SAFETY ANALYSIS

Nevada Department of Transportation

I-80 East Widening NEPA

July 2024

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Project Background

The Nevada Department of Transportation (NDOT) and the Federal Highway Administration (FHWA) are proposing improvements to accommodate future travel demands and improve safety along Interstate 80 (I-80) from Vista Boulevard to USA Parkway (SR 439). The proposed project aims to improve freeway operations, regional mobility, and safety as well as reduce congestion and travel delays. The section of I-80 between Vista Boulevard and USA Parkway (SR 439) has seen a significant increase in congestion and crashes over the past five years. The I-80 East Widening project would improve traffic operations and enhance safety along the thirteen (13)-mile corridor of I-80. The project will widen I-80 from four (4) to six (6) lanes, increase shoulder widths, and implement Intelligent Transportation Systems (ITS) and other traffic safety improvements.

This memorandum describes the safety analysis of the I-80 Corridor Study between Vista Boulevard and USA Parkway (SR 439).

Project Study Limits

The safety analysis study area includes the I-80 freeway corridor in Washoe County, Nevada, from the Vista Boulevard interchange on the west to approximately one mile east of the USA Parkway (SR 439) interchange. **Figure 1** shows the project limits and includes:

- **I-80:** East of Vista Boulevard to east of USA Parkway (SR 439)
- **Interchanges:** Lockwood, Frontage Road (Mustang), Waltham Way

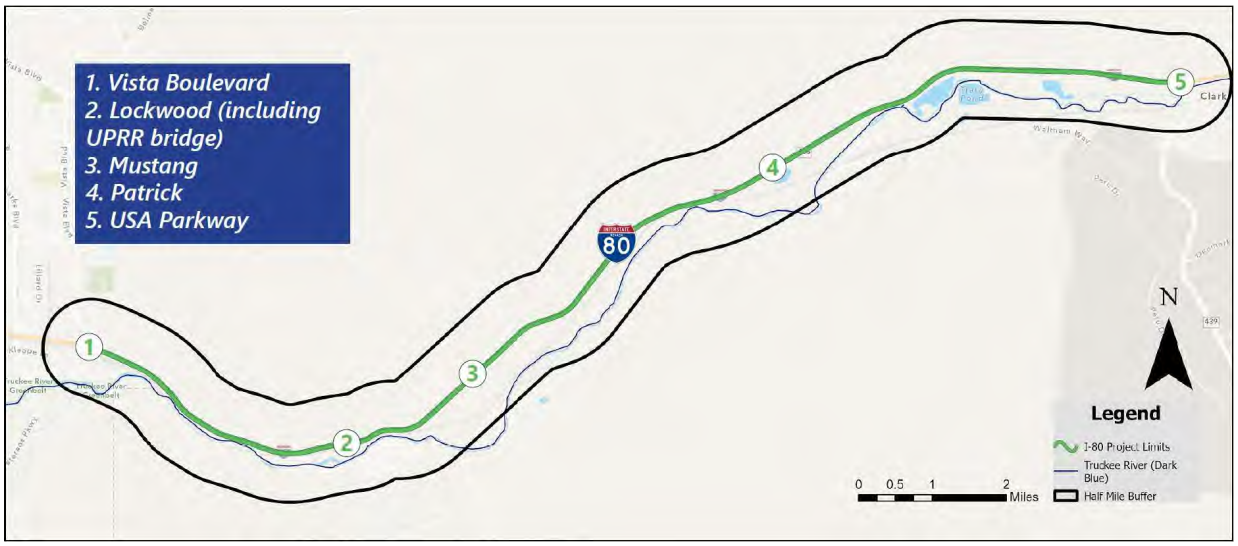

Figure 1. Project Limits for Traffic Analysis

Methodology

The Highway Safety Model (HSM) Part C predictive method was used to calculate the predicted average crashes. This method introduces the use of Crash Modification Factors (CMFs) and Safety Performance Functions (SPFs). The HSM provides predictive methods for evaluating freeways, ramps and interchanges, and urban and suburban arterials, among other facility types. The models can be used to evaluate the impact of design alternatives on crash frequency, diagnose safety issues, and assess future safety conditions. These models provide the advantages of measuring the effects of roadway geometry, physical features, and traffic volumes on crash frequency

Each model predicts average crash frequency using SPF and CMF. An SPF expresses the nonlinear relationship between traffic volume and crash frequency. It is established by modeling road segments and the crashes that are recorded on them. The SPF is based on the most frequent or common set of road characteristics, known as the "base condition."

The CMFs included as part of the predictive models are used to adjust the predicted average crash frequency, estimated by the SPF for a site with base conditions, to the local conditions of the site under evaluation. A CMF represents the relative change in estimated average crash frequency because of a change in one specific condition. It provides an estimate of the effectiveness of implementing a particular safety countermeasure (e.g., transportation solutions such as paving gravel shoulders, adding a left-turn lane, or increasing the radius of a horizontal curve).

