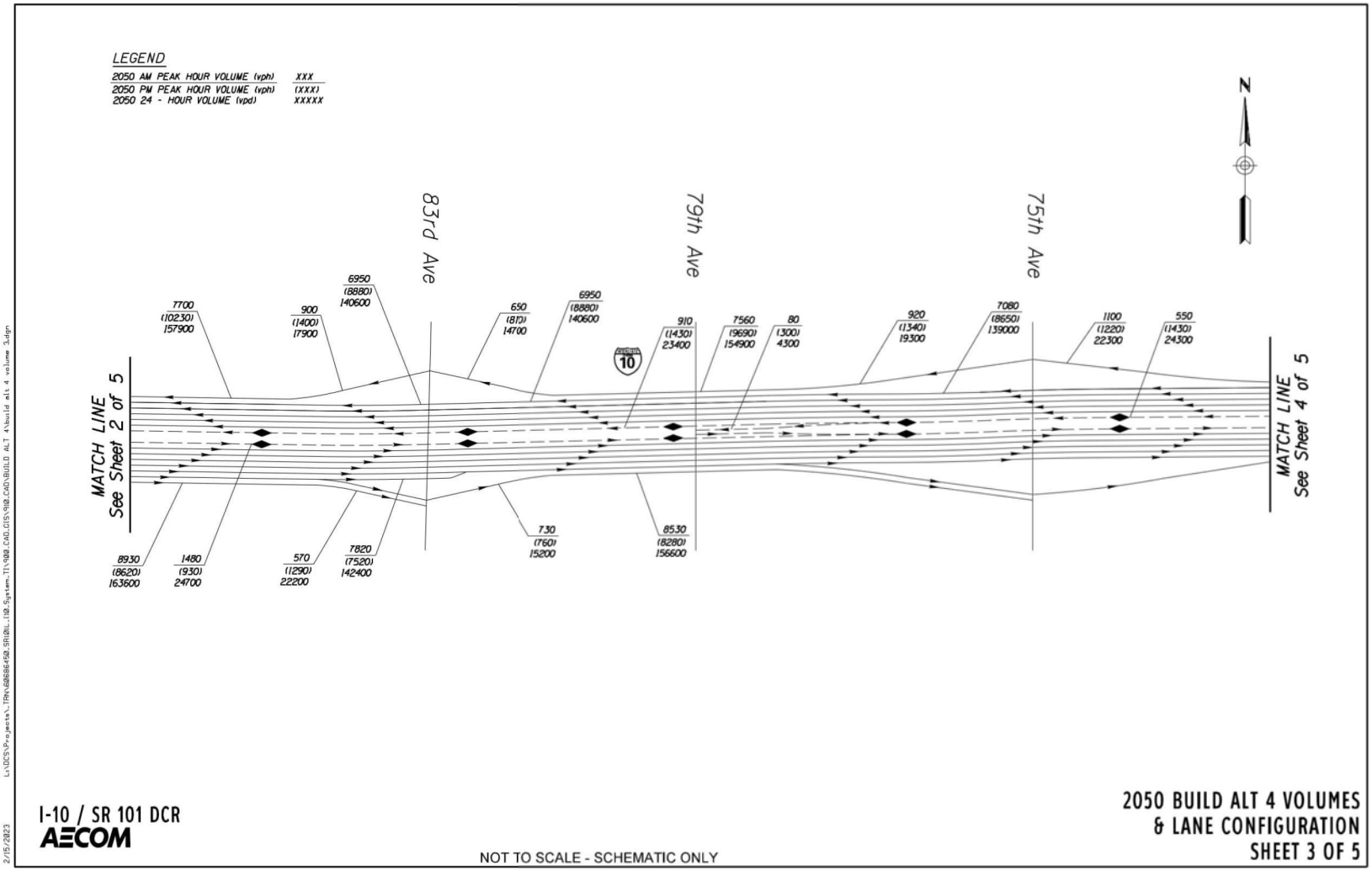

Figure 2-21. 2050 Build Alternative 4 Volumes and Lane Configuration
(Sheet 4 of 5)

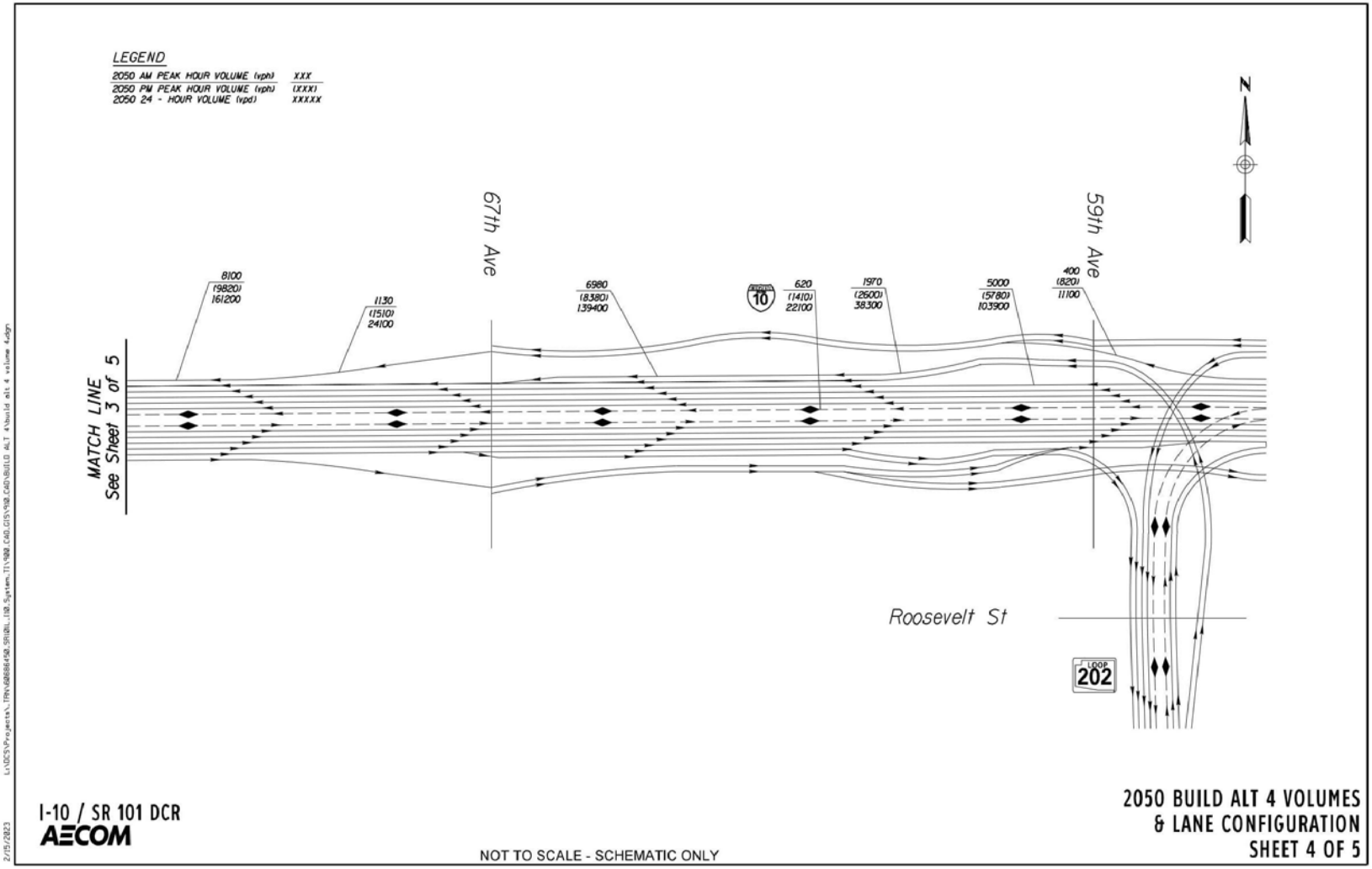

Figure 2-21. 2050 Build Alternative 4 Volumes and Lane Configuration
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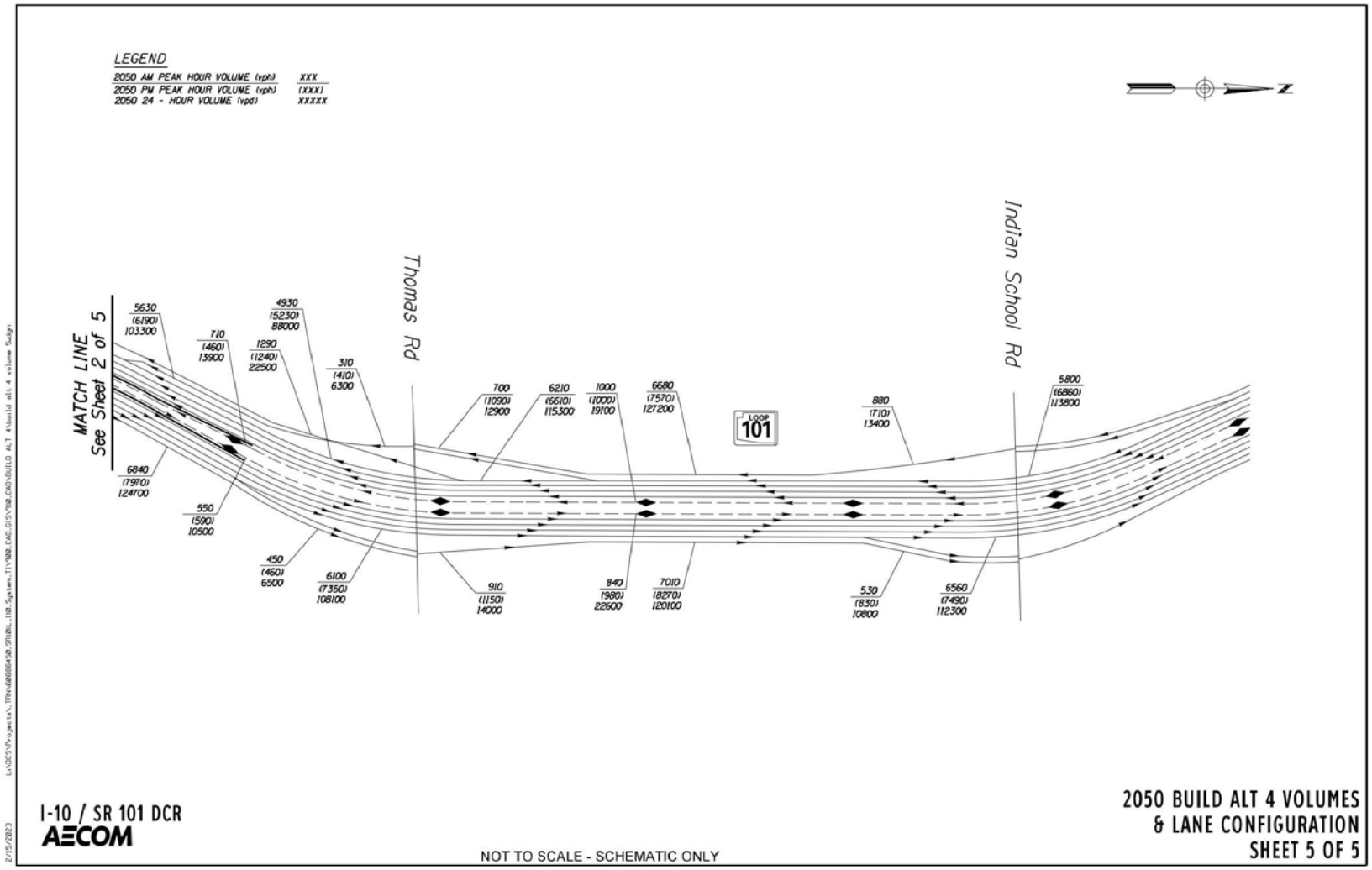

Alternative 3

Extended 91st Connector Ramp

IHSDM Analysis Results

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

March 22, 2023

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Report Overview

Report Generated: Mar 22, 2023 12:11 PM
Report Template: System: Single Page [System] (mlcpm3, Mar 7, 2023 12:48 PM)

Evaluation Date: Wed Mar 22 12:11:25 MST 2023
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: Jordan Rae Aguirre
Organization Name: Jacobs Engineering
Phone: 5307019417
E-Mail: jordanrae.aguirre@jacobs.com

Project Title: I-10/101L - Alternatives Analysis - Extended 91st Ave Ramp
Project Comment: Created using wizard
Project Unit System: U.S. Customary

Highway Title: Alignment Median SR 101
Highway Comment: Imported from Median SR 101.xml
Highway Version: 2

Evaluation Title: Evaluation 14
Evaluation Comment: Created Wed Mar 22 12:04:46 MST 2023

Minimum Location: 138+40.440
Maximum Location: 236+00.000

Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration

First Year of Analysis: 2050
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

Disclaimer Regarding Crash Prediction Method

IMPORTANT NOTICE ABOUT COMPARING RESULTS FROM HIGHWAY SAFETY MANUAL FIRST EDITION (2010) MODELS TO RESULTS FROM NEW MODELS DEVELOPED UNDER NCHRP PROJECTS 17-70, 17-58, AND 17-68

Since the publication of the Highway Safety Manual - First Edition (HSM-1), in 2010 by the American Association of State Highway and Transportation Officials (AASHTO), multiple research efforts have been undertaken through the National Cooperative Highway Research Program (NCHRP) to develop safety performance models for road segment and intersection facility types that were not initially reflected in the HSM-1, in order to expand the breadth and depth of the HSM in the future.

The IHSDM Crash Prediction Module (CPM) is intended as a faithful implementation of HSM Part C predictive methods. As NCHRP projects to develop new predictive methods for the HSM are completed, FHWA works to incorporate the new methods into IHSDM, sometimes in advance of publication in the HSM. The following new crash predictive methods have been accepted by NCHRP project panels and incorporated into IHSDM, while pending AASHTO's approval for incorporation into a future edition of the HSM:

- Roundabouts: completed in 2018 under NCHRP Project 17-70, the new methods will provide improved outcomes for the safety analysis of roundabouts.
- 6+ lane and one-way urban/suburban arterials (including models for segments and intersections): completed under NCHRP Project 17-58.
- Intersection crash prediction methods for some intersection configurations and traffic control types not currently addressed in the HSM (e.g., all-way stop; rural 3-leg signalized; 3-leg stop-controlled where the major leg turns; urban 5-leg signalized; urban high-speed intersections): completed in 2021 under NCHRP Project 17-68.

However, in the absence of local calibration factors (see HSM-1 Part C, Appendix A for guidance on calibration of the predictive models), it is neither appropriate nor advisable to directly compare the results from new models (from NCHRP Projects 17-58, 17-68, and 17-70) to results from HSM-1 models, as the models were not calibrated to the same base state data sets, and consequently can produce unexpected results. If local calibration factors are available and applied to both new models and HSM-1 models, then it may be appropriate to directly compare the results.*[Note: Work being performed under NCHRP Project 17-72 (Update of Crash Modification Factors for the Highway Safety Manual) is expected to re-calibrate many of the old (HSM-1) and new (e.g., NCHRP 17-70) models to data from a single (or small number of) states, that would allow results from all models to be directly compared.]*

The models produced for NCHRP Project 17-70 have independent value in terms of informing the design of a roundabout and assessing the effects of different design characteristics on the expected safety performance of a roundabout.

The HSM-1 interim method previously included in IHSDM for evaluating roundabouts on urban/suburban arterials (i.e., evaluating an existing intersection and then applying a Crash Modification Factor for replacing the existing intersection with a roundabout) has been deactivated in IHSDM, to minimize any confusion with the new roundabout methodology.

Section Types

Section 2 Evaluation

Section: Section 2
Evaluation Start Location: 138+40.440
Evaluation End Location: 236+00.000
Functional Class: Freeway
Type of Alignment: Divided, Multilane
Model Category: Freeway Segment
Calibration Factor: FI_EN=1.0; FI_EX=1.0; FI_MV=1.0; FI_SV=1.0; PDO_EN=1.0; PDO_EX=1.0; PDO_MV=1.0; PDO_SV=1.0;

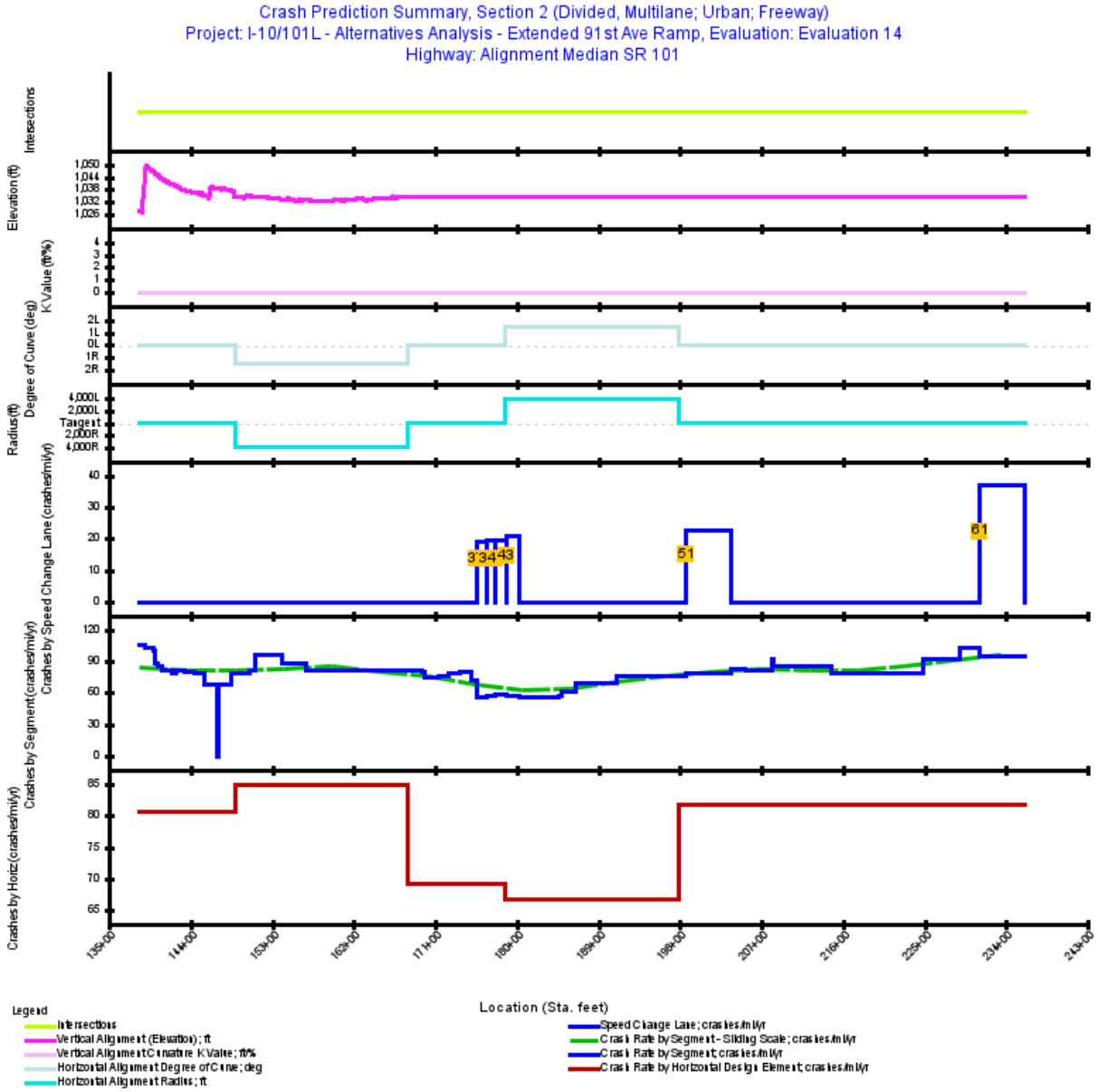

Figure 1. Crash Prediction Summary (Section 2)

Table 1. Evaluation Freeway - Homogeneous Segments (Section 2)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT	Median Width (ft)	Type	Effective Median Width (ft)
1	Four-lane Freeway	Urban	138+40.440	138+91.440	51.00	0.0097	2050: 197,400	41.71	Non-Traversable Median	56.96
2	Four-lane Freeway	Urban	138+91.440	139+84.440	93.00	0.0176	2050: 197,400	43.73	Non-Traversable Median	59.69
3	Four-lane Freeway	Urban	139+84.440	139+91.440	7.00	0.0013	2050: 197,400	45.12	Non-Traversable Median	61.58
4	Four-lane Freeway	Urban	139+91.440	140+07.440	16.00	0.0030	2050: 197,400	45.45	Non-Traversable Median	62.01
5	Six-lane Freeway	Urban	140+07.440	140+43.440	36.00	0.0068	2050: 197,400	46.17	Non-Traversable Median	63.00
6	Six-lane Freeway	Urban	140+43.440	140+91.440	48.00	0.0091	2050: 197,400	47.35	Non-Traversable Median	64.59
7	Six-lane Freeway	Urban	140+91.440	141+92.440	101.00	0.0191	2050: 197,400	49.43	Non-Traversable Median	67.41
8	Six-lane Freeway	Urban	141+92.440	142+46.440	54.00	0.0102	2050: 197,400	51.60	Non-Traversable Median	70.34
9	Six-lane Freeway	Urban	142+46.440	142+70.440	24.00	0.0045	2050: 197,400	52.69	Non-Traversable Median	72.81
10	Six-lane Freeway	Urban	142+70.440	143+41.440	71.00	0.0134	2050: 197,400	54.01	Non-Traversable Median	75.63
11	Six-lane Freeway	Urban	143+41.440	144+40.440	99.00	0.0187	2050: 197,400	56.39	Non-Traversable Median	78.88
12	Six-lane Freeway	Urban	144+40.440	145+47.440	107.00	0.0203	2050: 197,400	59.27	Non-Traversable Median	82.83
13	Eight-lane Freeway	Urban	145+47.440	146+07.400	59.96	0.0114	2050: 197,400	61.60	Non-Traversable Median	86.03
14	Eight-lane Freeway	Urban	146+07.400	146+58.500	51.10	0.0097	2050: 197,400	63.16	Non-Traversable Median	87.50
15	Eight-lane Freeway	Urban	146+58.500	146+99.440	40.94	0.0078	2050: 197,400	64.44	Non-Traversable Median	87.96
16	Eight-lane Freeway	Urban	146+99.440	147+04.440	5.00	0.0009	2050: 197,400	65.09	Non-Traversable Median	88.13
17	Eight-lane Freeway	Urban	147+04.440	147+52.560	48.12	0.0091	2050: 197,400	65.83	Non-Traversable Median	88.33
18	Eight-lane Freeway	Urban	147+52.560	148+46.440	93.88	0.0178	2050: 197,400	67.81	Non-Traversable Median	89.85
19	Eight-lane Freeway	Urban	148+46.440	150+57.440	211.00	0.0400	2050: 197,400	72.08	Non-Traversable Median	94.22
20	Eight-lane Freeway	Urban	150+57.440	151+11.980	54.54	0.0103	2050: 197,400	75.79	Non-Traversable Median	98.03
21	Eight-lane Freeway	Urban	151+11.980	154+14.440	302.46	0.0573	2050: 222,200	80.78	Non-Traversable Median	103.14
22	Eight-lane Freeway	Urban	154+14.440	156+77.440	263.00	0.0498	2050: 222,200	88.68	Non-Traversable Median	111.25
23	Eight-lane Freeway	Urban	156+77.440	157+72.440	95.00	0.0180	2050: 222,200	93.69	Non-Traversable Median	116.38
24	Eight-lane Freeway	Urban	157+72.440	161+30.440	358.00	0.0678	2050: 222,200	100.02	Non-Traversable Median	122.88
25	Eight-lane Freeway	Urban	161+30.440	161+52.440	22.00	0.0042	2050: 222,200	105.33	Non-Traversable Median	128.32

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT	Median Width (ft)	Type	Effective Median Width (ft)
26	Eight-lane Freeway	Urban	161+52.440	161+94.440	42.00	0.0080	2050: 222,200	105.72	Non-Traversable Median	128.33
27	Eight-lane Freeway	Urban	161+94.440	164+83.440	289.00	0.0547	2050: 222,200	99.98	Non-Traversable Median	123.12
28	Eight-lane Freeway	Urban	164+83.440	169+45.440	462.00	0.0875	2050: 222,200	87.66	Non-Traversable Median	113.39
29	Eight-lane Freeway	Urban	169+45.440	169+84.440	39.00	0.0074	2050: 222,200	84.77	Non-Traversable Median	108.35
30	Nine-lane Freeway	Urban	169+84.440	170+94.370	109.93	0.0208	2050: 222,200	83.91	Non-Traversable Median	107.54
31	Nine-lane Freeway	Urban	170+94.370	171+35.440	41.07	0.0078	2050: 222,200	83.04	Non-Traversable Median	106.37
32	Nine-lane Freeway	Urban	171+35.440	172+54.440	119.00	0.0225	2050: 222,200	82.12	Non-Traversable Median	104.10
33	Nine-lane Freeway	Urban	172+54.440	173+73.440	119.00	0.0225	2050: 222,200	80.74	Non-Traversable Median	100.73
34	Nine-lane Freeway	Urban	173+73.440	174+92.440	119.00	0.0225	2050: 222,200	79.37	Non-Traversable Median	97.37
35	Nine-lane Freeway	Urban	174+92.440	175+53.460	61.02	0.0116	2050: 222,200	78.33	Non-Traversable Median	86.82
36	Eight-lane Freeway	Urban	175+53.460	176+70.440	116.98	0.0222	2050: 196,100	76.47	Non-Traversable Median	76.47
38	Eight-lane Freeway	Urban	176+70.440	177+66.440	96.00	0.0182	2050: 196,100	73.77	Non-Traversable Median	73.77
40	Eight-lane Freeway	Urban	177+66.440	178+82.440	116.00	0.0220	2050: 196,100	71.07	Non-Traversable Median	71.07
42	Eight-lane Freeway	Urban	178+82.440	180+25.440	143.00	0.0271	2050: 196,100	67.78	Non-Traversable Median	67.78
44	Eight-lane Freeway	Urban	180+25.440	180+64.440	39.00	0.0074	2050: 196,100	65.47	Non-Traversable Median	65.47
45	Eight-lane Freeway	Urban	180+64.440	184+57.440	393.00	0.0744	2050: 196,100	59.98	Non-Traversable Median	59.98
46	Eight-lane Freeway	Urban	184+57.440	184+96.790	39.35	0.0075	2050: 196,100	54.49	Non-Traversable Median	54.49
47	Seven-lane Freeway	Urban	184+96.790	186+54.440	157.65	0.0299	2050: 196,100	51.99	Non-Traversable Median	44.50
48	Seven-lane Freeway	Urban	186+54.440	190+97.440	443.00	0.0839	2050: 196,100	25.00	Non-Traversable Median	28.46
49	Seven-lane Freeway	Urban	190+97.440	198+69.900	772.46	0.1463	2050: 196,100	3.00	Non-Traversable Median	21.93
50	Seven-lane Freeway	Urban	198+69.900	203+60.970	491.07	0.0930	2050: 196,100	3.00	Non-Traversable Median	21.94
52	Eight-lane Freeway	Urban	203+60.970	205+18.440	157.47	0.0298	2050: 223,400	3.00	Non-Traversable Median	21.94
53	Eight-lane Freeway	Urban	205+18.440	208+13.580	295.14	0.0559	2050: 223,400	3.00	Non-Traversable Median	21.95
54	Eight-lane Freeway	Urban	208+13.580	208+29.440	15.86	0.0030	2050: 223,400	3.00	Non-Traversable Median	21.95
55	Eight-lane Freeway	Urban	208+29.440	214+67.440	638.00	0.1208	2050: 223,400	3.00	Non-Traversable Median	21.95
56	Eight-lane Freeway	Urban	214+67.440	224+85.540	1,018.10	0.1928	2050: 223,400	3.00	Non-Traversable Median	21.97

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT	Median Width (ft)	Type	Effective Median Width (ft)
57	Eight-lane Freeway	Urban	224+85.540	228+92.450	406.91	0.0771	2050: 247,300	3.00	Non-Traversable Median	21.98
58	Seven-lane Freeway	Urban	228+92.450	231+12.440	219.99	0.0417	2050: 247,300	3.00	Non-Traversable Median	21.98
60	Seven-lane Freeway	Urban	231+12.440	236+00.000	487.56	0.0923	2050: 226,100	3.00	Non-Traversable Median	21.99

Table 2. Evaluation Freeway - Speed Change Lanes (Speed Change)

Seg. No.	Type	Ramp Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT	Median Width (ft)	Type	Effective Median Width (ft)
37	Eight-lane Freeway Speed Change	Entrance	175+53.460	176+70.440	116.98	0.0222	2050: 196,100	76.47	Non-Traversable Median	76.47
39	Eight-lane Freeway Speed Change	Entrance	176+70.440	177+66.440	96.00	0.0182	2050: 196,100	73.77	Non-Traversable Median	73.77
41	Eight-lane Freeway Speed Change	Entrance	177+66.440	178+82.440	116.00	0.0220	2050: 196,100	71.07	Non-Traversable Median	71.07
43	Eight-lane Freeway Speed Change	Entrance	178+82.440	180+24.760	142.32	0.0270	2050: 196,100	67.79	Non-Traversable Median	67.79
51	Seven-lane Freeway Speed Change	Exit	198+69.900	203+60.970	491.07	0.0930	2050: 196,100	3.00	Non-Traversable Median	21.94
59	Seven-lane Freeway Speed Change	Entrance	231+12.250	231+12.440	0.19	0.0000	2050: 226,100	3.00	Non-Traversable Median	21.98
61	Seven-lane Freeway Speed Change	Entrance	231+12.440	236+00.000	487.56	0.0923	2050: 226,100	3.00	Non-Traversable Median	21.99

Table 3. Predicted Freeway Crash Rates and Frequencies Summary (Section 2)

First Year of Analysis	**2050**
Last Year of Analysis	**2050**
Effective Length (mi)	**1.7101**
Average Future Road AADT (vpd)	**214,127**
Predicted Crashes	
Total Crashes	**136.70**
Fatal and Injury Crashes	**34.34**
Property-Damage-Only Crashes	**102.36**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**25**
Percent Property-Damage-Only Crashes (%)	**75**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**79.9350**
FI Crash Rate (crashes/mi/yr)	**20.0783**
PDO Crash Rate (crashes/mi/yr)	**59.8567**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**133.66**
Travel Crash Rate (crashes/million veh-mi)	**1.02**
Travel FI Crash Rate (crashes/million veh-mi)	**0.26**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.77**

Note: *Effective Length* is the *segment length* minus the length of the *speed change lanes* if present.

Table 4. Predicted Freeway Speed Change Lane Crash Rates and Frequencies Summary (Speed Change)

First Year of Analysis	**2050**
Last Year of Analysis	**2050**
Length (mi)	**0.2746**
Average Future Road AADT (vpd)	**103,095**
Predicted Crashes	
Total Crashes	**7.29**
Fatal and Injury Crashes	**2.29**
Property-Damage-Only Crashes	**5.00**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**31**
Percent Property-Damage-Only Crashes (%)	**69**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**26.5531**
FI Crash Rate (crashes/mi/yr)	**8.3465**
PDO Crash Rate (crashes/mi/yr)	**18.2066**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**10.33**
Travel Crash Rate (crashes/million veh-mi)	**0.71**
Travel FI Crash Rate (crashes/million veh-mi)	**0.22**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.48**

Note: *Total Travel and Crash Rates/Million Vehicle Miles* for *Speed Change Lanes* reflect AADTs that are **half of the Freeway Segment AADTs** based on the assumption of 50/50 directional distribution.

Table 5. Predicted Crash Frequencies and Rates by Freeway Segment/Intersection (Section 2)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Effective Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
1	138+40.440	138+91.440	0.0097	1.022	1.0222	0.2334	0.7888	105.8299	1.47
2	138+91.440	139+84.440	0.0176	1.827	1.8271	0.4219	1.4052	103.7322	1.44
3	139+84.440	139+91.440	0.0013	0.136	0.1355	0.0313	0.1042	102.2357	1.42
4	139+91.440	140+07.440	0.0030	0.306	0.3058	0.0684	0.2374	100.9265	1.40
5	140+07.440	140+43.440	0.0068	0.598	0.5982	0.1412	0.4570	87.7430	1.22
6	140+43.440	140+91.440	0.0091	0.777	0.7772	0.1851	0.5921	85.4903	1.19

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Effective Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
7	140+91.440	141+92.440	0.0191	1.566	1.5656	0.3827	1.1828	81.8427	1.14
8	141+92.440	142+46.440	0.0102	0.810	0.8099	0.2030	0.6069	79.1935	1.10
9	142+46.440	142+70.440	0.0045	0.369	0.3691	0.0918	0.2774	81.2095	1.13
10	142+70.440	143+41.440	0.0134	1.099	1.0989	0.2718	0.8271	81.7182	1.13
11	143+41.440	144+40.440	0.0187	1.511	1.5111	0.3736	1.1375	80.5913	1.12
12	144+40.440	145+47.440	0.0203	1.590	1.5902	0.3790	1.2112	78.4692	1.09
13	145+47.440	146+07.400	0.0114	0.772	0.7724	0.1964	0.5760	68.0197	0.94
14	146+07.400	146+58.500	0.0097	0.657	0.6568	0.1670	0.4898	67.8640	0.94
15	146+58.500	146+99.440	0.0078	0.527	0.5273	0.1341	0.3933	68.0070	0.94
16	146+99.440	147+04.440	0.0000	0.000	0.0000	0.0000	0.0000	0.0000	0.00
17	147+04.440	147+52.560	0.0091	0.624	0.6238	0.1587	0.4651	68.4491	0.95
18	147+52.560	148+46.440	0.0178	1.200	1.2001	0.3185	0.8816	67.4936	0.94
19	148+46.440	150+57.440	0.0400	3.147	3.1471	0.8285	2.3186	78.7509	1.09
20	150+57.440	151+11.980	0.0103	0.847	0.8471	0.2196	0.6276	82.0119	1.14
21	151+11.980	154+14.440	0.0573	5.553	5.5531	1.3921	4.1611	96.9403	1.20
22	154+14.440	156+77.440	0.0498	4.409	4.4088	1.0980	3.3107	88.5108	1.09
23	156+77.440	157+72.440	0.0180	1.477	1.4769	0.3659	1.1109	82.0823	1.01
24	157+72.440	161+30.440	0.0678	5.559	5.5589	1.3772	4.1817	81.9865	1.01
25	161+30.440	161+52.440	0.0042	0.341	0.3414	0.0846	0.2568	81.9352	1.01
26	161+52.440	161+94.440	0.0080	0.652	0.6517	0.1615	0.4903	81.9314	1.01
27	161+94.440	164+83.440	0.0547	4.485	4.4850	1.1112	3.3738	81.9404	1.01
28	164+83.440	169+45.440	0.0875	7.154	7.1538	1.7620	5.3918	81.7572	1.01
29	169+45.440	169+84.440	0.0074	0.590	0.5900	0.1501	0.4398	79.8733	0.98
30	169+84.440	170+94.370	0.0208	1.560	1.5601	0.4298	1.1303	74.9347	0.92
31	170+94.370	171+35.440	0.0078	0.586	0.5863	0.1616	0.4247	75.3755	0.93
32	171+35.440	172+54.440	0.0225	1.725	1.7248	0.4757	1.2491	76.5291	0.94
33	172+54.440	173+73.440	0.0225	1.767	1.7673	0.4881	1.2792	78.4145	0.97
34	173+73.440	174+92.440	0.0225	1.816	1.8160	0.5020	1.3140	80.5759	0.99
35	174+92.440	175+53.460	0.0116	0.837	0.8372	0.2479	0.5893	72.4411	0.89
36	175+53.460	176+70.440	0.0111	0.613	0.6131	0.1985	0.4146	55.3426	0.77
38	176+70.440	177+66.440	0.0091	0.516	0.5165	0.1663	0.3502	56.8193	0.79
40	177+66.440	178+82.440	0.0110	0.651	0.6510	0.2029	0.4481	59.2630	0.83
42	178+82.440	180+25.440	0.0136	0.788	0.7877	0.2293	0.5584	57.8930	0.81
44	180+25.440	180+64.440	0.0074	0.412	0.4123	0.1162	0.2961	55.8179	0.78
45	180+64.440	184+57.440	0.0744	4.213	4.2127	1.1815	3.0312	56.5978	0.79
46	184+57.440	184+96.790	0.0075	0.428	0.4277	0.1193	0.3084	57.3917	0.80
47	184+96.790	186+54.440	0.0299	1.849	1.8488	0.4848	1.3640	61.9207	0.86
48	186+54.440	190+97.440	0.0839	5.857	5.8574	1.4543	4.4031	69.8130	0.97
49	190+97.440	198+69.900	0.1463	11.169	11.1692	2.7587	8.4105	76.3449	1.07
50	198+69.900	203+60.970	0.0465	3.680	3.6800	0.9751	2.7049	79.1343	1.11
52	203+60.970	205+18.440	0.0298	2.463	2.4633	0.6181	1.8452	82.5944	1.01
53	205+18.440	208+13.580	0.0559	4.589	4.5891	1.0967	3.4923	82.0979	1.01
54	208+13.580	208+29.440	0.0030	0.277	0.2768	0.0686	0.2081	92.1357	1.13
55	208+29.440	214+67.440	0.1208	10.283	10.2827	2.5772	7.7055	85.0979	1.04
56	214+67.440	224+85.540	0.1928	15.165	15.1654	3.6632	11.5021	78.6495	0.97
57	224+85.540	228+92.450	0.0771	7.131	7.1308	1.6710	5.4598	92.5283	1.02
58	228+92.450	231+12.440	0.0416	4.308	4.3084	1.0240	3.2844	103.4509	1.15
60	231+12.440	236+00.000	0.0462	4.410	4.4099	1.1173	3.2926	95.5129	1.16
Total			1.7101	136.699	136.6994	34.3366	102.3628	79.9350	1.02

Note: *Effective Length* is the *segment length* minus the length of the *speed change lanes* if present. This may create Freeway segments with zero effective length and zero crashes.

Table 6. Predicted Crash Frequencies and Rates by Freeway Speed Change Lane (Speed Change)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
37	175+53.460	176+70.440	0.0222	0.426	0.4260	0.1329	0.2931	19.2283	0.54
39	176+70.440	177+66.440	0.0182	0.352	0.3524	0.1100	0.2424	19.3821	0.54
41	177+66.440	178+82.440	0.0220	0.432	0.4320	0.1345	0.2976	19.6651	0.55
43	178+82.440	180+24.760	0.0270	0.566	0.5661	0.1724	0.3937	21.0025	0.59
51	198+69.900	203+60.970	0.0930	2.091	2.0907	0.5867	1.5040	22.4797	0.63
59	231+12.250	231+12.440	0.0000	0.001	0.0013	0.0005	0.0009	37.0813	0.90
61	231+12.440	236+00.000	0.0923	3.424	3.4240	1.1554	2.2686	37.0802	0.90
Total			0.2746	7.293	7.2926	2.2923	5.0003	26.5531	0.71

Note: *Travel Crash Rates/Million Vehicle Miles* for *Speed Change Lanes* reflect AADTs that are **half of the Freeway Segment AADTs** based on the assumption of 50/50 directional distribution.