Analysis Tool

The Interactive Highway Safety Design Model (IHSDM) Crash Prediction Model (CPM) was used to predict the number of crashes for the existing condition, the 2030 No-Build and Build Alternatives, and the 2050 No-Build and Build Alternatives.

The FHWA developed the IHSDM tool as a suite of software analysis tools used to evaluate the operational effects of geometric design decisions on highways. IHSDM was originally designed to provide "decision support" in the highway design process comparing existing or proposed roadway designs against relevant design and operations policy values. A crash prediction module, which incorporates the HSM methodology, was added to estimate the safety impacts of design decisions.

The IHSDM requires the same data needed for the predictive models in Part C of the HSM, and these models differ for each facility and intersection type, i.e., Urban and Suburban Arterials and Freeway facilities, and three- or four-legged stop or signal-controlled intersections that tie into the facility type.

One advantage that IHSDM software has over other tools, such as ISATe, is the ability to import CAD files, which can substantially simplify both the segmenting of the freeway section being evaluated and the gathering of necessary roadway geometry data. However, if CAD files are not available, manual segmentation and gathering of roadway geometry are required.

IHSDM Data Input

IHSDM requires the same data needed for HSM Part C predictive models, which is different for each facility type. IHSDM uses geometric data, speed limit, area type, Average Annual Daily Traffic (AADT), and other data variables to create homogenous segments. The HSM predictive methods for the different facility types embedded into IHSDM require different data input elements to generate predicted crash frequencies. Some of these include, but are not limited to:

- Facility type
- Horizontal alignment
- AADT
- Cross section elements (e.g., number of lanes, lane width, inside and outside shoulder width, median width, clear zone, presence of ramps, inside and outside median barrier, presence of shoulder rumble strips)

All freeway and freeway interchange ramps were coded as part of a single network.

Freeway Predictive Models

HSM Chapter 18, Freeways and Interchanges, contains different SPFs for four-, six-, eight-, and ten-lane freeway segments. **Table 1** lists the different SPFs included in the freeways chapter.

The models are based on AADT and are used to predict crash frequency. Crash frequency is influenced by lane width and shoulder width dimensions, the presence and location of roadside and median barriers, mainline horizontal alignment, and entrance and exit ramps, with CMFs calculated for each factor.

Mainline crashes are influenced by congestion, the proximity of ramps with specific sensitivity to weaving, the location of ramps (left-hand versus right-hand), and their design (lane balance versus lane drop).

Table 1. HSM Chapter 18 Safety Performance Functions

Site Type	Cross Section/Type
Freeway Segments	Urban four-lane freeways
	Urban six-lane freeways
	Urban eight-lane freeways
	Urban ten-lane freeways
	Rural four-lane freeways
	Rural six-lane freeways
	Rural eight-lane freeways

Some of the limitations of the HSM freeway predictive models include:

- High-occupancy vehicle (HOV) lanes cannot be modeled.
- Ramps with more than two lanes cannot be modeled.
- Freeways with more than ten lanes cannot be modeled.
- Consecutive merge ramps within a single freeway section cannot be modeled.

Freeway Ramp Predictive Models

HSM Chapter 19, Predictive Method for Ramps, was used to estimate the safety performance of ramps, ramp terminals, and interchanges along the corridor and the arterials. **Table 2** summarizes the predictive models included in the HSM for different ramp segments. Similarly, the models are AADT-based and generate predicted average annual fatal and injury crash frequency and property damage only (PDO) crash frequency. A severity distribution function is available to further quantify the crash frequency by the following severity levels: fatal, incapacitating injury, non-incapacitating injury, and possible injury.

The ramp models use several factors including (but not limited to) the number of through lanes, presence of horizontal curve, radius of the curve, widths of lanes, and widths of right and left shoulders.

Table 2. HCM Chapter 19 Safety Performance Functions

Site Type	Cross Section/Type
Ramp Segments	One-lane entrance ramp
	Two-lane entrance ramp
	One-lane exit ramp
	Two-lane exit ramp

Alternatives Evaluated

The alternatives evaluated in this I-80 Safety Analysis included are:

- 2030 opening year No-Build and Build Alternatives
- 2050 design year No-Build and Build Alternatives

The 2030 and 2050 Build Alternative includes the selected alternative for the I-80 freeway, and the selected alternatives for the I-80 freeway interchanges.

I-80 Modeling

The I-80 freeway (from east of Vista Boulevard to east of USA Parkway) and freeway ramps used for the modeling process are summarized below:

- The 2030 (opening year) and 2050 (design year) No-Build Geometry includes the I-80 freeway and I-80 freeway interchange ramps for Lockwood Interchange, Mustang Interchange, and Waltham/Patrick Interchange.
- The 2030 and 2050 Build Alternative Geometry includes the I-80 freeway for Alternative 3A – Split Profile at Existing Grade, and the I-80 freeway interchange ramps for Alternative 3A for Lockwood interchange – Alternative L1, Mustang Interchange, and Waltham/Patrick Interchange – Alternative P2 (New Tight Diamond Interchange).
- The IHDSM analysis is based on the 2030 and 2050 Traffic Forecast.
- AADTs were provided for the I-80 freeway segments and freeway ramps from the post-processing of the Washoe County TransCAD model.