Table 7. Predicted Crash Frequencies and Rates by Horizontal Design Element (Section 2)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
Tangent	138+40.440	148+95.793	0.1999	16.127	16.1274	3.9515	12.1759	80.6864	1.12
Simple Curve 1	148+95.793	168+00.529	0.3607	30.644	30.6438	7.6541	22.9898	84.9459	1.06
Tangent	168+00.529	178+70.632	0.2027	14.006	14.0064	3.9187	10.0877	69.1089	1.07
Simple Curve 2	178+70.632	197+92.177	0.3639	24.268	24.2684	6.2734	17.9950	66.6843	0.99
Tangent	197+92.177	236+00.000	0.7212	58.946	58.9461	14.8313	44.1148	81.7358	1.24

Table 8. Predicted Crash Frequencies by Year (Section 2)

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2050	143.99	36.63	25.438	107.36	74.562
Total	143.99	36.63	25.438	107.36	74.562
Average	143.99	36.63	25.438	107.36	74.562

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 9. Predicted Crash Severity by Freeway Segment (Section 2)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.0040	0.0104	0.0741	0.1450	0.7888
2	0.0072	0.0188	0.1339	0.2620	1.4052
3	0.0005	0.0014	0.0099	0.0195	0.1042
4	0.0012	0.0030	0.0217	0.0425	0.2374
5	0.0022	0.0059	0.0432	0.0899	0.4570
6	0.0029	0.0078	0.0566	0.1178	0.5921
7	0.0061	0.0161	0.1170	0.2435	1.1828
8	0.0035	0.0090	0.0644	0.1261	0.6069
9	0.0016	0.0041	0.0291	0.0570	0.2774
10	0.0046	0.0121	0.0863	0.1688	0.8271
11	0.0064	0.0166	0.1186	0.2320	1.1375
12	0.0065	0.0168	0.1203	0.2354	1.2112
13	0.0031	0.0083	0.0600	0.1250	0.5760
14	0.0027	0.0070	0.0510	0.1063	0.4898
15	0.0021	0.0056	0.0410	0.0853	0.3933
16	0.0000	0.0000	0.0000	0.0000	0.0000
17	0.0025	0.0067	0.0485	0.1010	0.4651
18	0.0051	0.0134	0.0973	0.2027	0.8816
19	0.0159	0.0424	0.2781	0.4921	2.3186
20	0.0044	0.0117	0.0749	0.1286	0.6276
21	0.0276	0.0744	0.4750	0.8151	4.1611
22	0.0218	0.0587	0.3746	0.6429	3.3107
23	0.0073	0.0196	0.1248	0.2143	1.1109
24	0.0273	0.0736	0.4699	0.8064	4.1817
25	0.0017	0.0045	0.0289	0.0495	0.2568
26	0.0032	0.0086	0.0551	0.0945	0.4903
27	0.0220	0.0594	0.3791	0.6507	3.3738
28	0.0326	0.0875	0.5816	1.0603	5.3918
29	0.0024	0.0063	0.0459	0.0955	0.4398
30	0.0073	0.0191	0.1364	0.2669	1.1303
31	0.0028	0.0072	0.0513	0.1003	0.4247
32	0.0081	0.0212	0.1510	0.2954	1.2491

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
33	0.0083	0.0217	0.1549	0.3031	1.2792
34	0.0086	0.0223	0.1594	0.3118	1.3140
35	0.0043	0.0111	0.0789	0.1537	0.5893
36	0.0042	0.0104	0.0701	0.1138	0.4146
38	0.0035	0.0087	0.0588	0.0953	0.3502
40	0.0043	0.0108	0.0722	0.1155	0.4481
42	0.0054	0.0140	0.0854	0.1245	0.5584
44	0.0025	0.0066	0.0410	0.0662	0.2961
45	0.0251	0.0666	0.4172	0.6726	3.0312
46	0.0025	0.0067	0.0421	0.0679	0.3084
47	0.0103	0.0273	0.1712	0.2760	1.3640
48	0.0288	0.0777	0.4962	0.8515	4.4031
49	0.0539	0.1448	0.9347	1.6253	8.4105
50	0.0179	0.0458	0.3211	0.5902	2.7049
52	0.0113	0.0290	0.2035	0.3742	1.8452
53	0.0187	0.0488	0.3481	0.6811	3.4923
54	0.0012	0.0031	0.0218	0.0426	0.2081
55	0.0472	0.1211	0.8488	1.5600	7.7055
56	0.0672	0.1722	1.2065	2.2174	11.5021
57	0.0306	0.0785	0.5503	1.0115	5.4598
58	0.0188	0.0481	0.3373	0.6198	3.2844
60	0.0205	0.0525	0.3680	0.6763	3.2926
Total	0.6415	1.6852	11.3873	20.6226	102.3628

Table 10. Predicted Crash Severity by Speed Change Lane (Speed Change)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
37	0.0028	0.0070	0.0470	0.0762	0.2931
39	0.0023	0.0058	0.0389	0.0630	0.2424
41	0.0029	0.0072	0.0479	0.0766	0.2976
43	0.0042	0.0108	0.0650	0.0925	0.3937
51	0.0108	0.0276	0.1932	0.3551	1.5040
59	0.0000	0.0000	0.0001	0.0003	0.0009
61	0.0212	0.0543	0.3805	0.6994	2.2686
Total	0.0441	0.1126	0.7726	1.3630	5.0003

Table 11. Predicted Freeway Crash Type Distribution (Section 2)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.04	0.0	0.62	0.5	0.66	0.5
Highway Segment	Collision with Fixed Object	7.50	5.5	20.16	14.8	27.66	20.2
Highway Segment	Collision with Other Object	0.53	0.4	3.92	2.9	4.44	3.3
Highway Segment	Other Single-vehicle Collision	2.16	1.6	3.01	2.2	5.17	3.8
Highway Segment	Collision with Parked Vehicle	0.16	0.1	0.45	0.3	0.61	0.4
Highway Segment	Total Single Vehicle Crashes	10.38	7.6	28.16	20.6	38.54	28.2
Highway Segment	Right-Angle Collision	0.74	0.5	1.34	1.0	2.08	1.5
Highway Segment	Head-on Collision	0.19	0.1	0.15	0.1	0.34	0.2
Highway Segment	Other Multi-vehicle Collision	0.74	0.5	1.78	1.3	2.52	1.8
Highway Segment	Rear-end Collision	17.97	13.1	51.20	37.5	69.17	50.6
Highway Segment	Sideswipe, Same Direction Collision	4.31	3.2	19.74	14.4	24.05	17.6
Highway Segment	Total Multiple Vehicle Crashes	23.95	17.5	74.20	54.3	98.16	71.8
Highway Segment	Total Highway Segment Crashes	34.34	25.1	102.36	74.9	136.70	100.0
	Total Crashes	34.34	25.1	102.36	74.9	136.70	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 12. Predicted Exit Speed Change Lane Crash Type Distribution (Speed Change)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.00	0.0	0.01	0.5	0.01	0.5
Highway Segment	Collision with Fixed Object	0.12	5.5	0.31	14.9	0.43	20.4
Highway Segment	Collision with Other Object	0.01	0.4	0.04	2.2	0.06	2.6
Highway Segment	Other Single-vehicle Collision	0.03	1.4	0.04	1.7	0.06	3.0
Highway Segment	Collision with Parked Vehicle	0.00	0.0	0.00	0.0	0.00	0.0
Highway Segment	Total Single Vehicle Crashes	0.15	7.3	0.40	19.2	0.56	26.5
Highway Segment	Right-Angle Collision	0.01	0.3	0.02	0.9	0.03	1.2
Highway Segment	Head-on Collision	0.00	0.1	0.00	0.1	0.01	0.3
Highway Segment	Other Multi-vehicle Collision	0.01	0.4	0.02	1.2	0.03	1.6
Highway Segment	Rear-end Collision	0.32	15.4	0.85	40.6	1.17	56.1
Highway Segment	Sideswipe, Same Direction Collision	0.09	4.4	0.21	9.9	0.30	14.4
Highway Segment	Total Multiple Vehicle Crashes	0.43	20.7	1.10	52.7	1.54	73.5
Highway Segment	Total Highway Segment Crashes	0.59	28.1	1.50	71.9	2.09	100.0
	Total Crashes	0.59	28.1	1.50	71.9	2.09	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 13. Predicted Entrance Speed Change Lane Crash Type Distribution (Speed Change)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.00	0.0	0.01	0.1	0.01	0.1
Highway Segment	Collision with Fixed Object	0.33	6.4	0.45	8.7	0.78	15.0
Highway Segment	Collision with Other Object	0.03	0.6	0.13	2.4	0.16	3.0
Highway Segment	Other Single-vehicle Collision	0.11	2.2	0.06	1.1	0.17	3.3
Highway Segment	Collision with Parked Vehicle	0.01	0.1	0.01	0.2	0.02	0.3
Highway Segment	Total Single Vehicle Crashes	0.48	9.3	0.65	12.5	1.14	21.8
Highway Segment	Right-Angle Collision	0.03	0.6	0.06	1.1	0.09	1.7
Highway Segment	Head-on Collision	0.01	0.1	0.00	0.1	0.01	0.2
Highway Segment	Other Multi-vehicle Collision	0.03	0.6	0.05	1.0	0.08	1.6
Highway Segment	Rear-end Collision	0.93	17.8	1.85	35.6	2.78	53.4
Highway Segment	Sideswipe, Same Direction Collision	0.23	4.4	0.88	16.9	1.11	21.3
Highway Segment	Total Multiple Vehicle Crashes	1.22	23.5	2.85	54.7	4.07	78.2
Highway Segment	Total Highway Segment Crashes	1.71	32.8	3.50	67.2	5.20	100.0
	Total Crashes	1.71	32.8	3.50	67.2	5.20	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 14. Evaluation Message

Start Location (Sta. ft)	End Location (Sta. ft)	Message
138+40.440	138+91.440	Information: for segment #1 (138+40.440 to 138+91.440), Median barrier distance from edge of inside shoulder to barrier face (0.12 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
138+40.440	138+91.440	Information: for segment #1 (138+40.440 to 138+91.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
138+40.440	138+91.440	Information: for segment #1 (138+40.440 to 138+91.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
138+91.440	139+84.440	Information: for segment #2 (138+91.440 to 139+84.440), Median barrier distance from edge of inside shoulder to barrier face (0.45 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
138+91.440	139+84.440	Information: for segment #2 (138+91.440 to 139+84.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
138+91.440	139+84.440	Information: for segment #2 (138+91.440 to 139+84.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
139+84.440	139+91.440	Information: for segment #3 (139+84.440 to 139+91.440), Outside shoulder width (3.53 feet) is less than specified boundaries (4.00 feet); adjusted in CMF calculations.
139+84.440	139+91.440	Information: for segment #3 (139+84.440 to 139+91.440), Median barrier distance from edge of inside shoulder to barrier face (0.69 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
139+84.440	139+91.440	Information: for segment #3 (139+84.440 to 139+91.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
139+84.440	139+91.440	Information: for segment #3 (139+84.440 to 139+91.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
139+91.440	140+07.440	Information: for segment #4 (139+91.440 to 140+07.440), Median barrier distance from edge of inside shoulder to barrier face (0.74 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
139+91.440	140+07.440	Information: for segment #4 (139+91.440 to 140+07.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
139+91.440	140+07.440	Information: for segment #4 (139+91.440 to 140+07.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
140+07.440	140+43.440	Information: for segment #5 (140+07.440 to 140+43.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
140+07.440	140+43.440	Information: for segment #5 (140+07.440 to 140+43.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
140+07.440	140+43.440	Information: for segment #5 (140+07.440 to 140+43.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
140+43.440	140+91.440	Information: for segment #6 (140+43.440 to 140+91.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
140+43.440	140+91.440	Information: for segment #6 (140+43.440 to 140+91.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.

Start Location (Sta. ft)	End Location (Sta. ft)	Message
140+43.440	140+91.440	Information: for segment #6 (140+43.440 to 140+91.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
140+91.440	141+92.440	Information: for segment #7 (140+91.440 to 141+92.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
140+91.440	141+92.440	Information: for segment #7 (140+91.440 to 141+92.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
141+92.440	142+46.440	Information: for segment #8 (141+92.440 to 142+46.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
141+92.440	142+46.440	Information: for segment #8 (141+92.440 to 142+46.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
142+46.440	142+70.440	Information: for segment #9 (142+46.440 to 142+70.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
142+46.440	142+70.440	Information: for segment #9 (142+46.440 to 142+70.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
142+70.440	143+41.440	Information: for segment #10 (142+70.440 to 143+41.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
142+70.440	143+41.440	Information: for segment #10 (142+70.440 to 143+41.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
142+70.440	143+41.440	Information: for segment #10 (142+70.440 to 143+41.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
143+41.440	144+40.440	Information: for segment #11 (143+41.440 to 144+40.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
143+41.440	144+40.440	Information: for segment #11 (143+41.440 to 144+40.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
143+41.440	144+40.440	Information: for segment #11 (143+41.440 to 144+40.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
144+40.440	145+47.440	Information: for segment #12 (144+40.440 to 145+47.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
144+40.440	145+47.440	Information: for segment #12 (144+40.440 to 145+47.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
144+40.440	145+47.440	Information: for segment #12 (144+40.440 to 145+47.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
145+47.440	146+07.400	Information: for segment #13 (145+47.440 to 146+07.400), Inside shoulder width (12.21 feet) is greater than specified boundaries (12.00 feet); adjusted in CMF calculations.
145+47.440	146+07.400	Information: for segment #13 (145+47.440 to 146+07.400), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
145+47.440	146+07.400	Information: for segment #13 (145+47.440 to 146+07.400), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
145+47.440	146+07.400	Information: for segment #13 (145+47.440 to 146+07.400), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.

Start Location (Sta. ft)	End Location (Sta. ft)	Message
145+47.440	146+07.400	Information: for segment #13 (145+47.440 to 146+07.400), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+07.400	146+58.500	Information: for segment #14 (146+07.400 to 146+58.500), Inside shoulder width (12.17 feet) is greater than specified boundaries (12.00 feet); adjusted in CMF calculations.
146+07.400	146+58.500	Information: for segment #14 (146+07.400 to 146+58.500), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+07.400	146+58.500	Information: for segment #14 (146+07.400 to 146+58.500), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+07.400	146+58.500	Information: for segment #14 (146+07.400 to 146+58.500), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+07.400	146+58.500	Information: for segment #14 (146+07.400 to 146+58.500), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+58.500	146+99.440	Information: for segment #15 (146+58.500 to 146+99.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+58.500	146+99.440	Information: for segment #15 (146+58.500 to 146+99.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+58.500	146+99.440	Information: for segment #15 (146+58.500 to 146+99.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+58.500	146+99.440	Information: for segment #15 (146+58.500 to 146+99.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+99.440	147+04.440	Information: for segment #16 (146+99.440 to 147+04.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+99.440	147+04.440	Information: for segment #16 (146+99.440 to 147+04.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+99.440	147+04.440	Information: for segment #16 (146+99.440 to 147+04.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+99.440	147+04.440	Information: for segment #16 (146+99.440 to 147+04.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
147+04.440	147+52.560	Information: for segment #17 (147+04.440 to 147+52.560), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
147+04.440	147+52.560	Information: for segment #17 (147+04.440 to 147+52.560), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
147+04.440	147+52.560	Information: for segment #17 (147+04.440 to 147+52.560), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
147+04.440	147+52.560	Information: for segment #17 (147+04.440 to 147+52.560), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
147+52.560	148+46.440	Information: for segment #18 (147+52.560 to 148+46.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
147+52.560	148+46.440	Information: for segment #18 (147+52.560 to 148+46.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.

Start Location (Sta. ft)	End Location (Sta. ft)	Message
147+52.560	148+46.440	Information: for segment #18 (147+52.560 to 148+46.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
148+46.440	150+57.440	Information: for segment #19 (148+46.440 to 150+57.440), Effective median width (94.22 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
148+46.440	150+57.440	Information: for segment #19 (148+46.440 to 150+57.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
148+46.440	150+57.440	Information: for segment #19 (148+46.440 to 150+57.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
148+46.440	150+57.440	Information: for segment #19 (148+46.440 to 150+57.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
150+57.440	151+11.980	Information: for segment #20 (150+57.440 to 151+11.980), Effective median width (98.03 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
150+57.440	151+11.980	Information: for segment #20 (150+57.440 to 151+11.980), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
150+57.440	151+11.980	Information: for segment #20 (150+57.440 to 151+11.980), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
150+57.440	151+11.980	Information: for segment #20 (150+57.440 to 151+11.980), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
151+11.980	154+14.440	Information: for segment #21 (151+11.980 to 154+14.440), Effective median width (103.14 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
151+11.980	154+14.440	Information: for segment #21 (151+11.980 to 154+14.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
151+11.980	154+14.440	Information: for segment #21 (151+11.980 to 154+14.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
151+11.980	154+14.440	Information: for segment #21 (151+11.980 to 154+14.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
154+14.440	156+77.440	Information: for segment #22 (154+14.440 to 156+77.440), Effective median width (111.25 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
154+14.440	156+77.440	Information: for segment #22 (154+14.440 to 156+77.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
154+14.440	156+77.440	Information: for segment #22 (154+14.440 to 156+77.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
154+14.440	156+77.440	Information: for segment #22 (154+14.440 to 156+77.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
156+77.440	157+72.440	Information: for segment #23 (156+77.440 to 157+72.440), Effective median width (116.38 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
156+77.440	157+72.440	Information: for segment #23 (156+77.440 to 157+72.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
156+77.440	157+72.440	Information: for segment #23 (156+77.440 to 157+72.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.

Start Location (Sta. ft)	End Location (Sta. ft)	Message
156+77.440	157+72.440	Information: for segment #23 (156+77.440 to 157+72.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
157+72.440	161+30.440	Information: for segment #24 (157+72.440 to 161+30.440), Effective median width (122.88 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
157+72.440	161+30.440	Information: for segment #24 (157+72.440 to 161+30.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
157+72.440	161+30.440	Information: for segment #24 (157+72.440 to 161+30.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
157+72.440	161+30.440	Information: for segment #24 (157+72.440 to 161+30.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
161+30.440	161+52.440	Information: for segment #25 (161+30.440 to 161+52.440), Effective median width (128.32 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
161+30.440	161+52.440	Information: for segment #25 (161+30.440 to 161+52.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
161+30.440	161+52.440	Information: for segment #25 (161+30.440 to 161+52.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
161+30.440	161+52.440	Information: for segment #25 (161+30.440 to 161+52.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
161+52.440	161+94.440	Information: for segment #26 (161+52.440 to 161+94.440), Effective median width (128.33 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
161+52.440	161+94.440	Information: for segment #26 (161+52.440 to 161+94.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
161+52.440	161+94.440	Information: for segment #26 (161+52.440 to 161+94.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
161+52.440	161+94.440	Information: for segment #26 (161+52.440 to 161+94.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
161+94.440	164+83.440	Information: for segment #27 (161+94.440 to 164+83.440), Effective median width (123.12 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
161+94.440	164+83.440	Information: for segment #27 (161+94.440 to 164+83.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
161+94.440	164+83.440	Information: for segment #27 (161+94.440 to 164+83.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
161+94.440	164+83.440	Information: for segment #27 (161+94.440 to 164+83.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
164+83.440	169+45.440	Information: for segment #28 (164+83.440 to 169+45.440), Effective median width (113.39 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
164+83.440	169+45.440	Information: for segment #28 (164+83.440 to 169+45.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
164+83.440	169+45.440	Information: for segment #28 (164+83.440 to 169+45.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.

Start Location (Sta. ft)	End Location (Sta. ft)	Message
164+83.440	169+45.440	Information: for segment #28 (164+83.440 to 169+45.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
164+83.440	169+45.440	Information: for segment #28 (164+83.440 to 169+45.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
169+45.440	169+84.440	Information: for segment #29 (169+45.440 to 169+84.440), Effective median width (108.35 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
169+45.440	169+84.440	Information: for segment #29 (169+45.440 to 169+84.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
169+45.440	169+84.440	Information: for segment #29 (169+45.440 to 169+84.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
169+45.440	169+84.440	Information: for segment #29 (169+45.440 to 169+84.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
169+84.440	170+94.370	Information: for segment #30 (169+84.440 to 170+94.370), Effective median width (107.54 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
169+84.440	170+94.370	Information: for segment #30 (169+84.440 to 170+94.370), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
169+84.440	170+94.370	Information: for segment #30 (169+84.440 to 170+94.370), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
169+84.440	170+94.370	Information: for segment #30 (169+84.440 to 170+94.370), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
170+94.370	171+35.440	Information: for segment #31 (170+94.370 to 171+35.440), Effective median width (106.37 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
170+94.370	171+35.440	Information: for segment #31 (170+94.370 to 171+35.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
170+94.370	171+35.440	Information: for segment #31 (170+94.370 to 171+35.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
170+94.370	171+35.440	Information: for segment #31 (170+94.370 to 171+35.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
171+35.440	172+54.440	Information: for segment #32 (171+35.440 to 172+54.440), Effective median width (104.10 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
171+35.440	172+54.440	Information: for segment #32 (171+35.440 to 172+54.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
171+35.440	172+54.440	Information: for segment #32 (171+35.440 to 172+54.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
171+35.440	172+54.440	Information: for segment #32 (171+35.440 to 172+54.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
172+54.440	173+73.440	Information: for segment #33 (172+54.440 to 173+73.440), Effective median width (100.73 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
172+54.440	173+73.440	Information: for segment #33 (172+54.440 to 173+73.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.

Start Location (Sta. ft)	End Location (Sta. ft)	Message
172+54.440	173+73.440	Information: for segment #33 (172+54.440 to 173+73.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
172+54.440	173+73.440	Information: for segment #33 (172+54.440 to 173+73.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
173+73.440	174+92.440	Information: for segment #34 (173+73.440 to 174+92.440), Effective median width (97.37 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
173+73.440	174+92.440	Information: for segment #34 (173+73.440 to 174+92.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
173+73.440	174+92.440	Information: for segment #34 (173+73.440 to 174+92.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
173+73.440	174+92.440	Information: for segment #34 (173+73.440 to 174+92.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
174+92.440	175+53.460	Information: for segment #35 (174+92.440 to 175+53.460), Outside shoulder width (3.00 feet) is less than specified boundaries (4.00 feet); adjusted in CMF calculations.
175+53.460	176+70.440	Information: for segment #36 (175+53.460 to 176+70.440), Inside shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
175+53.460	176+70.440	Information: for segment #36 (175+53.460 to 176+70.440), Outside shoulder width (0.00 feet) is less than specified boundaries (4.00 feet); adjusted in CMF calculations.
176+70.440	177+66.440	Information: for segment #38 (176+70.440 to 177+66.440), Inside shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
176+70.440	177+66.440	Information: for segment #38 (176+70.440 to 177+66.440), Outside shoulder width (2.50 feet) is less than specified boundaries (4.00 feet); adjusted in CMF calculations.
177+66.440	178+82.440	Information: for segment #40 (177+66.440 to 178+82.440), Inside shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
178+82.440	180+25.440	Information: for segment #42 (178+82.440 to 180+25.440), Inside shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
178+82.440	180+25.440	Information: for segment #42 (178+82.440 to 180+25.440), Outside barrier distance from edge of outside shoulder to barrier face (0.50 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
180+25.440	180+64.440	Information: for segment #44 (180+25.440 to 180+64.440), Inside shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
180+25.440	180+64.440	Information: for segment #44 (180+25.440 to 180+64.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
180+25.440	180+64.440	Information: for segment #44 (180+25.440 to 180+64.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
180+64.440	184+57.440	Information: for segment #45 (180+64.440 to 184+57.440), Inside shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
180+64.440	184+57.440	Information: for segment #45 (180+64.440 to 184+57.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
180+64.440	184+57.440	Information: for segment #45 (180+64.440 to 184+57.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.

Start Location (Sta. ft)	End Location (Sta. ft)	Message
184+57.440	184+96.790	Information: for segment #46 (184+57.440 to 184+96.790), Inside shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
184+57.440	184+96.790	Information: for segment #46 (184+57.440 to 184+96.790), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
184+57.440	184+96.790	Information: for segment #46 (184+57.440 to 184+96.790), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
184+96.790	186+54.440	Information: for segment #47 (184+96.790 to 186+54.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
184+96.790	186+54.440	Information: for segment #47 (184+96.790 to 186+54.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
186+54.440	190+97.440	Information: for segment #48 (186+54.440 to 190+97.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
186+54.440	190+97.440	Information: for segment #48 (186+54.440 to 190+97.440), Median barrier offset on the left side of roadway from edge of inside traveled way to barrier face (9.00 feet) is greater than inside shoulder width plus median width (7.50 feet). This indicates there is problem with the input data.
186+54.440	190+97.440	Information: for segment #48 (186+54.440 to 190+97.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
186+54.440	190+97.440	Information: for segment #48 (186+54.440 to 190+97.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
190+97.440	198+69.900	Information: for segment #49 (190+97.440 to 198+69.900), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
190+97.440	198+69.900	Information: for segment #49 (190+97.440 to 198+69.900), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
198+69.900	203+60.970	Information: for segment #50 (198+69.900 to 203+60.970), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
198+69.900	203+60.970	Information: for segment #50 (198+69.900 to 203+60.970), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
203+60.970	205+18.440	Information: for segment #52 (203+60.970 to 205+18.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
203+60.970	205+18.440	Information: for segment #52 (203+60.970 to 205+18.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
205+18.440	208+13.580	Information: for segment #53 (205+18.440 to 208+13.580), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
205+18.440	208+13.580	Information: for segment #53 (205+18.440 to 208+13.580), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
205+18.440	208+13.580	Information: for segment #53 (205+18.440 to 208+13.580), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
208+13.580	208+29.440	Information: for segment #54 (208+13.580 to 208+29.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
208+13.580	208+29.440	Information: for segment #54 (208+13.580 to 208+29.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.

Start Location (Sta. ft)	End Location (Sta. ft)	Message
208+29.440	214+67.440	Information: for segment #55 (208+29.440 to 214+67.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
208+29.440	214+67.440	Information: for segment #55 (208+29.440 to 214+67.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
214+67.440	224+85.540	Information: for segment #56 (214+67.440 to 224+85.540), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
214+67.440	224+85.540	Information: for segment #56 (214+67.440 to 224+85.540), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
224+85.540	228+92.450	Information: for segment #57 (224+85.540 to 228+92.450), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
224+85.540	228+92.450	Information: for segment #57 (224+85.540 to 228+92.450), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
228+92.450	231+12.440	Information: for segment #58 (228+92.450 to 231+12.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
228+92.450	231+12.440	Information: for segment #58 (228+92.450 to 231+12.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
231+12.440	236+00.000	Information: for segment #60 (231+12.440 to 236+00.000), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
231+12.440	236+00.000	Information: for segment #60 (231+12.440 to 236+00.000), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
198+69.900	203+60.970	Information: for segment #51 (198+69.900 to 203+60.970), For Speed Change Lane the median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
231+12.250	231+12.440	Information: for segment #59 (231+12.250 to 231+12.440), For Speed Change Lane the median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
231+12.440	236+00.000	Information: for segment #61 (231+12.440 to 236+00.000), For Speed Change Lane the median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
138+40.440	138+91.440	Warning: for segment #1 (138+40.440 to 138+91.440), traffic volume (197,400 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
138+91.440	139+84.440	Warning: for segment #2 (138+91.440 to 139+84.440), traffic volume (197,400 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
139+84.440	139+91.440	Warning: for segment #3 (139+84.440 to 139+91.440), traffic volume (197,400 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
139+91.440	140+07.440	Warning: for segment #4 (139+91.440 to 140+07.440), traffic volume (197,400 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
140+07.440	140+43.440	Warning: for segment #5 (140+07.440 to 140+43.440), traffic volume (197,400 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
140+07.440	140+43.440	Warning: for segment #5 (140+07.440 to 140+43.440), Freeway Segment of type 6F is using unbalanced lane processing with 2 + 4 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
140+43.440	140+91.440	Warning: for segment #6 (140+43.440 to 140+91.440), traffic volume (197,400 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F

Start Location (Sta. ft)	End Location (Sta. ft)	Message
140+43.440	140+91.440	Warning: for segment #6 (140+43.440 to 140+91.440), Freeway Segment of type 6F is using unbalanced lane processing with 2 + 4 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
140+91.440	141+92.440	Warning: for segment #7 (140+91.440 to 141+92.440), traffic volume (197,400 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
140+91.440	141+92.440	Warning: for segment #7 (140+91.440 to 141+92.440), Freeway Segment of type 6F is using unbalanced lane processing with 2 + 4 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
141+92.440	142+46.440	Warning: for segment #8 (141+92.440 to 142+46.440), traffic volume (197,400 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
141+92.440	142+46.440	Warning: for segment #8 (141+92.440 to 142+46.440), Freeway Segment of type 6F is using unbalanced lane processing with 2 + 4 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
142+46.440	142+70.440	Warning: for segment #9 (142+46.440 to 142+70.440), traffic volume (197,400 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
142+46.440	142+70.440	Warning: for segment #9 (142+46.440 to 142+70.440), Freeway Segment of type 6F is using unbalanced lane processing with 2 + 4 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
142+70.440	143+41.440	Warning: for segment #10 (142+70.440 to 143+41.440), traffic volume (197,400 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
142+70.440	143+41.440	Warning: for segment #10 (142+70.440 to 143+41.440), Freeway Segment of type 6F is using unbalanced lane processing with 2 + 4 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
143+41.440	144+40.440	Warning: for segment #11 (143+41.440 to 144+40.440), traffic volume (197,400 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
143+41.440	144+40.440	Warning: for segment #11 (143+41.440 to 144+40.440), Freeway Segment of type 6F is using unbalanced lane processing with 2 + 4 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
144+40.440	145+47.440	Warning: for segment #12 (144+40.440 to 145+47.440), traffic volume (197,400 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
144+40.440	145+47.440	Warning: for segment #12 (144+40.440 to 145+47.440), Freeway Segment of type 6F is using unbalanced lane processing with 2 + 4 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
169+84.440	170+94.370	Information: for segment #30 (169+84.440 to 170+94.370), Freeway Segment of type Nine-lane Freeway is using unbalanced lane processing with types Eight-lane Freeway and Ten-lane Freeway
170+94.370	171+35.440	Information: for segment #31 (170+94.370 to 171+35.440), Freeway Segment of type Nine-lane Freeway is using unbalanced lane processing with types Eight-lane Freeway and Ten-lane Freeway
171+35.440	172+54.440	Information: for segment #32 (171+35.440 to 172+54.440), Freeway Segment of type Nine-lane Freeway is using unbalanced lane processing with types Eight-lane Freeway and Ten-lane Freeway
172+54.440	173+73.440	Information: for segment #33 (172+54.440 to 173+73.440), Freeway Segment of type Nine-lane Freeway is using unbalanced lane processing with types Eight-lane Freeway and Ten-lane Freeway
173+73.440	174+92.440	Information: for segment #34 (173+73.440 to 174+92.440), Freeway Segment of type Nine-lane Freeway is using unbalanced lane processing with types Eight-lane Freeway and Ten-lane Freeway
174+92.440	175+53.460	Information: for segment #35 (174+92.440 to 175+53.460), Freeway Segment of type Nine-lane Freeway is using unbalanced lane processing with types Eight-lane Freeway and Ten-lane Freeway
184+96.790	186+54.440	Warning: for segment #47 (184+96.790 to 186+54.440), traffic volume (196,100 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F

Start Location (Sta. ft)	End Location (Sta. ft)	Message
184+96.790	186+54.440	Information: for segment #47 (184+96.790 to 186+54.440), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
186+54.440	190+97.440	Warning: for segment #48 (186+54.440 to 190+97.440), traffic volume (196,100 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
186+54.440	190+97.440	Information: for segment #48 (186+54.440 to 190+97.440), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
190+97.440	198+69.900	Warning: for segment #49 (190+97.440 to 198+69.900), traffic volume (196,100 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
190+97.440	198+69.900	Information: for segment #49 (190+97.440 to 198+69.900), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
198+69.900	203+60.970	Warning: for segment #50 (198+69.900 to 203+60.970), traffic volume (196,100 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
198+69.900	203+60.970	Information: for segment #50 (198+69.900 to 203+60.970), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
203+60.970	205+18.440	Warning: for segment #52 (203+60.970 to 205+18.440), traffic volume (223,400 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
203+60.970	205+18.440	Warning: for segment #52 (203+60.970 to 205+18.440), Freeway Segment of type 8F is using unbalanced lane processing with 3 + 5 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
205+18.440	208+13.580	Warning: for segment #53 (205+18.440 to 208+13.580), traffic volume (223,400 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
205+18.440	208+13.580	Warning: for segment #53 (205+18.440 to 208+13.580), Freeway Segment of type 8F is using unbalanced lane processing with 3 + 5 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
208+13.580	208+29.440	Warning: for segment #54 (208+13.580 to 208+29.440), traffic volume (223,400 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
208+13.580	208+29.440	Warning: for segment #54 (208+13.580 to 208+29.440), Freeway Segment of type 8F is using unbalanced lane processing with 3 + 5 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
208+29.440	214+67.440	Warning: for segment #55 (208+29.440 to 214+67.440), traffic volume (223,400 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
208+29.440	214+67.440	Warning: for segment #55 (208+29.440 to 214+67.440), Freeway Segment of type 8F is using unbalanced lane processing with 3 + 5 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
214+67.440	224+85.540	Warning: for segment #56 (214+67.440 to 224+85.540), traffic volume (223,400 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
214+67.440	224+85.540	Warning: for segment #56 (214+67.440 to 224+85.540), Freeway Segment of type 8F is using unbalanced lane processing with 3 + 5 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
224+85.540	228+92.450	Warning: for segment #57 (224+85.540 to 228+92.450), traffic volume (247,300 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
224+85.540	228+92.450	Warning: for segment #57 (224+85.540 to 228+92.450), Freeway Segment of type 8F is using unbalanced lane processing with 3 + 5 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
228+92.450	231+12.440	Warning: for segment #58 (228+92.450 to 231+12.440), traffic volume (247,300 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F

Start Location (Sta. ft)	End Location (Sta. ft)	Message
228+92.450	231+12.440	Information: for segment #58 (228+92.450 to 231+12.440), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
231+12.440	236+00.000	Warning: for segment #60 (231+12.440 to 236+00.000), traffic volume (226,100 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
231+12.440	236+00.000	Information: for segment #60 (231+12.440 to 236+00.000), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
198+69.900	203+60.970	Warning: for segment #51 (198+69.900 to 203+60.970), traffic volume (196,100 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6SC
198+69.900	203+60.970	Information: for segment #51 (198+69.900 to 203+60.970), Speed Change Segment of type Seven-lane Freeway Speed Change is using unbalanced lane processing with types Six-lane Freeway Speed Change and Eight-lane Freeway Speed Change
231+12.250	231+12.440	Warning: for segment #59 (231+12.250 to 231+12.440), traffic volume (226,100 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6SC
231+12.250	231+12.440	Information: for segment #59 (231+12.250 to 231+12.440), Speed Change Segment of type Seven-lane Freeway Speed Change is using unbalanced lane processing with types Six-lane Freeway Speed Change and Eight-lane Freeway Speed Change
231+12.440	236+00.000	Warning: for segment #61 (231+12.440 to 236+00.000), traffic volume (226,100 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6SC
231+12.440	236+00.000	Information: for segment #61 (231+12.440 to 236+00.000), Speed Change Segment of type Seven-lane Freeway Speed Change is using unbalanced lane processing with types Six-lane Freeway Speed Change and Eight-lane Freeway Speed Change

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

March 9, 2023

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Report Overview

Report Generated: Mar 9, 2023 3:32 PM
Report Template: System: Single Page [System] (mlcpm3, Mar 7, 2023 12:48 PM)

Evaluation Date: Thu Mar 09 15:32:07 MST 2023
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: Jordan Rae Aguirre
Organization Name: Jacobs Engineering
Phone: 5307019417
E-Mail: jordanrae.aguirre@jacobs.com

Project Title: I-10/101L - Alternatives Analysis - Extended 91st Ave Ramp
Project Comment: Created using wizard
Project Unit System: U.S. Customary

Highway Title: Alignment 91st_RampB Prop
Highway Comment: Imported from 91st_RampB Prop_022823.xml
Highway Version: 1

Evaluation Title: Evaluation 3
Evaluation Comment: Created Thu Mar 09 15:31:18 MST 2023

Minimum Location: 0.000
Maximum Location: 51+63.340

Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration

First Year of Analysis: 2050
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

Disclaimer Regarding Crash Prediction Method

IMPORTANT NOTICE ABOUT COMPARING RESULTS FROM HIGHWAY SAFETY MANUAL FIRST EDITION (2010) MODELS TO RESULTS FROM NEW MODELS DEVELOPED UNDER NCHRP PROJECTS 17-70, 17-58, AND 17-68

Since the publication of the Highway Safety Manual - First Edition (HSM-1), in 2010 by the American Association of State Highway and Transportation Officials (AASHTO), multiple research efforts have been undertaken through the National Cooperative Highway Research Program (NCHRP) to develop safety performance models for road segment and intersection facility types that were not initially reflected in the HSM-1, in order to expand the breadth and depth of the HSM in the future.

The IHSDM Crash Prediction Module (CPM) is intended as a faithful implementation of HSM Part C predictive methods. As NCHRP projects to develop new predictive methods for the HSM are completed, FHWA works to incorporate the new methods into IHSDM, sometimes in advance of publication in the HSM. The following new crash predictive methods have been accepted by NCHRP project panels and incorporated into IHSDM, while pending AASHTO's approval for incorporation into a future edition of the HSM:

- Roundabouts: completed in 2018 under NCHRP Project 17-70, the new methods will provide improved outcomes for the safety analysis of roundabouts.
- 6+ lane and one-way urban/suburban arterials (including models for segments and intersections): completed under NCHRP Project 17-58.
- Intersection crash prediction methods for some intersection configurations and traffic control types not currently addressed in the HSM (e.g., all-way stop; rural 3-leg signalized; 3-leg stop-controlled where the major leg turns; urban 5-leg signalized; urban high-speed intersections): completed in 2021 under NCHRP Project 17-68.

However, in the absence of local calibration factors (see HSM-1 Part C, Appendix A for guidance on calibration of the predictive models), it is neither appropriate nor advisable to directly compare the results from new models (from NCHRP Projects 17-58, 17-68, and 17-70) to results from HSM-1 models, as the models were not calibrated to the same base state data sets, and consequently can produce unexpected results. If local calibration factors are available and applied to both new models and HSM-1 models, then it may be appropriate to directly compare the results.*[Note: Work being performed under NCHRP Project 17-72 (Update of Crash Modification Factors for the Highway Safety Manual) is expected to re-calibrate many of the old (HSM-1) and new (e.g., NCHRP 17-70) models to data from a single (or small number of) states, that would allow results from all models to be directly compared.]*

The models produced for NCHRP Project 17-70 have independent value in terms of informing the design of a roundabout and assessing the effects of different design characteristics on the expected safety performance of a roundabout.

The HSM-1 interim method previously included in IHSDM for evaluating roundabouts on urban/suburban arterials (i.e., evaluating an existing intersection and then applying a Crash Modification Factor for replacing the existing intersection with a roundabout) has been deactivated in IHSDM, to minimize any confusion with the new roundabout methodology.

Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 0.000
Evaluation End Location: 51+63.340
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: EX_RAMP_MV_FI=1.0; EX_RAMP_MV_PDO=1.0; EX_RAMP_SV_FI=1.0; EX_RAMP_SV_PDO=1.0;

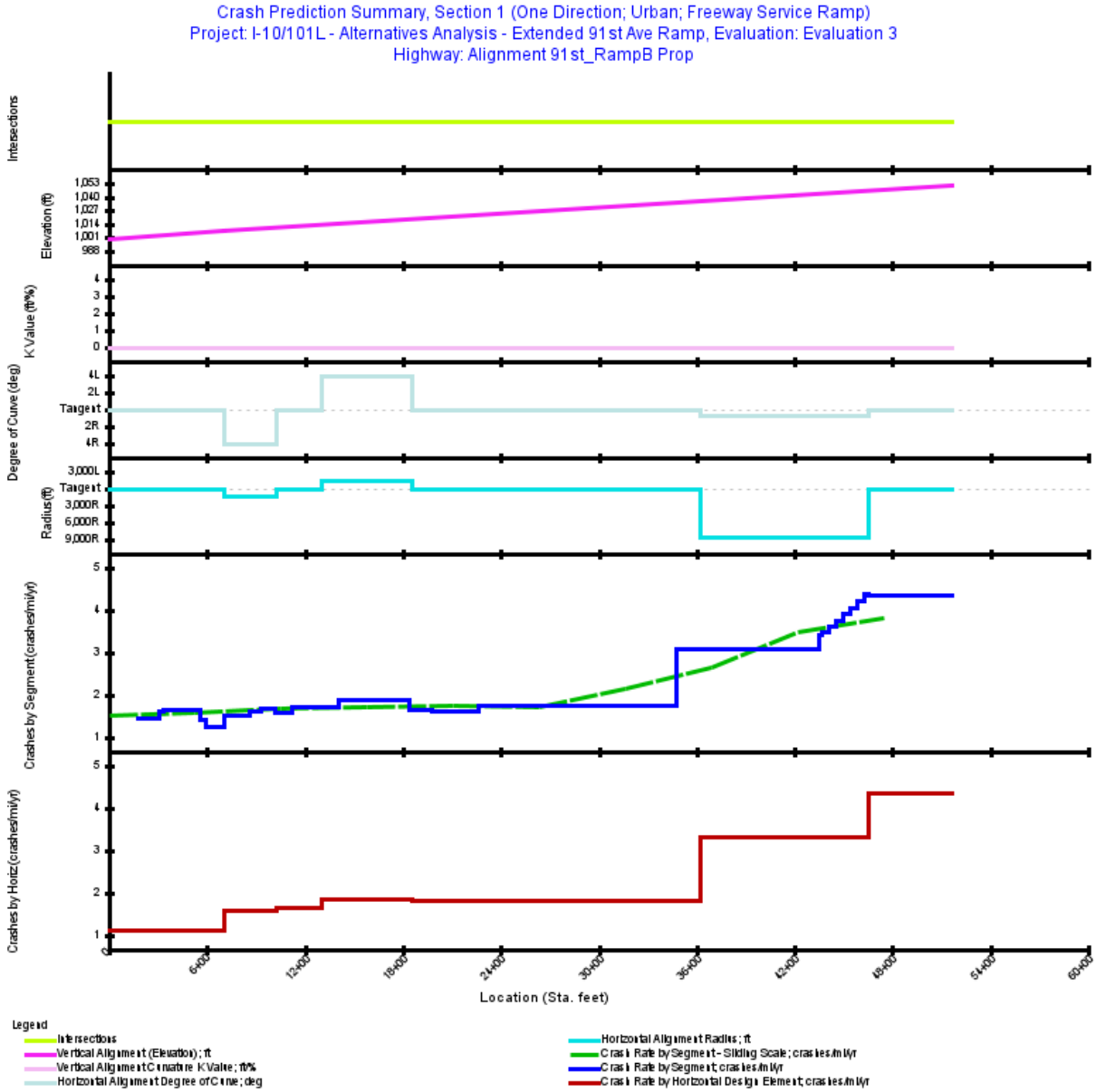

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT
1	Freeway Ramp and C-D Road Unknown	Urban	0.000	1+81.000	181.00	0.0343	2050: 6,500
2	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	1+81.000	3+06.000	125.00	0.0237	2050: 6,500
3	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	3+06.000	3+35.000	29.00	0.0055	2050: 6,500
4	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	3+35.000	5+61.000	226.00	0.0428	2050: 6,500
5	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	5+61.000	5+91.000	30.00	0.0057	2050: 6,500
6	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	5+91.000	6+29.000	38.00	0.0072	2050: 6,500
7	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	6+29.000	7+06.000	77.00	0.0146	2050: 6,500
8	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	7+06.000	7+82.000	76.00	0.0144	2050: 6,500
9	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	7+82.000	7+87.000	5.00	0.0009	2050: 6,500
10	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	7+87.000	8+58.000	71.00	0.0134	2050: 6,500
11	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	8+58.000	9+35.000	77.00	0.0146	2050: 6,500
12	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	9+35.000	10+13.000	78.00	0.0148	2050: 6,500
13	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	10+13.000	10+87.000	74.00	0.0140	2050: 6,500
14	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	10+87.000	11+24.990	37.99	0.0072	2050: 6,500
15	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	11+24.990	14+10.000	285.01	0.0540	2050: 6,500
16	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	14+10.000	14+84.000	74.00	0.0140	2050: 6,500
17	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	14+84.000	18+42.230	358.23	0.0678	2050: 6,500
18	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	18+42.230	19+79.000	136.77	0.0259	2050: 6,500
19	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	19+79.000	20+53.000	74.00	0.0140	2050: 6,500
20	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	20+53.000	22+62.910	209.91	0.0398	2050: 6,500
21	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	22+62.910	28+49.000	586.09	0.1110	2050: 6,500
22	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	28+49.000	33+07.000	458.00	0.0867	2050: 6,500
23	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	33+07.000	34+77.000	170.00	0.0322	2050: 6,500
24	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	34+77.000	43+49.680	872.68	0.1653	2050: 12,300
25	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	43+49.680	43+72.000	22.32	0.0042	2050: 12,300
26	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	43+72.000	44+14.000	42.00	0.0080	2050: 12,300
27	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	44+14.000	44+57.000	43.00	0.0081	2050: 12,300
28	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	44+57.000	45+00.000	43.00	0.0081	2050: 12,300
29	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	45+00.000	45+43.000	43.00	0.0081	2050: 12,300
30	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	45+43.000	45+86.000	43.00	0.0081	2050: 12,300
31	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	45+86.000	46+29.000	43.00	0.0081	2050: 12,300
32	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	46+29.000	46+50.000	21.00	0.0040	2050: 12,300
33	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	46+50.000	51+63.340	513.34	0.0972	2050: 12,300

Table 2. Predicted Ramp Crash Rates and Frequencies Summary (Freeway Ramp Sections)

First Year of Analysis	**2050**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.9436**
Average Future Road AADT (vpd)	**8,463**
Predicted Crashes	
Total Crashes	**2.21**
Fatal and Injury Crashes	**0.93**
Property-Damage-Only Crashes	**1.27**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**42**
Percent Property-Damage-Only Crashes (%)	**58**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**2.3364**
FI Crash Rate (crashes/mi/yr)	**0.9898**
PDO Crash Rate (crashes/mi/yr)	**1.3466**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**2.91**
Travel Crash Rate (crashes/million veh-mi)	**0.76**
Travel FI Crash Rate (crashes/million veh-mi)	**0.32**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.44**

Table 3. Predicted Crash Frequencies and Rates by Ramp Segment/Intersection (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
2	1+81.000	3+06.000	0.0237	0.034	0.0344	0.0144	0.0200	1.4521	0.61
3	3+06.000	3+35.000	0.0055	0.009	0.0089	0.0043	0.0047	1.6256	0.69
4	3+35.000	5+61.000	0.0428	0.071	0.0711	0.0342	0.0370	1.6621	0.70
5	5+61.000	5+91.000	0.0057	0.008	0.0081	0.0037	0.0044	1.4260	0.60
6	5+91.000	6+29.000	0.0072	0.009	0.0090	0.0039	0.0051	1.2544	0.53
7	6+29.000	7+06.000	0.0146	0.018	0.0185	0.0080	0.0105	1.2666	0.53
8	7+06.000	7+82.000	0.0144	0.022	0.0216	0.0092	0.0124	1.5022	0.63
9	7+82.000	7+87.000	0.0009	0.001	0.0014	0.0006	0.0008	1.5180	0.64
10	7+87.000	8+58.000	0.0134	0.021	0.0206	0.0088	0.0117	1.5298	0.65
11	8+58.000	9+35.000	0.0146	0.023	0.0234	0.0103	0.0132	1.6072	0.68
12	9+35.000	10+13.000	0.0148	0.025	0.0250	0.0112	0.0138	1.6931	0.71
13	10+13.000	10+87.000	0.0140	0.022	0.0220	0.0102	0.0118	1.5700	0.66
14	10+87.000	11+24.990	0.0072	0.011	0.0113	0.0053	0.0060	1.5774	0.67
15	11+24.990	14+10.000	0.0540	0.092	0.0921	0.0434	0.0488	1.7067	0.72
16	14+10.000	14+84.000	0.0140	0.026	0.0264	0.0123	0.0141	1.8842	0.79
17	14+84.000	18+42.230	0.0678	0.128	0.1282	0.0599	0.0683	1.8900	0.80
18	18+42.230	19+79.000	0.0259	0.043	0.0427	0.0202	0.0225	1.6487	0.69
19	19+79.000	20+53.000	0.0140	0.022	0.0225	0.0107	0.0118	1.6076	0.68
20	20+53.000	22+62.910	0.0398	0.064	0.0637	0.0302	0.0335	1.6021	0.68
21	22+62.910	28+49.000	0.1110	0.193	0.1930	0.0943	0.0987	1.7385	0.73
22	28+49.000	33+07.000	0.0867	0.152	0.1523	0.0747	0.0776	1.7559	0.74
23	33+07.000	34+77.000	0.0322	0.057	0.0569	0.0279	0.0289	1.7664	0.74
24	34+77.000	43+49.680	0.1653	0.509	0.5091	0.1664	0.3428	3.0804	0.69
25	43+49.680	43+72.000	0.0042	0.014	0.0144	0.0055	0.0089	3.4024	0.76
26	43+72.000	44+14.000	0.0080	0.028	0.0278	0.0108	0.0170	3.4973	0.78
27	44+14.000	44+57.000	0.0081	0.029	0.0295	0.0116	0.0179	3.6275	0.81
28	44+57.000	45+00.000	0.0081	0.031	0.0307	0.0123	0.0184	3.7648	0.84
29	45+00.000	45+43.000	0.0081	0.032	0.0318	0.0130	0.0189	3.9080	0.87
30	45+43.000	45+86.000	0.0081	0.033	0.0330	0.0137	0.0194	4.0575	0.90
31	45+86.000	46+29.000	0.0081	0.034	0.0343	0.0145	0.0199	4.2134	0.94
32	46+29.000	46+50.000	0.0040	0.017	0.0174	0.0074	0.0099	4.3728	0.97
33	46+50.000	51+63.340	0.0972	0.423	0.4233	0.1812	0.2420	4.3534	0.97
Total			0.9436	2.205	2.2047	0.9340	1.2707	2.3364	