No-Build Alternative

The No-Build Alternative is the existing configuration of the I-80 freeway and freeway interchange ramps within the project limits with 2030 opening year and 2050 design year No-Build model's traffic volumes.

I-80 is a four-lane divided freeway with two general purpose lanes in each direction with deceleration and acceleration lanes for most of the freeway ramps as well as median and outside barriers throughout most of the project limits.

The evaluated ramps were at Lockwood Interchange, Mustang Interchange, and Waltham Way/Patrick Interchange. The freeway ramps were all single 12-foot lanes with varying inside and outside shoulder widths, and some instances of barriers on either one side or both sides of the ramp.

Build Alternative

The Build Alternative is the selected alternative with improvements on the I-80 freeway and freeway interchange ramps within the project limits with 2030 opening year and 2050 design year Build model's traffic volumes.

The selected alternative, Alternative 3A Split Profile at Existing Grade, is a six-lane freeway with three general purpose lanes in each direction with deceleration and acceleration lanes for the freeway ramps, median and outside barriers were included throughout the entire project limits. The acceleration and deceleration lanes were all extended to meet or exceed the freeway design criteria.

The Build Alternative for the Lockwood Interchange is Alternative L1. This alternative incorporates minor improvements to the existing interchange geometry, including adding a separate lane and lengthening the westbound on-ramp, improving ramp acceleration and deceleration lanes onto the freeway, and widening shoulder widths on all ramps to meet current design criteria.

The Build Alternative for the Musting Interchange includes minor geometric improvements to address some design deficiencies and widen shoulder widths on all ramps to meet current design criteria.

The Build Alternative for the Waltham Way/Patrick Interchange is Alternative P2 New Tight Diamond Interchange. This alternative proposes combining the separated access points to a single new tight diamond interchange and widening shoulder widths on all ramps to meet current design criteria.

Evaluation Results

2030 Opening Year

I-80 Crash Prediction results for the 2030 No-Build and the 2030 Build Alternatives are reported by freeway and the combined freeway interchange ramps. These results are then summarized by I-80 freeway and interchange ramps. The results of the crash prediction models for the No-Build scenario and the Build Alternatives are presented in **Table 3** and **Figure 2.** Detailed results from the IHSDM analysis are provided in Appendix A.

The overall total predicted crashes for the selected alternatives are 20 percent lower than those for the No-Build Alternative. The reductions are mainly due to the addition of a general purpose lane in each direction, the lengthening of the acceleration and deceleration lanes, and the installation of barrier rail in the median along the entire length of the project.

Table 3. I-80 2030 Crash Prediction Results

	2030 No-Build			2030 Build Alternatives		
	FI	PDO	Total	FI	PDO	Total
I-80 Freeway	51.6	131.4	183.0	41.6	104.6	146.1
				-19%	-20%	-20%
I-80 Freeway Ramps	0.7	0.8	1.4	0.5	0.6	1.1
				-29%	-22%	-25%
Overall Total	52.3	132.2	184.4	42.0	105.2	147.2
				-20%	-20%	-20%

2050 Design Year

I-80 Crash Prediction results for the 2050 No-Build and the 2050 Build Alternatives are reported by freeway and the combined freeway interchange ramps. These results are then summarized by I-80 freeway and interchange ramps. The results of the crash prediction models for the No-Build scenario and the Build Alternatives are presented in **Table 4** and **Figure 2.** Detailed results from the IHSDM analysis are provided in Appendix A.

The overall total predicted crashes for the selected alternatives are 20 percent lower than those for the No-Build Alternative. The reductions are mainly due to the addition of a general purpose lane in each direction, the lengthening of the acceleration and deceleration lanes, and the installation of barrier rail in the median along the entire length of the project.

Table 4. I-80 2050 Crash Prediction Results

	2050 No-Build			2050 Build Alternatives		
	FI	PDO	Total	FI	PDO	Total
I-80 Freeway	62.2	166.7	228.9	50.3	132.2	182.5
				-20%	-21%	-20%
I-80 Freeway Ramps	0.7	0.8	1.6	0.5	0.7	1.2
				-22%	-12%	-25%
Overall Total	62.9	167.5	230.5	50.8	132.9	183.7
				-19%	-21%	-20%

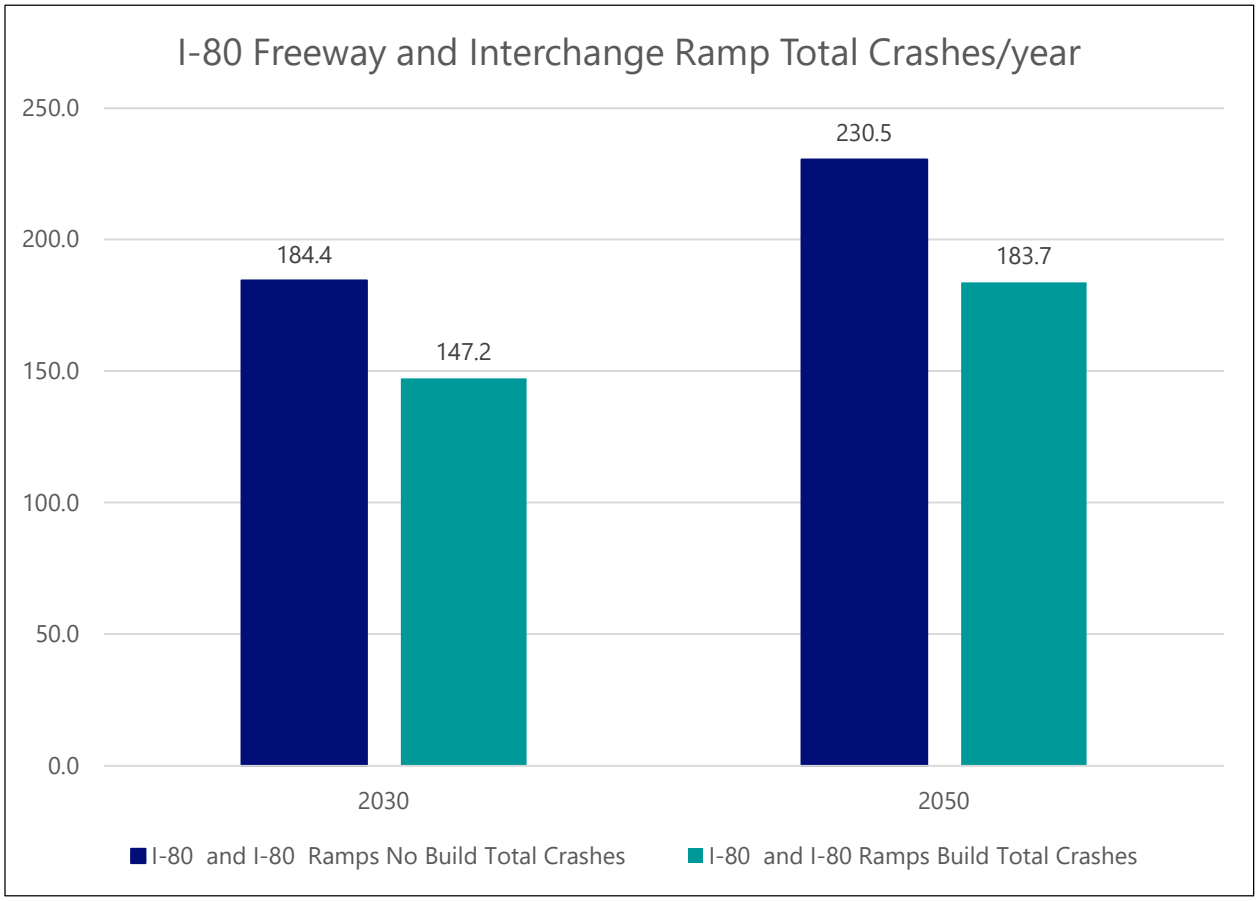

Figure 2. I-80 Crash Prediction Results

Conclusions

In conclusion, the predicted number of crashes in the 2030 and 2050 Build conditions are less than the No-Build conditions for the same years. This is due to the addition of a general-purpose lane in each direction; the widening of the inside and outside shoulders; the addition of barrier rail along the entire freeway section both in the median and the outside shoulder; and the improvements to the acceleration and deceleration lanes at the Lockwood, Mustang and Patrick interchanges. Installing barrier rail along the entire freeway section both in the median and the outside shoulders is known to reduce fatal and serious injuries by eliminating any crossover crashes and keeping errant vehicles from overturning when leaving the roadway either into the median or running off the roadway to the right. Widening the shoulders gives drivers additional time to recover from running off the road and provides areas for drivers to utilize in the case of an emergency. Increasing the deceleration and acceleration lanes for the interchanges also provides drivers with more decision time to maneuver, either while on the freeway to allow drivers to get onto the freeway or while on the ramp to get on or off the freeway.

The decrease in crashes also is related to the improvements at the Lockwood, Mustang and Patrick interchanges. Minor improvements to the existing interchange geometry, improving ramp acceleration and deceleration lanes onto the freeway, and widening shoulder widths on ramps to meet current design criteria all aided in the decrease of crashes.

Overall, the geometric improvements and road safety measures proposed in the Build conditions proved effective in improving road users' traffic safety.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

July 2, 2024

Disclaimer

The Interactive Highway Design Model (IHSDM) software is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its content or use thereof. This document does not constitute a standard, specification, or regulation.