Table 4. Predicted Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
Tangent	0.000	7+07.863	0.1341	0.151	0.1506	0.0686	0.0820	1.1232	0.47
Simple Curve 1	7+07.863	10+27.524	0.0605	0.096	0.0959	0.0419	0.0540	1.5835	0.67
Tangent	10+27.524	13+01.947	0.0520	0.086	0.0862	0.0405	0.0458	1.6592	0.70
Simple Curve 2	13+01.947	18+60.282	0.1057	0.195	0.1952	0.0913	0.1039	1.8460	0.78
Tangent	18+60.282	36+19.530	0.3332	0.609	0.6086	0.2825	0.3261	1.8266	0.72
Simple Curve 3	36+19.530	46+49.683	0.1951	0.645	0.6447	0.2279	0.4168	3.3044	0.74
Tangent	46+49.683	51+63.340	0.0973	0.423	0.4235	0.1813	0.2422	4.3534	0.97

Table 5. Predicted Crash Frequencies by Year (Freeway Ramp Sections)

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2050	2.21	0.93	42.363	1.27	57.637
Total	2.21	0.93	42.363	1.27	57.637
Average	2.21	0.93	42.363	1.27	57.637

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 6. Predicted Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
2	0.0004	0.0014	0.0057	0.0069	0.0200
3	0.0001	0.0004	0.0017	0.0020	0.0047
4	0.0011	0.0032	0.0135	0.0164	0.0370
5	0.0001	0.0003	0.0014	0.0018	0.0044
6	0.0001	0.0004	0.0015	0.0019	0.0051
7	0.0002	0.0008	0.0031	0.0038	0.0105
8	0.0003	0.0009	0.0036	0.0044	0.0124
9	0.0000	0.0001	0.0002	0.0003	0.0008
10	0.0003	0.0008	0.0035	0.0042	0.0117
11	0.0003	0.0010	0.0040	0.0049	0.0132
12	0.0003	0.0011	0.0044	0.0054	0.0138
13	0.0003	0.0010	0.0040	0.0049	0.0118
14	0.0002	0.0005	0.0021	0.0026	0.0060
15	0.0014	0.0041	0.0171	0.0208	0.0488
16	0.0004	0.0012	0.0049	0.0059	0.0141
17	0.0019	0.0057	0.0236	0.0288	0.0683
18	0.0006	0.0019	0.0080	0.0097	0.0225
19	0.0003	0.0010	0.0042	0.0051	0.0118
20	0.0009	0.0029	0.0119	0.0145	0.0335
21	0.0029	0.0089	0.0371	0.0453	0.0987
22	0.0023	0.0071	0.0294	0.0359	0.0776
23	0.0009	0.0026	0.0110	0.0134	0.0289
24	0.0050	0.0150	0.0507	0.0957	0.3428
25	0.0002	0.0005	0.0017	0.0032	0.0089
26	0.0003	0.0010	0.0033	0.0062	0.0170
27	0.0003	0.0011	0.0036	0.0067	0.0179
28	0.0004	0.0011	0.0037	0.0071	0.0184
29	0.0004	0.0012	0.0040	0.0075	0.0189
30	0.0004	0.0012	0.0042	0.0079	0.0194
31	0.0004	0.0013	0.0044	0.0083	0.0199
32	0.0002	0.0007	0.0023	0.0043	0.0099
33	0.0054	0.0163	0.0553	0.1042	0.2420
Total	0.0285	0.0865	0.3290	0.4900	1.2707

Table 7. Predicted Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.00	0.2	0.02	1.1	0.03	1.2
Highway Segment	Collision with Fixed Object	0.63	28.8	0.76	35.0	1.39	63.9
Highway Segment	Collision with Other Object	0.04	2.0	0.15	6.8	0.19	8.8
Highway Segment	Other Single-vehicle Collision	0.18	8.3	0.11	5.2	0.29	13.5
Highway Segment	Collision with Parked Vehicle	0.01	0.6	0.02	0.8	0.03	1.4
Highway Segment	Total Single Vehicle Crashes	0.87	39.9	1.06	48.9	1.93	88.9
Highway Segment	Right-Angle Collision	0.00	0.1	0.00	0.2	0.01	0.2
Highway Segment	Head-on Collision	0.00	0.0	0.00	0.0	0.00	0.0
Highway Segment	Other Multi-vehicle Collision	0.00	0.1	0.01	0.2	0.01	0.3
Highway Segment	Rear-end Collision	0.04	1.8	0.13	6.0	0.17	7.8
Highway Segment	Sideswipe, Same Direction Collision	0.01	0.4	0.05	2.3	0.06	2.8
Highway Segment	Total Multiple Vehicle Crashes	0.05	2.4	0.19	8.7	0.24	11.1
Highway Segment	Total Highway Segment Crashes	0.92	42.4	1.25	57.6	2.17	100.0
	Total Crashes	0.92	42.4	1.25	57.6	2.17	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 8. Evaluation Message

Start Location (Sta. ft)	End Location (Sta. ft)	Message
0.000	1+81.000	Warning: for segment #1 (0.000 to 1+81.000), unknown/unsupported segment type, no crash prediction supported
0.000	1+81.000	Warning: for segment #1 (0.000 to 1+81.000), no thru lanes specified; unknown/unsupported segment type, no crash prediction supported
1+81.000	3+06.000	Information: for segment #2 (1+81.000 to 3+06.000), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
3+06.000	3+35.000	Information: for segment #3 (3+06.000 to 3+35.000), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
3+35.000	5+61.000	Information: for segment #4 (3+35.000 to 5+61.000), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
5+91.000	6+29.000	Information: for segment #6 (5+91.000 to 6+29.000), Left shoulder width (12.75 feet) is greater than specified boundaries (10.00 feet); adjusted in CMF calculations.
6+29.000	7+06.000	Information: for segment #7 (6+29.000 to 7+06.000), Left shoulder width (11.99 feet) is greater than specified boundaries (10.00 feet); adjusted in CMF calculations.
7+06.000	7+82.000	Information: for segment #8 (7+06.000 to 7+82.000), Left shoulder width (10.99 feet) is greater than specified boundaries (10.00 feet); adjusted in CMF calculations.
7+82.000	7+87.000	Information: for segment #9 (7+82.000 to 7+87.000), Left shoulder width (10.46 feet) is greater than specified boundaries (10.00 feet); adjusted in CMF calculations.
28+49.000	33+07.000	Information: for segment #22 (28+49.000 to 33+07.000), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
46+29.000	46+50.000	Information: for segment #32 (46+29.000 to 46+50.000), Right shoulder width (1.24 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
46+50.000	51+63.340	Information: for segment #33 (46+50.000 to 51+63.340), Right shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
1+81.000	3+06.000	Program error: for segment #2 (1+81.000 to 3+06.000), GModelDataFRE_Ramp.getFRE_Ramp_BaseAADT(): unknown key: |0|urban, invalid configuration data or program call

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

March 9, 2023

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Evaluation Date: Thu Mar 09 15:23:26 MST 2023
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

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Organization Name: Jacobs Engineering
Phone: 5307019417
E-Mail: jordanrae.aguirre@jacobs.com

Project Title: I-10/101L - Alternatives Analysis - Extended 91st Ave Ramp
Project Comment: Created using wizard
Project Unit System: U.S. Customary

Highway Title: Alignment Thomas_RampC Prop
Highway Comment: Imported from Thomas_RampC Prop_030623.xml
Highway Version: 1

Evaluation Title: Evaluation 7
Evaluation Comment: Created Thu Mar 09 15:23:16 MST 2023

Minimum Location: 86.350
Maximum Location: 30+56.200

Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration

First Year of Analysis: 2050
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

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IMPORTANT NOTICE ABOUT COMPARING RESULTS FROM HIGHWAY SAFETY MANUAL FIRST EDITION (2010) MODELS TO RESULTS FROM NEW MODELS DEVELOPED UNDER NCHRP PROJECTS 17-70, 17-58, AND 17-68

Since the publication of the Highway Safety Manual - First Edition (HSM-1), in 2010 by the American Association of State Highway and Transportation Officials (AASHTO), multiple research efforts have been undertaken through the National Cooperative Highway Research Program (NCHRP) to develop safety performance models for road segment and intersection facility types that were not initially reflected in the HSM-1, in order to expand the breadth and depth of the HSM in the future.

The IHSDM Crash Prediction Module (CPM) is intended as a faithful implementation of HSM Part C predictive methods. As NCHRP projects to develop new predictive methods for the HSM are completed, FHWA works to incorporate the new methods into IHSDM, sometimes in advance of publication in the HSM. The following new crash predictive methods have been accepted by NCHRP project panels and incorporated into IHSDM, while pending AASHTO's approval for incorporation into a future edition of the HSM:

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- 6+ lane and one-way urban/suburban arterials (including models for segments and intersections): completed under NCHRP Project 17-58.
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However, in the absence of local calibration factors (see HSM-1 Part C, Appendix A for guidance on calibration of the predictive models), it is neither appropriate nor advisable to directly compare the results from new models (from NCHRP Projects 17-58, 17-68, and 17-70) to results from HSM-1 models, as the models were not calibrated to the same base state data sets, and consequently can produce unexpected results. If local calibration factors are available and applied to both new models and HSM-1 models, then it may be appropriate to directly compare the results.*[Note: Work being performed under NCHRP Project 17-72 (Update of Crash Modification Factors for the Highway Safety Manual) is expected to re-calibrate many of the old (HSM-1) and new (e.g., NCHRP 17-70) models to data from a single (or small number of) states, that would allow results from all models to be directly compared.]*

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Section Types

Freeway Ramp Evaluation

Section: Section 2
Evaluation Start Location: 86.350
Evaluation End Location: 30+56.200
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: EX_RAMP_MV_FI=1.0; EX_RAMP_MV_PDO=1.0; EX_RAMP_SV_FI=1.0; EX_RAMP_SV_PDO=1.0;

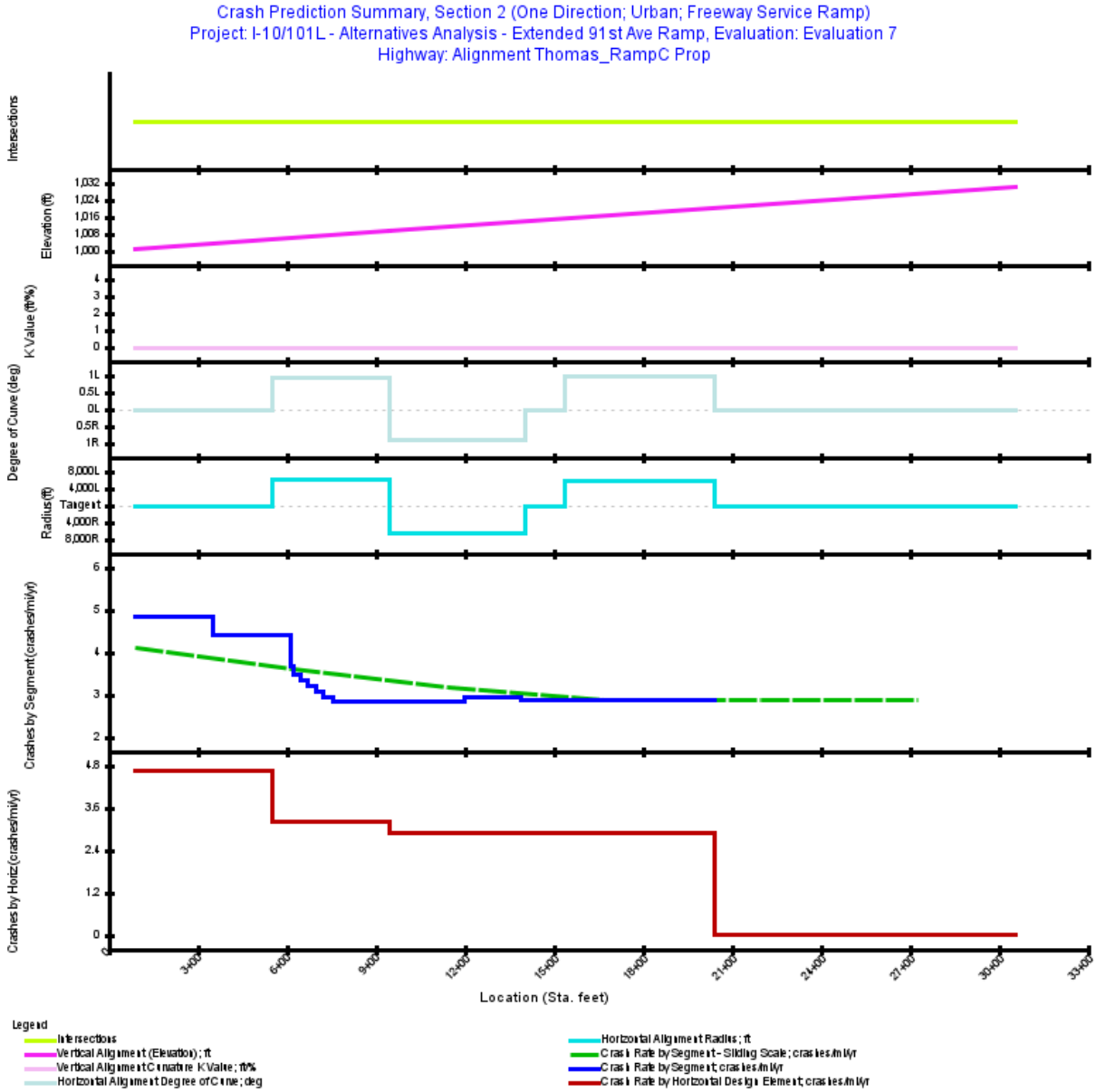

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT
1	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	86.350	3+50.000	263.65	0.0499	2050: 12,900
2	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	3+50.000	6+12.350	262.35	0.0497	2050: 12,900
3	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	6+12.350	6+19.350	7.00	0.0013	2050: 12,900
4	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	6+19.350	6+45.350	26.00	0.0049	2050: 12,900
5	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	6+45.350	6+70.350	25.00	0.0047	2050: 12,900
6	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	6+70.350	6+96.350	26.00	0.0049	2050: 12,900
7	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	6+96.350	7+21.350	25.00	0.0047	2050: 12,900
8	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	7+21.350	7+55.350	34.00	0.0064	2050: 12,900
9	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	7+55.350	11+98.350	443.00	0.0839	2050: 12,900
10	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	11+98.350	13+90.350	192.00	0.0364	2050: 12,900
11	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	13+90.350	20+41.350	651.00	0.1233	2050: 12,900
12	Freeway Ramp and C-D Road Unknown	Urban	20+41.350	27+18.350	677.00	0.1282	2050: 12,900
13	Freeway Ramp and C-D Road Unknown	Urban	27+18.350	30+56.200	337.85	0.0640	2050: 12,900

Table 2. Predicted Ramp Crash Rates and Frequencies Summary (Freeway Ramp Sections)

First Year of Analysis	**2050**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.3703**
Average Future Road AADT (vpd)	**12,900**
Predicted Crashes	
Total Crashes	**1.25**
Fatal and Injury Crashes	**0.62**
Property-Damage-Only Crashes	**0.63**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**50**
Percent Property-Damage-Only Crashes (%)	**50**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**3.3814**
FI Crash Rate (crashes/mi/yr)	**1.6765**
PDO Crash Rate (crashes/mi/yr)	**1.7049**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**1.74**
Travel Crash Rate (crashes/million veh-mi)	**0.72**
Travel FI Crash Rate (crashes/million veh-mi)	**0.36**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.36**

Table 3. Predicted Crash Frequencies and Rates by Ramp Segment/Intersection (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
1	86.350	3+50.000	0.0499	0.243	0.2429	0.1071	0.1358	4.8639	1.03
2	3+50.000	6+12.350	0.0497	0.219	0.2188	0.1296	0.0891	4.4028	0.94
3	6+12.350	6+19.350	0.0013	0.005	0.0049	0.0026	0.0023	3.6720	0.78
4	6+19.350	6+45.350	0.0049	0.017	0.0171	0.0088	0.0083	3.4790	0.74
5	6+45.350	6+70.350	0.0047	0.016	0.0158	0.0081	0.0078	3.3417	0.71
6	6+70.350	6+96.350	0.0049	0.016	0.0158	0.0079	0.0079	3.2104	0.68
7	6+96.350	7+21.350	0.0047	0.015	0.0146	0.0072	0.0074	3.0849	0.66
8	7+21.350	7+55.350	0.0064	0.019	0.0191	0.0093	0.0098	2.9657	0.63
9	7+55.350	11+98.350	0.0839	0.239	0.2391	0.1151	0.1240	2.8498	0.60
10	11+98.350	13+90.350	0.0364	0.107	0.1073	0.0523	0.0550	2.9507	0.63
11	13+90.350	20+41.350	0.1233	0.357	0.3566	0.1726	0.1840	2.8926	0.61
Total			0.3703	1.252	1.2520	0.6207	0.6313	3.3814	

Table 4. Predicted Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
Tangent	86.350	5+47.620	0.0874	0.408	0.4077	0.2048	0.2029	4.6663	0.99
Simple Curve 1	5+47.620	9+44.858	0.0752	0.244	0.2436	0.1252	0.1184	3.2378	0.69
Simple Curve 2	9+44.858	14+02.494	0.0867	0.251	0.2508	0.1214	0.1294	2.8933	0.61
Tangent	14+02.494	15+34.257	0.0250	0.072	0.0722	0.0349	0.0372	2.8926	0.61
Simple Curve 3	15+34.257	20+41.199	0.0960	0.278	0.2777	0.1344	0.1433	2.8926	0.61
Tangent	20+41.199	30+56.200	0.1922	0.000	0.0001	0.0000	0.0000	0.0004	0.00

Table 5. Predicted Crash Frequencies by Year (Freeway Ramp Sections)

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2050	1.25	0.62	49.579	0.63	50.421
Total	1.25	0.62	49.579	0.63	50.421
Average	1.25	0.62	49.579	0.63	50.421

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 6. Predicted Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.0032	0.0097	0.0327	0.0616	0.1358
2	0.0040	0.0123	0.0510	0.0623	0.0891
3	0.0001	0.0002	0.0010	0.0012	0.0023
4	0.0003	0.0008	0.0035	0.0042	0.0083
5	0.0003	0.0008	0.0032	0.0039	0.0078
6	0.0002	0.0008	0.0031	0.0038	0.0079
7	0.0002	0.0007	0.0028	0.0035	0.0074
8	0.0003	0.0009	0.0037	0.0045	0.0098
9	0.0036	0.0109	0.0453	0.0553	0.1240
10	0.0016	0.0050	0.0206	0.0251	0.0550
11	0.0054	0.0163	0.0680	0.0829	0.1840
Total	0.0192	0.0583	0.2349	0.3083	0.6313

Table 7. Predicted Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.00	0.2	0.01	0.9	0.01	1.1
Highway Segment	Collision with Fixed Object	0.42	33.8	0.39	30.8	0.81	64.6
Highway Segment	Collision with Other Object	0.03	2.4	0.07	6.0	0.10	8.4
Highway Segment	Other Single-vehicle Collision	0.12	9.7	0.06	4.6	0.18	14.3
Highway Segment	Collision with Parked Vehicle	0.01	0.7	0.01	0.7	0.02	1.4
Highway Segment	Total Single Vehicle Crashes	0.59	46.8	0.54	43.1	1.12	89.9
Highway Segment	Right-Angle Collision	0.00	0.1	0.00	0.1	0.00	0.2
Highway Segment	Head-on Collision	0.00	0.0	0.00	0.0	0.00	0.0
Highway Segment	Other Multi-vehicle Collision	0.00	0.1	0.00	0.2	0.00	0.3
Highway Segment	Rear-end Collision	0.03	2.1	0.06	5.1	0.09	7.2
Highway Segment	Sideswipe, Same Direction Collision	0.01	0.5	0.02	2.0	0.03	2.5
Highway Segment	Total Multiple Vehicle Crashes	0.04	2.8	0.09	7.3	0.13	10.1
Highway Segment	Total Highway Segment Crashes	0.62	49.6	0.63	50.4	1.25	100.0
	Total Crashes	0.62	49.6	0.63	50.4	1.25	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 8. Evaluation Message

Start Location (Sta. ft)	End Location (Sta. ft)	Message
11+98.350	13+90.350	Information: for segment #10 (11+98.350 to 13+90.350), Left shoulder width (1.75 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
13+90.350	20+41.350	Information: for segment #11 (13+90.350 to 20+41.350), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
20+41.350	27+18.350	Warning: for segment #12 (20+41.350 to 27+18.350), unknown/unsupported segment type, no crash prediction supported
20+41.350	27+18.350	Warning: for segment #12 (20+41.350 to 27+18.350), no thru lanes specified; unknown/unsupported segment type, no crash prediction supported
27+18.350	30+56.200	Warning: for segment #13 (27+18.350 to 30+56.200), unknown/unsupported segment type, no crash prediction supported
27+18.350	30+56.200	Warning: for segment #13 (27+18.350 to 30+56.200), no thru lanes specified; unknown/unsupported segment type, no crash prediction supported

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

March 10, 2023

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Report Overview

Report Generated: Mar 10, 2023 11:16 AM
Report Template: System: Single Page [System] (mlcpm3, Mar 7, 2023 12:48 PM)

Evaluation Date: Fri Mar 10 11:16:16 MST 2023
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: Jordan Rae Aguirre
Organization Name: Jacobs Engineering
Phone: 5307019417
E-Mail: jordanrae.aguirre@jacobs.com

Project Title: I-10/101L - Alternatives Analysis - Extended 91st Ave Ramp
Project Comment: Created using wizard
Project Unit System: U.S. Customary

Highway Title: Alignment IndianSchool_RampA
Highway Comment: Imported from IndianSchool_RampA.xml
Highway Version: 1

Evaluation Title: Evaluation 3
Evaluation Comment: Created Fri Mar 10 11:16:08 MST 2023

Minimum Location: 0.000
Maximum Location: 18+30.680

Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration

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Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
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However, in the absence of local calibration factors (see HSM-1 Part C, Appendix A for guidance on calibration of the predictive models), it is neither appropriate nor advisable to directly compare the results from new models (from NCHRP Projects 17-58, 17-68, and 17-70) to results from HSM-1 models, as the models were not calibrated to the same base state data sets, and consequently can produce unexpected results. If local calibration factors are available and applied to both new models and HSM-1 models, then it may be appropriate to directly compare the results.*[Note: Work being performed under NCHRP Project 17-72 (Update of Crash Modification Factors for the Highway Safety Manual) is expected to re-calibrate many of the old (HSM-1) and new (e.g., NCHRP 17-70) models to data from a single (or small number of) states, that would allow results from all models to be directly compared.]*

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Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 0.000
Evaluation End Location: 18+30.680
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: ENT_RAMP_MV_FI=1.0; ENT_RAMP_MV_PDO=1.0; ENT_RAMP_SV_FI=1.0; ENT_RAMP_SV_PDO=1.0;

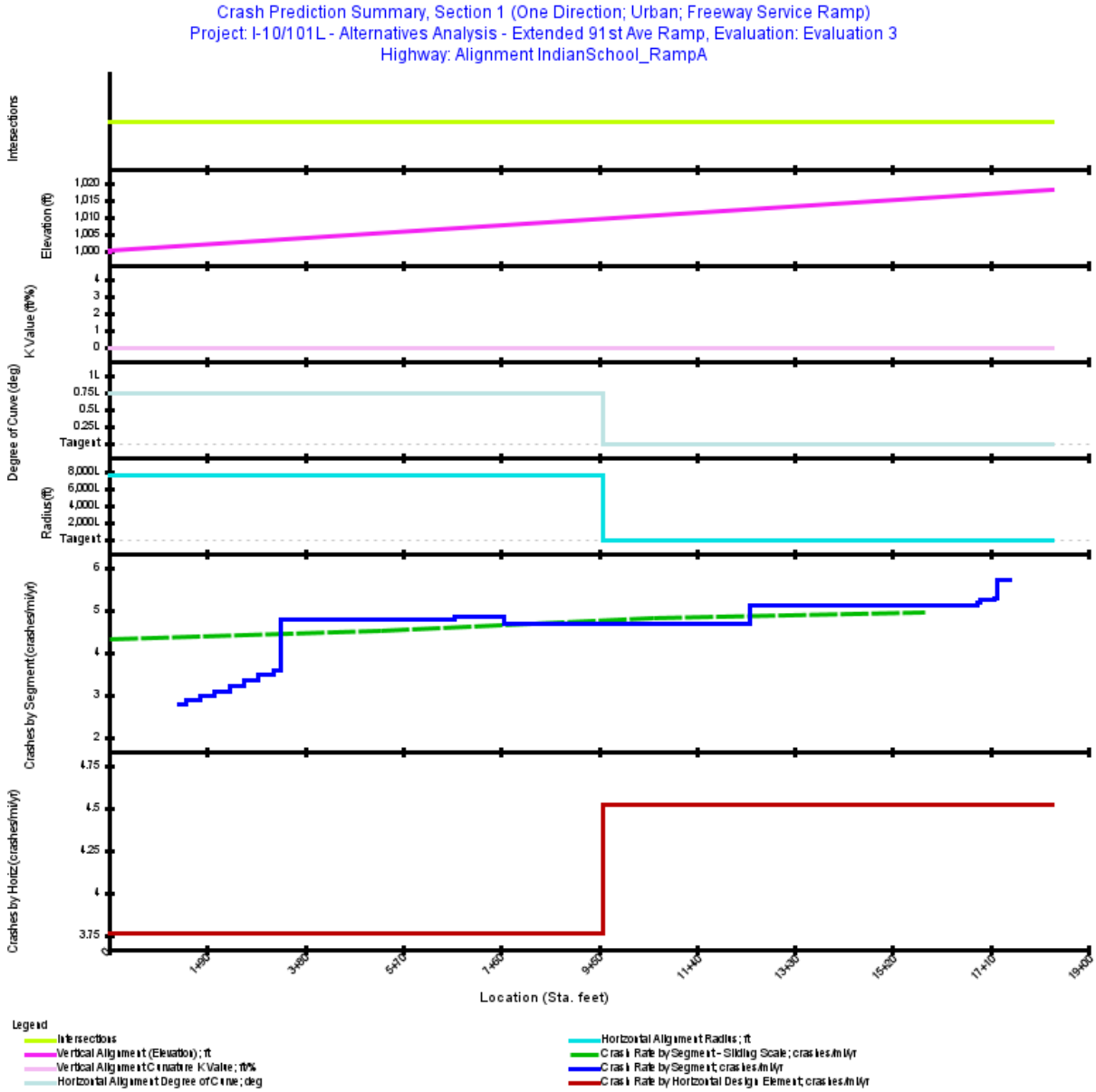

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT
1	Freeway Ramp and C-D Road Unknown	Urban	0.000	1+35.000	135.00	0.0256	2050: 13,400
2	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	1+35.000	1+49.000	14.00	0.0027	2050: 13,400
3	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	1+49.000	1+77.000	28.00	0.0053	2050: 13,400
4	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	1+77.000	2+05.000	28.00	0.0053	2050: 13,400
5	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	2+05.000	2+34.000	29.00	0.0055	2050: 13,400
6	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	2+34.000	2+62.000	28.00	0.0053	2050: 13,400
7	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	2+62.000	2+90.000	28.00	0.0053	2050: 13,400
8	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	2+90.000	3+19.000	29.00	0.0055	2050: 13,400
9	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	3+19.000	3+32.150	13.15	0.0025	2050: 13,400
10	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	3+32.150	6+70.000	337.85	0.0640	2050: 13,400
11	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	6+70.000	7+66.000	96.00	0.0182	2050: 13,400
12	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	7+66.000	9+47.610	181.61	0.0344	2050: 13,400
13	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	9+47.610	12+42.000	294.39	0.0558	2050: 13,400
14	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	12+42.000	13+46.000	104.00	0.0197	2050: 13,400
15	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	13+46.000	16+83.490	337.49	0.0639	2050: 13,400
16	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	16+83.490	16+90.000	6.51	0.0012	2050: 13,400
17	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	16+90.000	17+16.910	26.91	0.0051	2050: 13,400
18	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	17+16.910	17+22.000	5.09	0.0010	2050: 13,400
19	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	17+22.000	17+49.000	27.00	0.0051	2050: 13,400
20	Freeway Ramp and C-D Road Unknown	Urban	17+49.000	18+30.680	81.68	0.0155	2050: 13,400

Table 2. Predicted Ramp Crash Rates and Frequencies Summary (Freeway Ramp Sections)

First Year of Analysis	**2050**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.3057**
Average Future Road AADT (vpd)	**13,400**
Predicted Crashes	
Total Crashes	**1.43**
Fatal and Injury Crashes	**0.51**
Property-Damage-Only Crashes	**0.92**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**36**
Percent Property-Damage-Only Crashes (%)	**64**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**4.6799**
FI Crash Rate (crashes/mi/yr)	**1.6680**
PDO Crash Rate (crashes/mi/yr)	**3.0119**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**1.50**
Travel Crash Rate (crashes/million veh-mi)	**0.96**
Travel FI Crash Rate (crashes/million veh-mi)	**0.34**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.62**

Table 3. Predicted Crash Frequencies and Rates by Ramp Segment/Intersection (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
2	1+35.000	1+49.000	0.0027	0.007	0.0074	0.0032	0.0042	2.7885	0.57
3	1+49.000	1+77.000	0.0053	0.015	0.0152	0.0067	0.0086	2.8685	0.59
4	1+77.000	2+05.000	0.0053	0.016	0.0158	0.0070	0.0088	2.9792	0.61
5	2+05.000	2+34.000	0.0055	0.017	0.0170	0.0077	0.0093	3.0969	0.63
6	2+34.000	2+62.000	0.0053	0.017	0.0171	0.0078	0.0093	3.2199	0.66
7	2+62.000	2+90.000	0.0053	0.018	0.0177	0.0083	0.0095	3.3461	0.68
8	2+90.000	3+19.000	0.0055	0.019	0.0191	0.0090	0.0101	3.4804	0.71
9	3+19.000	3+32.150	0.0025	0.009	0.0089	0.0043	0.0047	3.5836	0.73
10	3+32.150	6+70.000	0.0640	0.306	0.3063	0.1006	0.2056	4.7868	0.98
11	6+70.000	7+66.000	0.0182	0.088	0.0880	0.0291	0.0589	4.8411	0.99
12	7+66.000	9+47.610	0.0344	0.161	0.1614	0.0525	0.1089	4.6922	0.96
13	9+47.610	12+42.000	0.0558	0.262	0.2615	0.0852	0.1763	4.6892	0.96
14	12+42.000	13+46.000	0.0197	0.101	0.1005	0.0381	0.0624	5.1013	1.04
15	13+46.000	16+83.490	0.0639	0.327	0.3272	0.1242	0.2030	5.1190	1.05
16	16+83.490	16+90.000	0.0012	0.006	0.0064	0.0024	0.0040	5.1841	1.06
17	16+90.000	17+16.910	0.0051	0.027	0.0267	0.0102	0.0165	5.2376	1.07
18	17+16.910	17+22.000	0.0010	0.005	0.0051	0.0020	0.0031	5.2784	1.08
19	17+22.000	17+49.000	0.0051	0.029	0.0293	0.0117	0.0176	5.7245	1.17
Total			0.3057	1.431	1.4306	0.5099	0.9207	4.6799	

Table 4. Predicted Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
Simple Curve 1	0.000	9+57.878	0.1814	0.683	0.6831	0.2391	0.4440	3.7654	0.77
Tangent	9+57.878	18+30.680	0.1653	0.748	0.7475	0.2708	0.4766	4.5217	0.93

Table 5. Predicted Crash Frequencies by Year (Freeway Ramp Sections)

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2050	1.43	0.51	35.642	0.92	64.358
Total	1.43	0.51	35.642	0.92	64.358
Average	1.43	0.51	35.642	0.92	64.358

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 6. Predicted Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
2	0.0001	0.0002	0.0013	0.0016	0.0042
3	0.0001	0.0004	0.0027	0.0033	0.0086
4	0.0001	0.0005	0.0029	0.0035	0.0088
5	0.0002	0.0005	0.0032	0.0039	0.0093
6	0.0002	0.0005	0.0032	0.0039	0.0093
7	0.0002	0.0005	0.0034	0.0041	0.0095
8	0.0002	0.0006	0.0037	0.0045	0.0101
9	0.0001	0.0003	0.0018	0.0021	0.0047
10	0.0020	0.0062	0.0320	0.0604	0.2056
11	0.0006	0.0018	0.0093	0.0175	0.0589
12	0.0011	0.0032	0.0167	0.0315	0.1089
13	0.0017	0.0052	0.0271	0.0511	0.1763
14	0.0008	0.0023	0.0121	0.0228	0.0624
15	0.0025	0.0076	0.0395	0.0745	0.2030
16	0.0000	0.0002	0.0008	0.0015	0.0040
17	0.0002	0.0006	0.0033	0.0061	0.0165
18	0.0000	0.0001	0.0006	0.0012	0.0031
19	0.0002	0.0007	0.0037	0.0070	0.0176
Total	0.0104	0.0315	0.1673	0.3007	0.9207

Table 7. Predicted Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.00	0.1	0.01	0.8	0.01	0.9
Highway Segment	Collision with Fixed Object	0.24	16.9	0.35	24.8	0.59	41.6
Highway Segment	Collision with Other Object	0.02	1.2	0.07	4.8	0.09	6.0
Highway Segment	Other Single-vehicle Collision	0.07	4.9	0.05	3.7	0.12	8.6
Highway Segment	Collision with Parked Vehicle	0.01	0.3	0.01	0.6	0.01	0.9
Highway Segment	Total Single Vehicle Crashes	0.33	23.4	0.49	34.6	0.83	57.9
Highway Segment	Right-Angle Collision	0.01	0.4	0.01	0.5	0.01	0.9
Highway Segment	Head-on Collision	0.00	0.1	0.00	0.1	0.00	0.2
Highway Segment	Other Multi-vehicle Collision	0.01	0.4	0.01	0.7	0.02	1.1
Highway Segment	Rear-end Collision	0.13	9.2	0.29	20.5	0.43	29.8
Highway Segment	Sideswipe, Same Direction Collision	0.03	2.2	0.11	7.9	0.14	10.1
Highway Segment	Total Multiple Vehicle Crashes	0.18	12.3	0.43	29.8	0.60	42.1
Highway Segment	Total Highway Segment Crashes	0.51	35.6	0.92	64.4	1.43	100.0
	Total Crashes	0.51	35.6	0.92	64.4	1.43	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 8. Evaluation Message

Start Location (Sta. ft)	End Location (Sta. ft)	Message
0.000	1+35.000	Warning: for segment #1 (0.000 to 1+35.000), unknown/unsupported segment type, no crash prediction supported
0.000	1+35.000	Warning: for segment #1 (0.000 to 1+35.000), no thru lanes specified; unknown/unsupported segment type, no crash prediction supported
1+35.000	1+49.000	Information: for segment #2 (1+35.000 to 1+49.000), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
1+49.000	1+77.000	Information: for segment #3 (1+49.000 to 1+77.000), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
1+77.000	2+05.000	Information: for segment #4 (1+77.000 to 2+05.000), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
2+05.000	2+34.000	Information: for segment #5 (2+05.000 to 2+34.000), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
2+34.000	2+62.000	Information: for segment #6 (2+34.000 to 2+62.000), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
2+62.000	2+90.000	Information: for segment #7 (2+62.000 to 2+90.000), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
2+90.000	3+19.000	Information: for segment #8 (2+90.000 to 3+19.000), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
3+19.000	3+32.150	Information: for segment #9 (3+19.000 to 3+32.150), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
3+32.150	6+70.000	Information: for segment #10 (3+32.150 to 6+70.000), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
6+70.000	7+66.000	Information: for segment #11 (6+70.000 to 7+66.000), Left shoulder width (1.50 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
17+22.000	17+49.000	Information: for segment #19 (17+22.000 to 17+49.000), Left shoulder width (1.75 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
17+22.000	17+49.000	Information: for segment #19 (17+22.000 to 17+49.000), Right shoulder width (1.25 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
17+49.000	18+30.680	Warning: for segment #20 (17+49.000 to 18+30.680), unknown/unsupported segment type, no crash prediction supported
17+49.000	18+30.680	Warning: for segment #20 (17+49.000 to 18+30.680), no thru lanes specified; unknown/unsupported segment type, no crash prediction supported

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

March 29, 2023

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Report Overview

Report Generated: Mar 29, 2023 8:33 AM
Report Template: System: Single Page [System] (mlcpm3, Mar 7, 2023 12:48 PM)

Evaluation Date: Wed Mar 29 08:33:55 MST 2023
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: Jordan Rae Aguirre
Organization Name: Jacobs Engineering
Phone: 5307019417
E-Mail: jordanrae.aguirre@jacobs.com

Project Title: I-10/101L - Alternatives Analysis - Extended 91st Ave Ramp
Project Comment: Created using wizard
Project Unit System: U.S. Customary

Highway Title: Alignment SE Ramp Prop
Highway Comment: Imported from SE Ramp Prop_022823.xml
Highway Version: 1

Evaluation Title: Evaluation 7
Evaluation Comment: Created Wed Mar 29 08:33:38 MST 2023

Minimum Location: 40+43.407
Maximum Location: 109+64.841

Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration

First Year of Analysis: 2050
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

Disclaimer Regarding Crash Prediction Method

IMPORTANT NOTICE ABOUT COMPARING RESULTS FROM HIGHWAY SAFETY MANUAL FIRST EDITION (2010) MODELS TO RESULTS FROM NEW MODELS DEVELOPED UNDER NCHRP PROJECTS 17-70, 17-58, AND 17-68

Since the publication of the Highway Safety Manual - First Edition (HSM-1), in 2010 by the American Association of State Highway and Transportation Officials (AASHTO), multiple research efforts have been undertaken through the National Cooperative Highway Research Program (NCHRP) to develop safety performance models for road segment and intersection facility types that were not initially reflected in the HSM-1, in order to expand the breadth and depth of the HSM in the future.

The IHSDM Crash Prediction Module (CPM) is intended as a faithful implementation of HSM Part C predictive methods. As NCHRP projects to develop new predictive methods for the HSM are completed, FHWA works to incorporate the new methods into IHSDM, sometimes in advance of publication in the HSM. The following new crash predictive methods have been accepted by NCHRP project panels and incorporated into IHSDM, while pending AASHTO's approval for incorporation into a future edition of the HSM:

- Roundabouts: completed in 2018 under NCHRP Project 17-70, the new methods will provide improved outcomes for the safety analysis of roundabouts.
- 6+ lane and one-way urban/suburban arterials (including models for segments and intersections): completed under NCHRP Project 17-58.
- Intersection crash prediction methods for some intersection configurations and traffic control types not currently addressed in the HSM (e.g., all-way stop; rural 3-leg signalized; 3-leg stop-controlled where the major leg turns; urban 5-leg signalized; urban high-speed intersections): completed in 2021 under NCHRP Project 17-68.

However, in the absence of local calibration factors (see HSM-1 Part C, Appendix A for guidance on calibration of the predictive models), it is neither appropriate nor advisable to directly compare the results from new models (from NCHRP Projects 17-58, 17-68, and 17-70) to results from HSM-1 models, as the models were not calibrated to the same base state data sets, and consequently can produce unexpected results. If local calibration factors are available and applied to both new models and HSM-1 models, then it may be appropriate to directly compare the results.*[Note: Work being performed under NCHRP Project 17-72 (Update of Crash Modification Factors for the Highway Safety Manual) is expected to re-calibrate many of the old (HSM-1) and new (e.g., NCHRP 17-70) models to data from a single (or small number of) states, that would allow results from all models to be directly compared.]*

The models produced for NCHRP Project 17-70 have independent value in terms of informing the design of a roundabout and assessing the effects of different design characteristics on the expected safety performance of a roundabout.

The HSM-1 interim method previously included in IHSDM for evaluating roundabouts on urban/suburban arterials (i.e., evaluating an existing intersection and then applying a Crash Modification Factor for replacing the existing intersection with a roundabout) has been deactivated in IHSDM, to minimize any confusion with the new roundabout methodology.

Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 40+43.407
Evaluation End Location: 109+64.841
Functional Class: Freeway C-D Road & System Ramp
Type of Alignment: One Direction
Model Category: C-D Road & System Ramp
Calibration Factor: CD_MV_FI=1.0; CD_MV_PDO=1.0; CD_SV_FI=1.0; CD_SV_PDO=1.0;

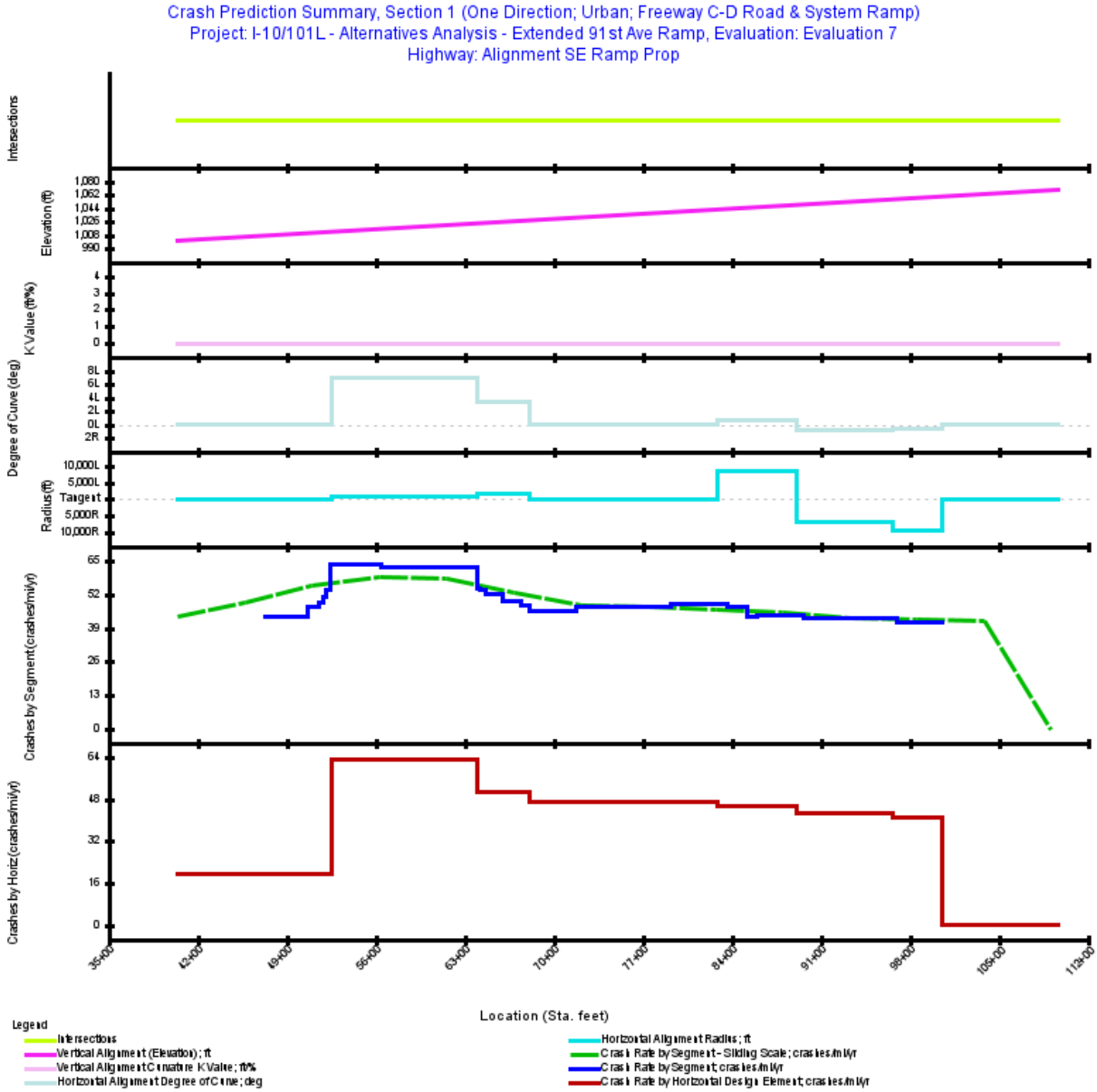

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT
1	Freeway Ramp and C-D Road Unknown	Urban	40+43.407	47+27.407	684.00	0.1295	2050: 48,700

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT
2	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	47+27.407	50+57.407	330.00	0.0625	2050: 48,700
3	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	50+57.407	50+71.407	14.00	0.0027	2050: 48,700
4	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	50+71.407	50+98.407	27.00	0.0051	2050: 48,700
5	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	50+98.407	51+26.407	28.00	0.0053	2050: 48,700
6	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	51+26.407	51+53.407	27.00	0.0051	2050: 48,700
7	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	51+53.407	51+80.407	27.00	0.0051	2050: 48,700
8	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	51+80.407	52+08.407	28.00	0.0053	2050: 48,700
9	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	52+08.407	52+35.407	27.00	0.0051	2050: 48,700
10	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	52+35.407	56+38.407	403.00	0.0763	2050: 48,700
11	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	56+38.407	63+93.320	754.91	0.1430	2050: 48,700
12	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	63+93.320	64+16.407	23.09	0.0044	2050: 48,700
13	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	64+16.407	64+62.407	46.00	0.0087	2050: 48,700
14	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	64+62.407	65+99.407	137.00	0.0259	2050: 48,700
15	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	65+99.407	67+36.407	137.00	0.0259	2050: 48,700
16	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	67+36.407	68+04.420	68.01	0.0129	2050: 48,700
17	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	68+04.420	71+75.407	370.99	0.0703	2050: 48,700
18	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	71+75.407	79+17.407	742.00	0.1405	2050: 48,700
19	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	79+17.407	82+87.320	369.91	0.0701	2050: 48,700
20	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	82+87.320	83+63.407	76.09	0.0144	2050: 48,700
21	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	83+63.407	85+15.407	152.00	0.0288	2050: 48,700
22	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	85+15.407	85+91.407	76.00	0.0144	2050: 48,700
23	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	85+91.407	89+57.407	366.00	0.0693	2050: 48,700
24	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	89+57.407	96+89.407	732.00	0.1386	2050: 48,700
25	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	96+89.407	100+55.407	366.00	0.0693	2050: 48,700

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT
26	Freeway Ramp and C-D Road Unknown	Urban	100+55.407	109+64.841	909.43	0.1722	2050: 48,700

Table 2. Predicted Ramp Crash Rates and Frequencies Summary (Freeway Ramp Sections)

First Year of Analysis	**2050**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**1.0091**
Average Future Road AADT (vpd)	**48,700**
Predicted Crashes	
Total Crashes	**49.86**
Fatal and Injury Crashes	**31.07**
Property-Damage-Only Crashes	**18.80**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**62**
Percent Property-Damage-Only Crashes (%)	**38**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**49.4142**
FI Crash Rate (crashes/mi/yr)	**30.7866**
PDO Crash Rate (crashes/mi/yr)	**18.6276**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**17.94**
Travel Crash Rate (crashes/million veh-mi)	**2.78**
Travel FI Crash Rate (crashes/million veh-mi)	**1.73**
Travel PDO Crash Rate (crashes/million veh-mi)	**1.05**

Table 3. Predicted Crash Frequencies and Rates by Ramp Segment/Intersection (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
2	47+27.407	50+57.407	0.0625	2.722	2.7218	1.7257	0.9961	43.5481	2.45
3	50+57.407	50+71.407	0.0027	0.125	0.1246	0.0760	0.0486	46.9914	2.64
4	50+71.407	50+98.407	0.0051	0.240	0.2403	0.1465	0.0938	46.9914	2.64
5	50+98.407	51+26.407	0.0053	0.249	0.2492	0.1519	0.0973	46.9914	2.64
6	51+26.407	51+53.407	0.0051	0.240	0.2405	0.1467	0.0939	47.0407	2.65
7	51+53.407	51+80.407	0.0051	0.251	0.2510	0.1547	0.0963	49.0771	2.76
8	51+80.407	52+08.407	0.0053	0.272	0.2718	0.1693	0.1025	51.2513	2.88
9	52+08.407	52+35.407	0.0051	0.274	0.2737	0.1723	0.1014	53.5317	3.01
10	52+35.407	56+38.407	0.0763	4.864	4.8635	3.0812	1.7823	63.7210	3.58
11	56+38.407	63+93.320	0.1430	8.964	8.9637	5.6505	3.3132	62.6938	3.53
12	63+93.320	64+16.407	0.0044	0.238	0.2380	0.1490	0.0890	54.4237	3.06
13	64+16.407	64+62.407	0.0087	0.468	0.4681	0.2921	0.1760	53.7278	3.02
14	64+62.407	65+99.407	0.0259	1.347	1.3475	0.8339	0.5136	51.9314	2.92
15	65+99.407	67+36.407	0.0259	1.281	1.2808	0.7827	0.4982	49.3639	2.78
16	67+36.407	68+04.420	0.0129	0.612	0.6123	0.3706	0.2417	47.5342	2.67
17	68+04.420	71+75.407	0.0703	3.197	3.1972	1.9333	1.2639	45.5038	2.56
18	71+75.407	79+17.407	0.1405	6.604	6.6039	4.0263	2.5776	46.9928	2.64
19	79+17.407	82+87.320	0.0701	3.400	3.4003	2.0900	1.3102	48.5342	2.73
20	82+87.320	83+63.407	0.0144	0.700	0.7004	0.4305	0.2699	48.6064	2.73
21	83+63.407	85+15.407	0.0288	1.355	1.3547	0.8259	0.5288	47.0577	2.65
22	85+15.407	85+91.407	0.0144	0.625	0.6249	0.3917	0.2332	43.4132	2.44
23	85+91.407	89+57.407	0.0693	3.055	3.0555	1.9421	1.1134	44.0797	2.48
24	89+57.407	96+89.407	0.1386	5.918	5.9185	3.7330	2.1855	42.6910	2.40
25	96+89.407	100+55.407	0.0693	2.861	2.8612	1.7906	1.0706	41.2757	2.32
Total			1.0091	49.863	49.8634	31.0665	18.7969	49.4142	

Table 4. Predicted Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi /yr)	Predicted Travel Crash Rate (crashes/mi llion veh-mi)
Tangent	40+43.407	52+49.250	0.2284	4.540	4.5400	2.8490	1.6910	19.8790	1.12
Simple Curve 1	52+49.250	63+93.320	0.2167	13.660	13.6602	8.6259	5.0342	63.0432	3.55
Simple Curve 2	63+93.320	68+04.418	0.0779	3.947	3.9466	2.4282	1.5185	50.6893	2.85
Tangent	68+04.418	82+87.317	0.2809	13.201	13.2014	8.0496	5.1518	47.0048	2.64
Simple Curve 3	82+87.317	89+00.824	0.1162	5.263	5.2632	3.2900	1.9732	45.2963	2.55
Simple Curve 4	89+00.824	96+60.946	0.1440	6.161	6.1608	3.8881	2.2727	42.7943	2.41
Simple Curve 5	96+60.946	100+55.334	0.0747	3.091	3.0907	1.9354	1.1553	41.3778	2.33
Tangent	100+55.334	109+64.841	0.1723	0.001	0.0006	0.0004	0.0002	0.0033	0.00

Table 5. Predicted Crash Frequencies by Year (Freeway Ramp Sections)

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2050	49.86	31.07	62.303	18.80	37.697
Total	49.86	31.07	62.303	18.80	37.697
Average	49.86	31.07	62.303	18.80	37.697

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 6. Predicted Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
2	0.0299	0.0906	0.4807	1.1245	0.9961
3	0.0011	0.0034	0.0183	0.0532	0.0486
4	0.0021	0.0065	0.0353	0.1025	0.0938
5	0.0022	0.0067	0.0367	0.1063	0.0973
6	0.0021	0.0065	0.0354	0.1027	0.0939
7	0.0023	0.0069	0.0373	0.1083	0.0963
8	0.0025	0.0075	0.0408	0.1185	0.1025
9	0.0025	0.0076	0.0416	0.1206	0.1014
10	0.0451	0.1366	0.7433	2.1563	1.7823
11	0.0826	0.2505	1.3631	3.9543	3.3132
12	0.0022	0.0066	0.0359	0.1042	0.0890
13	0.0043	0.0130	0.0705	0.2044	0.1760
14	0.0122	0.0370	0.2012	0.5836	0.5136
15	0.0114	0.0347	0.1888	0.5477	0.4982
16	0.0054	0.0164	0.0894	0.2593	0.2417
17	0.0283	0.0857	0.4664	1.3529	1.2639
18	0.0589	0.1785	0.9713	2.8176	2.5776
19	0.0306	0.0927	0.5042	1.4626	1.3102
20	0.0063	0.0191	0.1039	0.3013	0.2699
21	0.0121	0.0366	0.1992	0.5780	0.5288
22	0.0057	0.0174	0.0947	0.2739	0.2332
23	0.0336	0.1020	0.5411	1.2654	1.1134
24	0.0646	0.1960	1.0401	2.4323	2.1855
25	0.0310	0.0940	0.4989	1.1667	1.0706
Total	0.4790	1.4524	7.8382	21.2969	18.7969

Table 7. Predicted Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.01	0.0	0.05	0.1	0.06	0.1
Highway Segment	Collision with Fixed Object	1.13	2.3	1.68	3.4	2.81	5.6
Highway Segment	Collision with Other Object	0.08	0.2	0.33	0.7	0.41	0.8
Highway Segment	Other Single-vehicle Collision	0.33	0.7	0.25	0.5	0.58	1.2
Highway Segment	Collision with Parked Vehicle	0.02	0.0	0.04	0.1	0.06	0.1
Highway Segment	Total Single Vehicle Crashes	1.57	3.1	2.35	4.7	3.92	7.9
Highway Segment	Right-Angle Collision	0.91	1.8	0.30	0.6	1.21	2.4
Highway Segment	Head-on Collision	0.24	0.5	0.03	0.1	0.27	0.5
Highway Segment	Other Multi-vehicle Collision	0.91	1.8	0.40	0.8	1.31	2.6
Highway Segment	Rear-end Collision	22.12	44.4	11.35	22.8	33.47	67.1
Highway Segment	Sideswipe, Same Direction Collision	5.31	10.6	4.38	8.8	9.69	19.4
Highway Segment	Total Multiple Vehicle Crashes	29.50	59.2	16.45	33.0	45.95	92.1
Highway Segment	Total Highway Segment Crashes	31.07	62.3	18.80	37.7	49.86	100.0
	Total Crashes	31.07	62.3	18.80	37.7	49.86	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 8. Evaluation Message

Start Location (Sta. ft)	End Location (Sta. ft)	Message
40+43.407	47+27.407	Warning: for segment #1 (40+43.407 to 47+27.407), unknown/unsupported segment type, no crash prediction supported
40+43.407	47+27.407	Warning: for segment #1 (40+43.407 to 47+27.407), no thru lanes specified; unknown/unsupported segment type, no crash prediction supported
50+57.407	50+71.407	Information: for segment #3 (50+57.407 to 50+71.407), Right shoulder width (14.73 feet) is greater than specified boundaries (12.00 feet); adjusted in CMF calculations.
50+71.407	50+98.407	Information: for segment #4 (50+71.407 to 50+98.407), Right shoulder width (13.98 feet) is greater than specified boundaries (12.00 feet); adjusted in CMF calculations.
50+98.407	51+26.407	Information: for segment #5 (50+98.407 to 51+26.407), Right shoulder width (12.98 feet) is greater than specified boundaries (12.00 feet); adjusted in CMF calculations.
85+91.407	89+57.407	Information: for segment #23 (85+91.407 to 89+57.407), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
89+57.407	96+89.407	Information: for segment #24 (89+57.407 to 96+89.407), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
96+89.407	100+55.407	Information: for segment #25 (96+89.407 to 100+55.407), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
100+55.407	109+64.841	Warning: for segment #26 (100+55.407 to 109+64.841), unknown/unsupported segment type, no crash prediction supported
100+55.407	109+64.841	Warning: for segment #26 (100+55.407 to 109+64.841), no thru lanes specified; unknown/unsupported segment type, no crash prediction supported
47+27.407	50+57.407	Warning: for segment #2 (47+27.407 to 50+57.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
50+57.407	50+71.407	Warning: for segment #3 (50+57.407 to 50+71.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
50+71.407	50+98.407	Warning: for segment #4 (50+71.407 to 50+98.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
50+98.407	51+26.407	Warning: for segment #5 (50+98.407 to 51+26.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
51+26.407	51+53.407	Warning: for segment #6 (51+26.407 to 51+53.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
51+53.407	51+80.407	Warning: for segment #7 (51+53.407 to 51+80.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
51+80.407	52+08.407	Warning: for segment #8 (51+80.407 to 52+08.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
52+08.407	52+35.407	Warning: for segment #9 (52+08.407 to 52+35.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
52+35.407	56+38.407	Warning: for segment #10 (52+35.407 to 56+38.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
56+38.407	63+93.320	Warning: for segment #11 (56+38.407 to 63+93.320), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD

Start Location (Sta. ft)	End Location (Sta. ft)	Message
63+93.320	64+16.407	Warning: for segment #12 (63+93.320 to 64+16.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
64+16.407	64+62.407	Warning: for segment #13 (64+16.407 to 64+62.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
64+62.407	65+99.407	Warning: for segment #14 (64+62.407 to 65+99.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
65+99.407	67+36.407	Warning: for segment #15 (65+99.407 to 67+36.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
67+36.407	68+04.420	Warning: for segment #16 (67+36.407 to 68+04.420), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
68+04.420	71+75.407	Warning: for segment #17 (68+04.420 to 71+75.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
71+75.407	79+17.407	Warning: for segment #18 (71+75.407 to 79+17.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
79+17.407	82+87.320	Warning: for segment #19 (79+17.407 to 82+87.320), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
82+87.320	83+63.407	Warning: for segment #20 (82+87.320 to 83+63.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
83+63.407	85+15.407	Warning: for segment #21 (83+63.407 to 85+15.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
85+15.407	85+91.407	Warning: for segment #22 (85+15.407 to 85+91.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
85+91.407	89+57.407	Warning: for segment #23 (85+91.407 to 89+57.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
89+57.407	96+89.407	Warning: for segment #24 (89+57.407 to 96+89.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
96+89.407	100+55.407	Warning: for segment #25 (96+89.407 to 100+55.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

March 9, 2023

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Report Overview

Report Generated: Mar 9, 2023 3:35 PM
Report Template: System: Single Page [System] (mlcpm3, Mar 7, 2023 12:48 PM)

Evaluation Date: Thu Mar 09 15:35:03 MST 2023
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: Jordan Rae Aguirre
Organization Name: Jacobs Engineering
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E-Mail: jordanrae.aguirre@jacobs.com

Project Title: I-10/101L - Alternatives Analysis - Extended 91st Ave Ramp
Project Comment: Created using wizard
Project Unit System: U.S. Customary

Highway Title: Alignment McDowell_RampC Prop
Highway Comment: Imported from McDowell_RampC Prop_022823.xml
Highway Version: 1

Evaluation Title: Evaluation 3
Evaluation Comment: Created Thu Mar 09 15:34:40 MST 2023

Minimum Location: 56.780
Maximum Location: 18+82.428

Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration

First Year of Analysis: 2050
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

Disclaimer Regarding Crash Prediction Method

IMPORTANT NOTICE ABOUT COMPARING RESULTS FROM HIGHWAY SAFETY MANUAL FIRST EDITION (2010) MODELS TO RESULTS FROM NEW MODELS DEVELOPED UNDER NCHRP PROJECTS 17-70, 17-58, AND 17-68

Since the publication of the Highway Safety Manual - First Edition (HSM-1), in 2010 by the American Association of State Highway and Transportation Officials (AASHTO), multiple research efforts have been undertaken through the National Cooperative Highway Research Program (NCHRP) to develop safety performance models for road segment and intersection facility types that were not initially reflected in the HSM-1, in order to expand the breadth and depth of the HSM in the future.

The IHSDM Crash Prediction Module (CPM) is intended as a faithful implementation of HSM Part C predictive methods. As NCHRP projects to develop new predictive methods for the HSM are completed, FHWA works to incorporate the new methods into IHSDM, sometimes in advance of publication in the HSM. The following new crash predictive methods have been accepted by NCHRP project panels and incorporated into IHSDM, while pending AASHTO's approval for incorporation into a future edition of the HSM:

- Roundabouts: completed in 2018 under NCHRP Project 17-70, the new methods will provide improved outcomes for the safety analysis of roundabouts.
- 6+ lane and one-way urban/suburban arterials (including models for segments and intersections): completed under NCHRP Project 17-58.
- Intersection crash prediction methods for some intersection configurations and traffic control types not currently addressed in the HSM (e.g., all-way stop; rural 3-leg signalized; 3-leg stop-controlled where the major leg turns; urban 5-leg signalized; urban high-speed intersections): completed in 2021 under NCHRP Project 17-68.

However, in the absence of local calibration factors (see HSM-1 Part C, Appendix A for guidance on calibration of the predictive models), it is neither appropriate nor advisable to directly compare the results from new models (from NCHRP Projects 17-58, 17-68, and 17-70) to results from HSM-1 models, as the models were not calibrated to the same base state data sets, and consequently can produce unexpected results. If local calibration factors are available and applied to both new models and HSM-1 models, then it may be appropriate to directly compare the results.*[Note: Work being performed under NCHRP Project 17-72 (Update of Crash Modification Factors for the Highway Safety Manual) is expected to re-calibrate many of the old (HSM-1) and new (e.g., NCHRP 17-70) models to data from a single (or small number of) states, that would allow results from all models to be directly compared.]*

The models produced for NCHRP Project 17-70 have independent value in terms of informing the design of a roundabout and assessing the effects of different design characteristics on the expected safety performance of a roundabout.

The HSM-1 interim method previously included in IHSDM for evaluating roundabouts on urban/suburban arterials (i.e., evaluating an existing intersection and then applying a Crash Modification Factor for replacing the existing intersection with a roundabout) has been deactivated in IHSDM, to minimize any confusion with the new roundabout methodology.

Section Types

Freeway Ramp Evaluation

Section: Section 2
Evaluation Start Location: 56.780
Evaluation End Location: 18+82.428
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: EX_RAMP_MV_FI=1.0; EX_RAMP_MV_PDO=1.0; EX_RAMP_SV_FI=1.0; EX_RAMP_SV_PDO=1.0;

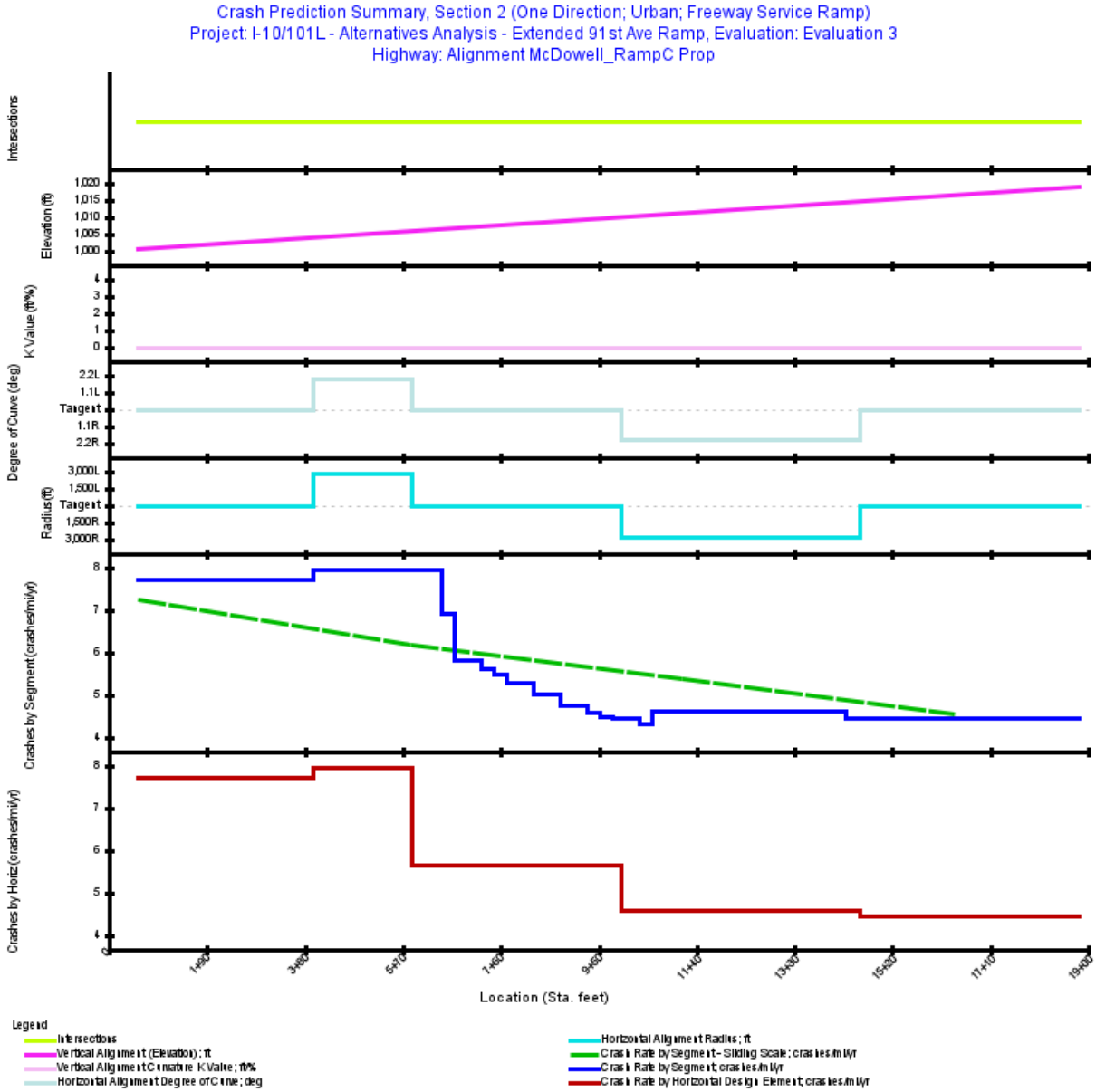

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT
1	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	56.780	3+96.230	339.45	0.0643	2050: 22,500
2	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	3+96.230	6+44.340	248.11	0.0470	2050: 22,500
3	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	6+44.340	6+70.780	26.44	0.0050	2050: 22,500
4	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	6+70.780	7+21.780	51.00	0.0097	2050: 22,500
5	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	7+21.780	7+47.780	26.00	0.0049	2050: 22,500
6	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	7+47.780	7+72.780	25.00	0.0047	2050: 22,500
7	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	7+72.780	8+24.780	52.00	0.0098	2050: 22,500
8	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	8+24.780	8+75.780	51.00	0.0097	2050: 22,500
9	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	8+75.780	9+27.780	52.00	0.0098	2050: 22,500
10	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	9+27.780	9+52.780	25.00	0.0047	2050: 22,500
11	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	9+52.780	9+78.780	26.00	0.0049	2050: 22,500
12	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	9+78.780	10+29.780	51.00	0.0097	2050: 22,500
13	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	10+29.780	10+55.330	25.55	0.0048	2050: 22,500
14	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	10+55.330	14+29.780	374.45	0.0709	2050: 22,500
15	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	14+29.780	18+82.428	452.65	0.0857	2050: 22,500

Table 2. Predicted Ramp Crash Rates and Frequencies Summary (Freeway Ramp Sections)

First Year of Analysis	**2050**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.3458**
Average Future Road AADT (vpd)	**22,500**
Predicted Crashes	
Total Crashes	**1.98**
Fatal and Injury Crashes	**0.94**
Property-Damage-Only Crashes	**1.04**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**47**
Percent Property-Damage-Only Crashes (%)	**53**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**5.7220**
FI Crash Rate (crashes/mi/yr)	**2.7048**
PDO Crash Rate (crashes/mi/yr)	**3.0172**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**2.84**
Travel Crash Rate (crashes/million veh-mi)	**0.70**
Travel FI Crash Rate (crashes/million veh-mi)	**0.33**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.37**

Table 3. Predicted Crash Frequencies and Rates by Ramp Segment/Intersection (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
1	56.780	3+96.230	0.0643	0.496	0.4956	0.2194	0.2762	7.7086	0.94
2	3+96.230	6+44.340	0.0470	0.373	0.3731	0.1648	0.2083	7.9399	0.97
3	6+44.340	6+70.780	0.0050	0.035	0.0346	0.0207	0.0139	6.9102	0.84
4	6+70.780	7+21.780	0.0097	0.056	0.0563	0.0301	0.0262	5.8298	0.71
5	7+21.780	7+47.780	0.0049	0.028	0.0276	0.0146	0.0131	5.6114	0.68
6	7+47.780	7+72.780	0.0047	0.026	0.0259	0.0136	0.0124	5.4718	0.67
7	7+72.780	8+24.780	0.0098	0.052	0.0519	0.0268	0.0251	5.2683	0.64
8	8+24.780	8+75.780	0.0097	0.048	0.0484	0.0246	0.0238	5.0092	0.61
9	8+75.780	9+27.780	0.0098	0.047	0.0469	0.0234	0.0235	4.7643	0.58
10	9+27.780	9+52.780	0.0047	0.022	0.0217	0.0107	0.0110	4.5900	0.56
11	9+52.780	9+78.780	0.0049	0.022	0.0221	0.0108	0.0113	4.4786	0.55
12	9+78.780	10+29.780	0.0097	0.043	0.0429	0.0206	0.0223	4.4413	0.54
13	10+29.780	10+55.330	0.0048	0.021	0.0210	0.0099	0.0110	4.3316	0.53
14	10+55.330	14+29.780	0.0709	0.328	0.3283	0.1593	0.1690	4.6291	0.56
15	14+29.780	18+82.428	0.0857	0.382	0.3822	0.1861	0.1961	4.4582	0.54
Total			0.3458	1.978	1.9785	0.9352	1.0432	5.7220	

Table 4. Predicted Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
Tangent	56.780	3+96.230	0.0643	0.496	0.4956	0.2194	0.2762	7.7086	0.94
Simple Curve 1	3+96.230	5+87.453	0.0362	0.288	0.2876	0.1270	0.1605	7.9399	0.97
Tangent	5+87.453	9+93.638	0.0769	0.433	0.4335	0.2189	0.2146	5.6347	0.69
Simple Curve 2	9+93.638	14+57.793	0.0879	0.403	0.4033	0.1953	0.2080	4.5878	0.56
Tangent	14+57.793	18+82.428	0.0804	0.358	0.3585	0.1745	0.1840	4.4582	0.54

Table 5. Predicted Crash Frequencies by Year (Freeway Ramp Sections)

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2050	1.98	0.94	47.270	1.04	52.730
Total	1.98	0.94	47.270	1.04	52.730
Average	1.98	0.94	47.270	1.04	52.730

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 6. Predicted Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.0065	0.0198	0.0669	0.1261	0.2762
2	0.0049	0.0149	0.0503	0.0948	0.2083
3	0.0006	0.0020	0.0081	0.0099	0.0139
4	0.0009	0.0028	0.0118	0.0144	0.0262
5	0.0005	0.0014	0.0057	0.0070	0.0131
6	0.0004	0.0013	0.0053	0.0065	0.0124
7	0.0008	0.0025	0.0106	0.0129	0.0251
8	0.0008	0.0023	0.0097	0.0118	0.0238
9	0.0007	0.0022	0.0092	0.0112	0.0235
10	0.0003	0.0010	0.0042	0.0051	0.0110
11	0.0003	0.0010	0.0042	0.0052	0.0113
12	0.0006	0.0020	0.0081	0.0099	0.0223
13	0.0003	0.0009	0.0039	0.0048	0.0110
14	0.0050	0.0151	0.0627	0.0765	0.1690
15	0.0058	0.0176	0.0733	0.0894	0.1961
Total	0.0286	0.0868	0.3341	0.4856	1.0432

Table 7. Predicted Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.00	0.2	0.02	0.9	0.02	1.1
Highway Segment	Collision with Fixed Object	0.60	30.5	0.59	29.9	1.19	60.4
Highway Segment	Collision with Other Object	0.04	2.2	0.12	5.8	0.16	8.0
Highway Segment	Other Single-vehicle Collision	0.17	8.8	0.09	4.5	0.26	13.2
Highway Segment	Collision with Parked Vehicle	0.01	0.6	0.01	0.7	0.03	1.3
Highway Segment	Total Single Vehicle Crashes	0.84	42.2	0.82	41.7	1.66	84.0
Highway Segment	Right-Angle Collision	0.00	0.2	0.00	0.2	0.01	0.4
Highway Segment	Head-on Collision	0.00	0.0	0.00	0.0	0.00	0.1
Highway Segment	Other Multi-vehicle Collision	0.00	0.2	0.01	0.3	0.01	0.4
Highway Segment	Rear-end Collision	0.07	3.8	0.15	7.6	0.23	11.4
Highway Segment	Sideswipe, Same Direction Collision	0.02	0.9	0.06	2.9	0.08	3.8
Highway Segment	Total Multiple Vehicle Crashes	0.10	5.0	0.22	11.0	0.32	16.0
Highway Segment	Total Highway Segment Crashes	0.94	47.3	1.04	52.7	1.98	100.0
	Total Crashes	0.94	47.3	1.04	52.7	1.98	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 8. Evaluation Message

Start Location (Sta. ft)	End Location (Sta. ft)	Message
14+29.780	18+82.428	Information: for segment #15 (14+29.780 to 18+82.428), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
6+44.340	6+70.780	Warning: for segment #3 (6+44.340 to 6+70.780), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
6+70.780	7+21.780	Warning: for segment #4 (6+70.780 to 7+21.780), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
7+21.780	7+47.780	Warning: for segment #5 (7+21.780 to 7+47.780), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
7+47.780	7+72.780	Warning: for segment #6 (7+47.780 to 7+72.780), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
7+72.780	8+24.780	Warning: for segment #7 (7+72.780 to 8+24.780), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
8+24.780	8+75.780	Warning: for segment #8 (8+24.780 to 8+75.780), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
8+75.780	9+27.780	Warning: for segment #9 (8+75.780 to 9+27.780), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
9+27.780	9+52.780	Warning: for segment #10 (9+27.780 to 9+52.780), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
9+52.780	9+78.780	Warning: for segment #11 (9+52.780 to 9+78.780), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
9+78.780	10+29.780	Warning: for segment #12 (9+78.780 to 10+29.780), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
10+29.780	10+55.330	Warning: for segment #13 (10+29.780 to 10+55.330), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
10+55.330	14+29.780	Warning: for segment #14 (10+55.330 to 14+29.780), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
14+29.780	18+82.428	Warning: for segment #15 (14+29.780 to 18+82.428), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

March 8, 2023

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Report Overview

Report Generated: Mar 8, 2023 9:11 AM
Report Template: System: Single Page [System] (mlcpm3, Mar 7, 2023 12:48 PM)

Evaluation Date: Wed Mar 08 09:11:52 MST 2023
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: Jordan Rae Aguirre
Organization Name: Jacobs Engineering
Phone: 5307019417
E-Mail: jordanrae.aguirre@jacobs.com

Project Title: I-10/101L - Alternatives Analysis - Extended 91st Ave Ramp
Project Comment: Created using wizard
Project Unit System: U.S. Customary

Highway Title: Alignment 91st_Conn
Highway Comment: Imported from 91st_Conn_022823.xml
Highway Version: 1

Evaluation Title: Evaluation 1
Evaluation Comment: Created Wed Mar 08 09:11:40 MST 2023

Minimum Location: 0.000
Maximum Location: 103+51.907

Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration

First Year of Analysis: 2050
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

Disclaimer Regarding Crash Prediction Method

IMPORTANT NOTICE ABOUT COMPARING RESULTS FROM HIGHWAY SAFETY MANUAL FIRST EDITION (2010) MODELS TO RESULTS FROM NEW MODELS DEVELOPED UNDER NCHRP PROJECTS 17-70, 17-58, AND 17-68

Since the publication of the Highway Safety Manual - First Edition (HSM-1), in 2010 by the American Association of State Highway and Transportation Officials (AASHTO), multiple research efforts have been undertaken through the National Cooperative Highway Research Program (NCHRP) to develop safety performance models for road segment and intersection facility types that were not initially reflected in the HSM-1, in order to expand the breadth and depth of the HSM in the future.

The IHSDM Crash Prediction Module (CPM) is intended as a faithful implementation of HSM Part C predictive methods. As NCHRP projects to develop new predictive methods for the HSM are completed, FHWA works to incorporate the new methods into IHSDM, sometimes in advance of publication in the HSM. The following new crash predictive methods have been accepted by NCHRP project panels and incorporated into IHSDM, while pending AASHTO's approval for incorporation into a future edition of the HSM:

- Roundabouts: completed in 2018 under NCHRP Project 17-70, the new methods will provide improved outcomes for the safety analysis of roundabouts.
- 6+ lane and one-way urban/suburban arterials (including models for segments and intersections): completed under NCHRP Project 17-58.
- Intersection crash prediction methods for some intersection configurations and traffic control types not currently addressed in the HSM (e.g., all-way stop; rural 3-leg signalized; 3-leg stop-controlled where the major leg turns; urban 5-leg signalized; urban high-speed intersections): completed in 2021 under NCHRP Project 17-68.

However, in the absence of local calibration factors (see HSM-1 Part C, Appendix A for guidance on calibration of the predictive models), it is neither appropriate nor advisable to directly compare the results from new models (from NCHRP Projects 17-58, 17-68, and 17-70) to results from HSM-1 models, as the models were not calibrated to the same base state data sets, and consequently can produce unexpected results. If local calibration factors are available and applied to both new models and HSM-1 models, then it may be appropriate to directly compare the results.*[Note: Work being performed under NCHRP Project 17-72 (Update of Crash Modification Factors for the Highway Safety Manual) is expected to re-calibrate many of the old (HSM-1) and new (e.g., NCHRP 17-70) models to data from a single (or small number of) states, that would allow results from all models to be directly compared.]*

The models produced for NCHRP Project 17-70 have independent value in terms of informing the design of a roundabout and assessing the effects of different design characteristics on the expected safety performance of a roundabout.

The HSM-1 interim method previously included in IHSDM for evaluating roundabouts on urban/suburban arterials (i.e., evaluating an existing intersection and then applying a Crash Modification Factor for replacing the existing intersection with a roundabout) has been deactivated in IHSDM, to minimize any confusion with the new roundabout methodology.

Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 0.000
Evaluation End Location: 103+51.907
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: ENT_RAMP_MV_FI=1.0; ENT_RAMP_MV_PDO=1.0; ENT_RAMP_SV_FI=1.0; ENT_RAMP_SV_PDO=1.0;

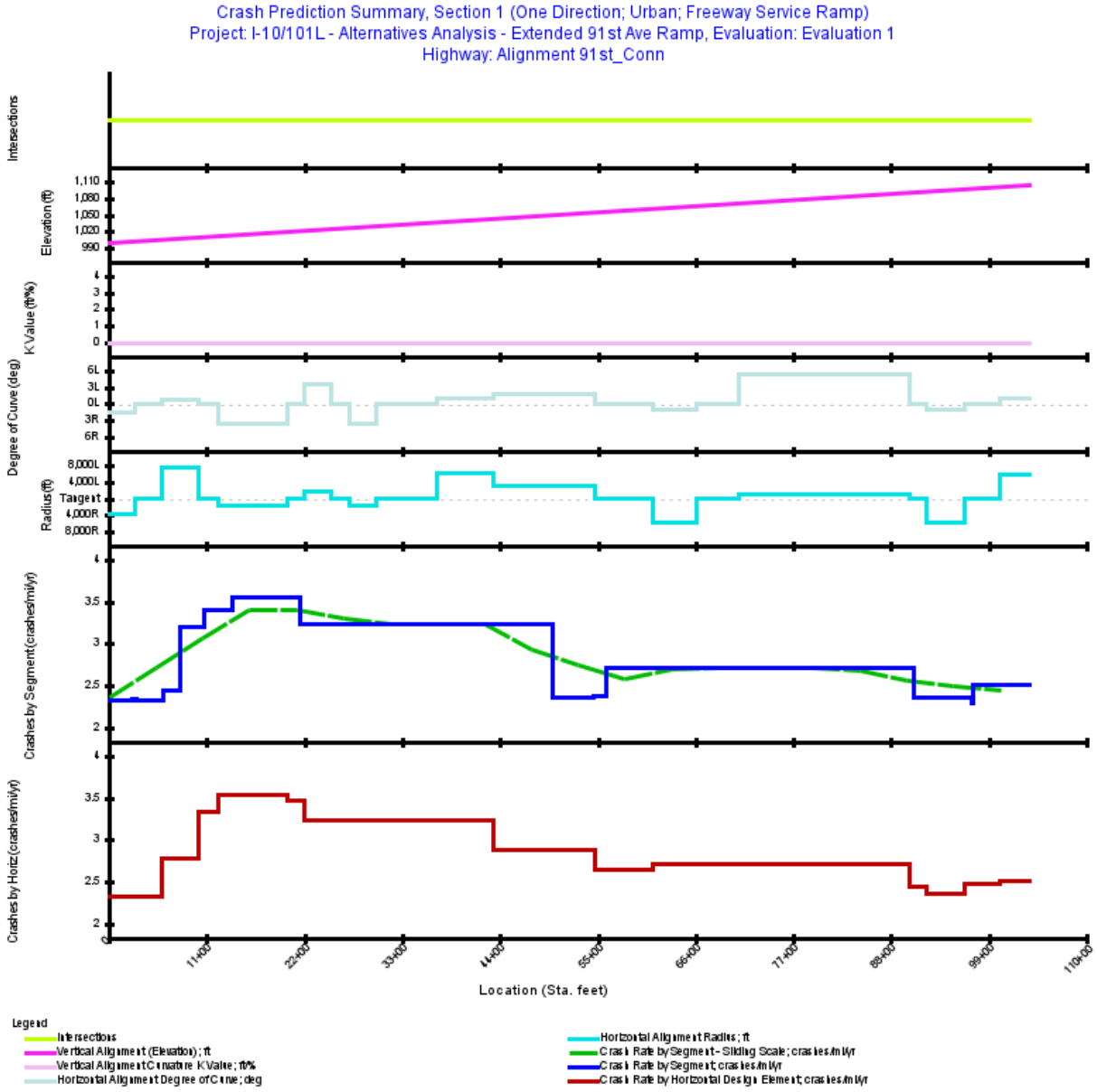

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT
1	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	0.000	2+69.000	269.00	0.0509	2050: 5,800
2	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	2+69.000	3+03.340	34.34	0.0065	2050: 5,800
3	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	3+03.340	6+16.000	312.66	0.0592	2050: 5,800
4	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	6+16.000	8+07.000	191.00	0.0362	2050: 5,800
5	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	8+07.000	10+75.030	268.03	0.0508	2050: 5,800
6	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	10+75.030	13+82.000	306.97	0.0581	2050: 5,800
7	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	13+82.000	21+46.870	764.87	0.1449	2050: 5,800
8	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	21+46.870	49+96.000	2,849.13	0.5396	2050: 5,800
9	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	49+96.000	54+47.010	451.01	0.0854	2050: 5,800
10	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	54+47.010	56+02.000	154.99	0.0294	2050: 5,800
11	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	56+02.000	90+55.880	3,453.88	0.6541	2050: 5,800
12	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	90+55.880	97+04.000	648.12	0.1227	2050: 5,800
13	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	97+04.000	97+25.000	21.00	0.0040	2050: 5,800
14	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	97+25.000	103+51.907	626.91	0.1187	2050: 5,800

Table 2. Predicted Ramp Crash Rates and Frequencies Summary (Freeway Ramp Sections)

First Year of Analysis	**2050**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**1.9606**
Average Future Road AADT (vpd)	**5,800**
Predicted Crashes	
Total Crashes	**5.63**
Fatal and Injury Crashes	**2.32**
Property-Damage-Only Crashes	**3.31**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**41**
Percent Property-Damage-Only Crashes (%)	**59**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**2.8713**
FI Crash Rate (crashes/mi/yr)	**1.1847**
PDO Crash Rate (crashes/mi/yr)	**1.6866**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**4.15**
Travel Crash Rate (crashes/million veh-mi)	**1.36**
Travel FI Crash Rate (crashes/million veh-mi)	**0.56**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.80**

Table 3. Predicted Crash Frequencies and Rates by Ramp Segment/Intersection (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
1	0.000	2+69.000	0.0509	0.119	0.1188	0.0360	0.0828	2.3314	1.10
2	2+69.000	3+03.340	0.0065	0.015	0.0153	0.0047	0.0106	2.3497	1.11
3	3+03.340	6+16.000	0.0592	0.138	0.1383	0.0424	0.0959	2.3353	1.10
4	6+16.000	8+07.000	0.0362	0.088	0.0882	0.0308	0.0575	2.4390	1.15
5	8+07.000	10+75.030	0.0508	0.162	0.1622	0.0580	0.1042	3.1944	1.51
6	10+75.030	13+82.000	0.0581	0.198	0.1975	0.0709	0.1266	3.3977	1.60
7	13+82.000	21+46.870	0.1449	0.516	0.5161	0.1860	0.3301	3.5627	1.68
8	21+46.870	49+96.000	0.5396	1.748	1.7483	0.6824	1.0659	3.2399	1.53
9	49+96.000	54+47.010	0.0854	0.201	0.2014	0.1003	0.1011	2.3577	1.11
10	54+47.010	56+02.000	0.0294	0.070	0.0699	0.0317	0.0382	2.3808	1.12
11	56+02.000	90+55.880	0.6541	1.775	1.7753	0.7929	0.9824	2.7140	1.28
12	90+55.880	97+04.000	0.1227	0.290	0.2899	0.1310	0.1588	2.3614	1.11
13	97+04.000	97+25.000	0.0040	0.009	0.0091	0.0044	0.0047	2.2914	1.08
14	97+25.000	103+51.907	0.1187	0.299	0.2992	0.1513	0.1479	2.5199	1.19
Total			1.9606	5.629	5.6294	2.3228	3.3066	2.8713	

Table 4. Predicted Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
Simple Curve 1	0.000	3+00.000	0.0568	0.133	0.1326	0.0402	0.0924	2.3333	1.10
Tangent	3+00.000	5+89.093	0.0548	0.128	0.1279	0.0392	0.0886	2.3355	1.10
Simple Curve 2	5+89.093	10+00.214	0.0779	0.217	0.2170	0.0762	0.1408	2.7872	1.32
Tangent	10+00.214	12+36.223	0.0447	0.149	0.1490	0.0534	0.0956	3.3332	1.57
Simple Curve 3	12+36.223	20+11.853	0.1469	0.519	0.5188	0.1868	0.3320	3.5317	1.67
Tangent	20+11.853	22+04.853	0.0366	0.127	0.1267	0.0467	0.0800	3.4658	1.64
Simple Curve 4	22+04.853	25+04.853	0.0568	0.184	0.1841	0.0719	0.1122	3.2399	1.53
Tangent	25+04.853	26+99.496	0.0369	0.119	0.1194	0.0466	0.0728	3.2399	1.53
Simple Curve 5	26+99.496	30+06.981	0.0582	0.189	0.1887	0.0736	0.1150	3.2399	1.53
Tangent	30+06.981	36+92.412	0.1298	0.421	0.4206	0.1642	0.2564	3.2399	1.53
Simple Curve 6	36+92.412	43+19.014	0.1187	0.385	0.3845	0.1501	0.2344	3.2399	1.53
Simple Curve 7	43+19.014	54+66.483	0.2173	0.626	0.6256	0.2665	0.3591	2.8786	1.36
Tangent	54+66.483	61+12.539	0.1224	0.324	0.3235	0.1449	0.1786	2.6441	1.25
Simple Curve 8	61+12.539	66+12.539	0.0947	0.257	0.2570	0.1148	0.1422	2.7140	1.28
Tangent	66+12.539	70+83.900	0.0893	0.242	0.2423	0.1082	0.1341	2.7140	1.28
Simple Curve 9	70+83.900	90+09.105	0.3646	0.990	0.9896	0.4420	0.5476	2.7140	1.28
Tangent	90+09.105	91+93.712	0.0350	0.086	0.0857	0.0386	0.0471	2.4507	1.16
Simple Curve 10	91+93.712	96+19.913	0.0807	0.191	0.1906	0.0862	0.1045	2.3614	1.11
Tangent	96+19.913	100+23.855	0.0765	0.189	0.1894	0.0936	0.0958	2.4750	1.17
Simple Curve 11	100+23.855	103+51.907	0.0621	0.157	0.1566	0.0792	0.0774	2.5199	1.19

Table 5. Predicted Crash Frequencies by Year (Freeway Ramp Sections)

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2050	5.63	2.32	41.262	3.31	58.738
Total	5.63	2.32	41.262	3.31	58.738
Average	5.63	2.32	41.262	3.31	58.738

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 6. Predicted Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.0006	0.0019	0.0100	0.0234	0.0828
2	0.0001	0.0002	0.0013	0.0030	0.0106
3	0.0007	0.0022	0.0118	0.0276	0.0959
4	0.0005	0.0016	0.0085	0.0201	0.0575
5	0.0008	0.0026	0.0140	0.0406	0.1042
6	0.0010	0.0031	0.0171	0.0496	0.1266
7	0.0027	0.0082	0.0449	0.1301	0.3301
8	0.0100	0.0303	0.1646	0.4775	1.0659
9	0.0019	0.0057	0.0369	0.0559	0.1011
10	0.0005	0.0015	0.0103	0.0194	0.0382
11	0.0127	0.0385	0.2577	0.4840	0.9824
12	0.0021	0.0064	0.0426	0.0800	0.1588
13	0.0001	0.0002	0.0014	0.0027	0.0047
14	0.0028	0.0085	0.0557	0.0843	0.1479
Total	0.0366	0.1110	0.6769	1.4983	3.3066

Table 7. Predicted Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.01	0.1	0.05	0.9	0.06	1.0
Highway Segment	Collision with Fixed Object	1.30	23.1	1.67	29.6	2.97	52.7
Highway Segment	Collision with Other Object	0.09	1.6	0.32	5.8	0.42	7.4
Highway Segment	Other Single-vehicle Collision	0.38	6.7	0.25	4.4	0.62	11.1
Highway Segment	Collision with Parked Vehicle	0.03	0.5	0.04	0.7	0.06	1.1
Highway Segment	Total Single Vehicle Crashes	1.80	32.0	2.33	41.4	4.13	73.4
Highway Segment	Right-Angle Collision	0.02	0.3	0.02	0.3	0.03	0.6
Highway Segment	Head-on Collision	0.00	0.1	0.00	0.0	0.01	0.1
Highway Segment	Other Multi-vehicle Collision	0.02	0.3	0.02	0.4	0.04	0.7
Highway Segment	Rear-end Collision	0.39	6.9	0.68	12.0	1.06	18.9
Highway Segment	Sideswipe, Same Direction Collision	0.09	1.7	0.26	4.6	0.35	6.3
Highway Segment	Total Multiple Vehicle Crashes	0.52	9.2	0.98	17.4	1.50	26.6
Highway Segment	Total Highway Segment Crashes	2.32	41.3	3.31	58.7	5.63	100.0
	Total Crashes	2.32	41.3	3.31	58.7	5.63	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 8. Evaluation Message

Start Location (Sta. ft)	End Location (Sta. ft)	Message
0.000	2+69.000	Information: for segment #1 (0.000 to 2+69.000), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
2+69.000	3+03.340	Information: for segment #2 (2+69.000 to 3+03.340), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
97+25.000	103+51.907	Information: for segment #14 (97+25.000 to 103+51.907), Right shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.