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Report Overview

Report Generated: Jul 2, 2024 8:12 AM
Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Fri Jun 21 10:02:31 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: I 80 Vista Boulevard Interchange to USA Parkway Interchange
Project Comment: Created Fri Apr 26 14:41:46 PDT 2024
Project Unit System: U.S. Customary

Highway Title: I-80 Capacity Improvements - Existing Conditions
Highway Comment: Existing Conditions
Highway Version: 1

Evaluation Title: Evaluation 15
Evaluation Comment: Created Fri Jun 21 10:00:15 PDT 2024

Minimum Location: 553+89.850
Maximum Location: 1235+84.647

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

First Year of Analysis: 2023
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 1 Evaluation

Section: Section 1
Evaluation Start Location: 553+89.850
Evaluation End Location: 1235+84.647
Functional Class: Freeway
Type of Alignment: Divided, Multilane
Model Category: Freeway Segment
Calibration Factor: FI_MV=1.0; FI_SV=1.0; PDO_MV=1.0; PDO_SV=1.0;

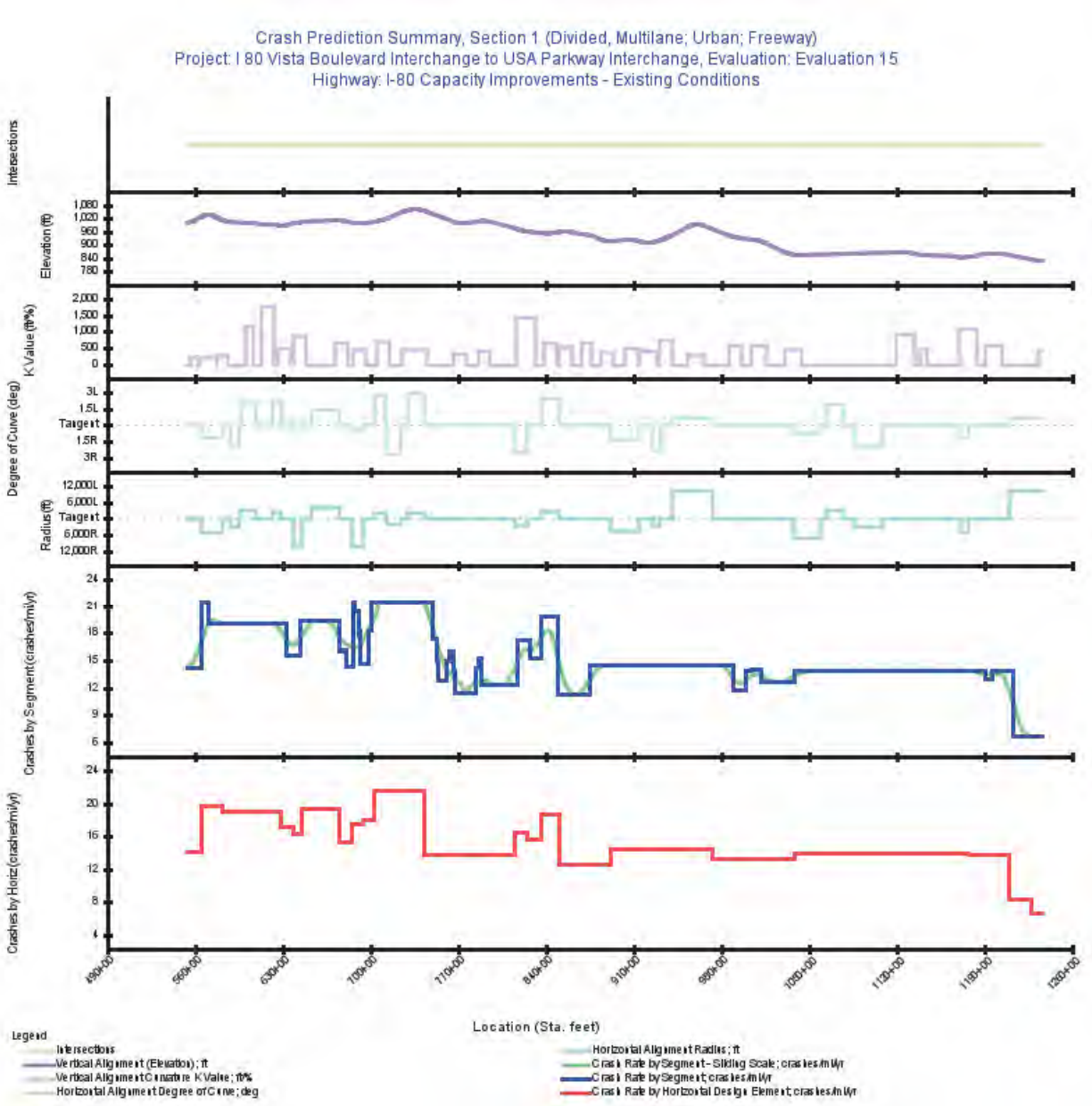

Figure 1. Crash Prediction Summary (Section 1)