Alternative 4

Slip Ramp

IHSDM Analysis Results

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

March 22, 2023

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Report Overview

Report Generated: Mar 22, 2023 12:11 PM
Report Template: System: Single Page [System] (mlcpm3, Mar 7, 2023 12:48 PM)

Evaluation Date: Wed Mar 22 12:11:13 MST 2023
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: Jordan Rae Aguirre
Organization Name: Jacobs Engineering
Phone: 5307019417
E-Mail: jordanrae.aguirre@jacobs.com

Project Title: I-10/101L - Alternatives Analysis - Slip Ramp
Project Comment: Created using wizard
Project Unit System: U.S. Customary

Highway Title: Alignment Median SR 101
Highway Comment: Imported from Median SR 101.xml
Highway Version: 2

Evaluation Title: Evaluation 15
Evaluation Comment: Created Wed Mar 22 12:04:36 MST 2023

Minimum Location: 138+40.440
Maximum Location: 236+00.000

Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration

First Year of Analysis: 2050
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

Disclaimer Regarding Crash Prediction Method

IMPORTANT NOTICE ABOUT COMPARING RESULTS FROM HIGHWAY SAFETY MANUAL FIRST EDITION (2010) MODELS TO RESULTS FROM NEW MODELS DEVELOPED UNDER NCHRP PROJECTS 17-70, 17-58, AND 17-68

Since the publication of the Highway Safety Manual - First Edition (HSM-1), in 2010 by the American Association of State Highway and Transportation Officials (AASHTO), multiple research efforts have been undertaken through the National Cooperative Highway Research Program (NCHRP) to develop safety performance models for road segment and intersection facility types that were not initially reflected in the HSM-1, in order to expand the breadth and depth of the HSM in the future.

The IHSDM Crash Prediction Module (CPM) is intended as a faithful implementation of HSM Part C predictive methods. As NCHRP projects to develop new predictive methods for the HSM are completed, FHWA works to incorporate the new methods into IHSDM, sometimes in advance of publication in the HSM. The following new crash predictive methods have been accepted by NCHRP project panels and incorporated into IHSDM, while pending AASHTO's approval for incorporation into a future edition of the HSM:

- Roundabouts: completed in 2018 under NCHRP Project 17-70, the new methods will provide improved outcomes for the safety analysis of roundabouts.
- 6+ lane and one-way urban/suburban arterials (including models for segments and intersections): completed under NCHRP Project 17-58.
- Intersection crash prediction methods for some intersection configurations and traffic control types not currently addressed in the HSM (e.g., all-way stop; rural 3-leg signalized; 3-leg stop-controlled where the major leg turns; urban 5-leg signalized; urban high-speed intersections): completed in 2021 under NCHRP Project 17-68.

However, in the absence of local calibration factors (see HSM-1 Part C, Appendix A for guidance on calibration of the predictive models), it is neither appropriate nor advisable to directly compare the results from new models (from NCHRP Projects 17-58, 17-68, and 17-70) to results from HSM-1 models, as the models were not calibrated to the same base state data sets, and consequently can produce unexpected results. If local calibration factors are available and applied to both new models and HSM-1 models, then it may be appropriate to directly compare the results.*[Note: Work being performed under NCHRP Project 17-72 (Update of Crash Modification Factors for the Highway Safety Manual) is expected to re-calibrate many of the old (HSM-1) and new (e.g., NCHRP 17-70) models to data from a single (or small number of) states, that would allow results from all models to be directly compared.]*

The models produced for NCHRP Project 17-70 have independent value in terms of informing the design of a roundabout and assessing the effects of different design characteristics on the expected safety performance of a roundabout.

The HSM-1 interim method previously included in IHSDM for evaluating roundabouts on urban/suburban arterials (i.e., evaluating an existing intersection and then applying a Crash Modification Factor for replacing the existing intersection with a roundabout) has been deactivated in IHSDM, to minimize any confusion with the new roundabout methodology.

Section Types

Section 2 Evaluation

Section: Section 2
Evaluation Start Location: 138+40.440
Evaluation End Location: 236+00.000
Functional Class: Freeway
Type of Alignment: Divided, Multilane
Model Category: Freeway Segment
Calibration Factor: FI_EN=1.0; FI_EX=1.0; FI_MV=1.0; FI_SV=1.0; PDO_EN=1.0; PDO_EX=1.0; PDO_MV=1.0; PDO_SV=1.0;

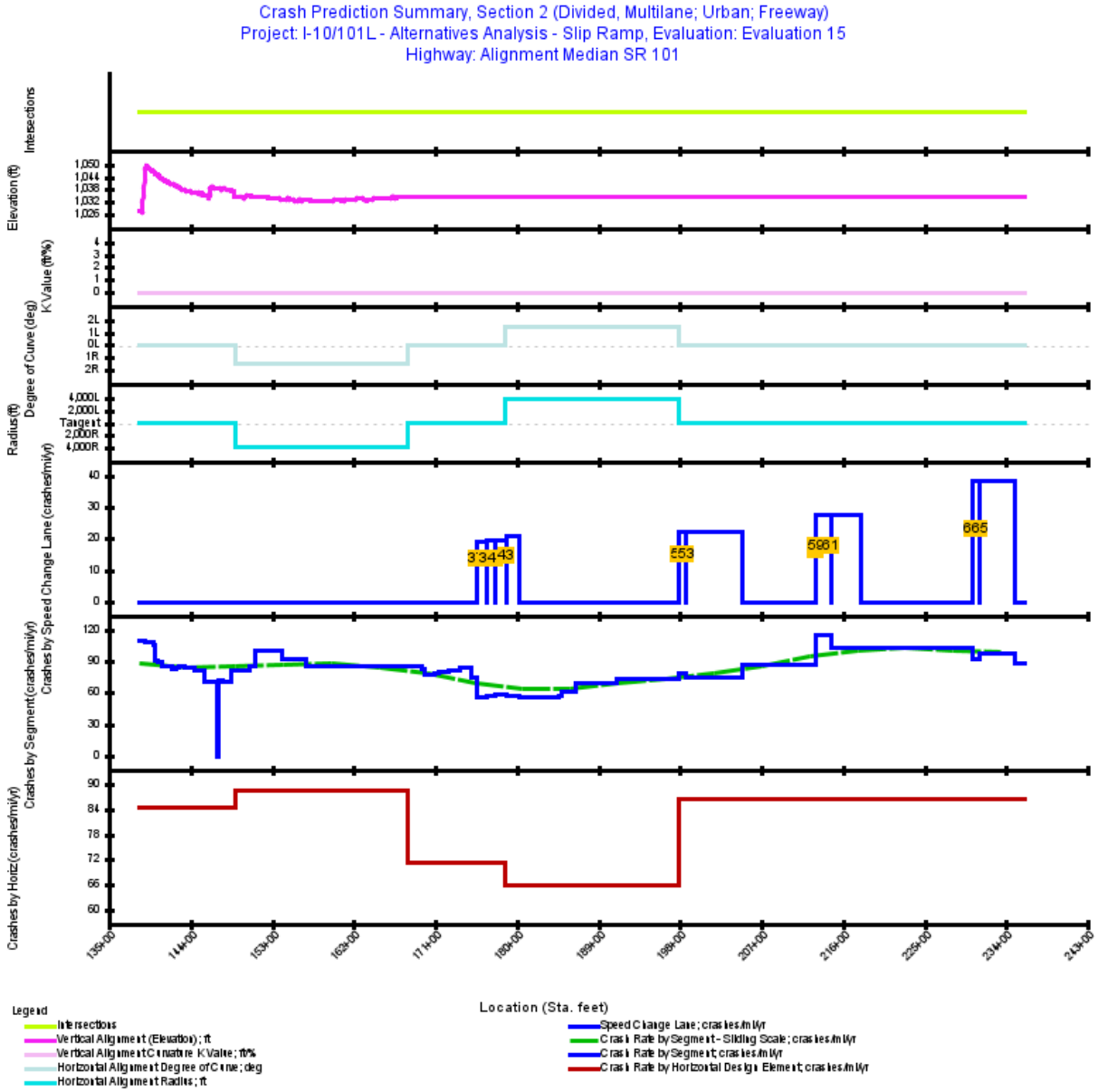

Figure 1. Crash Prediction Summary (Section 2)

Table 1. Evaluation Freeway - Homogeneous Segments (Section 2)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT	Median Width (ft)	Type	Effective Median Width (ft)
1	Four-lane Freeway	Urban	138+40.440	138+91.440	51.00	0.0097	2050: 203,200	41.71	Non-Traversable Median	56.96
2	Four-lane Freeway	Urban	138+91.440	139+84.440	93.00	0.0176	2050: 203,200	43.73	Non-Traversable Median	59.69
3	Four-lane Freeway	Urban	139+84.440	139+91.440	7.00	0.0013	2050: 203,200	45.12	Non-Traversable Median	61.58
4	Four-lane Freeway	Urban	139+91.440	140+07.440	16.00	0.0030	2050: 203,200	45.45	Non-Traversable Median	62.01
5	Six-lane Freeway	Urban	140+07.440	140+43.440	36.00	0.0068	2050: 203,200	46.17	Non-Traversable Median	63.00
6	Six-lane Freeway	Urban	140+43.440	140+91.440	48.00	0.0091	2050: 203,200	47.35	Non-Traversable Median	64.59
7	Six-lane Freeway	Urban	140+91.440	141+92.440	101.00	0.0191	2050: 203,200	49.43	Non-Traversable Median	67.41
8	Six-lane Freeway	Urban	141+92.440	142+46.440	54.00	0.0102	2050: 203,200	51.60	Non-Traversable Median	70.34
9	Six-lane Freeway	Urban	142+46.440	142+70.440	24.00	0.0045	2050: 203,200	52.69	Non-Traversable Median	72.81
10	Six-lane Freeway	Urban	142+70.440	143+41.440	71.00	0.0134	2050: 203,200	54.01	Non-Traversable Median	75.63
11	Six-lane Freeway	Urban	143+41.440	144+40.440	99.00	0.0187	2050: 203,200	56.39	Non-Traversable Median	78.88
12	Six-lane Freeway	Urban	144+40.440	145+47.440	107.00	0.0203	2050: 203,200	59.27	Non-Traversable Median	82.83
13	Eight-lane Freeway	Urban	145+47.440	146+07.400	59.96	0.0114	2050: 203,200	61.60	Non-Traversable Median	86.03
14	Eight-lane Freeway	Urban	146+07.400	146+58.500	51.10	0.0097	2050: 203,200	63.16	Non-Traversable Median	87.50
15	Eight-lane Freeway	Urban	146+58.500	146+99.440	40.94	0.0078	2050: 203,200	64.44	Non-Traversable Median	87.96
16	Eight-lane Freeway	Urban	146+99.440	147+04.440	5.00	0.0009	2050: 203,200	65.09	Non-Traversable Median	88.13
17	Eight-lane Freeway	Urban	147+04.440	147+52.560	48.12	0.0091	2050: 203,200	65.83	Non-Traversable Median	88.33
18	Eight-lane Freeway	Urban	147+52.560	148+46.440	93.88	0.0178	2050: 203,200	67.81	Non-Traversable Median	89.85
19	Eight-lane Freeway	Urban	148+46.440	150+57.440	211.00	0.0400	2050: 203,200	72.08	Non-Traversable Median	94.22
20	Eight-lane Freeway	Urban	150+57.440	151+11.980	54.54	0.0103	2050: 203,200	75.79	Non-Traversable Median	98.03
21	Eight-lane Freeway	Urban	151+11.980	154+14.440	302.46	0.0573	2050: 228,000	80.78	Non-Traversable Median	103.14
22	Eight-lane Freeway	Urban	154+14.440	156+77.440	263.00	0.0498	2050: 228,000	88.68	Non-Traversable Median	111.25
23	Eight-lane Freeway	Urban	156+77.440	157+72.440	95.00	0.0180	2050: 228,000	93.69	Non-Traversable Median	116.38
24	Eight-lane Freeway	Urban	157+72.440	161+30.440	358.00	0.0678	2050: 228,000	100.02	Non-Traversable Median	122.88
25	Eight-lane Freeway	Urban	161+30.440	161+52.440	22.00	0.0042	2050: 228,000	105.33	Non-Traversable Median	128.32

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT	Median Width (ft)	Type	Effective Median Width (ft)
26	Eight-lane Freeway	Urban	161+52.440	161+94.440	42.00	0.0080	2050: 228,000	105.72	Non-Traversable Median	128.33
27	Eight-lane Freeway	Urban	161+94.440	164+83.440	289.00	0.0547	2050: 228,000	99.98	Non-Traversable Median	123.12
28	Eight-lane Freeway	Urban	164+83.440	169+45.440	462.00	0.0875	2050: 228,000	87.66	Non-Traversable Median	113.39
29	Eight-lane Freeway	Urban	169+45.440	169+84.440	39.00	0.0074	2050: 228,000	84.77	Non-Traversable Median	108.35
30	Nine-lane Freeway	Urban	169+84.440	170+94.370	109.93	0.0208	2050: 228,000	83.91	Non-Traversable Median	107.54
31	Nine-lane Freeway	Urban	170+94.370	171+35.440	41.07	0.0078	2050: 228,000	83.04	Non-Traversable Median	106.37
32	Nine-lane Freeway	Urban	171+35.440	172+54.440	119.00	0.0225	2050: 228,000	82.12	Non-Traversable Median	104.10
33	Nine-lane Freeway	Urban	172+54.440	173+73.440	119.00	0.0225	2050: 228,000	80.74	Non-Traversable Median	100.73
34	Nine-lane Freeway	Urban	173+73.440	174+92.440	119.00	0.0225	2050: 228,000	79.37	Non-Traversable Median	97.37
35	Nine-lane Freeway	Urban	174+92.440	175+53.460	61.02	0.0116	2050: 228,000	78.33	Non-Traversable Median	86.82
36	Eight-lane Freeway	Urban	175+53.460	176+70.440	116.98	0.0222	2050: 196,100	76.47	Non-Traversable Median	76.47
38	Eight-lane Freeway	Urban	176+70.440	177+66.440	96.00	0.0182	2050: 196,100	73.77	Non-Traversable Median	73.77
40	Eight-lane Freeway	Urban	177+66.440	178+82.440	116.00	0.0220	2050: 196,100	71.07	Non-Traversable Median	71.07
42	Eight-lane Freeway	Urban	178+82.440	180+25.440	143.00	0.0271	2050: 196,100	67.78	Non-Traversable Median	67.78
44	Eight-lane Freeway	Urban	180+25.440	180+64.440	39.00	0.0074	2050: 196,100	65.47	Non-Traversable Median	65.47
45	Eight-lane Freeway	Urban	180+64.440	184+57.440	393.00	0.0744	2050: 196,100	59.98	Non-Traversable Median	59.98
46	Eight-lane Freeway	Urban	184+57.440	184+96.790	39.35	0.0075	2050: 196,100	54.49	Non-Traversable Median	54.49
47	Seven-lane Freeway	Urban	184+96.790	186+54.440	157.65	0.0299	2050: 196,100	51.99	Non-Traversable Median	44.50
48	Seven-lane Freeway	Urban	186+54.440	190+97.440	443.00	0.0839	2050: 196,100	25.00	Non-Traversable Median	28.46
49	Seven-lane Freeway	Urban	190+97.440	197+89.450	692.01	0.1311	2050: 196,100	3.00	Non-Traversable Median	21.93
50	Seven-lane Freeway	Urban	197+89.450	198+69.440	79.99	0.0151	2050: 196,100	3.00	Non-Traversable Median	21.93
52	Seven-lane Freeway	Urban	198+69.440	204+83.410	613.97	0.1163	2050: 196,100	3.00	Non-Traversable Median	21.94
54	Seven-lane Freeway	Urban	204+83.410	205+18.440	35.03	0.0066	2050: 223,400	3.00	Non-Traversable Median	21.94
55	Seven-lane Freeway	Urban	205+18.440	208+29.440	311.00	0.0589	2050: 223,400	3.00	Non-Traversable Median	21.95
56	Seven-lane Freeway	Urban	208+29.440	213+04.793	475.35	0.0900	2050: 223,400	3.00	Non-Traversable Median	21.95
58	Seven-lane Freeway	Urban	213+04.793	214+67.440	162.65	0.0308	2050: 247,300	3.00	Non-Traversable Median	21.96

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT	Median Width (ft)	Type	Effective Median Width (ft)
60	Seven-lane Freeway	Urban	214+67.440	230+25.910	1,558.47	0.2952	2050: 247,300	3.00	Non-Traversable Median	21.97
62	Seven-lane Freeway	Urban	230+25.910	231+12.440	86.53	0.0164	2050: 226,100	3.00	Non-Traversable Median	21.98
64	Seven-lane Freeway	Urban	231+12.440	234+99.370	386.93	0.0733	2050: 226,100	3.00	Non-Traversable Median	21.99
66	Seven-lane Freeway	Urban	234+99.370	236+00.000	100.63	0.0191	2050: 226,100	3.00	Non-Traversable Median	21.99

Table 2. Evaluation Freeway - Speed Change Lanes (Speed Change)

Seg. No.	Type	Ramp Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT	Median Width (ft)	Type	Effective Median Width (ft)
37	Eight-lane Freeway Speed Change	Entrance	175+53.460	176+70.440	116.98	0.0222	2050: 196,100	76.47	Non-Traversable Median	76.47
39	Eight-lane Freeway Speed Change	Entrance	176+70.440	177+66.440	96.00	0.0182	2050: 196,100	73.77	Non-Traversable Median	73.77
41	Eight-lane Freeway Speed Change	Entrance	177+66.440	178+82.440	116.00	0.0220	2050: 196,100	71.07	Non-Traversable Median	71.07
43	Eight-lane Freeway Speed Change	Entrance	178+82.440	180+24.760	142.32	0.0270	2050: 196,100	67.79	Non-Traversable Median	67.79
51	Seven-lane Freeway Speed Change	Exit	197+89.450	198+69.440	79.99	0.0151	2050: 196,100	3.00	Non-Traversable Median	21.93
53	Seven-lane Freeway Speed Change	Exit	198+69.440	204+83.410	613.97	0.1163	2050: 196,100	3.00	Non-Traversable Median	21.94
57	Seven-lane Freeway Speed Change	Exit	213+04.790	213+04.793	0.00	0.0000	2050: 223,400	3.00	Non-Traversable Median	21.95
59	Seven-lane Freeway Speed Change	Exit	213+04.793	214+67.440	162.65	0.0308	2050: 247,300	3.00	Non-Traversable Median	21.96
61	Seven-lane Freeway Speed Change	Exit	214+67.440	217+94.930	327.49	0.0620	2050: 247,300	3.00	Non-Traversable Median	21.96
63	Seven-lane Freeway Speed Change	Entrance	230+25.910	231+12.440	86.53	0.0164	2050: 226,100	3.00	Non-Traversable Median	21.98
65	Seven-lane Freeway Speed Change	Entrance	231+12.440	234+99.370	386.93	0.0733	2050: 226,100	3.00	Non-Traversable Median	21.99

Table 3. Predicted Freeway Crash Rates and Frequencies Summary (Section 2)

First Year of Analysis	**2050**
Last Year of Analysis	**2050**
Effective Length (mi)	**1.6459**
Average Future Road AADT (vpd)	**218,539**
Predicted Crashes	
Total Crashes	**138.81**
Fatal and Injury Crashes	**34.52**
Property-Damage-Only Crashes	**104.29**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**25**
Percent Property-Damage-Only Crashes (%)	**75**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**84.3382**
FI Crash Rate (crashes/mi/yr)	**20.9749**
PDO Crash Rate (crashes/mi/yr)	**63.3633**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**131.28**
Travel Crash Rate (crashes/million veh-mi)	**1.06**
Travel FI Crash Rate (crashes/million veh-mi)	**0.26**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.79**

Note: *Effective Length* is the *segment length* minus the length of the *speed change lanes* if present.

Table 4. Predicted Freeway Speed Change Lane Crash Rates and Frequencies Summary (Speed Change)

First Year of Analysis	**2050**
Last Year of Analysis	**2050**
Length (mi)	**0.4032**
Average Future Road AADT (vpd)	**107,280**
Predicted Crashes	
Total Crashes	**10.75**
Fatal and Injury Crashes	**3.25**
Property-Damage-Only Crashes	**7.50**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**30**
Percent Property-Damage-Only Crashes (%)	**70**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**26.6620**
FI Crash Rate (crashes/mi/yr)	**8.0540**
PDO Crash Rate (crashes/mi/yr)	**18.6080**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**15.79**
Travel Crash Rate (crashes/million veh-mi)	**0.68**
Travel FI Crash Rate (crashes/million veh-mi)	**0.21**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.47**

Note: *Total Travel and Crash Rates/Million Vehicle Miles* for *Speed Change Lanes* reflect AADTs that are **half of the Freeway Segment AADTs** based on the assumption of 50/50 directional distribution.

Table 5. Predicted Crash Frequencies and Rates by Freeway Segment/Intersection (Section 2)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Effective Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
1	138+40.440	138+91.440	0.0097	1.067	1.0675	0.2413	0.8261	110.5169	1.49
2	138+91.440	139+84.440	0.0176	1.909	1.9086	0.4362	1.4724	108.3590	1.46
3	139+84.440	139+91.440	0.0013	0.142	0.1416	0.0324	0.1092	106.8206	1.44
4	139+91.440	140+07.440	0.0030	0.320	0.3196	0.0708	0.2489	105.4835	1.42
5	140+07.440	140+43.440	0.0068	0.625	0.6246	0.1461	0.4784	91.6012	1.24
6	140+43.440	140+91.440	0.0091	0.811	0.8114	0.1915	0.6199	89.2581	1.20

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Effective Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
7	140+91.440	141+92.440	0.0191	1.635	1.6351	0.3960	1.2391	85.4786	1.15
8	141+92.440	142+46.440	0.0102	0.846	0.8461	0.2101	0.6361	82.7341	1.11
9	142+46.440	142+70.440	0.0045	0.386	0.3857	0.0950	0.2907	84.8506	1.14
10	142+70.440	143+41.440	0.0134	1.148	1.1483	0.2813	0.8670	85.3921	1.15
11	143+41.440	144+40.440	0.0187	1.579	1.5793	0.3867	1.1926	84.2278	1.14
12	144+40.440	145+47.440	0.0203	1.663	1.6627	0.3926	1.2701	82.0467	1.11
13	145+47.440	146+07.400	0.0114	0.806	0.8063	0.2034	0.6029	71.0060	0.96
14	146+07.400	146+58.500	0.0097	0.686	0.6857	0.1730	0.5127	70.8469	0.95
15	146+58.500	146+99.440	0.0078	0.550	0.5505	0.1389	0.4116	70.9987	0.96
16	146+99.440	147+04.440	0.0000	0.000	0.0000	0.0000	0.0000	0.0000	0.00
17	147+04.440	147+52.560	0.0091	0.651	0.6513	0.1644	0.4869	71.4626	0.96
18	147+52.560	148+46.440	0.0178	1.253	1.2532	0.3298	0.9234	70.4845	0.95
19	148+46.440	150+57.440	0.0400	3.280	3.2802	0.8565	2.4238	82.0838	1.11
20	150+57.440	151+11.980	0.0103	0.883	0.8826	0.2269	0.6557	85.4464	1.15
21	151+11.980	154+14.440	0.0573	5.764	5.7643	1.4343	4.3300	100.6271	1.21
22	154+14.440	156+77.440	0.0498	4.583	4.5835	1.1329	3.4506	92.0176	1.11
23	156+77.440	157+72.440	0.0180	1.538	1.5375	0.3780	1.1595	85.4519	1.03
24	157+72.440	161+30.440	0.0678	5.787	5.7872	1.4227	4.3645	85.3535	1.03
25	161+30.440	161+52.440	0.0042	0.355	0.3554	0.0874	0.2680	85.3010	1.02
26	161+52.440	161+94.440	0.0080	0.678	0.6785	0.1668	0.5117	85.2972	1.02
27	161+94.440	164+83.440	0.0547	4.669	4.6693	1.1480	3.5213	85.3074	1.02
28	164+83.440	169+45.440	0.0875	7.446	7.4460	1.8203	5.6257	85.0966	1.02
29	169+45.440	169+84.440	0.0074	0.614	0.6139	0.1550	0.4588	83.1081	1.00
30	169+84.440	170+94.370	0.0208	1.622	1.6217	0.4432	1.1785	77.8898	0.94
31	170+94.370	171+35.440	0.0078	0.609	0.6094	0.1666	0.4429	78.3502	0.94
32	171+35.440	172+54.440	0.0225	1.793	1.7929	0.4905	1.3024	79.5519	0.96
33	172+54.440	173+73.440	0.0225	1.837	1.8372	0.5033	1.3340	81.5171	0.98
34	173+73.440	174+92.440	0.0225	1.888	1.8880	0.5177	1.3703	83.7713	1.01
35	174+92.440	175+53.460	0.0116	0.871	0.8705	0.2556	0.6149	75.3277	0.91
36	175+53.460	176+70.440	0.0111	0.613	0.6131	0.1985	0.4146	55.3426	0.77
38	176+70.440	177+66.440	0.0091	0.516	0.5165	0.1663	0.3502	56.8193	0.79
40	177+66.440	178+82.440	0.0110	0.651	0.6510	0.2029	0.4481	59.2630	0.83
42	178+82.440	180+25.440	0.0136	0.788	0.7877	0.2293	0.5584	57.8930	0.81
44	180+25.440	180+64.440	0.0074	0.412	0.4123	0.1162	0.2961	55.8179	0.78
45	180+64.440	184+57.440	0.0744	4.213	4.2127	1.1815	3.0312	56.5978	0.79
46	184+57.440	184+96.790	0.0075	0.428	0.4277	0.1193	0.3084	57.3917	0.80
47	184+96.790	186+54.440	0.0299	1.849	1.8488	0.4848	1.3640	61.9207	0.86
48	186+54.440	190+97.440	0.0839	5.857	5.8574	1.4543	4.4031	69.8130	0.97
49	190+97.440	197+89.450	0.1311	9.670	9.6698	2.3658	7.3040	73.7801	1.03
50	197+89.450	198+69.440	0.0076	0.599	0.5989	0.1526	0.4463	79.0622	1.10
52	198+69.440	204+83.410	0.0581	4.343	4.3434	1.1543	3.1891	74.7041	1.04
54	204+83.410	205+18.440	0.0066	0.578	0.5782	0.1418	0.4364	87.1560	1.07
55	205+18.440	208+29.440	0.0589	5.095	5.0951	1.2408	3.8543	86.5018	1.06
56	208+29.440	213+04.793	0.0900	7.801	7.8011	1.9884	5.8127	86.6511	1.06
58	213+04.793	214+67.440	0.0154	1.775	1.7750	0.4208	1.3542	115.2410	1.28
60	214+67.440	230+25.910	0.2642	27.313	27.3134	6.2932	21.0203	103.4003	1.15
62	230+25.910	231+12.440	0.0082	0.755	0.7546	0.1846	0.5699	92.0870	1.12
64	231+12.440	234+99.370	0.0366	3.585	3.5847	0.9071	2.6777	97.8335	1.19
66	234+99.370	236+00.000	0.0191	1.671	1.6715	0.4240	1.2475	87.7032	1.06

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Effective Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
Total			1.6459	138.809	138.8087	34.5218	104.2869	84.3382	1.06

Note: *Effective Length* is the *segment length* minus the length of the *speed change lanes* if present. This may create Freeway segments with zero effective length and zero crashes.

Table 6. Predicted Crash Frequencies and Rates by Freeway Speed Change Lane (Speed Change)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
37	175+53.460	176+70.440	0.0222	0.426	0.4260	0.1329	0.2931	19.2283	0.54
39	176+70.440	177+66.440	0.0182	0.352	0.3524	0.1100	0.2424	19.3821	0.54
41	177+66.440	178+82.440	0.0220	0.432	0.4320	0.1345	0.2976	19.6651	0.55
43	178+82.440	180+24.760	0.0270	0.566	0.5661	0.1724	0.3937	21.0025	0.59
51	197+89.450	198+69.440	0.0151	0.338	0.3379	0.0923	0.2456	22.3048	0.62
53	198+69.440	204+83.410	0.1163	2.588	2.5877	0.7073	1.8804	22.2536	0.62
57	213+04.790	213+04.793	0.0000	0.000	0.0000	0.0000	0.0000	25.3544	0.62
59	213+04.793	214+67.440	0.0308	0.858	0.8579	0.2396	0.6183	27.8503	0.62
61	214+67.440	217+94.930	0.0620	1.727	1.7274	0.4825	1.2449	27.8495	0.62
63	230+25.910	231+12.440	0.0164	0.633	0.6328	0.2149	0.4179	38.6143	0.94
65	231+12.440	234+99.370	0.0733	2.830	2.8297	0.9610	1.8686	38.6132	0.94
Total			0.4032	10.750	10.7499	3.2473	7.5026	26.6620	0.68

Note: *Travel Crash Rates/Million Vehicle Miles* for *Speed Change Lanes* reflect AADTs that are **half of the Freeway Segment AADTs** based on the assumption of 50/50 directional distribution.

Table 7. Predicted Crash Frequencies and Rates by Horizontal Design Element (Section 2)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi /yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
Tangent	138+40.440	148+95.793	0.1999	16.845	16.8448	4.0900	12.7548	84.2756	1.14
Simple Curve 1	148+95.793	168+00.529	0.3607	31.882	31.8818	7.9024	23.9793	88.3775	1.08
Tangent	168+00.529	178+70.632	0.2027	14.450	14.4500	4.0135	10.4365	71.2979	1.08
Simple Curve 2	178+70.632	197+92.177	0.3639	23.925	23.9247	6.1664	17.7584	65.7401	0.98
Tangent	197+92.177	236+00.000	0.7212	62.457	62.4573	15.5968	46.8605	86.6045	1.43

Table 8. Predicted Crash Frequencies by Year (Section 2)

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2050	149.56	37.77	25.254	111.79	74.746
Total	149.56	37.77	25.254	111.79	74.746
Average	149.56	37.77	25.254	111.79	74.746

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 9. Predicted Crash Severity by Freeway Segment (Section 2)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.0041	0.0107	0.0766	0.1499	0.8261
2	0.0074	0.0194	0.1385	0.2709	1.4724
3	0.0006	0.0014	0.0103	0.0201	0.1092
4	0.0012	0.0031	0.0224	0.0440	0.2489
5	0.0023	0.0061	0.0447	0.0930	0.4784
6	0.0030	0.0080	0.0585	0.1219	0.6199
7	0.0063	0.0166	0.1211	0.2520	1.2391
8	0.0036	0.0093	0.0667	0.1304	0.6361
9	0.0016	0.0042	0.0301	0.0590	0.2907
10	0.0048	0.0125	0.0893	0.1747	0.8670
11	0.0066	0.0172	0.1228	0.2401	1.1926
12	0.0067	0.0175	0.1246	0.2438	1.2701

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
13	0.0032	0.0085	0.0622	0.1295	0.6029
14	0.0027	0.0073	0.0529	0.1101	0.5127
15	0.0022	0.0058	0.0424	0.0884	0.4116
16	0.0000	0.0000	0.0000	0.0000	0.0000
17	0.0026	0.0069	0.0502	0.1046	0.4869
18	0.0052	0.0139	0.1008	0.2099	0.9234
19	0.0164	0.0439	0.2875	0.5087	2.4238
20	0.0045	0.0121	0.0774	0.1329	0.6557
21	0.0284	0.0767	0.4894	0.8399	4.3300
22	0.0225	0.0606	0.3865	0.6634	3.4506
23	0.0075	0.0202	0.1290	0.2213	1.1595
24	0.0282	0.0760	0.4854	0.8330	4.3645
25	0.0017	0.0047	0.0298	0.0512	0.2680
26	0.0033	0.0089	0.0569	0.0977	0.5117
27	0.0227	0.0614	0.3917	0.6722	3.5213
28	0.0337	0.0904	0.6008	1.0954	5.6257
29	0.0025	0.0065	0.0474	0.0986	0.4588
30	0.0076	0.0197	0.1407	0.2752	1.1785
31	0.0028	0.0074	0.0529	0.1035	0.4429
32	0.0084	0.0218	0.1557	0.3046	1.3024
33	0.0086	0.0224	0.1598	0.3125	1.3340
34	0.0088	0.0230	0.1643	0.3215	1.3703
35	0.0044	0.0114	0.0814	0.1584	0.6149
36	0.0042	0.0104	0.0701	0.1138	0.4146
38	0.0035	0.0087	0.0588	0.0953	0.3502
40	0.0043	0.0108	0.0722	0.1155	0.4481
42	0.0054	0.0140	0.0854	0.1245	0.5584
44	0.0025	0.0066	0.0410	0.0662	0.2961
45	0.0251	0.0666	0.4172	0.6726	3.0312
46	0.0025	0.0067	0.0421	0.0679	0.3084
47	0.0103	0.0273	0.1712	0.2760	1.3640
48	0.0288	0.0777	0.4962	0.8515	4.4031
49	0.0469	0.1265	0.8072	1.3853	7.3040
50	0.0028	0.0072	0.0504	0.0922	0.4463
52	0.0212	0.0543	0.3802	0.6987	3.1891
54	0.0026	0.0067	0.0467	0.0859	0.4364
55	0.0212	0.0552	0.3939	0.7706	3.8543
56	0.0365	0.0935	0.6549	1.2036	5.8127
58	0.0077	0.0198	0.1386	0.2547	1.3542
60	0.1154	0.2958	2.0727	3.8093	21.0203
62	0.0034	0.0087	0.0608	0.1118	0.5699
64	0.0166	0.0426	0.2987	0.5490	2.6777
66	0.0078	0.0199	0.1397	0.2567	1.2475
Total	0.6450	1.6947	11.4486	20.7335	104.2869

Table 10. Predicted Crash Severity by Speed Change Lane (Speed Change)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
37	0.0028	0.0070	0.0470	0.0762	0.2931
39	0.0023	0.0058	0.0389	0.0630	0.2424
41	0.0029	0.0072	0.0479	0.0766	0.2976
43	0.0042	0.0108	0.0650	0.0925	0.3937
51	0.0015	0.0039	0.0283	0.0586	0.2456
53	0.0130	0.0332	0.2329	0.4281	1.8804
57	0.0000	0.0000	0.0000	0.0000	0.0000
59	0.0044	0.0113	0.0789	0.1450	0.6183
61	0.0088	0.0227	0.1589	0.2920	1.2449
63	0.0039	0.0101	0.0708	0.1301	0.4179
65	0.0176	0.0452	0.3165	0.5817	1.8686
Total	0.0614	0.1570	1.0850	1.9439	7.5026

Table 11. Predicted Freeway Crash Type Distribution (Section 2)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.04	0.0	0.60	0.4	0.64	0.5
Highway Segment	Collision with Fixed Object	7.28	5.2	19.63	14.1	26.91	19.4
Highway Segment	Collision with Other Object	0.52	0.4	3.81	2.7	4.33	3.1
Highway Segment	Other Single-vehicle Collision	2.10	1.5	2.93	2.1	5.03	3.6
Highway Segment	Collision with Parked Vehicle	0.15	0.1	0.44	0.3	0.59	0.4
Highway Segment	Total Single Vehicle Crashes	10.09	7.3	27.42	19.8	37.50	27.0
Highway Segment	Right-Angle Collision	0.76	0.5	1.38	1.0	2.14	1.5
Highway Segment	Head-on Collision	0.20	0.1	0.15	0.1	0.35	0.3
Highway Segment	Other Multi-vehicle Collision	0.76	0.5	1.84	1.3	2.60	1.9
Highway Segment	Rear-end Collision	18.32	13.2	53.04	38.2	71.37	51.4
Highway Segment	Sideswipe, Same Direction Collision	4.40	3.2	20.45	14.7	24.85	17.9
Highway Segment	Total Multiple Vehicle Crashes	24.43	17.6	76.87	55.4	101.31	73.0
Highway Segment	Total Highway Segment Crashes	34.52	24.9	104.29	75.1	138.81	100.0
	Total Crashes	34.52	24.9	104.29	75.1	138.81	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 12. Predicted Exit Speed Change Lane Crash Type Distribution (Speed Change)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.00	0.0	0.03	0.5	0.03	0.5
Highway Segment	Collision with Fixed Object	0.30	5.4	0.83	15.0	1.12	20.4
Highway Segment	Collision with Other Object	0.02	0.4	0.12	2.2	0.14	2.6
Highway Segment	Other Single-vehicle Collision	0.07	1.4	0.09	1.7	0.17	3.0
Highway Segment	Collision with Parked Vehicle	0.00	0.0	0.00	0.0	0.00	0.0
Highway Segment	Total Single Vehicle Crashes	0.40	7.2	1.06	19.3	1.46	26.5
Highway Segment	Right-Angle Collision	0.02	0.3	0.05	0.9	0.07	1.2
Highway Segment	Head-on Collision	0.01	0.1	0.01	0.1	0.02	0.3
Highway Segment	Other Multi-vehicle Collision	0.02	0.4	0.06	1.2	0.09	1.6
Highway Segment	Rear-end Collision	0.83	15.2	2.25	40.9	3.09	56.1
Highway Segment	Sideswipe, Same Direction Collision	0.24	4.4	0.55	10.0	0.79	14.4
Highway Segment	Total Multiple Vehicle Crashes	1.12	20.4	2.92	53.1	4.05	73.5
Highway Segment	Total Highway Segment Crashes	1.52	27.6	3.99	72.4	5.51	100.0
	Total Crashes	1.52	27.6	3.99	72.4	5.51	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 13. Predicted Entrance Speed Change Lane Crash Type Distribution (Speed Change)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.00	0.0	0.01	0.1	0.01	0.1
Highway Segment	Collision with Fixed Object	0.34	6.4	0.45	8.7	0.79	15.0
Highway Segment	Collision with Other Object	0.03	0.6	0.13	2.4	0.16	3.0
Highway Segment	Other Single-vehicle Collision	0.12	2.2	0.06	1.1	0.17	3.3
Highway Segment	Collision with Parked Vehicle	0.01	0.1	0.01	0.2	0.02	0.3
Highway Segment	Total Single Vehicle Crashes	0.49	9.4	0.65	12.5	1.14	21.8
Highway Segment	Right-Angle Collision	0.03	0.6	0.06	1.1	0.09	1.7
Highway Segment	Head-on Collision	0.01	0.1	0.00	0.1	0.01	0.2
Highway Segment	Other Multi-vehicle Collision	0.03	0.6	0.05	1.0	0.08	1.6
Highway Segment	Rear-end Collision	0.94	17.9	1.86	35.5	2.80	53.4
Highway Segment	Sideswipe, Same Direction Collision	0.23	4.4	0.89	16.9	1.11	21.3
Highway Segment	Total Multiple Vehicle Crashes	1.24	23.6	2.86	54.6	4.09	78.2
Highway Segment	Total Highway Segment Crashes	1.73	32.9	3.51	67.1	5.24	100.0
	Total Crashes	1.73	32.9	3.51	67.1	5.24	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 14. Evaluation Message

Start Location (Sta. ft)	End Location (Sta. ft)	Message
138+40.440	138+91.440	Information: for segment #1 (138+40.440 to 138+91.440), Median barrier distance from edge of inside shoulder to barrier face (0.12 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
138+40.440	138+91.440	Information: for segment #1 (138+40.440 to 138+91.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
138+40.440	138+91.440	Information: for segment #1 (138+40.440 to 138+91.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
138+91.440	139+84.440	Information: for segment #2 (138+91.440 to 139+84.440), Median barrier distance from edge of inside shoulder to barrier face (0.45 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
138+91.440	139+84.440	Information: for segment #2 (138+91.440 to 139+84.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
138+91.440	139+84.440	Information: for segment #2 (138+91.440 to 139+84.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
139+84.440	139+91.440	Information: for segment #3 (139+84.440 to 139+91.440), Outside shoulder width (3.53 feet) is less than specified boundaries (4.00 feet); adjusted in CMF calculations.
139+84.440	139+91.440	Information: for segment #3 (139+84.440 to 139+91.440), Median barrier distance from edge of inside shoulder to barrier face (0.69 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
139+84.440	139+91.440	Information: for segment #3 (139+84.440 to 139+91.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
139+84.440	139+91.440	Information: for segment #3 (139+84.440 to 139+91.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
139+91.440	140+07.440	Information: for segment #4 (139+91.440 to 140+07.440), Median barrier distance from edge of inside shoulder to barrier face (0.74 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
139+91.440	140+07.440	Information: for segment #4 (139+91.440 to 140+07.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
139+91.440	140+07.440	Information: for segment #4 (139+91.440 to 140+07.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
140+07.440	140+43.440	Information: for segment #5 (140+07.440 to 140+43.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
140+07.440	140+43.440	Information: for segment #5 (140+07.440 to 140+43.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
140+07.440	140+43.440	Information: for segment #5 (140+07.440 to 140+43.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
140+43.440	140+91.440	Information: for segment #6 (140+43.440 to 140+91.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
140+43.440	140+91.440	Information: for segment #6 (140+43.440 to 140+91.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.

Start Location (Sta. ft)	End Location (Sta. ft)	Message
140+43.440	140+91.440	Information: for segment #6 (140+43.440 to 140+91.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
140+91.440	141+92.440	Information: for segment #7 (140+91.440 to 141+92.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
140+91.440	141+92.440	Information: for segment #7 (140+91.440 to 141+92.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
141+92.440	142+46.440	Information: for segment #8 (141+92.440 to 142+46.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
141+92.440	142+46.440	Information: for segment #8 (141+92.440 to 142+46.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
142+46.440	142+70.440	Information: for segment #9 (142+46.440 to 142+70.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
142+46.440	142+70.440	Information: for segment #9 (142+46.440 to 142+70.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
142+70.440	143+41.440	Information: for segment #10 (142+70.440 to 143+41.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
142+70.440	143+41.440	Information: for segment #10 (142+70.440 to 143+41.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
142+70.440	143+41.440	Information: for segment #10 (142+70.440 to 143+41.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
143+41.440	144+40.440	Information: for segment #11 (143+41.440 to 144+40.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
143+41.440	144+40.440	Information: for segment #11 (143+41.440 to 144+40.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
143+41.440	144+40.440	Information: for segment #11 (143+41.440 to 144+40.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
144+40.440	145+47.440	Information: for segment #12 (144+40.440 to 145+47.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
144+40.440	145+47.440	Information: for segment #12 (144+40.440 to 145+47.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
144+40.440	145+47.440	Information: for segment #12 (144+40.440 to 145+47.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
145+47.440	146+07.400	Information: for segment #13 (145+47.440 to 146+07.400), Inside shoulder width (12.21 feet) is greater than specified boundaries (12.00 feet); adjusted in CMF calculations.
145+47.440	146+07.400	Information: for segment #13 (145+47.440 to 146+07.400), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
145+47.440	146+07.400	Information: for segment #13 (145+47.440 to 146+07.400), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
145+47.440	146+07.400	Information: for segment #13 (145+47.440 to 146+07.400), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.

Start Location (Sta. ft)	End Location (Sta. ft)	Message
145+47.440	146+07.400	Information: for segment #13 (145+47.440 to 146+07.400), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+07.400	146+58.500	Information: for segment #14 (146+07.400 to 146+58.500), Inside shoulder width (12.17 feet) is greater than specified boundaries (12.00 feet); adjusted in CMF calculations.
146+07.400	146+58.500	Information: for segment #14 (146+07.400 to 146+58.500), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+07.400	146+58.500	Information: for segment #14 (146+07.400 to 146+58.500), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+07.400	146+58.500	Information: for segment #14 (146+07.400 to 146+58.500), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+07.400	146+58.500	Information: for segment #14 (146+07.400 to 146+58.500), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+58.500	146+99.440	Information: for segment #15 (146+58.500 to 146+99.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+58.500	146+99.440	Information: for segment #15 (146+58.500 to 146+99.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+58.500	146+99.440	Information: for segment #15 (146+58.500 to 146+99.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+58.500	146+99.440	Information: for segment #15 (146+58.500 to 146+99.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+99.440	147+04.440	Information: for segment #16 (146+99.440 to 147+04.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+99.440	147+04.440	Information: for segment #16 (146+99.440 to 147+04.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+99.440	147+04.440	Information: for segment #16 (146+99.440 to 147+04.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
146+99.440	147+04.440	Information: for segment #16 (146+99.440 to 147+04.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
147+04.440	147+52.560	Information: for segment #17 (147+04.440 to 147+52.560), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
147+04.440	147+52.560	Information: for segment #17 (147+04.440 to 147+52.560), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
147+04.440	147+52.560	Information: for segment #17 (147+04.440 to 147+52.560), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
147+04.440	147+52.560	Information: for segment #17 (147+04.440 to 147+52.560), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
147+52.560	148+46.440	Information: for segment #18 (147+52.560 to 148+46.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
147+52.560	148+46.440	Information: for segment #18 (147+52.560 to 148+46.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.

Start Location (Sta. ft)	End Location (Sta. ft)	Message
147+52.560	148+46.440	Information: for segment #18 (147+52.560 to 148+46.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
148+46.440	150+57.440	Information: for segment #19 (148+46.440 to 150+57.440), Effective median width (94.22 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
148+46.440	150+57.440	Information: for segment #19 (148+46.440 to 150+57.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
148+46.440	150+57.440	Information: for segment #19 (148+46.440 to 150+57.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
148+46.440	150+57.440	Information: for segment #19 (148+46.440 to 150+57.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
150+57.440	151+11.980	Information: for segment #20 (150+57.440 to 151+11.980), Effective median width (98.03 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
150+57.440	151+11.980	Information: for segment #20 (150+57.440 to 151+11.980), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
150+57.440	151+11.980	Information: for segment #20 (150+57.440 to 151+11.980), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
150+57.440	151+11.980	Information: for segment #20 (150+57.440 to 151+11.980), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
151+11.980	154+14.440	Information: for segment #21 (151+11.980 to 154+14.440), Effective median width (103.14 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
151+11.980	154+14.440	Information: for segment #21 (151+11.980 to 154+14.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
151+11.980	154+14.440	Information: for segment #21 (151+11.980 to 154+14.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
151+11.980	154+14.440	Information: for segment #21 (151+11.980 to 154+14.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
154+14.440	156+77.440	Information: for segment #22 (154+14.440 to 156+77.440), Effective median width (111.25 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
154+14.440	156+77.440	Information: for segment #22 (154+14.440 to 156+77.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
154+14.440	156+77.440	Information: for segment #22 (154+14.440 to 156+77.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
154+14.440	156+77.440	Information: for segment #22 (154+14.440 to 156+77.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
156+77.440	157+72.440	Information: for segment #23 (156+77.440 to 157+72.440), Effective median width (116.38 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
156+77.440	157+72.440	Information: for segment #23 (156+77.440 to 157+72.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
156+77.440	157+72.440	Information: for segment #23 (156+77.440 to 157+72.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.

Start Location (Sta. ft)	End Location (Sta. ft)	Message
156+77.440	157+72.440	Information: for segment #23 (156+77.440 to 157+72.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
157+72.440	161+30.440	Information: for segment #24 (157+72.440 to 161+30.440), Effective median width (122.88 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
157+72.440	161+30.440	Information: for segment #24 (157+72.440 to 161+30.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
157+72.440	161+30.440	Information: for segment #24 (157+72.440 to 161+30.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
157+72.440	161+30.440	Information: for segment #24 (157+72.440 to 161+30.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
161+30.440	161+52.440	Information: for segment #25 (161+30.440 to 161+52.440), Effective median width (128.32 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
161+30.440	161+52.440	Information: for segment #25 (161+30.440 to 161+52.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
161+30.440	161+52.440	Information: for segment #25 (161+30.440 to 161+52.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
161+30.440	161+52.440	Information: for segment #25 (161+30.440 to 161+52.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
161+52.440	161+94.440	Information: for segment #26 (161+52.440 to 161+94.440), Effective median width (128.33 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
161+52.440	161+94.440	Information: for segment #26 (161+52.440 to 161+94.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
161+52.440	161+94.440	Information: for segment #26 (161+52.440 to 161+94.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
161+52.440	161+94.440	Information: for segment #26 (161+52.440 to 161+94.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
161+94.440	164+83.440	Information: for segment #27 (161+94.440 to 164+83.440), Effective median width (123.12 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
161+94.440	164+83.440	Information: for segment #27 (161+94.440 to 164+83.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
161+94.440	164+83.440	Information: for segment #27 (161+94.440 to 164+83.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
161+94.440	164+83.440	Information: for segment #27 (161+94.440 to 164+83.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
164+83.440	169+45.440	Information: for segment #28 (164+83.440 to 169+45.440), Effective median width (113.39 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
164+83.440	169+45.440	Information: for segment #28 (164+83.440 to 169+45.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
164+83.440	169+45.440	Information: for segment #28 (164+83.440 to 169+45.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.

Start Location (Sta. ft)	End Location (Sta. ft)	Message
164+83.440	169+45.440	Information: for segment #28 (164+83.440 to 169+45.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
164+83.440	169+45.440	Information: for segment #28 (164+83.440 to 169+45.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
169+45.440	169+84.440	Information: for segment #29 (169+45.440 to 169+84.440), Effective median width (108.35 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
169+45.440	169+84.440	Information: for segment #29 (169+45.440 to 169+84.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
169+45.440	169+84.440	Information: for segment #29 (169+45.440 to 169+84.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
169+45.440	169+84.440	Information: for segment #29 (169+45.440 to 169+84.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
169+84.440	170+94.370	Information: for segment #30 (169+84.440 to 170+94.370), Effective median width (107.54 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
169+84.440	170+94.370	Information: for segment #30 (169+84.440 to 170+94.370), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
169+84.440	170+94.370	Information: for segment #30 (169+84.440 to 170+94.370), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
169+84.440	170+94.370	Information: for segment #30 (169+84.440 to 170+94.370), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
170+94.370	171+35.440	Information: for segment #31 (170+94.370 to 171+35.440), Effective median width (106.37 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
170+94.370	171+35.440	Information: for segment #31 (170+94.370 to 171+35.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
170+94.370	171+35.440	Information: for segment #31 (170+94.370 to 171+35.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
170+94.370	171+35.440	Information: for segment #31 (170+94.370 to 171+35.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
171+35.440	172+54.440	Information: for segment #32 (171+35.440 to 172+54.440), Effective median width (104.10 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
171+35.440	172+54.440	Information: for segment #32 (171+35.440 to 172+54.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
171+35.440	172+54.440	Information: for segment #32 (171+35.440 to 172+54.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
171+35.440	172+54.440	Information: for segment #32 (171+35.440 to 172+54.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
172+54.440	173+73.440	Information: for segment #33 (172+54.440 to 173+73.440), Effective median width (100.73 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
172+54.440	173+73.440	Information: for segment #33 (172+54.440 to 173+73.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.

Start Location (Sta. ft)	End Location (Sta. ft)	Message
164+83.440	169+45.440	Information: for segment #28 (164+83.440 to 169+45.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
164+83.440	169+45.440	Information: for segment #28 (164+83.440 to 169+45.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
169+45.440	169+84.440	Information: for segment #29 (169+45.440 to 169+84.440), Effective median width (108.35 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
169+45.440	169+84.440	Information: for segment #29 (169+45.440 to 169+84.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
169+45.440	169+84.440	Information: for segment #29 (169+45.440 to 169+84.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
169+45.440	169+84.440	Information: for segment #29 (169+45.440 to 169+84.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
169+84.440	170+94.370	Information: for segment #30 (169+84.440 to 170+94.370), Effective median width (107.54 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
169+84.440	170+94.370	Information: for segment #30 (169+84.440 to 170+94.370), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
169+84.440	170+94.370	Information: for segment #30 (169+84.440 to 170+94.370), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
169+84.440	170+94.370	Information: for segment #30 (169+84.440 to 170+94.370), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
170+94.370	171+35.440	Information: for segment #31 (170+94.370 to 171+35.440), Effective median width (106.37 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
170+94.370	171+35.440	Information: for segment #31 (170+94.370 to 171+35.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
170+94.370	171+35.440	Information: for segment #31 (170+94.370 to 171+35.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
170+94.370	171+35.440	Information: for segment #31 (170+94.370 to 171+35.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
171+35.440	172+54.440	Information: for segment #32 (171+35.440 to 172+54.440), Effective median width (104.10 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
171+35.440	172+54.440	Information: for segment #32 (171+35.440 to 172+54.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
171+35.440	172+54.440	Information: for segment #32 (171+35.440 to 172+54.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
171+35.440	172+54.440	Information: for segment #32 (171+35.440 to 172+54.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
172+54.440	173+73.440	Information: for segment #33 (172+54.440 to 173+73.440), Effective median width (100.73 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
172+54.440	173+73.440	Information: for segment #33 (172+54.440 to 173+73.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.

Start Location (Sta. ft)	End Location (Sta. ft)	Message
172+54.440	173+73.440	Information: for segment #33 (172+54.440 to 173+73.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
172+54.440	173+73.440	Information: for segment #33 (172+54.440 to 173+73.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
173+73.440	174+92.440	Information: for segment #34 (173+73.440 to 174+92.440), Effective median width (97.37 feet) is greater than specified boundaries (90.00 feet); adjusted in CMF calculations.
173+73.440	174+92.440	Information: for segment #34 (173+73.440 to 174+92.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
173+73.440	174+92.440	Information: for segment #34 (173+73.440 to 174+92.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
173+73.440	174+92.440	Information: for segment #34 (173+73.440 to 174+92.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
174+92.440	175+53.460	Information: for segment #35 (174+92.440 to 175+53.460), Outside shoulder width (3.00 feet) is less than specified boundaries (4.00 feet); adjusted in CMF calculations.
175+53.460	176+70.440	Information: for segment #36 (175+53.460 to 176+70.440), Inside shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
175+53.460	176+70.440	Information: for segment #36 (175+53.460 to 176+70.440), Outside shoulder width (0.00 feet) is less than specified boundaries (4.00 feet); adjusted in CMF calculations.
176+70.440	177+66.440	Information: for segment #38 (176+70.440 to 177+66.440), Inside shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
176+70.440	177+66.440	Information: for segment #38 (176+70.440 to 177+66.440), Outside shoulder width (2.50 feet) is less than specified boundaries (4.00 feet); adjusted in CMF calculations.
177+66.440	178+82.440	Information: for segment #40 (177+66.440 to 178+82.440), Inside shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
178+82.440	180+25.440	Information: for segment #42 (178+82.440 to 180+25.440), Inside shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
178+82.440	180+25.440	Information: for segment #42 (178+82.440 to 180+25.440), Outside barrier distance from edge of outside shoulder to barrier face (0.50 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
180+25.440	180+64.440	Information: for segment #44 (180+25.440 to 180+64.440), Inside shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
180+25.440	180+64.440	Information: for segment #44 (180+25.440 to 180+64.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
180+25.440	180+64.440	Information: for segment #44 (180+25.440 to 180+64.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
180+64.440	184+57.440	Information: for segment #45 (180+64.440 to 184+57.440), Inside shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
180+64.440	184+57.440	Information: for segment #45 (180+64.440 to 184+57.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
180+64.440	184+57.440	Information: for segment #45 (180+64.440 to 184+57.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.

Start Location (Sta. ft)	End Location (Sta. ft)	Message
184+57.440	184+96.790	Information: for segment #46 (184+57.440 to 184+96.790), Inside shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
184+57.440	184+96.790	Information: for segment #46 (184+57.440 to 184+96.790), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
184+57.440	184+96.790	Information: for segment #46 (184+57.440 to 184+96.790), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
184+96.790	186+54.440	Information: for segment #47 (184+96.790 to 186+54.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
184+96.790	186+54.440	Information: for segment #47 (184+96.790 to 186+54.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
186+54.440	190+97.440	Information: for segment #48 (186+54.440 to 190+97.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
186+54.440	190+97.440	Information: for segment #48 (186+54.440 to 190+97.440), Median barrier offset on the left side of roadway from edge of inside traveled way to barrier face (9.00 feet) is greater than inside shoulder width plus median width (7.50 feet). This indicates there is problem with the input data.
186+54.440	190+97.440	Information: for segment #48 (186+54.440 to 190+97.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
186+54.440	190+97.440	Information: for segment #48 (186+54.440 to 190+97.440), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
190+97.440	197+89.450	Information: for segment #49 (190+97.440 to 197+89.450), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
190+97.440	197+89.450	Information: for segment #49 (190+97.440 to 197+89.450), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
190+97.440	197+89.450	Information: for segment #49 (190+97.440 to 197+89.450), Outside barrier distance from edge of outside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
197+89.450	198+69.440	Information: for segment #50 (197+89.450 to 198+69.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
197+89.450	198+69.440	Information: for segment #50 (197+89.450 to 198+69.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
198+69.440	204+83.410	Information: for segment #52 (198+69.440 to 204+83.410), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
198+69.440	204+83.410	Information: for segment #52 (198+69.440 to 204+83.410), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
204+83.410	205+18.440	Information: for segment #54 (204+83.410 to 205+18.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
204+83.410	205+18.440	Information: for segment #54 (204+83.410 to 205+18.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
205+18.440	208+29.440	Information: for segment #55 (205+18.440 to 208+29.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
205+18.440	208+29.440	Information: for segment #55 (205+18.440 to 208+29.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.

Start Location (Sta. ft)	End Location (Sta. ft)	Message
208+29.440	213+04.793	Information: for segment #56 (208+29.440 to 213+04.793), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
208+29.440	213+04.793	Information: for segment #56 (208+29.440 to 213+04.793), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
213+04.793	214+67.440	Information: for segment #58 (213+04.793 to 214+67.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
213+04.793	214+67.440	Information: for segment #58 (213+04.793 to 214+67.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
214+67.440	230+25.910	Information: for segment #60 (214+67.440 to 230+25.910), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
214+67.440	230+25.910	Information: for segment #60 (214+67.440 to 230+25.910), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
230+25.910	231+12.440	Information: for segment #62 (230+25.910 to 231+12.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
230+25.910	231+12.440	Information: for segment #62 (230+25.910 to 231+12.440), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
231+12.440	234+99.370	Information: for segment #64 (231+12.440 to 234+99.370), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
231+12.440	234+99.370	Information: for segment #64 (231+12.440 to 234+99.370), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
234+99.370	236+00.000	Information: for segment #66 (234+99.370 to 236+00.000), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
234+99.370	236+00.000	Information: for segment #66 (234+99.370 to 236+00.000), Median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
197+89.450	198+69.440	Information: for segment #51 (197+89.450 to 198+69.440), For Speed Change Lane the median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
198+69.440	204+83.410	Information: for segment #53 (198+69.440 to 204+83.410), For Speed Change Lane the median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
213+04.790	213+04.793	Information: for segment #57 (213+04.790 to 213+04.793), For Speed Change Lane the median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
213+04.793	214+67.440	Information: for segment #59 (213+04.793 to 214+67.440), For Speed Change Lane the median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
214+67.440	217+94.930	Information: for segment #61 (214+67.440 to 217+94.930), For Speed Change Lane the median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
230+25.910	231+12.440	Information: for segment #63 (230+25.910 to 231+12.440), For Speed Change Lane the median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
231+12.440	234+99.370	Information: for segment #65 (231+12.440 to 234+99.370), For Speed Change Lane the median barrier distance from edge of inside shoulder to barrier face (0.00 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
138+40.440	138+91.440	Warning: for segment #1 (138+40.440 to 138+91.440), traffic volume (203,200 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F

Start Location (Sta. ft)	End Location (Sta. ft)	Message
138+91.440	139+84.440	Warning: for segment #2 (138+91.440 to 139+84.440), traffic volume (203,200 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
139+84.440	139+91.440	Warning: for segment #3 (139+84.440 to 139+91.440), traffic volume (203,200 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
139+91.440	140+07.440	Warning: for segment #4 (139+91.440 to 140+07.440), traffic volume (203,200 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
140+07.440	140+43.440	Warning: for segment #5 (140+07.440 to 140+43.440), traffic volume (203,200 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
140+07.440	140+43.440	Warning: for segment #5 (140+07.440 to 140+43.440), Freeway Segment of type 6F is using unbalanced lane processing with 2 + 4 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
140+43.440	140+91.440	Warning: for segment #6 (140+43.440 to 140+91.440), traffic volume (203,200 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
140+43.440	140+91.440	Warning: for segment #6 (140+43.440 to 140+91.440), Freeway Segment of type 6F is using unbalanced lane processing with 2 + 4 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
140+91.440	141+92.440	Warning: for segment #7 (140+91.440 to 141+92.440), traffic volume (203,200 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
140+91.440	141+92.440	Warning: for segment #7 (140+91.440 to 141+92.440), Freeway Segment of type 6F is using unbalanced lane processing with 2 + 4 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
141+92.440	142+46.440	Warning: for segment #8 (141+92.440 to 142+46.440), traffic volume (203,200 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
141+92.440	142+46.440	Warning: for segment #8 (141+92.440 to 142+46.440), Freeway Segment of type 6F is using unbalanced lane processing with 2 + 4 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
142+46.440	142+70.440	Warning: for segment #9 (142+46.440 to 142+70.440), traffic volume (203,200 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
142+46.440	142+70.440	Warning: for segment #9 (142+46.440 to 142+70.440), Freeway Segment of type 6F is using unbalanced lane processing with 2 + 4 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
142+70.440	143+41.440	Warning: for segment #10 (142+70.440 to 143+41.440), traffic volume (203,200 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
142+70.440	143+41.440	Warning: for segment #10 (142+70.440 to 143+41.440), Freeway Segment of type 6F is using unbalanced lane processing with 2 + 4 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
143+41.440	144+40.440	Warning: for segment #11 (143+41.440 to 144+40.440), traffic volume (203,200 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
143+41.440	144+40.440	Warning: for segment #11 (143+41.440 to 144+40.440), Freeway Segment of type 6F is using unbalanced lane processing with 2 + 4 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
144+40.440	145+47.440	Warning: for segment #12 (144+40.440 to 145+47.440), traffic volume (203,200 vpd) for 2050 is not within the model limit (110,000 vpd) for reliable results for segment type 4F
144+40.440	145+47.440	Warning: for segment #12 (144+40.440 to 145+47.440), Freeway Segment of type 6F is using unbalanced lane processing with 2 + 4 lanes. While results are provided, the HSM specifies that this approach only applies when the number of lanes varies by no more than one lane between the two travel directions.
169+84.440	170+94.370	Information: for segment #30 (169+84.440 to 170+94.370), Freeway Segment of type Nine-lane Freeway is using unbalanced lane processing with types Eight-lane Freeway and Ten-lane Freeway

Start Location (Sta. ft)	End Location (Sta. ft)	Message
170+94.370	171+35.440	Information: for segment #31 (170+94.370 to 171+35.440), Freeway Segment of type Nine-lane Freeway is using unbalanced lane processing with types Eight-lane Freeway and Ten-lane Freeway
171+35.440	172+54.440	Information: for segment #32 (171+35.440 to 172+54.440), Freeway Segment of type Nine-lane Freeway is using unbalanced lane processing with types Eight-lane Freeway and Ten-lane Freeway
172+54.440	173+73.440	Information: for segment #33 (172+54.440 to 173+73.440), Freeway Segment of type Nine-lane Freeway is using unbalanced lane processing with types Eight-lane Freeway and Ten-lane Freeway
173+73.440	174+92.440	Information: for segment #34 (173+73.440 to 174+92.440), Freeway Segment of type Nine-lane Freeway is using unbalanced lane processing with types Eight-lane Freeway and Ten-lane Freeway
174+92.440	175+53.460	Information: for segment #35 (174+92.440 to 175+53.460), Freeway Segment of type Nine-lane Freeway is using unbalanced lane processing with types Eight-lane Freeway and Ten-lane Freeway
184+96.790	186+54.440	Warning: for segment #47 (184+96.790 to 186+54.440), traffic volume (196,100 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
184+96.790	186+54.440	Information: for segment #47 (184+96.790 to 186+54.440), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
186+54.440	190+97.440	Warning: for segment #48 (186+54.440 to 190+97.440), traffic volume (196,100 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
186+54.440	190+97.440	Information: for segment #48 (186+54.440 to 190+97.440), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
190+97.440	197+89.450	Warning: for segment #49 (190+97.440 to 197+89.450), traffic volume (196,100 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
190+97.440	197+89.450	Information: for segment #49 (190+97.440 to 197+89.450), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
197+89.450	198+69.440	Warning: for segment #50 (197+89.450 to 198+69.440), traffic volume (196,100 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
197+89.450	198+69.440	Information: for segment #50 (197+89.450 to 198+69.440), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
198+69.440	204+83.410	Warning: for segment #52 (198+69.440 to 204+83.410), traffic volume (196,100 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
198+69.440	204+83.410	Information: for segment #52 (198+69.440 to 204+83.410), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
204+83.410	205+18.440	Warning: for segment #54 (204+83.410 to 205+18.440), traffic volume (223,400 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
204+83.410	205+18.440	Information: for segment #54 (204+83.410 to 205+18.440), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
205+18.440	208+29.440	Warning: for segment #55 (205+18.440 to 208+29.440), traffic volume (223,400 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
205+18.440	208+29.440	Information: for segment #55 (205+18.440 to 208+29.440), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
208+29.440	213+04.793	Warning: for segment #56 (208+29.440 to 213+04.793), traffic volume (223,400 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F

Start Location (Sta. ft)	End Location (Sta. ft)	Message
208+29.440	213+04.793	Information: for segment #56 (208+29.440 to 213+04.793), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
213+04.793	214+67.440	Warning: for segment #58 (213+04.793 to 214+67.440), traffic volume (247,300 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
213+04.793	214+67.440	Information: for segment #58 (213+04.793 to 214+67.440), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
214+67.440	230+25.910	Warning: for segment #60 (214+67.440 to 230+25.910), traffic volume (247,300 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
214+67.440	230+25.910	Information: for segment #60 (214+67.440 to 230+25.910), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
230+25.910	231+12.440	Warning: for segment #62 (230+25.910 to 231+12.440), traffic volume (226,100 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
230+25.910	231+12.440	Information: for segment #62 (230+25.910 to 231+12.440), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
231+12.440	234+99.370	Warning: for segment #64 (231+12.440 to 234+99.370), traffic volume (226,100 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
231+12.440	234+99.370	Information: for segment #64 (231+12.440 to 234+99.370), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
234+99.370	236+00.000	Warning: for segment #66 (234+99.370 to 236+00.000), traffic volume (226,100 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6F
234+99.370	236+00.000	Information: for segment #66 (234+99.370 to 236+00.000), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
197+89.450	198+69.440	Warning: for segment #51 (197+89.450 to 198+69.440), traffic volume (196,100 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6SC
197+89.450	198+69.440	Information: for segment #51 (197+89.450 to 198+69.440), Speed Change Segment of type Seven-lane Freeway Speed Change is using unbalanced lane processing with types Six-lane Freeway Speed Change and Eight-lane Freeway Speed Change
198+69.440	204+83.410	Warning: for segment #53 (198+69.440 to 204+83.410), traffic volume (196,100 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6SC
198+69.440	204+83.410	Information: for segment #53 (198+69.440 to 204+83.410), Speed Change Segment of type Seven-lane Freeway Speed Change is using unbalanced lane processing with types Six-lane Freeway Speed Change and Eight-lane Freeway Speed Change
213+04.790	213+04.793	Warning: for segment #57 (213+04.790 to 213+04.793), traffic volume (223,400 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6SC
213+04.790	213+04.793	Information: for segment #57 (213+04.790 to 213+04.793), Speed Change Segment of type Seven-lane Freeway Speed Change is using unbalanced lane processing with types Six-lane Freeway Speed Change and Eight-lane Freeway Speed Change
213+04.793	214+67.440	Warning: for segment #59 (213+04.793 to 214+67.440), traffic volume (247,300 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6SC
213+04.793	214+67.440	Information: for segment #59 (213+04.793 to 214+67.440), Speed Change Segment of type Seven-lane Freeway Speed Change is using unbalanced lane processing with types Six-lane Freeway Speed Change and Eight-lane Freeway Speed Change
214+67.440	217+94.930	Warning: for segment #61 (214+67.440 to 217+94.930), traffic volume (247,300 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6SC

Start Location (Sta. ft)	End Location (Sta. ft)	Message
214+67.440	217+94.930	Information: for segment #61 (214+67.440 to 217+94.930), Speed Change Segment of type Seven-lane Freeway Speed Change is using unbalanced lane processing with types Six-lane Freeway Speed Change and Eight-lane Freeway Speed Change
230+25.910	231+12.440	Warning: for segment #63 (230+25.910 to 231+12.440), traffic volume (226,100 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6SC
230+25.910	231+12.440	Information: for segment #63 (230+25.910 to 231+12.440), Speed Change Segment of type Seven-lane Freeway Speed Change is using unbalanced lane processing with types Six-lane Freeway Speed Change and Eight-lane Freeway Speed Change
231+12.440	234+99.370	Warning: for segment #65 (231+12.440 to 234+99.370), traffic volume (226,100 vpd) for 2050 is not within the model limit (180,000 vpd) for reliable results for segment type 6SC
231+12.440	234+99.370	Information: for segment #65 (231+12.440 to 234+99.370), Speed Change Segment of type Seven-lane Freeway Speed Change is using unbalanced lane processing with types Six-lane Freeway Speed Change and Eight-lane Freeway Speed Change

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

March 9, 2023

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Report Overview

Report Generated: Mar 9, 2023 3:42 PM
Report Template: System: Single Page [System] (mlcpm3, Mar 7, 2023 12:48 PM)

Evaluation Date: Thu Mar 09 15:42:49 MST 2023
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: Jordan Rae Aguirre
Organization Name: Jacobs Engineering
Phone: 5307019417
E-Mail: jordanrae.aguirre@jacobs.com

Project Title: I-10/101L - Alternatives Analysis - Slip Ramp
Project Comment: Created using wizard
Project Unit System: U.S. Customary

Highway Title: Alignment 91st_RampB Prop
Highway Comment: Imported from 91st_RampB Prop_022823.xml
Highway Version: 1

Evaluation Title: Evaluation 3
Evaluation Comment: Created Thu Mar 09 15:42:19 MST 2023

Minimum Location: 1+80.760
Maximum Location: 52+26.899

Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration

First Year of Analysis: 2050
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

Disclaimer Regarding Crash Prediction Method

IMPORTANT NOTICE ABOUT COMPARING RESULTS FROM HIGHWAY SAFETY MANUAL FIRST EDITION (2010) MODELS TO RESULTS FROM NEW MODELS DEVELOPED UNDER NCHRP PROJECTS 17-70, 17-58, AND 17-68

Since the publication of the Highway Safety Manual - First Edition (HSM-1), in 2010 by the American Association of State Highway and Transportation Officials (AASHTO), multiple research efforts have been undertaken through the National Cooperative Highway Research Program (NCHRP) to develop safety performance models for road segment and intersection facility types that were not initially reflected in the HSM-1, in order to expand the breadth and depth of the HSM in the future.

The IHSDM Crash Prediction Module (CPM) is intended as a faithful implementation of HSM Part C predictive methods. As NCHRP projects to develop new predictive methods for the HSM are completed, FHWA works to incorporate the new methods into IHSDM, sometimes in advance of publication in the HSM. The following new crash predictive methods have been accepted by NCHRP project panels and incorporated into IHSDM, while pending AASHTO's approval for incorporation into a future edition of the HSM:

- Roundabouts: completed in 2018 under NCHRP Project 17-70, the new methods will provide improved outcomes for the safety analysis of roundabouts.
- 6+ lane and one-way urban/suburban arterials (including models for segments and intersections): completed under NCHRP Project 17-58.
- Intersection crash prediction methods for some intersection configurations and traffic control types not currently addressed in the HSM (e.g., all-way stop; rural 3-leg signalized; 3-leg stop-controlled where the major leg turns; urban 5-leg signalized; urban high-speed intersections): completed in 2021 under NCHRP Project 17-68.

However, in the absence of local calibration factors (see HSM-1 Part C, Appendix A for guidance on calibration of the predictive models), it is neither appropriate nor advisable to directly compare the results from new models (from NCHRP Projects 17-58, 17-68, and 17-70) to results from HSM-1 models, as the models were not calibrated to the same base state data sets, and consequently can produce unexpected results. If local calibration factors are available and applied to both new models and HSM-1 models, then it may be appropriate to directly compare the results.*[Note: Work being performed under NCHRP Project 17-72 (Update of Crash Modification Factors for the Highway Safety Manual) is expected to re-calibrate many of the old (HSM-1) and new (e.g., NCHRP 17-70) models to data from a single (or small number of) states, that would allow results from all models to be directly compared.]*

The models produced for NCHRP Project 17-70 have independent value in terms of informing the design of a roundabout and assessing the effects of different design characteristics on the expected safety performance of a roundabout.

The HSM-1 interim method previously included in IHSDM for evaluating roundabouts on urban/suburban arterials (i.e., evaluating an existing intersection and then applying a Crash Modification Factor for replacing the existing intersection with a roundabout) has been deactivated in IHSDM, to minimize any confusion with the new roundabout methodology.

Section Types

Freeway Ramp Evaluation

Section: Section 2
Evaluation Start Location: 1+80.760
Evaluation End Location: 52+26.899
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: EX_RAMP_MV_FI=1.0; EX_RAMP_MV_PDO=1.0; EX_RAMP_SV_FI=1.0; EX_RAMP_SV_PDO=1.0;

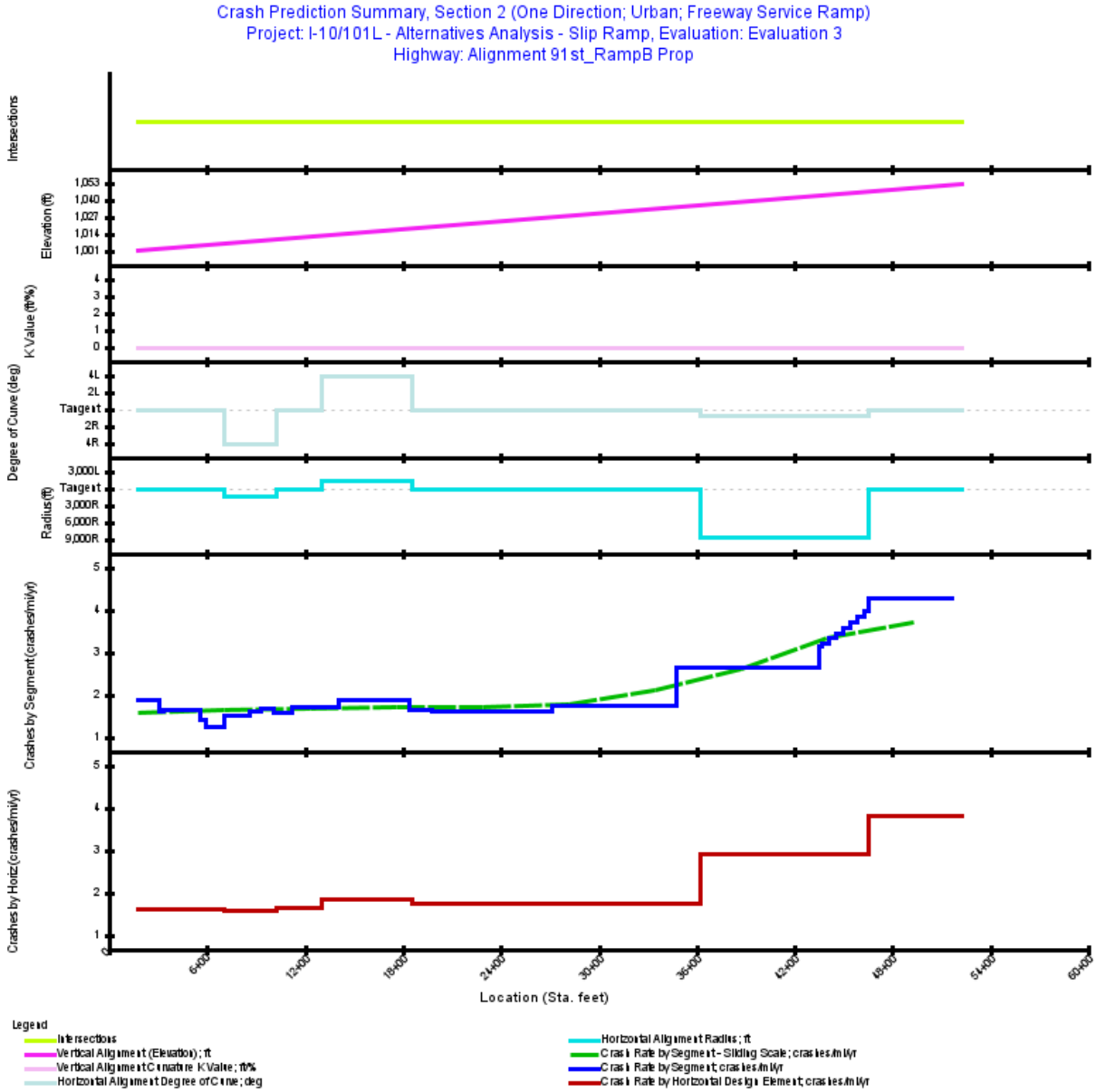

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT
1	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	1+80.760	3+05.760	125.00	0.0237	2050: 6,500
2	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	3+05.760	3+35.760	30.00	0.0057	2050: 6,500
3	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	3+35.760	5+60.760	225.00	0.0426	2050: 6,500
4	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	5+60.760	5+90.760	30.00	0.0057	2050: 6,500
5	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	5+90.760	6+29.760	39.00	0.0074	2050: 6,500
6	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	6+29.760	7+05.760	76.00	0.0144	2050: 6,500
7	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	7+05.760	7+81.760	76.00	0.0144	2050: 6,500
8	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	7+81.760	7+86.760	5.00	0.0009	2050: 6,500
9	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	7+86.760	8+58.760	72.00	0.0136	2050: 6,500
10	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	8+58.760	9+34.760	76.00	0.0144	2050: 6,500
11	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	9+34.760	10+12.760	78.00	0.0148	2050: 6,500
12	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	10+12.760	10+87.760	75.00	0.0142	2050: 6,500
13	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	10+87.760	11+24.990	37.23	0.0071	2050: 6,500
14	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	11+24.990	14+09.760	284.77	0.0539	2050: 6,500
15	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	14+09.760	14+83.760	74.00	0.0140	2050: 6,500
16	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	14+83.760	18+42.230	358.47	0.0679	2050: 6,500
17	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	18+42.230	19+78.760	136.53	0.0259	2050: 6,500
18	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	19+78.760	20+52.760	74.00	0.0140	2050: 6,500
19	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	20+52.760	22+62.910	210.15	0.0398	2050: 6,500
20	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	22+62.910	27+17.330	454.42	0.0861	2050: 6,500
21	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	27+17.330	28+48.760	131.43	0.0249	2050: 6,500
22	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	28+48.760	33+06.760	458.00	0.0867	2050: 6,500
23	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	33+06.760	34+76.760	170.00	0.0322	2050: 6,500
24	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	34+76.760	43+49.680	872.92	0.1653	2050: 12,300
25	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	43+49.680	43+71.760	22.08	0.0042	2050: 12,300
26	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	43+71.760	44+14.760	43.00	0.0081	2050: 12,300
27	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	44+14.760	44+57.760	43.00	0.0081	2050: 12,300
28	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	44+57.760	44+99.760	42.00	0.0080	2050: 12,300
29	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	44+99.760	45+42.760	43.00	0.0081	2050: 12,300
30	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	45+42.760	45+85.760	43.00	0.0081	2050: 12,300
31	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	45+85.760	46+28.760	43.00	0.0081	2050: 12,300
32	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	46+28.760	46+49.760	21.00	0.0040	2050: 12,300
33	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	46+49.760	51+63.760	514.00	0.0973	2050: 12,300
34	Freeway Ramp and C-D Road Unknown	Urban	51+63.760	52+26.899	63.14	0.0120	2050: 12,300

Table 2. Predicted Ramp Crash Rates and Frequencies Summary (Freeway Ramp Sections)

First Year of Analysis	**2050**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.9437**
Average Future Road AADT (vpd)	**8,464**
Predicted Crashes	
Total Crashes	**2.11**
Fatal and Injury Crashes	**0.94**
Property-Damage-Only Crashes	**1.17**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**45**
Percent Property-Damage-Only Crashes (%)	**55**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**2.2345**
FI Crash Rate (crashes/mi/yr)	**0.9976**
PDO Crash Rate (crashes/mi/yr)	**1.2369**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**2.92**
Travel Crash Rate (crashes/million veh-mi)	**0.72**
Travel FI Crash Rate (crashes/million veh-mi)	**0.32**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.40**

Table 3. Predicted Crash Frequencies and Rates by Ramp Segment/Intersection (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
1	1+80.760	3+05.760	0.0237	0.045	0.0449	0.0249	0.0200	1.8965	0.80
2	3+05.760	3+35.760	0.0057	0.009	0.0092	0.0044	0.0048	1.6257	0.69
3	3+35.760	5+60.760	0.0426	0.071	0.0708	0.0340	0.0368	1.6622	0.70
4	5+60.760	5+90.760	0.0057	0.008	0.0081	0.0037	0.0044	1.4259	0.60
5	5+90.760	6+29.760	0.0074	0.009	0.0093	0.0040	0.0053	1.2544	0.53
6	6+29.760	7+05.760	0.0144	0.018	0.0182	0.0079	0.0104	1.2666	0.53
7	7+05.760	7+81.760	0.0144	0.022	0.0216	0.0092	0.0124	1.5014	0.63
8	7+81.760	7+86.760	0.0009	0.001	0.0014	0.0006	0.0008	1.5179	0.64
9	7+86.760	8+58.760	0.0136	0.021	0.0209	0.0090	0.0119	1.5301	0.65
10	8+58.760	9+34.760	0.0144	0.023	0.0231	0.0101	0.0130	1.6075	0.68
11	9+34.760	10+12.760	0.0148	0.025	0.0250	0.0112	0.0138	1.6928	0.71
12	10+12.760	10+87.760	0.0142	0.022	0.0223	0.0103	0.0120	1.5704	0.66
13	10+87.760	11+24.990	0.0071	0.011	0.0111	0.0052	0.0059	1.5778	0.67
14	11+24.990	14+09.760	0.0539	0.092	0.0920	0.0433	0.0487	1.7066	0.72
15	14+09.760	14+83.760	0.0140	0.026	0.0264	0.0123	0.0141	1.8842	0.79
16	14+83.760	18+42.230	0.0679	0.128	0.1283	0.0600	0.0684	1.8900	0.80
17	18+42.230	19+78.760	0.0259	0.043	0.0426	0.0202	0.0224	1.6488	0.69
18	19+78.760	20+52.760	0.0140	0.022	0.0225	0.0107	0.0118	1.6077	0.68
19	20+52.760	22+62.910	0.0398	0.064	0.0638	0.0302	0.0335	1.6021	0.68
20	22+62.910	27+17.330	0.0861	0.138	0.1381	0.0655	0.0726	1.6049	0.68
21	27+17.330	28+48.760	0.0249	0.044	0.0438	0.0216	0.0222	1.7578	0.74
22	28+48.760	33+06.760	0.0867	0.152	0.1523	0.0747	0.0776	1.7558	0.74
23	33+06.760	34+76.760	0.0322	0.057	0.0569	0.0279	0.0289	1.7663	0.74
24	34+76.760	43+49.680	0.1653	0.440	0.4399	0.2097	0.2302	2.6606	0.59
25	43+49.680	43+71.760	0.0042	0.013	0.0131	0.0043	0.0088	3.1336	0.70
26	43+71.760	44+14.760	0.0081	0.026	0.0262	0.0088	0.0174	3.2185	0.72
27	44+14.760	44+57.760	0.0081	0.027	0.0272	0.0093	0.0179	3.3347	0.74
28	44+57.760	44+99.760	0.0080	0.028	0.0275	0.0095	0.0179	3.4542	0.77
29	44+99.760	45+42.760	0.0081	0.029	0.0291	0.0103	0.0189	3.5787	0.80
30	45+42.760	45+85.760	0.0081	0.030	0.0302	0.0109	0.0193	3.7099	0.83
31	45+85.760	46+28.760	0.0081	0.031	0.0313	0.0115	0.0199	3.8466	0.86
32	46+28.760	46+49.760	0.0040	0.016	0.0159	0.0059	0.0099	3.9870	0.89
33	46+49.760	51+63.760	0.0973	0.416	0.4156	0.1604	0.2552	4.2697	0.95
Total			0.9437	2.109	2.1088	0.9415	1.1673	2.2345	

Table 4. Predicted Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi /yr)	Predicted Travel Crash Rate (crashes/mi llion veh-mi)
Tangent	1+80.760	7+07.863	0.0998	0.161	0.1612	0.0791	0.0820	1.6144	0.68
Simple Curve 1	7+07.863	10+27.524	0.0605	0.096	0.0959	0.0419	0.0540	1.5832	0.67
Tangent	10+27.524	13+01.947	0.0520	0.086	0.0862	0.0405	0.0458	1.6592	0.70
Simple Curve 2	13+01.947	18+60.282	0.1057	0.195	0.1952	0.0914	0.1039	1.8460	0.78
Tangent	18+60.282	36+19.530	0.3332	0.586	0.5863	0.2825	0.3038	1.7596	0.70
Simple Curve 3	36+19.530	46+49.683	0.1951	0.568	0.5684	0.2458	0.3226	2.9131	0.65
Tangent	46+49.683	52+26.899	0.1093	0.416	0.4157	0.1604	0.2553	3.8026	0.85

Table 5. Predicted Crash Frequencies by Year (Freeway Ramp Sections)

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2050	2.11	0.94	44.645	1.17	55.355
Total	2.11	0.94	44.645	1.17	55.355
Average	2.11	0.94	44.645	1.17	55.355

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 6. Predicted Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.0008	0.0024	0.0098	0.0120	0.0200
2	0.0001	0.0004	0.0017	0.0021	0.0048
3	0.0011	0.0032	0.0134	0.0164	0.0368
4	0.0001	0.0003	0.0014	0.0018	0.0044
5	0.0001	0.0004	0.0016	0.0019	0.0053
6	0.0002	0.0007	0.0031	0.0038	0.0104
7	0.0003	0.0009	0.0036	0.0044	0.0124
8	0.0000	0.0001	0.0002	0.0003	0.0008
9	0.0003	0.0008	0.0035	0.0043	0.0119
10	0.0003	0.0010	0.0040	0.0049	0.0130
11	0.0003	0.0011	0.0044	0.0054	0.0138
12	0.0003	0.0010	0.0041	0.0050	0.0120
13	0.0002	0.0005	0.0021	0.0025	0.0059
14	0.0014	0.0041	0.0171	0.0208	0.0487
15	0.0004	0.0012	0.0049	0.0059	0.0141
16	0.0019	0.0057	0.0236	0.0288	0.0684
17	0.0006	0.0019	0.0080	0.0097	0.0224
18	0.0003	0.0010	0.0042	0.0051	0.0118
19	0.0009	0.0029	0.0119	0.0145	0.0335
20	0.0020	0.0062	0.0258	0.0315	0.0726
21	0.0007	0.0020	0.0085	0.0104	0.0222
22	0.0023	0.0071	0.0294	0.0359	0.0776
23	0.0009	0.0026	0.0110	0.0134	0.0289
24	0.0065	0.0199	0.0826	0.1007	0.2302
25	0.0001	0.0004	0.0013	0.0025	0.0088
26	0.0003	0.0008	0.0027	0.0050	0.0174
27	0.0003	0.0008	0.0028	0.0053	0.0179
28	0.0003	0.0009	0.0029	0.0055	0.0179
29	0.0003	0.0009	0.0031	0.0059	0.0189
30	0.0003	0.0010	0.0033	0.0062	0.0193
31	0.0003	0.0010	0.0035	0.0066	0.0199
32	0.0002	0.0005	0.0018	0.0034	0.0099
33	0.0048	0.0145	0.0489	0.0922	0.2552
Total	0.0291	0.0881	0.3502	0.4741	1.1673

Table 7. Predicted Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.00	0.2	0.02	1.1	0.03	1.2
Highway Segment	Collision with Fixed Object	0.63	30.4	0.71	34.5	1.34	64.9
Highway Segment	Collision with Other Object	0.04	2.1	0.14	6.7	0.18	8.8
Highway Segment	Other Single-vehicle Collision	0.18	8.8	0.11	5.2	0.29	13.9
Highway Segment	Collision with Parked Vehicle	0.01	0.6	0.02	0.8	0.03	1.4
Highway Segment	Total Single Vehicle Crashes	0.87	42.1	0.99	48.2	1.86	90.3
Highway Segment	Right-Angle Collision	0.00	0.1	0.00	0.1	0.00	0.2
Highway Segment	Head-on Collision	0.00	0.0	0.00	0.0	0.00	0.0
Highway Segment	Other Multi-vehicle Collision	0.00	0.1	0.00	0.2	0.01	0.2
Highway Segment	Rear-end Collision	0.04	1.7	0.10	5.1	0.14	6.8
Highway Segment	Sideswipe, Same Direction Collision	0.01	0.4	0.04	2.0	0.05	2.4
Highway Segment	Total Multiple Vehicle Crashes	0.05	2.3	0.15	7.4	0.20	9.7
Highway Segment	Total Highway Segment Crashes	0.92	44.4	1.15	55.6	2.06	100.0
	Total Crashes	0.92	44.4	1.15	55.6	2.06	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 8. Evaluation Message

Start Location (Sta. ft)	End Location (Sta. ft)	Message
1+80.760	3+05.760	Information: for segment #1 (1+80.760 to 3+05.760), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
3+05.760	3+35.760	Information: for segment #2 (3+05.760 to 3+35.760), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
3+35.760	5+60.760	Information: for segment #3 (3+35.760 to 5+60.760), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
5+90.760	6+29.760	Information: for segment #5 (5+90.760 to 6+29.760), Left shoulder width (12.74 feet) is greater than specified boundaries (10.00 feet); adjusted in CMF calculations.
6+29.760	7+05.760	Information: for segment #6 (6+29.760 to 7+05.760), Left shoulder width (11.99 feet) is greater than specified boundaries (10.00 feet); adjusted in CMF calculations.
7+05.760	7+81.760	Information: for segment #7 (7+05.760 to 7+81.760), Left shoulder width (10.99 feet) is greater than specified boundaries (10.00 feet); adjusted in CMF calculations.
7+81.760	7+86.760	Information: for segment #8 (7+81.760 to 7+86.760), Left shoulder width (10.46 feet) is greater than specified boundaries (10.00 feet); adjusted in CMF calculations.
28+48.760	33+06.760	Information: for segment #22 (28+48.760 to 33+06.760), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
46+28.760	46+49.760	Information: for segment #32 (46+28.760 to 46+49.760), Right shoulder width (1.24 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
46+49.760	51+63.760	Information: for segment #33 (46+49.760 to 51+63.760), Right shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
51+63.760	52+26.899	Warning: for segment #34 (51+63.760 to 52+26.899), unknown/unsupported segment type, no crash prediction supported
51+63.760	52+26.899	Warning: for segment #34 (51+63.760 to 52+26.899), no thru lanes specified; unknown/unsupported segment type, no crash prediction supported
1+80.760	3+05.760	Program error: for segment #1 (1+80.760 to 3+05.760), GModelDataFRE_Ramp.getFRE_Ramp_BaseAADT(): unknown key: |0|urban, invalid configuration data or program call

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

March 9, 2023

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Report Overview

Report Generated: Mar 9, 2023 3:52 PM
Report Template: System: Single Page [System] (mlcpm3, Mar 7, 2023 12:48 PM)

Evaluation Date: Thu Mar 09 15:52:06 MST 2023
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: Jordan Rae Aguirre
Organization Name: Jacobs Engineering
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E-Mail: jordanrae.aguirre@jacobs.com

Project Title: I-10/101L - Alternatives Analysis - Slip Ramp
Project Comment: Created using wizard
Project Unit System: U.S. Customary

Highway Title: Alignment Thomas_RampC
Highway Comment: Imported from Thomas_RampC.xml
Highway Version: 1

Evaluation Title: Evaluation 2
Evaluation Comment: Created Thu Mar 09 15:51:56 MST 2023

Minimum Location: 86.350
Maximum Location: 20+93.969

Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration

First Year of Analysis: 2050
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

Disclaimer Regarding Crash Prediction Method

IMPORTANT NOTICE ABOUT COMPARING RESULTS FROM HIGHWAY SAFETY MANUAL FIRST EDITION (2010) MODELS TO RESULTS FROM NEW MODELS DEVELOPED UNDER NCHRP PROJECTS 17-70, 17-58, AND 17-68

Since the publication of the Highway Safety Manual - First Edition (HSM-1), in 2010 by the American Association of State Highway and Transportation Officials (AASHTO), multiple research efforts have been undertaken through the National Cooperative Highway Research Program (NCHRP) to develop safety performance models for road segment and intersection facility types that were not initially reflected in the HSM-1, in order to expand the breadth and depth of the HSM in the future.