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

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	553+89.850	565+28.850	1,139.00	0.2157	2023: 48,560; 2024: 49,774; 2025: 50,988; 2026: 52,202; 2027: 53,417; 2028: 54,631; 2029: 55,845; 2030: 57,060; 2031: 57,630; 2032: 58,201; 2033: 58,771; 2034: 59,342; 2035: 59,912; 2036: 60,483; 2037: 61,053; 2038: 61,624; 2039: 62,194; 2040: 62,765; 2041: 63,335; 2042: 63,906; 2043: 64,476; 2044: 65,047; 2045: 65,617; 2046: 66,188; 2047: 66,758; 2048: 67,329; 2049: 67,899; 2050: 68,470	6.00	Non-Traversable Median	12.00
2	Four-lane Freeway	Urban	565+28.850	570+30.000	501.15	0.0949	2023: 48,560; 2024: 49,774; 2025: 50,988; 2026: 52,202; 2027: 53,417; 2028: 54,631; 2029: 55,845; 2030: 57,060; 2031: 57,630; 2032: 58,201; 2033: 58,771; 2034: 59,342; 2035: 59,912; 2036: 60,483; 2037: 61,053; 2038: 61,624; 2039: 62,194; 2040: 62,765; 2041: 63,335; 2042: 63,906; 2043: 64,476; 2044: 65,047; 2045: 65,617; 2046: 66,188; 2047: 66,758; 2048: 67,329; 2049: 67,899; 2050: 68,470	2.00	Non-Traversable Median	10.00
3	Four-lane Freeway	Urban	570+30.000	632+75.000	6,245.00	1.1828	2023: 48,560; 2024: 49,774; 2025: 50,988; 2026: 52,202; 2027: 53,417; 2028: 54,631; 2029: 55,845; 2030: 57,060; 2031: 57,630; 2032: 58,201; 2033: 58,771; 2034: 59,342; 2035: 59,912; 2036: 60,483; 2037: 61,053; 2038: 61,624; 2039: 62,194; 2040: 62,765; 2041: 63,335; 2042: 63,906; 2043: 64,476; 2044: 65,047; 2045: 65,617; 2046: 66,188; 2047: 66,758; 2048: 67,329; 2049: 67,899; 2050: 68,470	2.00	Non-Traversable Median	10.00
4	Four-lane Freeway	Urban	632+75.000	644+00.000	1,125.00	0.2131	2023: 48,560; 2024: 49,774; 2025: 50,988; 2026: 52,202; 2027: 53,417; 2028: 54,631; 2029: 55,845; 2030: 57,060; 2031: 57,630; 2032: 58,201; 2033: 58,771; 2034: 59,342; 2035: 59,912; 2036: 60,483; 2037: 61,053; 2038: 61,624; 2039: 62,194; 2040: 62,765; 2041: 63,335; 2042: 63,906; 2043: 64,476; 2044: 65,047; 2045: 65,617; 2046: 66,188; 2047: 66,758; 2048: 67,329; 2049: 67,899; 2050: 68,470	2.00	Non-Traversable Median	10.00
5	Four-lane Freeway	Urban	644+00.000	675+46.700	3,146.70	0.5960	2023: 48,560; 2024: 49,774; 2025: 50,988; 2026: 52,202; 2027: 53,417; 2028: 54,631; 2029: 55,845; 2030: 57,060; 2031: 57,630; 2032: 58,201; 2033: 58,771; 2034: 59,342; 2035: 59,912; 2036: 60,483; 2037: 61,053; 2038: 61,624; 2039: 62,194; 2040: 62,765; 2041: 63,335; 2042: 63,906; 2043: 64,476; 2044: 65,047; 2045: 65,617; 2046: 66,188; 2047: 66,758; 2048: 67,329; 2049: 67,899; 2050: 68,470	2.00	Non-Traversable Median	10.00
6	Four-lane Freeway	Urban	675+46.700	676+82.480	135.78	0.0257	2023: 46,310; 2024: 47,558; 2025: 48,807; 2026: 50,055; 2027: 51,304; 2028: 52,552; 2029: 53,801; 2030: 55,050; 2031: 55,600; 2032: 56,151; 2033: 56,701; 2034: 57,252; 2035: 57,802; 2036: 58,353; 2037: 58,903; 2038: 59,454; 2039: 60,004; 2040: 60,555; 2041: 61,105; 2042: 61,656; 2043: 62,206; 2044: 62,757; 2045: 63,307; 2046: 63,858; 2047: 64,408; 2048: 64,959; 2049: 65,509; 2050: 66,060	2.00	Non-Traversable Median	10.00
7	Five-lane Freeway	Urban	676+82.480	680+11.200	328.72	0.0623	2023: 46,310; 2024: 47,558; 2025: 48,807; 2026: 50,055; 2027: 51,304; 2028: 52,552; 2029: 53,801; 2030: 55,050; 2031: 55,600; 2032: 56,151; 2033: 56,701; 2034: 57,252; 2035: 57,802; 2036: 58,353; 2037: 58,903; 2038: 59,454; 2039: 60,004; 2040: 60,555; 2041: 61,105; 2042: 61,656; 2043: 62,206; 2044: 62,757; 2045: 63,307; 2046: 63,858; 2047: 64,408; 2048: 64,959; 2049: 65,509; 2050: 66,060	2.00	Non-Traversable Median	10.00
8	Four-lane Freeway	Urban	680+11.200	686+00.000	588.80	0.1115	2023: 46,310; 2024: 47,558; 2025: 48,807; 2026: 50,055; 2027: 51,304; 2028: 52,552; 2029: 53,801; 2030: 55,050; 2031: 55,600; 2032: 56,151; 2033: 56,701; 2034: 57,252; 2035: 57,802; 2036: 58,353; 2037: 58,903; 2038: 59,454; 2039: 60,004; 2040: 60,555; 2041: 61,105; 2042: 61,656; 2043: 62,206; 2044: 62,757; 2045: 63,307; 2046: 63,858; 2047: 64,408; 2048: 64,959; 2049: 65,509; 2050: 66,060	2.00	Non-Traversable Median	10.00
9	Four-lane Freeway	Urban	686+00.000	686+28.200	28.20	0.0053	2023: 46,310; 2024: 47,558; 2025: 48,807; 2026: 50,055; 2027: 51,304; 2028: 52,552; 2029: 53,801; 2030: 55,050; 2031: 55,600; 2032: 56,151; 2033: 56,701; 2034: 57,252; 2035: 57,802; 2036: 58,353; 2037: 58,903; 2038: 59,454; 2039: 60,004; 2040: 60,555; 2041: 61,105; 2042: 61,656; 2043: 62,206; 2044: 62,757; 2045: 63,307; 2046: 63,858; 2047: 64,408; 2048: 64,959; 2049: 65,509; 2050: 66,060	2.00	Non-Traversable Median	10.00
10	Five-lane Freeway	Urban	686+28.200	687+50.000	121.80	0.0231	2023: 46,310; 2024: 47,558; 2025: 48,807; 2026: 50,055; 2027: 51,304; 2028: 52,552; 2029: 53,801; 2030: 55,050; 2031: 55,600; 2032: 56,151; 2033: 56,701; 2034: 57,252; 2035: 57,802; 2036: 58,353; 2037: 58,903; 2038: 59,454; 2039: 60,004; 2040: 60,555; 2041: 61,105; 2042: 61,656; 2043: 62,206; 2044: 62,757; 2045: 63,307; 2046: 63,858; 2047: 64,408; 2048: 64,959; 2049: 65,509; 2050: 66,060	2.00	Non-Traversable Median	10.00
11	Five-lane Freeway	Urban	687+50.000	690+00.000	250.00	0.0473	2023: 46,310; 2024: 47,558; 2025: 48,807; 2026: 50,055; 2027: 51,304; 2028: 52,552; 2029: 53,801; 2030: 55,050; 2031: 55,600; 2032: 56,151; 2033: 56,701; 2034: 57,252; 2035: 57,802; 2036: 58,353; 2037: 58,903; 2038: 59,454; 2039: 60,004; 2040: 60,555; 2041: 61,105; 2042: 61,656; 2043: 62,206; 2044: 62,757; 2045: 63,307; 2046: 63,858; 2047: 64,408; 2048: 64,959; 2049: 65,509; 2050: 66,060	2.00	Non-Traversable Median	10.00
12	Five-lane Freeway	Urban	690+00.000	690+41.600	41.60	0.0079	2023: 46,310; 2024: 47,558; 2025: 48,807; 2026: 50,055; 2027: 51,304; 2028: 52,552; 2029: 53,801; 2030: 55,050; 2031: 55,600; 2032: 56,151; 2033: 56,701; 2034: 57,252; 2035: 57,802; 2036: 58,353; 2037: 58,903; 2038: 59,454; 2039: 60,004; 2040: 60,555; 2041: 61,105; 2042: 61,656; 2043: 62,206; 2044: 62,757; 2045: 63,307; 2046: 63,858; 2047: 64,408; 2048: 64,959; 2049: 65,509; 2050: 66,060	2.00	Non-Traversable Median	10.00
13	Four-lane Freeway	Urban	690+41.600	691+25.000	83.40	0.0158	2023: 46,310; 2024: 47,558; 2025: 48,807; 2026: 50,055; 2027: 51,304; 2028: 52,552; 2029: 53,801; 2030: 55,050; 2031: 55,600; 2032: 56,151; 2033: 56,701; 2034: 57,252; 2035: 57,802; 2036: 58,353; 2037: 58,903; 2038: 59,454; 2039: 60,004; 2040: 60,555; 2041: 61,105; 2042: 61,656; 2043: 62,206; 2044: 62,757; 2045: 63,307; 2046: 63,858; 2047: 64,408; 2048: 64,959; 2049: 65,509; 2050: 66,060	2.00	Non-Traversable Median	10.00
14	Four-lane Freeway	Urban	691+25.000	698+11.400	686.40	0.1300	2023: 46,310; 2024: 47,558; 2025: 48,807; 2026: 50,055; 2027: 51,304; 2028: 52,552; 2029: 53,801; 2030: 55,050; 2031: 55,600; 2032: 56,151; 2033: 56,701; 2034: 57,252; 2035: 57,802; 2036: 58,353; 2037: 58,903; 2038: 59,454; 2039: 60,004; 2040: 60,555; 2041: 61,105; 2042: 61,656; 2043: 62,206; 2044: 62,757; 2045: 63,307; 2046: 63,858; 2047: 64,408; 2048: 64,959; 2049: 65,509; 2050: 66,060	2.00	Non-Traversable Median	10.00
15	Four-lane Freeway	Urban	698+11.400	700+00.000	188.60	0.0357	2023: 46,740; 2024: 47,998; 2025: 49,257; 2026: 50,515; 2027: 51,774; 2028: 53,032; 2029: 54,291; 2030: 55,550; 2031: 56,105; 2032: 56,661; 2033: 57,216; 2034: 57,772; 2035: 58,327; 2036: 58,883; 2037: 59,438; 2038: 59,994; 2039: 60,549; 2040: 61,105; 2041: 61,660; 2042: 62,216; 2043: 62,771; 2044: 63,327; 2045: 63,882; 2046: 64,438; 2047: 64,993; 2048: 65,549; 2049: 66,104; 2050: 66,660	2.00	Non-Traversable Median	10.00