The IHSDM Crash Prediction Module (CPM) is intended as a faithful implementation of HSM Part C predictive methods. As NCHRP projects to develop new predictive methods for the HSM are completed, FHWA works to incorporate the new methods into IHSDM, sometimes in advance of publication in the HSM. The following new crash predictive methods have been accepted by NCHRP project panels and incorporated into IHSDM, while pending AASHTO's approval for incorporation into a future edition of the HSM:

- Roundabouts: completed in 2018 under NCHRP Project 17-70, the new methods will provide improved outcomes for the safety analysis of roundabouts.
- 6+ lane and one-way urban/suburban arterials (including models for segments and intersections): completed under NCHRP Project 17-58.
- Intersection crash prediction methods for some intersection configurations and traffic control types not currently addressed in the HSM (e.g., all-way stop; rural 3-leg signalized; 3-leg stop-controlled where the major leg turns; urban 5-leg signalized; urban high-speed intersections): completed in 2021 under NCHRP Project 17-68.

However, in the absence of local calibration factors (see HSM-1 Part C, Appendix A for guidance on calibration of the predictive models), it is neither appropriate nor advisable to directly compare the results from new models (from NCHRP Projects 17-58, 17-68, and 17-70) to results from HSM-1 models, as the models were not calibrated to the same base state data sets, and consequently can produce unexpected results. If local calibration factors are available and applied to both new models and HSM-1 models, then it may be appropriate to directly compare the results.*[Note: Work being performed under NCHRP Project 17-72 (Update of Crash Modification Factors for the Highway Safety Manual) is expected to re-calibrate many of the old (HSM-1) and new (e.g., NCHRP 17-70) models to data from a single (or small number of) states, that would allow results from all models to be directly compared.]*

The models produced for NCHRP Project 17-70 have independent value in terms of informing the design of a roundabout and assessing the effects of different design characteristics on the expected safety performance of a roundabout.

The HSM-1 interim method previously included in IHSDM for evaluating roundabouts on urban/suburban arterials (i.e., evaluating an existing intersection and then applying a Crash Modification Factor for replacing the existing intersection with a roundabout) has been deactivated in IHSDM, to minimize any confusion with the new roundabout methodology.

Section Types

Freeway Ramp Evaluation

Section: Section 2
Evaluation Start Location: 86.350
Evaluation End Location: 20+93.969
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: EX_RAMP_MV_FI=1.0; EX_RAMP_MV_PDO=1.0; EX_RAMP_SV_FI=1.0; EX_RAMP_SV_PDO=1.0;

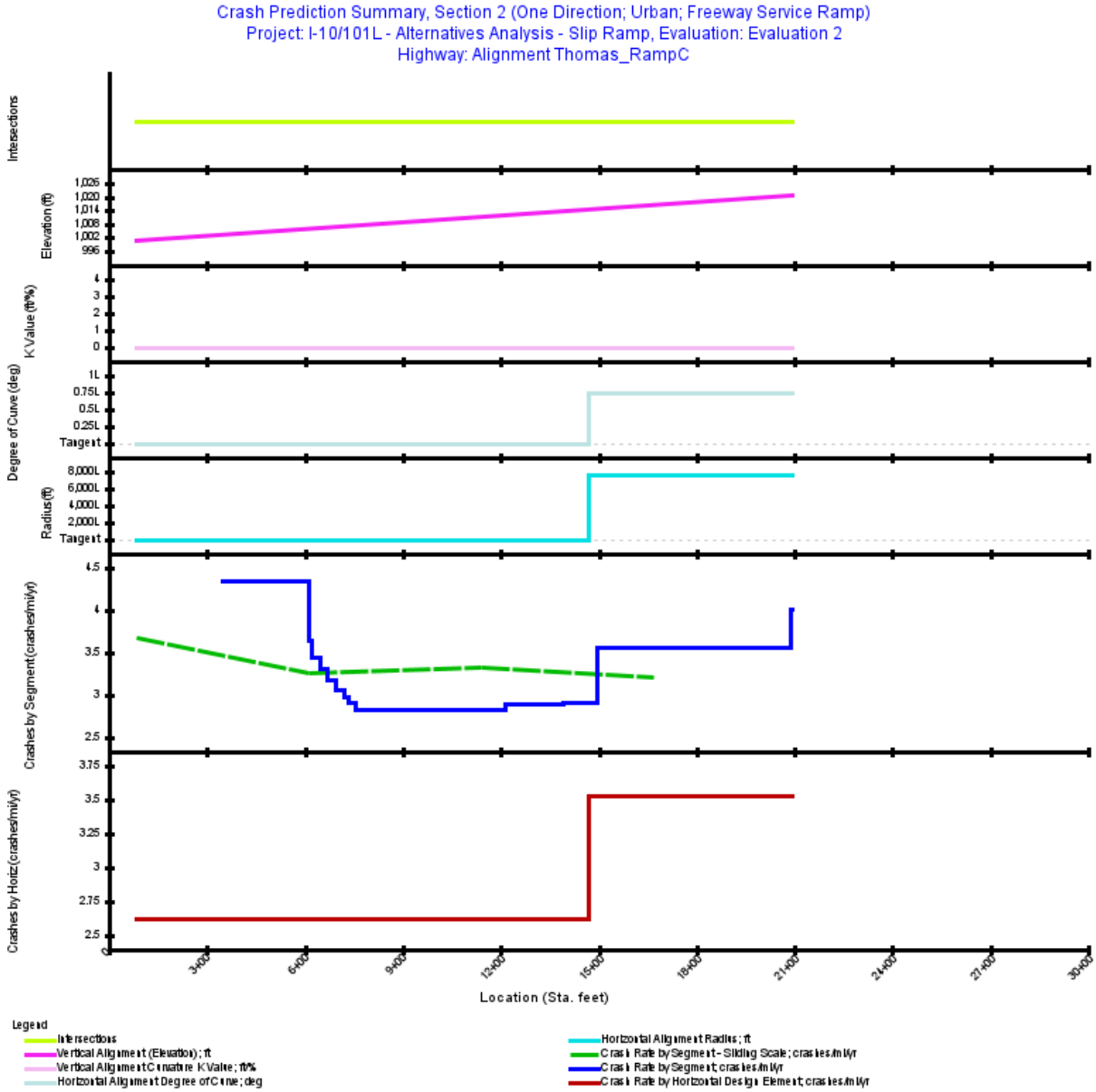

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT
1	Freeway Ramp and C-D Road Unknown	Urban	86.350	1+16.000	29.65	0.0056	2050: 12,900
2	Freeway Ramp and C-D Road Unknown	Urban	1+16.000	3+50.350	234.35	0.0444	2050: 12,900
3	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	3+50.350	6+12.350	262.00	0.0496	2050: 12,900
4	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	6+12.350	6+19.350	7.00	0.0013	2050: 12,900
5	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	6+19.350	6+45.350	26.00	0.0049	2050: 12,900
6	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	6+45.350	6+70.350	25.00	0.0047	2050: 12,900
7	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	6+70.350	6+96.350	26.00	0.0049	2050: 12,900
8	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	6+96.350	7+21.350	25.00	0.0047	2050: 12,900
9	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	7+21.350	7+34.000	12.65	0.0024	2050: 12,900
10	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	7+34.000	7+55.350	21.35	0.0040	2050: 12,900
11	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	7+55.350	12+14.350	459.00	0.0869	2050: 12,900
12	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	12+14.350	13+91.350	177.00	0.0335	2050: 12,900
13	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	13+91.350	14+95.350	104.00	0.0197	2050: 12,900
14	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	14+95.350	20+90.350	595.00	0.1127	2050: 12,900
15	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	20+90.350	20+93.969	3.62	0.0007	2050: 12,900

Table 2. Predicted Ramp Crash Rates and Frequencies Summary (Freeway Ramp Sections)

First Year of Analysis	**2050**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.3302**
Average Future Road AADT (vpd)	**12,900**
Predicted Crashes	
Total Crashes	**1.10**
Fatal and Injury Crashes	**0.53**
Property-Damage-Only Crashes	**0.58**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**48**
Percent Property-Damage-Only Crashes (%)	**52**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**3.3452**
FI Crash Rate (crashes/mi/yr)	**1.6017**
PDO Crash Rate (crashes/mi/yr)	**1.7434**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**1.55**
Travel Crash Rate (crashes/million veh-mi)	**0.71**
Travel FI Crash Rate (crashes/million veh-mi)	**0.34**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.37**

Table 3. Predicted Crash Frequencies and Rates by Ramp Segment/Intersection (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
3	3+50.350	6+12.350	0.0496	0.215	0.2150	0.0820	0.1330	4.3335	0.92
4	6+12.350	6+19.350	0.0013	0.005	0.0048	0.0025	0.0023	3.6364	0.77
5	6+19.350	6+45.350	0.0049	0.017	0.0170	0.0088	0.0082	3.4455	0.73
6	6+45.350	6+70.350	0.0047	0.016	0.0157	0.0080	0.0077	3.3098	0.70
7	6+70.350	6+96.350	0.0049	0.016	0.0157	0.0079	0.0078	3.1801	0.68
8	6+96.350	7+21.350	0.0047	0.015	0.0145	0.0072	0.0073	3.0560	0.65
9	7+21.350	7+34.000	0.0024	0.007	0.0071	0.0035	0.0036	2.9679	0.63
10	7+34.000	7+55.350	0.0040	0.012	0.0118	0.0057	0.0060	2.9096	0.62
11	7+55.350	12+14.350	0.0869	0.246	0.2456	0.1183	0.1273	2.8247	0.60
12	12+14.350	13+91.350	0.0335	0.097	0.0972	0.0472	0.0499	2.8983	0.62
13	13+91.350	14+95.350	0.0197	0.057	0.0574	0.0279	0.0294	2.9130	0.62
14	14+95.350	20+90.350	0.1127	0.400	0.4003	0.2084	0.1919	3.5526	0.76
15	20+90.350	20+93.969	0.0007	0.003	0.0027	0.0015	0.0013	4.0001	0.85
Total			0.3302	1.105	1.1047	0.5289	0.5757	3.3452	

Table 4. Predicted Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
Tangent	86.350	14+69.451	0.2620	0.687	0.6873	0.3121	0.3752	2.6238	0.56
Simple Curve 1	14+69.451	20+93.969	0.1183	0.417	0.4174	0.2169	0.2005	3.5287	0.75

Table 5. Predicted Crash Frequencies by Year (Freeway Ramp Sections)

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2050	1.10	0.53	47.882	0.58	52.118
Total	1.10	0.53	47.882	0.58	52.118
Average	1.10	0.53	47.882	0.58	52.118

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 6. Predicted Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
3	0.0024	0.0074	0.0250	0.0472	0.1330
4	0.0001	0.0002	0.0010	0.0012	0.0023
5	0.0003	0.0008	0.0035	0.0042	0.0082
6	0.0002	0.0008	0.0031	0.0038	0.0077
7	0.0002	0.0007	0.0031	0.0038	0.0078
8	0.0002	0.0007	0.0028	0.0034	0.0073
9	0.0001	0.0003	0.0014	0.0017	0.0036
10	0.0002	0.0005	0.0023	0.0028	0.0060
11	0.0037	0.0112	0.0466	0.0568	0.1273
12	0.0015	0.0045	0.0186	0.0227	0.0499
13	0.0009	0.0026	0.0110	0.0134	0.0294
14	0.0065	0.0197	0.0821	0.1001	0.1919
15	0.0000	0.0001	0.0006	0.0007	0.0013
Total	0.0164	0.0497	0.2010	0.2619	0.5757

Table 7. Predicted Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.00	0.2	0.01	1.0	0.01	1.2
Highway Segment	Collision with Fixed Object	0.36	32.6	0.35	31.8	0.71	64.5
Highway Segment	Collision with Other Object	0.03	2.3	0.07	6.2	0.09	8.5
Highway Segment	Other Single-vehicle Collision	0.10	9.4	0.05	4.8	0.16	14.2
Highway Segment	Collision with Parked Vehicle	0.01	0.7	0.01	0.7	0.01	1.4
Highway Segment	Total Single Vehicle Crashes	0.50	45.2	0.49	44.4	0.99	89.7
Highway Segment	Right-Angle Collision	0.00	0.1	0.00	0.1	0.00	0.2
Highway Segment	Head-on Collision	0.00	0.0	0.00	0.0	0.00	0.0
Highway Segment	Other Multi-vehicle Collision	0.00	0.1	0.00	0.2	0.00	0.3
Highway Segment	Rear-end Collision	0.02	2.0	0.06	5.3	0.08	7.3
Highway Segment	Sideswipe, Same Direction Collision	0.01	0.5	0.02	2.0	0.03	2.5
Highway Segment	Total Multiple Vehicle Crashes	0.03	2.7	0.09	7.7	0.11	10.3
Highway Segment	Total Highway Segment Crashes	0.53	47.9	0.58	52.1	1.10	100.0
	Total Crashes	0.53	47.9	0.58	52.1	1.10	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 8. Evaluation Message

Start Location (Sta. ft)	End Location (Sta. ft)	Message
86.350	1+16.000	Warning: for segment #1 (86.350 to 1+16.000), unknown/unsupported segment type, no crash prediction supported
86.350	1+16.000	Warning: for segment #1 (86.350 to 1+16.000), no thru lanes specified; unknown/unsupported segment type, no crash prediction supported
1+16.000	3+50.350	Warning: for segment #2 (1+16.000 to 3+50.350), unknown/unsupported segment type, no crash prediction supported
1+16.000	3+50.350	Warning: for segment #2 (1+16.000 to 3+50.350), no thru lanes specified; unknown/unsupported segment type, no crash prediction supported
13+91.350	14+95.350	Information: for segment #13 (13+91.350 to 14+95.350), Left shoulder width (0.50 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
14+95.350	20+90.350	Information: for segment #14 (14+95.350 to 20+90.350), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
20+90.350	20+93.969	Information: for segment #15 (20+90.350 to 20+93.969), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
20+90.350	20+93.969	Information: for segment #15 (20+90.350 to 20+93.969), Right shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

March 8, 2023

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Report Overview

Report Generated: Mar 8, 2023 10:12 AM
Report Template: System: Single Page [System] (mlcpm3, Mar 7, 2023 12:48 PM)

Evaluation Date: Wed Mar 08 10:12:26 MST 2023
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: Jordan Rae Aguirre
Organization Name: Jacobs Engineering
Phone: 5307019417
E-Mail: jordanrae.aguirre@jacobs.com

Project Title: I-10/101L - Alternatives Analysis - Slip Ramp
Project Comment: Created using wizard
Project Unit System: U.S. Customary

Highway Title: Alignment IndianSchool_RampA
Highway Comment: Imported from IndianSchool_RampA.xml
Highway Version: 1

Evaluation Title: Evaluation 1
Evaluation Comment: Created Wed Mar 08 10:12:11 MST 2023

Minimum Location: 0.000
Maximum Location: 18+30.680

Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration

First Year of Analysis: 2050
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

Disclaimer Regarding Crash Prediction Method

IMPORTANT NOTICE ABOUT COMPARING RESULTS FROM HIGHWAY SAFETY MANUAL FIRST EDITION (2010) MODELS TO RESULTS FROM NEW MODELS DEVELOPED UNDER NCHRP PROJECTS 17-70, 17-58, AND 17-68

Since the publication of the Highway Safety Manual - First Edition (HSM-1), in 2010 by the American Association of State Highway and Transportation Officials (AASHTO), multiple research efforts have been undertaken through the National Cooperative Highway Research Program (NCHRP) to develop safety performance models for road segment and intersection facility types that were not initially reflected in the HSM-1, in order to expand the breadth and depth of the HSM in the future.

The IHSDM Crash Prediction Module (CPM) is intended as a faithful implementation of HSM Part C predictive methods. As NCHRP projects to develop new predictive methods for the HSM are completed, FHWA works to incorporate the new methods into IHSDM, sometimes in advance of publication in the HSM. The following new crash predictive methods have been accepted by NCHRP project panels and incorporated into IHSDM, while pending AASHTO's approval for incorporation into a future edition of the HSM:

- Roundabouts: completed in 2018 under NCHRP Project 17-70, the new methods will provide improved outcomes for the safety analysis of roundabouts.
- 6+ lane and one-way urban/suburban arterials (including models for segments and intersections): completed under NCHRP Project 17-58.
- Intersection crash prediction methods for some intersection configurations and traffic control types not currently addressed in the HSM (e.g., all-way stop; rural 3-leg signalized; 3-leg stop-controlled where the major leg turns; urban 5-leg signalized; urban high-speed intersections): completed in 2021 under NCHRP Project 17-68.

However, in the absence of local calibration factors (see HSM-1 Part C, Appendix A for guidance on calibration of the predictive models), it is neither appropriate nor advisable to directly compare the results from new models (from NCHRP Projects 17-58, 17-68, and 17-70) to results from HSM-1 models, as the models were not calibrated to the same base state data sets, and consequently can produce unexpected results. If local calibration factors are available and applied to both new models and HSM-1 models, then it may be appropriate to directly compare the results.*[Note: Work being performed under NCHRP Project 17-72 (Update of Crash Modification Factors for the Highway Safety Manual) is expected to re-calibrate many of the old (HSM-1) and new (e.g., NCHRP 17-70) models to data from a single (or small number of) states, that would allow results from all models to be directly compared.]*

The models produced for NCHRP Project 17-70 have independent value in terms of informing the design of a roundabout and assessing the effects of different design characteristics on the expected safety performance of a roundabout.

The HSM-1 interim method previously included in IHSDM for evaluating roundabouts on urban/suburban arterials (i.e., evaluating an existing intersection and then applying a Crash Modification Factor for replacing the existing intersection with a roundabout) has been deactivated in IHSDM, to minimize any confusion with the new roundabout methodology.

Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 0.000
Evaluation End Location: 18+30.680
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: ENT_RAMP_MV_FI=1.0; ENT_RAMP_MV_PDO=1.0; ENT_RAMP_SV_FI=1.0; ENT_RAMP_SV_PDO=1.0;

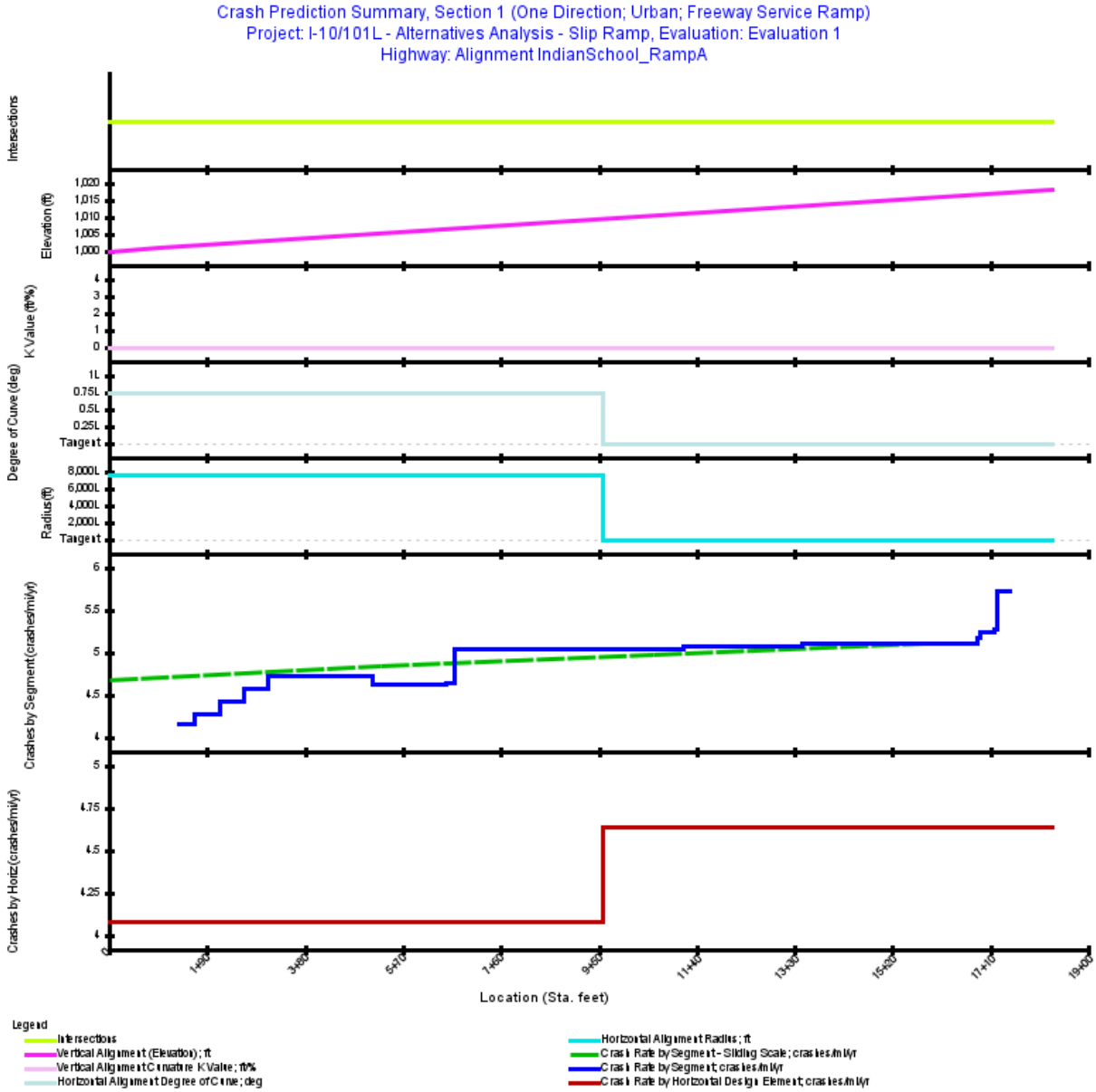

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT
1	Freeway Ramp and C-D Road Unknown	Urban	0.000	24.000	24.00	0.0045	2050: 13,400
2	Freeway Ramp and C-D Road Unknown	Urban	24.000	72.000	48.00	0.0091	2050: 13,400
3	Freeway Ramp and C-D Road Unknown	Urban	72.000	1+19.000	47.00	0.0089	2050: 13,400
4	Freeway Ramp and C-D Road Unknown	Urban	1+19.000	1+35.000	16.00	0.0030	2050: 13,400
5	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	1+35.000	1+67.000	32.00	0.0061	2050: 13,400
6	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	1+67.000	2+14.000	47.00	0.0089	2050: 13,400
7	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	2+14.000	2+61.000	47.00	0.0089	2050: 13,400
8	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	2+61.000	3+09.000	48.00	0.0091	2050: 13,400
9	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	3+09.000	5+12.000	203.00	0.0384	2050: 13,400
10	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	5+12.000	6+54.640	142.64	0.0270	2050: 13,400
11	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	6+54.640	6+70.000	15.36	0.0029	2050: 13,400
12	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	6+70.000	11+15.000	445.00	0.0843	2050: 13,400
13	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	11+15.000	13+46.000	231.00	0.0437	2050: 13,400
14	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	13+46.000	16+83.490	337.49	0.0639	2050: 13,400
15	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	16+83.490	16+90.000	6.51	0.0012	2050: 13,400
16	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	16+90.000	17+16.910	26.91	0.0051	2050: 13,400
17	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	17+16.910	17+22.000	5.09	0.0010	2050: 13,400
18	Freeway Ramp and C-D Road Two-lane Ramp Entrance	Urban	17+22.000	17+49.000	27.00	0.0051	2050: 13,400
19	Freeway Ramp and C-D Road Unknown	Urban	17+49.000	18+30.680	81.68	0.0155	2050: 13,400

Table 2. Predicted Ramp Crash Rates and Frequencies Summary (Freeway Ramp Sections)

First Year of Analysis	**2050**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.3057**
Average Future Road AADT (vpd)	**13,400**
Predicted Crashes	
Total Crashes	**1.51**
Fatal and Injury Crashes	**0.54**
Property-Damage-Only Crashes	**0.96**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**36**
Percent Property-Damage-Only Crashes (%)	**64**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**4.9283**
FI Crash Rate (crashes/mi/yr)	**1.7788**
PDO Crash Rate (crashes/mi/yr)	**3.1495**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**1.50**
Travel Crash Rate (crashes/million veh-mi)	**1.01**
Travel FI Crash Rate (crashes/million veh-mi)	**0.36**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.64**

Table 3. Predicted Crash Frequencies and Rates by Ramp Segment/Intersection (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
5	1+35.000	1+67.000	0.0061	0.025	0.0252	0.0077	0.0175	4.1558	0.85
6	1+67.000	2+14.000	0.0089	0.038	0.0381	0.0118	0.0263	4.2768	0.87
7	2+14.000	2+61.000	0.0089	0.039	0.0394	0.0124	0.0270	4.4261	0.91
8	2+61.000	3+09.000	0.0091	0.042	0.0417	0.0134	0.0283	4.5830	0.94
9	3+09.000	5+12.000	0.0384	0.182	0.1817	0.0593	0.1224	4.7266	0.97
10	5+12.000	6+54.640	0.0270	0.125	0.1251	0.0404	0.0847	4.6322	0.95
11	6+54.640	6+70.000	0.0029	0.013	0.0135	0.0044	0.0091	4.6405	0.95
12	6+70.000	11+15.000	0.0843	0.426	0.4256	0.1603	0.2653	5.0499	1.03
13	11+15.000	13+46.000	0.0437	0.222	0.2221	0.0840	0.1381	5.0763	1.04
14	13+46.000	16+83.490	0.0639	0.327	0.3267	0.1239	0.2028	5.1106	1.04
15	16+83.490	16+90.000	0.0012	0.006	0.0064	0.0024	0.0040	5.1829	1.06
16	16+90.000	17+16.910	0.0051	0.027	0.0267	0.0102	0.0165	5.2370	1.07
17	17+16.910	17+22.000	0.0010	0.005	0.0051	0.0020	0.0031	5.2784	1.08
18	17+22.000	17+49.000	0.0051	0.029	0.0293	0.0117	0.0176	5.7245	1.17
Total			0.3057	1.506	1.5065	0.5437	0.9627	4.9283	

Table 4. Predicted Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
Simple Curve 1	0.000	9+57.878	0.1814	0.740	0.7400	0.2529	0.4871	4.0791	0.83
Tangent	9+57.878	18+30.680	0.1653	0.766	0.7665	0.2908	0.4757	4.6367	0.95

Table 5. Predicted Crash Frequencies by Year (Freeway Ramp Sections)

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2050	1.51	0.54	36.093	0.96	63.907
Total	1.51	0.54	36.093	0.96	63.907
Average	1.51	0.54	36.093	0.96	63.907

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 6. Predicted Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
5	0.0002	0.0005	0.0024	0.0046	0.0175
6	0.0002	0.0007	0.0037	0.0071	0.0263
7	0.0003	0.0008	0.0039	0.0074	0.0270
8	0.0003	0.0008	0.0043	0.0080	0.0283
9	0.0012	0.0036	0.0189	0.0356	0.1224
10	0.0008	0.0025	0.0129	0.0242	0.0847
11	0.0001	0.0003	0.0014	0.0026	0.0091
12	0.0033	0.0099	0.0510	0.0962	0.2653
13	0.0017	0.0052	0.0267	0.0504	0.1381
14	0.0025	0.0076	0.0394	0.0743	0.2028
15	0.0000	0.0002	0.0008	0.0015	0.0040
16	0.0002	0.0006	0.0033	0.0061	0.0165
17	0.0000	0.0001	0.0006	0.0012	0.0031
18	0.0002	0.0007	0.0037	0.0070	0.0176
Total	0.0110	0.0334	0.1731	0.3262	0.9627

Table 7. Predicted Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.00	0.1	0.01	0.7	0.01	0.8
Highway Segment	Collision with Fixed Object	0.25	16.8	0.36	24.2	0.62	41.0
Highway Segment	Collision with Other Object	0.02	1.2	0.07	4.7	0.09	5.9
Highway Segment	Other Single-vehicle Collision	0.07	4.8	0.05	3.6	0.13	8.4
Highway Segment	Collision with Parked Vehicle	0.01	0.3	0.01	0.5	0.01	0.9
Highway Segment	Total Single Vehicle Crashes	0.35	23.2	0.51	33.8	0.86	57.0
Highway Segment	Right-Angle Collision	0.01	0.4	0.01	0.5	0.01	0.9
Highway Segment	Head-on Collision	0.00	0.1	0.00	0.1	0.00	0.2
Highway Segment	Other Multi-vehicle Collision	0.01	0.4	0.01	0.7	0.02	1.1
Highway Segment	Rear-end Collision	0.14	9.6	0.31	20.8	0.46	30.4
Highway Segment	Sideswipe, Same Direction Collision	0.04	2.3	0.12	8.0	0.16	10.3
Highway Segment	Total Multiple Vehicle Crashes	0.19	12.9	0.45	30.1	0.65	43.0
Highway Segment	Total Highway Segment Crashes	0.54	36.1	0.96	63.9	1.51	100.0
	Total Crashes	0.54	36.1	0.96	63.9	1.51	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 8. Evaluation Message

Start Location (Sta. ft)	End Location (Sta. ft)	Message
0.000	24.000	Warning: for segment #1 (0.000 to 24.000), unknown/unsupported segment type, no crash prediction supported
0.000	24.000	Warning: for segment #1 (0.000 to 24.000), no thru lanes specified; unknown/unsupported segment type, no crash prediction supported
24.000	72.000	Warning: for segment #2 (24.000 to 72.000), unknown/unsupported segment type, no crash prediction supported
24.000	72.000	Warning: for segment #2 (24.000 to 72.000), no thru lanes specified; unknown/unsupported segment type, no crash prediction supported
72.000	1+19.000	Warning: for segment #3 (72.000 to 1+19.000), unknown/unsupported segment type, no crash prediction supported
72.000	1+19.000	Warning: for segment #3 (72.000 to 1+19.000), no thru lanes specified; unknown/unsupported segment type, no crash prediction supported
1+19.000	1+35.000	Warning: for segment #4 (1+19.000 to 1+35.000), unknown/unsupported segment type, no crash prediction supported
1+19.000	1+35.000	Warning: for segment #4 (1+19.000 to 1+35.000), no thru lanes specified; unknown/unsupported segment type, no crash prediction supported
1+35.000	1+67.000	Information: for segment #5 (1+35.000 to 1+67.000), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
1+67.000	2+14.000	Information: for segment #6 (1+67.000 to 2+14.000), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
2+14.000	2+61.000	Information: for segment #7 (2+14.000 to 2+61.000), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
2+61.000	3+09.000	Information: for segment #8 (2+61.000 to 3+09.000), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
3+09.000	5+12.000	Information: for segment #9 (3+09.000 to 5+12.000), Left shoulder width (1.50 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
17+22.000	17+49.000	Information: for segment #18 (17+22.000 to 17+49.000), Left shoulder width (1.75 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
17+22.000	17+49.000	Information: for segment #18 (17+22.000 to 17+49.000), Right shoulder width (1.25 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
17+49.000	18+30.680	Warning: for segment #19 (17+49.000 to 18+30.680), unknown/unsupported segment type, no crash prediction supported
17+49.000	18+30.680	Warning: for segment #19 (17+49.000 to 18+30.680), no thru lanes specified; unknown/unsupported segment type, no crash prediction supported

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

March 29, 2023

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Report Overview

Report Generated: Mar 29, 2023 8:35 AM
Report Template: System: Single Page [System] (mlcpm3, Mar 7, 2023 12:48 PM)

Evaluation Date: Wed Mar 29 08:35:09 MST 2023
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: Jordan Rae Aguirre
Organization Name: Jacobs Engineering
Phone: 5307019417
E-Mail: jordanrae.aguirre@jacobs.com

Project Title: I-10/101L - Alternatives Analysis - Slip Ramp
Project Comment: Created using wizard
Project Unit System: U.S. Customary

Highway Title: Alignment SE Ramp Prop
Highway Comment: Imported from SE Ramp Prop_022823.xml
Highway Version: 1

Evaluation Title: Evaluation 11
Evaluation Comment: Created Wed Mar 29 08:34:40 MST 2023

Minimum Location: 40+43.407
Maximum Location: 109+64.841

Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration

First Year of Analysis: 2050
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

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IMPORTANT NOTICE ABOUT COMPARING RESULTS FROM HIGHWAY SAFETY MANUAL FIRST EDITION (2010) MODELS TO RESULTS FROM NEW MODELS DEVELOPED UNDER NCHRP PROJECTS 17-70, 17-58, AND 17-68

Since the publication of the Highway Safety Manual - First Edition (HSM-1), in 2010 by the American Association of State Highway and Transportation Officials (AASHTO), multiple research efforts have been undertaken through the National Cooperative Highway Research Program (NCHRP) to develop safety performance models for road segment and intersection facility types that were not initially reflected in the HSM-1, in order to expand the breadth and depth of the HSM in the future.

The IHSDM Crash Prediction Module (CPM) is intended as a faithful implementation of HSM Part C predictive methods. As NCHRP projects to develop new predictive methods for the HSM are completed, FHWA works to incorporate the new methods into IHSDM, sometimes in advance of publication in the HSM. The following new crash predictive methods have been accepted by NCHRP project panels and incorporated into IHSDM, while pending AASHTO's approval for incorporation into a future edition of the HSM:

- Roundabouts: completed in 2018 under NCHRP Project 17-70, the new methods will provide improved outcomes for the safety analysis of roundabouts.
- 6+ lane and one-way urban/suburban arterials (including models for segments and intersections): completed under NCHRP Project 17-58.
- Intersection crash prediction methods for some intersection configurations and traffic control types not currently addressed in the HSM (e.g., all-way stop; rural 3-leg signalized; 3-leg stop-controlled where the major leg turns; urban 5-leg signalized; urban high-speed intersections): completed in 2021 under NCHRP Project 17-68.

However, in the absence of local calibration factors (see HSM-1 Part C, Appendix A for guidance on calibration of the predictive models), it is neither appropriate nor advisable to directly compare the results from new models (from NCHRP Projects 17-58, 17-68, and 17-70) to results from HSM-1 models, as the models were not calibrated to the same base state data sets, and consequently can produce unexpected results. If local calibration factors are available and applied to both new models and HSM-1 models, then it may be appropriate to directly compare the results.*[Note: Work being performed under NCHRP Project 17-72 (Update of Crash Modification Factors for the Highway Safety Manual) is expected to re-calibrate many of the old (HSM-1) and new (e.g., NCHRP 17-70) models to data from a single (or small number of) states, that would allow results from all models to be directly compared.]*

The models produced for NCHRP Project 17-70 have independent value in terms of informing the design of a roundabout and assessing the effects of different design characteristics on the expected safety performance of a roundabout.

The HSM-1 interim method previously included in IHSDM for evaluating roundabouts on urban/suburban arterials (i.e., evaluating an existing intersection and then applying a Crash Modification Factor for replacing the existing intersection with a roundabout) has been deactivated in IHSDM, to minimize any confusion with the new roundabout methodology.

Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 40+43.407
Evaluation End Location: 109+64.841
Functional Class: Freeway C-D Road & System Ramp
Type of Alignment: One Direction
Model Category: C-D Road & System Ramp
Calibration Factor: CD_MV_FI=1.0; CD_MV_PDO=1.0; CD_SV_FI=1.0; CD_SV_PDO=1.0;

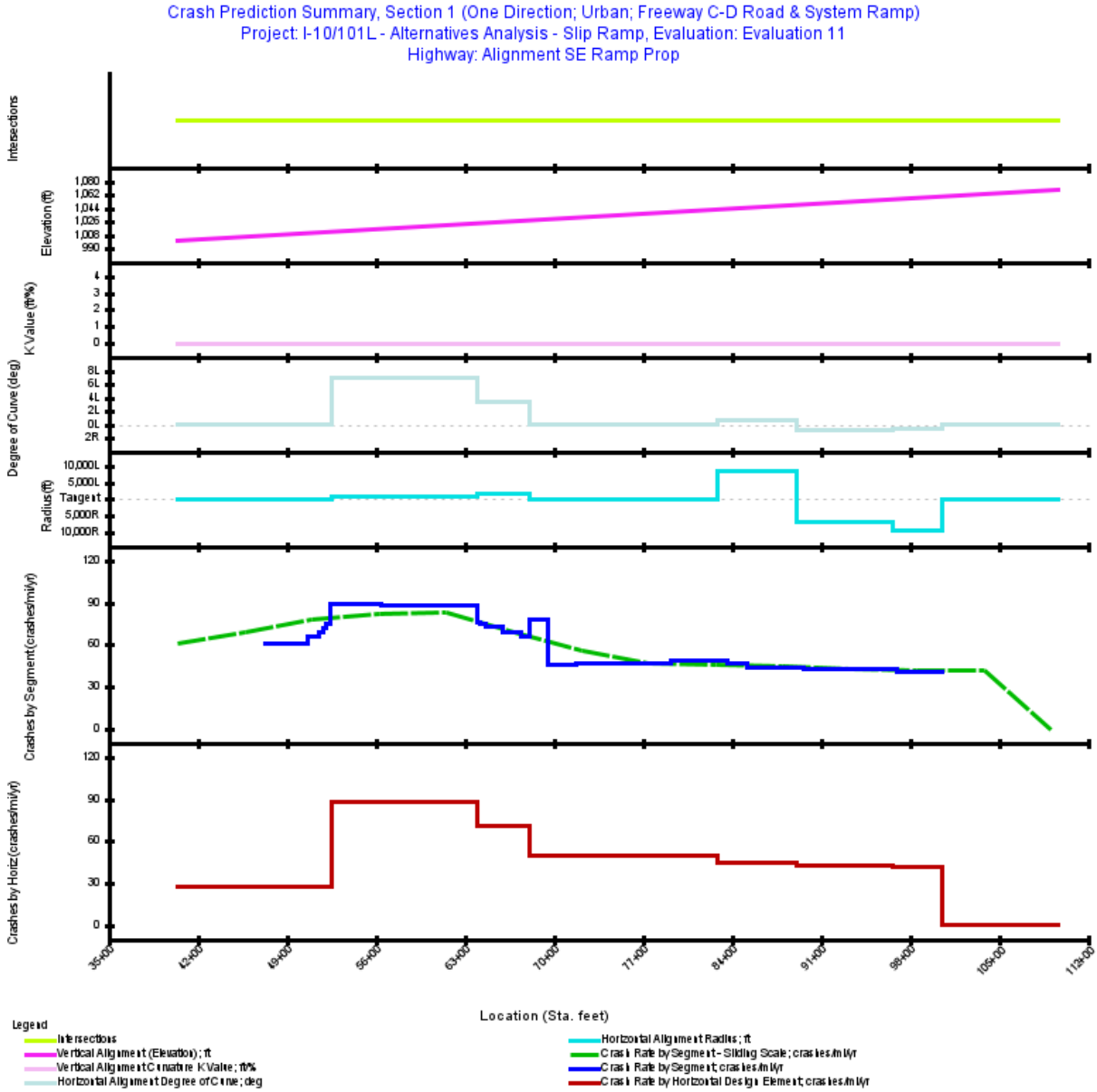

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT
1	Freeway Ramp and C-D Road Unknown	Urban	40+43.407	47+27.407	684.00	0.1295	2050: 54,500

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT
2	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	47+27.407	50+57.407	330.00	0.0625	2050: 54,500
3	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	50+57.407	50+71.407	14.00	0.0027	2050: 54,500
4	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	50+71.407	50+98.407	27.00	0.0051	2050: 54,500
5	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	50+98.407	51+26.407	28.00	0.0053	2050: 54,500
6	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	51+26.407	51+53.407	27.00	0.0051	2050: 54,500
7	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	51+53.407	51+80.407	27.00	0.0051	2050: 54,500
8	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	51+80.407	52+08.407	28.00	0.0053	2050: 54,500
9	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	52+08.407	52+35.407	27.00	0.0051	2050: 54,500
10	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	52+35.407	56+38.407	403.00	0.0763	2050: 54,500
11	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	56+38.407	63+93.320	754.91	0.1430	2050: 54,500
12	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	63+93.320	64+16.407	23.09	0.0044	2050: 54,500
13	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	64+16.407	64+62.407	46.00	0.0087	2050: 54,500
14	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	64+62.407	65+99.407	137.00	0.0259	2050: 54,500
15	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	65+99.407	67+36.407	137.00	0.0259	2050: 54,500
16	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	67+36.407	68+04.420	68.01	0.0129	2050: 54,500
17	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	68+04.420	69+46.800	142.38	0.0270	2050: 54,500
18	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	69+46.800	71+75.407	228.61	0.0433	2050: 48,700
19	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	71+75.407	79+17.407	742.00	0.1405	2050: 48,700
20	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	79+17.407	82+87.320	369.91	0.0701	2050: 48,700
21	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	82+87.320	83+63.407	76.09	0.0144	2050: 48,700
22	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	83+63.407	85+15.407	152.00	0.0288	2050: 48,700
23	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	85+15.407	85+91.407	76.00	0.0144	2050: 48,700
24	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	85+91.407	89+57.407	366.00	0.0693	2050: 48,700
25	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	89+57.407	96+89.407	732.00	0.1386	2050: 48,700

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT
26	Freeway Ramp and C-D Road Two-lane C-D Ramp	Urban	96+89.407	100+55.407	366.00	0.0693	2050: 48,700
27	Freeway Ramp and C-D Road Unknown	Urban	100+55.407	109+64.841	909.43	0.1722	2050: 48,700

Table 2. Predicted Ramp Crash Rates and Frequencies Summary (Freeway Ramp Sections)

First Year of Analysis	**2050**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**1.0091**
Average Future Road AADT (vpd)	**51,116**
Predicted Crashes	
Total Crashes	**59.75**
Fatal and Injury Crashes	**39.72**
Property-Damage-Only Crashes	**20.04**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**66**
Percent Property-Damage-Only Crashes (%)	**34**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**59.2153**
FI Crash Rate (crashes/mi/yr)	**39.3609**
PDO Crash Rate (crashes/mi/yr)	**19.8544**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**18.83**
Travel Crash Rate (crashes/million veh-mi)	**3.17**
Travel FI Crash Rate (crashes/million veh-mi)	**2.11**
Travel PDO Crash Rate (crashes/million veh-mi)	**1.06**

Table 3. Predicted Crash Frequencies and Rates by Ramp Segment/Intersection (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
2	47+27.407	50+57.407	0.0625	3.844	3.8441	2.7048	1.1393	61.5059	3.09
3	50+57.407	50+71.407	0.0027	0.175	0.1747	0.1191	0.0556	65.8844	3.31
4	50+71.407	50+98.407	0.0051	0.337	0.3369	0.2296	0.1073	65.8844	3.31
5	50+98.407	51+26.407	0.0053	0.349	0.3494	0.2381	0.1113	65.8844	3.31
6	51+26.407	51+53.407	0.0051	0.337	0.3373	0.2299	0.1074	65.9568	3.32
7	51+53.407	51+80.407	0.0051	0.353	0.3526	0.2425	0.1101	68.9479	3.47
8	51+80.407	52+08.407	0.0053	0.383	0.3826	0.2654	0.1172	72.1459	3.63
9	52+08.407	52+35.407	0.0051	0.386	0.3861	0.2701	0.1160	75.5049	3.80
10	52+35.407	56+38.407	0.0763	6.844	6.8437	4.8105	2.0332	89.6645	4.51
11	56+38.407	63+93.320	0.1430	12.600	12.6000	8.8207	3.7792	88.1265	4.43
12	63+93.320	64+16.407	0.0044	0.335	0.3349	0.2332	0.1017	76.6018	3.85
13	64+16.407	64+62.407	0.0087	0.658	0.6584	0.4573	0.2011	75.5782	3.80
14	64+62.407	65+99.407	0.0259	1.893	1.8925	1.3055	0.5870	72.9377	3.67
15	65+99.407	67+36.407	0.0259	1.795	1.7947	1.2253	0.5694	69.1690	3.48
16	67+36.407	68+04.420	0.0129	0.856	0.8564	0.5801	0.2763	66.4872	3.34
17	68+04.420	69+46.800	0.0270	2.112	2.1116	1.5589	0.5526	78.3047	3.94
18	69+46.800	71+75.407	0.0433	1.978	1.9783	1.1975	0.7808	45.6914	2.57
19	71+75.407	79+17.407	0.1405	6.604	6.6039	4.0263	2.5776	46.9928	2.64
20	79+17.407	82+87.320	0.0701	3.400	3.4003	2.0900	1.3102	48.5342	2.73
21	82+87.320	83+63.407	0.0144	0.700	0.7004	0.4305	0.2699	48.6064	2.73
22	83+63.407	85+15.407	0.0288	1.355	1.3547	0.8259	0.5288	47.0577	2.65
23	85+15.407	85+91.407	0.0144	0.625	0.6249	0.3917	0.2332	43.4132	2.44
24	85+91.407	89+57.407	0.0693	3.055	3.0555	1.9421	1.1134	44.0797	2.48
25	89+57.407	96+89.407	0.1386	5.918	5.9185	3.7330	2.1855	42.6910	2.40
26	96+89.407	100+55.407	0.0693	2.861	2.8612	1.7906	1.0706	41.2757	2.32
Total			1.0091	59.754	59.7537	39.7187	20.0349	59.2153	

Table 4. Predicted Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
Tangent	40+43.407	52+49.250	0.2284	6.399	6.3987	4.4647	1.9340	28.0180	1.41
Simple Curve 1	52+49.250	63+93.320	0.2167	19.209	19.2086	13.4660	5.7426	88.6496	4.46
Simple Curve 2	63+93.320	68+04.418	0.0779	5.537	5.5370	3.8015	1.7356	71.1159	3.57
Tangent	68+04.418	82+87.317	0.2809	14.094	14.0940	8.8728	5.2213	50.1831	2.78
Simple Curve 3	82+87.317	89+00.824	0.1162	5.263	5.2632	3.2900	1.9732	45.2963	2.55
Simple Curve 4	89+00.824	96+60.946	0.1440	6.161	6.1608	3.8881	2.2727	42.7943	2.41
Simple Curve 5	96+60.946	100+55.334	0.0747	3.091	3.0907	1.9354	1.1553	41.3778	2.33
Tangent	100+55.334	109+64.841	0.1723	0.001	0.0006	0.0004	0.0002	0.0033	0.00

Table 5. Predicted Crash Frequencies by Year (Freeway Ramp Sections)

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2050	59.75	39.72	66.471	20.04	33.529
Total	59.75	39.72	66.471	20.04	33.529
Average	59.75	39.72	66.471	20.04	33.529

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 6. Predicted Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
2	0.0468	0.1420	0.7535	1.7625	1.1393
3	0.0017	0.0053	0.0287	0.0833	0.0556
4	0.0034	0.0102	0.0554	0.1607	0.1073
5	0.0035	0.0106	0.0574	0.1666	0.1113
6	0.0034	0.0102	0.0555	0.1609	0.1074
7	0.0035	0.0107	0.0585	0.1697	0.1101
8	0.0039	0.0118	0.0640	0.1857	0.1172
9	0.0039	0.0120	0.0652	0.1890	0.1160
10	0.0703	0.2133	1.1605	3.3664	2.0332
11	0.1290	0.3911	2.1279	6.1728	3.7792
12	0.0034	0.0103	0.0563	0.1632	0.1017
13	0.0067	0.0203	0.1103	0.3200	0.2011
14	0.0191	0.0579	0.3149	0.9136	0.5870
15	0.0179	0.0543	0.2956	0.8575	0.5694
16	0.0085	0.0257	0.1400	0.4060	0.2763
17	0.0228	0.0691	0.3761	1.0909	0.5526
18	0.0175	0.0531	0.2889	0.8380	0.7808
19	0.0589	0.1785	0.9713	2.8176	2.5776
20	0.0306	0.0927	0.5042	1.4626	1.3102
21	0.0063	0.0191	0.1039	0.3013	0.2699
22	0.0121	0.0366	0.1992	0.5780	0.5288
23	0.0057	0.0174	0.0947	0.2739	0.2332
24	0.0336	0.1020	0.5411	1.2654	1.1134
25	0.0646	0.1960	1.0401	2.4323	2.1855
26	0.0310	0.0940	0.4989	1.1667	1.0706
Total	0.6081	1.8440	9.9620	27.3046	20.0349

Table 7. Predicted Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.01	0.0	0.05	0.1	0.06	0.1
Highway Segment	Collision with Fixed Object	1.18	2.0	1.75	2.9	2.93	4.9
Highway Segment	Collision with Other Object	0.08	0.1	0.34	0.6	0.42	0.7
Highway Segment	Other Single-vehicle Collision	0.34	0.6	0.26	0.4	0.60	1.0
Highway Segment	Collision with Parked Vehicle	0.03	0.0	0.04	0.1	0.06	0.1
Highway Segment	Total Single Vehicle Crashes	1.64	2.7	2.45	4.1	4.08	6.8
Highway Segment	Right-Angle Collision	1.18	2.0	0.32	0.5	1.50	2.5
Highway Segment	Head-on Collision	0.30	0.5	0.04	0.1	0.34	0.6
Highway Segment	Other Multi-vehicle Collision	1.18	2.0	0.42	0.7	1.60	2.7
Highway Segment	Rear-end Collision	28.56	47.8	12.14	20.3	40.70	68.1
Highway Segment	Sideswipe, Same Direction Collision	6.86	11.5	4.68	7.8	11.53	19.3
Highway Segment	Total Multiple Vehicle Crashes	38.08	63.7	17.59	29.4	55.67	93.2
Highway Segment	Total Highway Segment Crashes	39.72	66.5	20.04	33.5	59.75	100.0
	Total Crashes	39.72	66.5	20.04	33.5	59.75	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 8. Evaluation Message

Start Location (Sta. ft)	End Location (Sta. ft)	Message
40+43.407	47+27.407	Warning: for segment #1 (40+43.407 to 47+27.407), unknown/unsupported segment type, no crash prediction supported
40+43.407	47+27.407	Warning: for segment #1 (40+43.407 to 47+27.407), no thru lanes specified; unknown/unsupported segment type, no crash prediction supported
50+57.407	50+71.407	Information: for segment #3 (50+57.407 to 50+71.407), Right shoulder width (14.73 feet) is greater than specified boundaries (12.00 feet); adjusted in CMF calculations.
50+71.407	50+98.407	Information: for segment #4 (50+71.407 to 50+98.407), Right shoulder width (13.98 feet) is greater than specified boundaries (12.00 feet); adjusted in CMF calculations.
50+98.407	51+26.407	Information: for segment #5 (50+98.407 to 51+26.407), Right shoulder width (12.98 feet) is greater than specified boundaries (12.00 feet); adjusted in CMF calculations.
85+91.407	89+57.407	Information: for segment #24 (85+91.407 to 89+57.407), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
89+57.407	96+89.407	Information: for segment #25 (89+57.407 to 96+89.407), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
96+89.407	100+55.407	Information: for segment #26 (96+89.407 to 100+55.407), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
100+55.407	109+64.841	Warning: for segment #27 (100+55.407 to 109+64.841), unknown/unsupported segment type, no crash prediction supported
100+55.407	109+64.841	Warning: for segment #27 (100+55.407 to 109+64.841), no thru lanes specified; unknown/unsupported segment type, no crash prediction supported
47+27.407	50+57.407	Warning: for segment #2 (47+27.407 to 50+57.407), traffic volume (54,500 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
50+57.407	50+71.407	Warning: for segment #3 (50+57.407 to 50+71.407), traffic volume (54,500 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
50+71.407	50+98.407	Warning: for segment #4 (50+71.407 to 50+98.407), traffic volume (54,500 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
50+98.407	51+26.407	Warning: for segment #5 (50+98.407 to 51+26.407), traffic volume (54,500 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
51+26.407	51+53.407	Warning: for segment #6 (51+26.407 to 51+53.407), traffic volume (54,500 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
51+53.407	51+80.407	Warning: for segment #7 (51+53.407 to 51+80.407), traffic volume (54,500 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
51+80.407	52+08.407	Warning: for segment #8 (51+80.407 to 52+08.407), traffic volume (54,500 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
52+08.407	52+35.407	Warning: for segment #9 (52+08.407 to 52+35.407), traffic volume (54,500 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
52+35.407	56+38.407	Warning: for segment #10 (52+35.407 to 56+38.407), traffic volume (54,500 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
56+38.407	63+93.320	Warning: for segment #11 (56+38.407 to 63+93.320), traffic volume (54,500 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD

Start Location (Sta. ft)	End Location (Sta. ft)	Message
63+93.320	64+16.407	Warning: for segment #12 (63+93.320 to 64+16.407), traffic volume (54,500 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
64+16.407	64+62.407	Warning: for segment #13 (64+16.407 to 64+62.407), traffic volume (54,500 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
64+62.407	65+99.407	Warning: for segment #14 (64+62.407 to 65+99.407), traffic volume (54,500 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
65+99.407	67+36.407	Warning: for segment #15 (65+99.407 to 67+36.407), traffic volume (54,500 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
67+36.407	68+04.420	Warning: for segment #16 (67+36.407 to 68+04.420), traffic volume (54,500 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
68+04.420	69+46.800	Warning: for segment #17 (68+04.420 to 69+46.800), traffic volume (54,500 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
69+46.800	71+75.407	Warning: for segment #18 (69+46.800 to 71+75.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
71+75.407	79+17.407	Warning: for segment #19 (71+75.407 to 79+17.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
79+17.407	82+87.320	Warning: for segment #20 (79+17.407 to 82+87.320), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
82+87.320	83+63.407	Warning: for segment #21 (82+87.320 to 83+63.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
83+63.407	85+15.407	Warning: for segment #22 (83+63.407 to 85+15.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
85+15.407	85+91.407	Warning: for segment #23 (85+15.407 to 85+91.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
85+91.407	89+57.407	Warning: for segment #24 (85+91.407 to 89+57.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
89+57.407	96+89.407	Warning: for segment #25 (89+57.407 to 96+89.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD
96+89.407	100+55.407	Warning: for segment #26 (96+89.407 to 100+55.407), traffic volume (48,700 vpd) for 2050 is not within the model limit (32,000 vpd) for reliable results for segment type 2CD

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

March 9, 2023

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Report Overview

Report Generated: Mar 9, 2023 3:48 PM
Report Template: System: Single Page [System] (mlcpm3, Mar 7, 2023 12:48 PM)

Evaluation Date: Thu Mar 09 15:48:30 MST 2023
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: Jordan Rae Aguirre
Organization Name: Jacobs Engineering
Phone: 5307019417
E-Mail: jordanrae.aguirre@jacobs.com

Project Title: I-10/101L - Alternatives Analysis - Slip Ramp
Project Comment: Created using wizard
Project Unit System: U.S. Customary

Highway Title: Alignment SB101_McDowell_Ramp
Highway Comment: Imported from SB101_McDowell_Ramp_030623.xml
Highway Version: 1

Evaluation Title: Evaluation 3
Evaluation Comment: Created Thu Mar 09 15:48:14 MST 2023

Minimum Location: 0.000
Maximum Location: 66+36.550

Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration

First Year of Analysis: 2050
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

Disclaimer Regarding Crash Prediction Method

IMPORTANT NOTICE ABOUT COMPARING RESULTS FROM HIGHWAY SAFETY MANUAL FIRST EDITION (2010) MODELS TO RESULTS FROM NEW MODELS DEVELOPED UNDER NCHRP PROJECTS 17-70, 17-58, AND 17-68

Since the publication of the Highway Safety Manual - First Edition (HSM-1), in 2010 by the American Association of State Highway and Transportation Officials (AASHTO), multiple research efforts have been undertaken through the National Cooperative Highway Research Program (NCHRP) to develop safety performance models for road segment and intersection facility types that were not initially reflected in the HSM-1, in order to expand the breadth and depth of the HSM in the future.

The IHSDM Crash Prediction Module (CPM) is intended as a faithful implementation of HSM Part C predictive methods. As NCHRP projects to develop new predictive methods for the HSM are completed, FHWA works to incorporate the new methods into IHSDM, sometimes in advance of publication in the HSM. The following new crash predictive methods have been accepted by NCHRP project panels and incorporated into IHSDM, while pending AASHTO's approval for incorporation into a future edition of the HSM:

- Roundabouts: completed in 2018 under NCHRP Project 17-70, the new methods will provide improved outcomes for the safety analysis of roundabouts.
- 6+ lane and one-way urban/suburban arterials (including models for segments and intersections): completed under NCHRP Project 17-58.
- Intersection crash prediction methods for some intersection configurations and traffic control types not currently addressed in the HSM (e.g., all-way stop; rural 3-leg signalized; 3-leg stop-controlled where the major leg turns; urban 5-leg signalized; urban high-speed intersections): completed in 2021 under NCHRP Project 17-68.

However, in the absence of local calibration factors (see HSM-1 Part C, Appendix A for guidance on calibration of the predictive models), it is neither appropriate nor advisable to directly compare the results from new models (from NCHRP Projects 17-58, 17-68, and 17-70) to results from HSM-1 models, as the models were not calibrated to the same base state data sets, and consequently can produce unexpected results. If local calibration factors are available and applied to both new models and HSM-1 models, then it may be appropriate to directly compare the results.*[Note: Work being performed under NCHRP Project 17-72 (Update of Crash Modification Factors for the Highway Safety Manual) is expected to re-calibrate many of the old (HSM-1) and new (e.g., NCHRP 17-70) models to data from a single (or small number of) states, that would allow results from all models to be directly compared.]*

The models produced for NCHRP Project 17-70 have independent value in terms of informing the design of a roundabout and assessing the effects of different design characteristics on the expected safety performance of a roundabout.

The HSM-1 interim method previously included in IHSDM for evaluating roundabouts on urban/suburban arterials (i.e., evaluating an existing intersection and then applying a Crash Modification Factor for replacing the existing intersection with a roundabout) has been deactivated in IHSDM, to minimize any confusion with the new roundabout methodology.

Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 0.000
Evaluation End Location: 66+36.550
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: EX_RAMP_MV_FI=1.0; EX_RAMP_MV_PDO=1.0; EX_RAMP_SV_FI=1.0; EX_RAMP_SV_PDO=1.0;

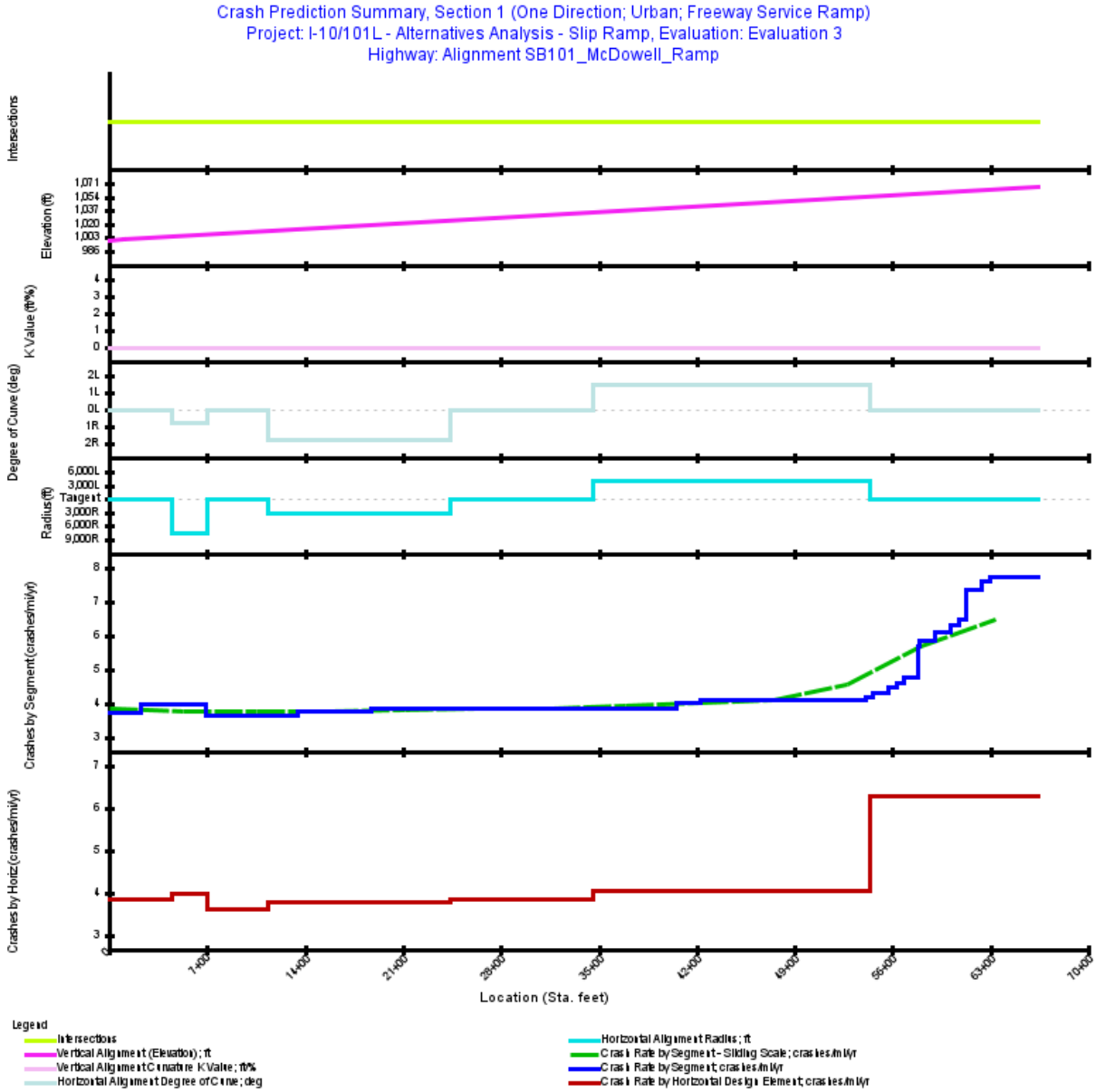

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT
1	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	0.000	2+26.000	226.00	0.0428	2050: 22,500
2	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	2+26.000	6+95.000	469.00	0.0888	2050: 22,500
3	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	6+95.000	13+52.000	657.00	0.1244	2050: 22,500
4	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	13+52.000	18+73.000	521.00	0.0987	2050: 22,500
5	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	18+73.000	40+56.000	2,183.00	0.4134	2050: 22,500
6	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	40+56.000	42+30.000	174.00	0.0330	2050: 22,500
7	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	42+30.000	54+07.690	1,177.69	0.2230	2050: 22,500
8	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	54+07.690	54+64.000	56.31	0.0107	2050: 22,500
9	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	54+64.000	55+75.000	111.00	0.0210	2050: 22,500
10	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	55+75.000	56+31.000	56.00	0.0106	2050: 22,500
11	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	56+31.000	56+86.000	55.00	0.0104	2050: 22,500
12	Freeway Ramp and C-D Road One-lane Ramp Exit	Urban	56+86.000	57+83.110	97.11	0.0184	2050: 22,500
13	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	57+83.110	57+97.000	13.89	0.0026	2050: 22,500
14	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	57+97.000	59+08.000	111.00	0.0210	2050: 22,500
15	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	59+08.000	60+20.000	112.00	0.0212	2050: 22,500
16	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	60+20.000	60+75.000	55.00	0.0104	2050: 22,500
17	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	60+75.000	61+25.090	50.09	0.0095	2050: 22,500
18	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	61+25.090	61+31.000	5.91	0.0011	2050: 22,500
19	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	61+31.000	62+42.000	111.00	0.0210	2050: 22,500
20	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	62+42.000	62+97.100	55.10	0.0104	2050: 22,500
21	Freeway Ramp and C-D Road Two-lane Ramp Exit	Urban	62+97.100	66+36.550	339.45	0.0643	2050: 22,500

Table 2. Predicted Ramp Crash Rates and Frequencies Summary (Freeway Ramp Sections)

First Year of Analysis	**2050**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**1.2569**
Average Future Road AADT (vpd)	**22,500**
Predicted Crashes	
Total Crashes	**5.44**
Fatal and Injury Crashes	**2.45**
Property-Damage-Only Crashes	**2.99**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**45**
Percent Property-Damage-Only Crashes (%)	**55**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**4.3264**
FI Crash Rate (crashes/mi/yr)	**1.9496**
PDO Crash Rate (crashes/mi/yr)	**2.3768**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**10.32**
Travel Crash Rate (crashes/million veh-mi)	**0.53**
Travel FI Crash Rate (crashes/million veh-mi)	**0.24**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.29**

Table 3. Predicted Crash Frequencies and Rates by Ramp Segment/Intersection (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
1	0.000	2+26.000	0.0428	0.159	0.1590	0.0662	0.0928	3.7154	0.45
2	2+26.000	6+95.000	0.0888	0.354	0.3545	0.1656	0.1890	3.9915	0.49
3	6+95.000	13+52.000	0.1244	0.452	0.4516	0.2024	0.2491	3.6290	0.44
4	13+52.000	18+73.000	0.0987	0.372	0.3722	0.1677	0.2044	3.7716	0.46
5	18+73.000	40+56.000	0.4134	1.598	1.5980	0.7332	0.8648	3.8651	0.47
6	40+56.000	42+30.000	0.0330	0.133	0.1330	0.0619	0.0712	4.0373	0.49
7	42+30.000	54+07.690	0.2230	0.919	0.9195	0.4311	0.4885	4.1227	0.50
8	54+07.690	54+64.000	0.0107	0.045	0.0449	0.0213	0.0236	4.2065	0.51
9	54+64.000	55+75.000	0.0210	0.091	0.0908	0.0437	0.0471	4.3185	0.53
10	55+75.000	56+31.000	0.0106	0.048	0.0475	0.0232	0.0243	4.4816	0.55
11	56+31.000	56+86.000	0.0104	0.048	0.0479	0.0236	0.0243	4.5938	0.56
12	56+86.000	57+83.110	0.0184	0.087	0.0874	0.0436	0.0438	4.7527	0.58
13	57+83.110	57+97.000	0.0026	0.015	0.0150	0.0052	0.0098	5.6985	0.69
14	57+97.000	59+08.000	0.0210	0.123	0.1228	0.0435	0.0794	5.8433	0.71
15	59+08.000	60+20.000	0.0212	0.130	0.1297	0.0470	0.0827	6.1125	0.74
16	60+20.000	60+75.000	0.0104	0.066	0.0659	0.0243	0.0416	6.3234	0.77
17	60+75.000	61+25.090	0.0095	0.061	0.0613	0.0228	0.0385	6.4603	0.79
18	61+25.090	61+31.000	0.0011	0.007	0.0073	0.0027	0.0046	6.5347	0.80
19	61+31.000	62+42.000	0.0210	0.154	0.1545	0.0671	0.0875	7.3512	0.89
20	62+42.000	62+97.100	0.0104	0.080	0.0795	0.0350	0.0445	7.6178	0.93
21	62+97.100	66+36.550	0.0643	0.496	0.4956	0.2194	0.2762	7.7086	0.94
Total			1.2569	5.438	5.4379	2.4504	2.9875	4.3264	

Table 4. Predicted Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
Tangent	0.000	4+50.359	0.0853	0.329	0.3286	0.1454	0.1832	3.8529	0.47
Simple Curve 1	4+50.359	7+06.223	0.0485	0.193	0.1927	0.0898	0.1028	3.9756	0.48
Tangent	7+06.223	11+34.031	0.0810	0.294	0.2940	0.1318	0.1622	3.6290	0.44
Simple Curve 2	11+34.031	24+42.682	0.2479	0.939	0.9390	0.4262	0.5128	3.7886	0.46
Tangent	24+42.682	34+57.589	0.1922	0.743	0.7429	0.3409	0.4021	3.8651	0.47
Simple Curve 3	34+57.589	54+35.903	0.3747	1.513	1.5131	0.7046	0.8085	4.0384	0.49
Tangent	54+35.903	66+36.550	0.2274	1.428	1.4276	0.6117	0.8159	6.2779	0.76

Table 5. Predicted Crash Frequencies by Year (Freeway Ramp Sections)

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2050	5.44	2.45	45.062	2.99	54.938
Total	5.44	2.45	45.062	2.99	54.938
Average	5.44	2.45	45.062	2.99	54.938

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 6. Predicted Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.0021	0.0063	0.0261	0.0318	0.0928
2	0.0052	0.0157	0.0652	0.0795	0.1890
3	0.0063	0.0192	0.0797	0.0972	0.2491
4	0.0052	0.0159	0.0660	0.0806	0.2044
5	0.0229	0.0694	0.2887	0.3522	0.8648
6	0.0019	0.0059	0.0244	0.0297	0.0712
7	0.0135	0.0408	0.1697	0.2071	0.4885
8	0.0007	0.0020	0.0084	0.0102	0.0236
9	0.0014	0.0041	0.0172	0.0210	0.0471
10	0.0007	0.0022	0.0091	0.0111	0.0243
11	0.0007	0.0022	0.0093	0.0113	0.0243
12	0.0014	0.0041	0.0172	0.0209	0.0438
13	0.0002	0.0005	0.0016	0.0030	0.0098
14	0.0013	0.0039	0.0133	0.0250	0.0794
15	0.0014	0.0042	0.0143	0.0270	0.0827
16	0.0007	0.0022	0.0074	0.0139	0.0416
17	0.0007	0.0021	0.0070	0.0131	0.0385
18	0.0001	0.0002	0.0008	0.0016	0.0046
19	0.0020	0.0061	0.0205	0.0386	0.0875
20	0.0010	0.0032	0.0107	0.0201	0.0445
21	0.0065	0.0198	0.0669	0.1261	0.2762
Total	0.0758	0.2299	0.9233	1.2213	2.9875

Table 7. Predicted Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.01	0.2	0.05	1.0	0.06	1.1
Highway Segment	Collision with Fixed Object	1.56	29.5	1.68	31.8	3.24	61.3
Highway Segment	Collision with Other Object	0.11	2.1	0.33	6.2	0.44	8.3
Highway Segment	Other Single-vehicle Collision	0.45	8.5	0.25	4.8	0.70	13.3
Highway Segment	Collision with Parked Vehicle	0.03	0.6	0.04	0.7	0.07	1.3
Highway Segment	Total Single Vehicle Crashes	2.16	40.8	2.35	44.5	4.50	85.3
Highway Segment	Right-Angle Collision	0.01	0.1	0.01	0.2	0.02	0.3
Highway Segment	Head-on Collision	0.00	0.0	0.00	0.0	0.00	0.1
Highway Segment	Other Multi-vehicle Collision	0.01	0.1	0.01	0.2	0.02	0.4
Highway Segment	Rear-end Collision	0.17	3.2	0.38	7.2	0.55	10.4
Highway Segment	Sideswipe, Same Direction Collision	0.04	0.8	0.15	2.8	0.19	3.5
Highway Segment	Total Multiple Vehicle Crashes	0.23	4.3	0.55	10.4	0.78	14.7
Highway Segment	Total Highway Segment Crashes	2.38	45.2	2.90	54.8	5.28	100.0
	Total Crashes	2.38	45.2	2.90	54.8	5.28	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 8. Evaluation Message

Start Location (Sta. ft)	End Location (Sta. ft)	Message
0.000	2+26.000	Information: for segment #1 (0.000 to 2+26.000), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
0.000	2+26.000	Program error: for segment #1 (0.000 to 2+26.000), GModelDataFRE_Ramp.getFRE_Ramp_BaseAADT(): unknown key: |0|urban, invalid configuration data or program call
2+26.000	6+95.000	Warning: for segment #2 (2+26.000 to 6+95.000), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
6+95.000	13+52.000	Warning: for segment #3 (6+95.000 to 13+52.000), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
13+52.000	18+73.000	Warning: for segment #4 (13+52.000 to 18+73.000), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
18+73.000	40+56.000	Warning: for segment #5 (18+73.000 to 40+56.000), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
40+56.000	42+30.000	Warning: for segment #6 (40+56.000 to 42+30.000), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
42+30.000	54+07.690	Warning: for segment #7 (42+30.000 to 54+07.690), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
54+07.690	54+64.000	Warning: for segment #8 (54+07.690 to 54+64.000), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
54+64.000	55+75.000	Warning: for segment #9 (54+64.000 to 55+75.000), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
55+75.000	56+31.000	Warning: for segment #10 (55+75.000 to 56+31.000), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
56+31.000	56+86.000	Warning: for segment #11 (56+31.000 to 56+86.000), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
56+86.000	57+83.110	Warning: for segment #12 (56+86.000 to 57+83.110), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 1EX
57+83.110	57+97.000	Warning: for segment #13 (57+83.110 to 57+97.000), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 2EX
57+97.000	59+08.000	Warning: for segment #14 (57+97.000 to 59+08.000), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 2EX
59+08.000	60+20.000	Warning: for segment #15 (59+08.000 to 60+20.000), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 2EX
60+20.000	60+75.000	Warning: for segment #16 (60+20.000 to 60+75.000), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 2EX
60+75.000	61+25.090	Warning: for segment #17 (60+75.000 to 61+25.090), traffic volume (22,500 vpd) for 2050 is not within the model limit (18,000 vpd) for reliable results for segment type 2EX

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

March 8, 2023

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Report Overview

Report Generated: Mar 8, 2023 10:14 AM
Report Template: System: Single Page [System] (mlcpm3, Mar 7, 2023 12:48 PM)

Evaluation Date: Wed Mar 08 10:14:54 MST 2023
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: Jordan Rae Aguirre
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Project Title: I-10/101L - Alternatives Analysis - Slip Ramp
Project Comment: Created using wizard
Project Unit System: U.S. Customary

Highway Title: Alignment 91st_Slip
Highway Comment: Imported from 91st_Slip_030723.xml
Highway Version: 1

Evaluation Title: Evaluation 1
Evaluation Comment: Created Wed Mar 08 10:14:39 MST 2023

Minimum Location: 0.000
Maximum Location: 15+80.576

Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration

First Year of Analysis: 2050
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

Disclaimer Regarding Crash Prediction Method

IMPORTANT NOTICE ABOUT COMPARING RESULTS FROM HIGHWAY SAFETY MANUAL FIRST EDITION (2010) MODELS TO RESULTS FROM NEW MODELS DEVELOPED UNDER NCHRP PROJECTS 17-70, 17-58, AND 17-68

Since the publication of the Highway Safety Manual - First Edition (HSM-1), in 2010 by the American Association of State Highway and Transportation Officials (AASHTO), multiple research efforts have been undertaken through the National Cooperative Highway Research Program (NCHRP) to develop safety performance models for road segment and intersection facility types that were not initially reflected in the HSM-1, in order to expand the breadth and depth of the HSM in the future.

The IHSDM Crash Prediction Module (CPM) is intended as a faithful implementation of HSM Part C predictive methods. As NCHRP projects to develop new predictive methods for the HSM are completed, FHWA works to incorporate the new methods into IHSDM, sometimes in advance of publication in the HSM. The following new crash predictive methods have been accepted by NCHRP project panels and incorporated into IHSDM, while pending AASHTO's approval for incorporation into a future edition of the HSM:

- Roundabouts: completed in 2018 under NCHRP Project 17-70, the new methods will provide improved outcomes for the safety analysis of roundabouts.
- 6+ lane and one-way urban/suburban arterials (including models for segments and intersections): completed under NCHRP Project 17-58.
- Intersection crash prediction methods for some intersection configurations and traffic control types not currently addressed in the HSM (e.g., all-way stop; rural 3-leg signalized; 3-leg stop-controlled where the major leg turns; urban 5-leg signalized; urban high-speed intersections): completed in 2021 under NCHRP Project 17-68.

However, in the absence of local calibration factors (see HSM-1 Part C, Appendix A for guidance on calibration of the predictive models), it is neither appropriate nor advisable to directly compare the results from new models (from NCHRP Projects 17-58, 17-68, and 17-70) to results from HSM-1 models, as the models were not calibrated to the same base state data sets, and consequently can produce unexpected results. If local calibration factors are available and applied to both new models and HSM-1 models, then it may be appropriate to directly compare the results.*[Note: Work being performed under NCHRP Project 17-72 (Update of Crash Modification Factors for the Highway Safety Manual) is expected to re-calibrate many of the old (HSM-1) and new (e.g., NCHRP 17-70) models to data from a single (or small number of) states, that would allow results from all models to be directly compared.]*

The models produced for NCHRP Project 17-70 have independent value in terms of informing the design of a roundabout and assessing the effects of different design characteristics on the expected safety performance of a roundabout.

The HSM-1 interim method previously included in IHSDM for evaluating roundabouts on urban/suburban arterials (i.e., evaluating an existing intersection and then applying a Crash Modification Factor for replacing the existing intersection with a roundabout) has been deactivated in IHSDM, to minimize any confusion with the new roundabout methodology.

Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 0.000
Evaluation End Location: 15+80.576
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: ENT_RAMP_MV_FI=1.0; ENT_RAMP_MV_PDO=1.0; ENT_RAMP_SV_FI=1.0; ENT_RAMP_SV_PDO=1.0;

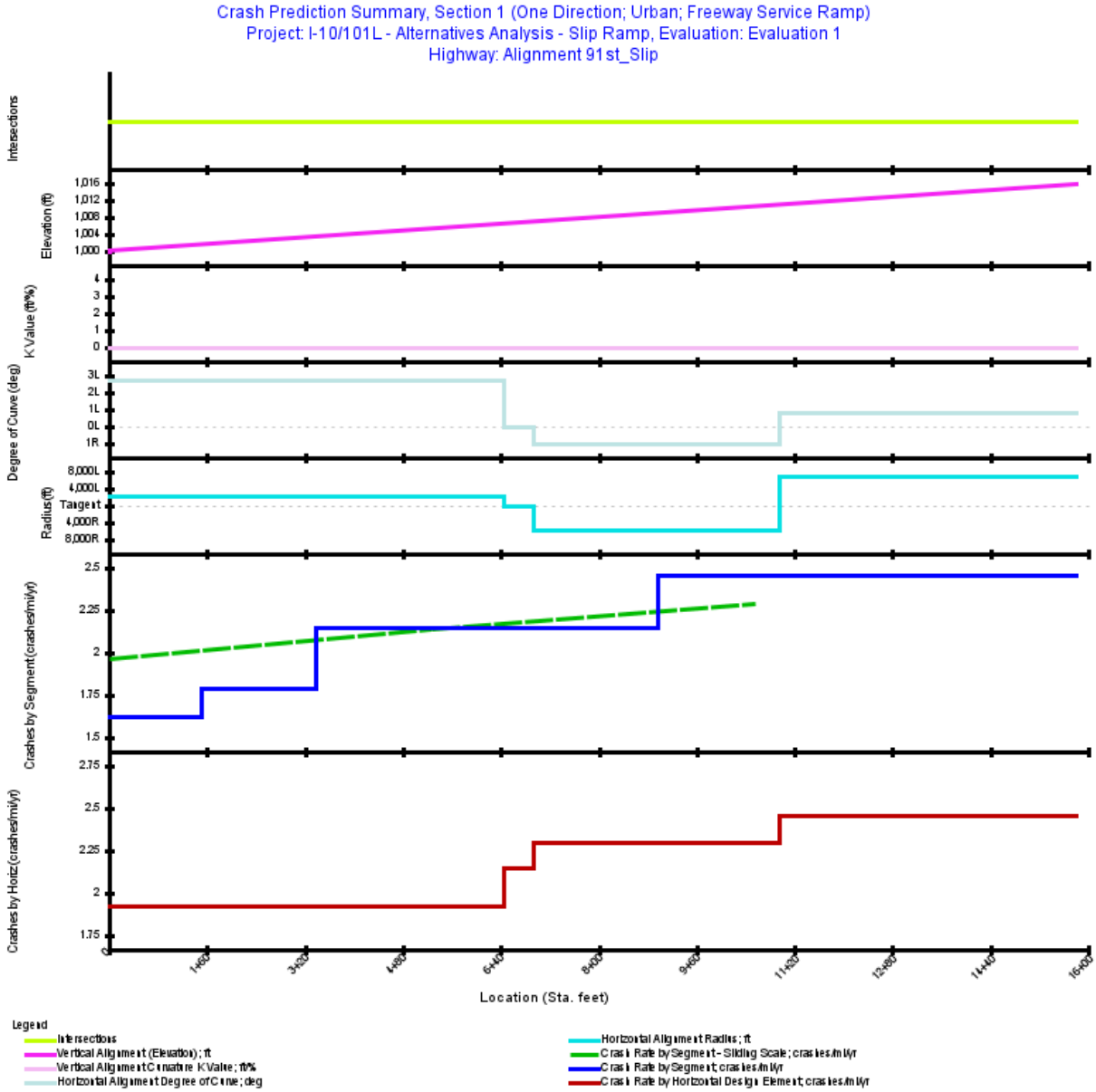

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length (mi)	AADT
1	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	0.000	1+51.000	151.00	0.0286	2050: 5,800
2	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	1+51.000	3+38.000	187.00	0.0354	2050: 5,800
3	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	3+38.000	8+96.000	558.00	0.1057	2050: 5,800
4	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	8+96.000	15+80.576	684.58	0.1297	2050: 5,800

Table 2. Predicted Ramp Crash Rates and Frequencies Summary (Freeway Ramp Sections)

First Year of Analysis	**2050**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.2994**
Average Future Road AADT (vpd)	**5,800**
Predicted Crashes	
Total Crashes	**0.66**
Fatal and Injury Crashes	**0.32**
Property-Damage-Only Crashes	**0.34**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**48**
Percent Property-Damage-Only Crashes (%)	**52**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**2.1868**
FI Crash Rate (crashes/mi/yr)	**1.0597**
PDO Crash Rate (crashes/mi/yr)	**1.1271**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**0.63**
Travel Crash Rate (crashes/million veh-mi)	**1.03**
Travel FI Crash Rate (crashes/million veh-mi)	**0.50**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.53**

Table 3. Predicted Crash Frequencies and Rates by Ramp Segment/Intersection (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
1	0.000	1+51.000	0.0286	0.046	0.0463	0.0189	0.0274	1.6189	0.77
2	1+51.000	3+38.000	0.0354	0.063	0.0634	0.0295	0.0339	1.7908	0.85
3	3+38.000	8+96.000	0.1057	0.227	0.2272	0.1098	0.1174	2.1496	1.01
4	8+96.000	15+80.576	0.1297	0.318	0.3177	0.1590	0.1587	2.4507	1.16
Total			0.2994	0.655	0.6546	0.3172	0.3374	2.1868	

Table 4. Predicted Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)
Simple Curve 1	0.000	6+45.486	0.1223	0.235	0.2349	0.1089	0.1260	1.9215	0.91
Tangent	6+45.486	6+93.417	0.0091	0.019	0.0195	0.0094	0.0101	2.1496	1.01
Simple Curve 2	6+93.417	10+96.671	0.0764	0.176	0.1756	0.0865	0.0891	2.2994	1.09
Simple Curve 3	10+96.671	15+80.576	0.0916	0.225	0.2246	0.1124	0.1122	2.4507	1.16

Table 5. Predicted Crash Frequencies by Year (Freeway Ramp Sections)

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2050	0.66	0.32	48.458	0.34	51.542
Total	0.66	0.32	48.458	0.34	51.542
Average	0.66	0.32	48.458	0.34	51.542

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 6. Predicted Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.0004	0.0011	0.0070	0.0105	0.0274
2	0.0005	0.0017	0.0109	0.0164	0.0339
3	0.0019	0.0057	0.0378	0.0644	0.1174
4	0.0030	0.0090	0.0585	0.0886	0.1587
Total	0.0057	0.0174	0.1141	0.1799	0.3374

Table 7. Predicted Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.00	0.2	0.01	0.8	0.01	1.0
Highway Segment	Collision with Fixed Object	0.18	28.9	0.17	27.6	0.34	56.5
Highway Segment	Collision with Other Object	0.01	2.0	0.03	5.4	0.04	7.4
Highway Segment	Other Single-vehicle Collision	0.05	8.3	0.03	4.1	0.08	12.5
Highway Segment	Collision with Parked Vehicle	0.00	0.6	0.00	0.6	0.01	1.2
Highway Segment	Total Single Vehicle Crashes	0.24	40.0	0.23	38.6	0.48	78.6
Highway Segment	Right-Angle Collision	0.00	0.3	0.00	0.2	0.00	0.5
Highway Segment	Head-on Collision	0.00	0.1	0.00	0.0	0.00	0.1
Highway Segment	Other Multi-vehicle Collision	0.00	0.3	0.00	0.3	0.00	0.6
Highway Segment	Rear-end Collision	0.04	6.7	0.05	8.5	0.09	15.3
Highway Segment	Sideswipe, Same Direction Collision	0.01	1.6	0.02	3.3	0.03	4.9
Highway Segment	Total Multiple Vehicle Crashes	0.06	9.0	0.07	12.4	0.13	21.4
Highway Segment	Total Highway Segment Crashes	0.30	49.0	0.31	51.0	0.61	100.0
	Total Crashes	0.30	49.0	0.31	51.0	0.61	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 8. Evaluation Message

Start Location (Sta. ft)	End Location (Sta. ft)	Message
0.000	1+51.000	Information: for segment #1 (0.000 to 1+51.000), Left shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
8+96.000	15+80.576	Information: for segment #4 (8+96.000 to 15+80.576), Right shoulder width (0.00 feet) is less than specified boundaries (2.00 feet); adjusted in CMF calculations.
0.000	1+51.000	Program error: for segment #1 (0.000 to 1+51.000), GModelDataFRE_Ramp.getFRE_Ramp_BaseAADT(): unknown key: |0|urban, invalid configuration data or program call