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)
16	Four-lane Freeway	Urban	700+00.000	749+82.380	4,982.38	0.9436	2023: 46,740; 2024: 47,998; 2025: 49,257; 2026: 50,515; 2027: 51,774; 2028: 53,032; 2029: 54,291; 2030: 55,550; 2031: 56,105; 2032: 56,661; 2033: 57,216; 2034: 57,772; 2035: 58,327; 2036: 58,883; 2037: 59,438; 2038: 59,994; 2039: 60,549; 2040: 61,105; 2041: 61,660; 2042: 62,216; 2043: 62,771; 2044: 63,327; 2045: 63,882; 2046: 64,438; 2047: 64,993; 2048: 65,549; 2049: 66,104; 2050: 66,660	2.00	Non-Traversable Median	10.00
17	Five-lane Freeway	Urban	749+82.380	752+69.100	286.72	0.0543	2023: 46,740; 2024: 47,998; 2025: 49,257; 2026: 50,515; 2027: 51,774; 2028: 53,032; 2029: 54,291; 2030: 55,550; 2031: 56,105; 2032: 56,661; 2033: 57,216; 2034: 57,772; 2035: 58,327; 2036: 58,883; 2037: 59,438; 2038: 59,994; 2039: 60,549; 2040: 61,105; 2041: 61,660; 2042: 62,216; 2043: 62,771; 2044: 63,327; 2045: 63,882; 2046: 64,438; 2047: 64,993; 2048: 65,549; 2049: 66,104; 2050: 66,660	2.00	Non-Traversable Median	10.00
18	Four-lane Freeway	Urban	752+69.100	754+40.350	171.25	0.0324	2023: 42,535; 2024: 43,830; 2025: 45,125; 2026: 46,420; 2027: 47,715; 2028: 49,010; 2029: 50,305; 2030: 51,600; 2031: 52,116; 2032: 52,632; 2033: 53,148; 2034: 53,664; 2035: 54,180; 2036: 54,696; 2037: 55,212; 2038: 55,728; 2039: 56,244; 2040: 56,760; 2041: 57,276; 2042: 57,792; 2043: 58,308; 2044: 58,824; 2045: 59,340; 2046: 59,856; 2047: 60,372; 2048: 60,888; 2049: 61,404; 2050: 61,920	2.00	Non-Traversable Median	10.00
19	Four-lane Freeway	Urban	754+40.350	761+00.000	659.65	0.1249	2023: 42,535; 2024: 43,830; 2025: 45,125; 2026: 46,420; 2027: 47,715; 2028: 49,010; 2029: 50,305; 2030: 51,600; 2031: 52,116; 2032: 52,632; 2033: 53,148; 2034: 53,664; 2035: 54,180; 2036: 54,696; 2037: 55,212; 2038: 55,728; 2039: 56,244; 2040: 56,760; 2041: 57,276; 2042: 57,792; 2043: 58,308; 2044: 58,824; 2045: 59,340; 2046: 59,856; 2047: 60,372; 2048: 60,888; 2049: 61,404; 2050: 61,920	2.00	Non-Traversable Median	10.00
20	Four-lane Freeway	Urban	761+00.000	763+00.000	200.00	0.0379	2023: 42,535; 2024: 43,830; 2025: 45,125; 2026: 46,420; 2027: 47,715; 2028: 49,010; 2029: 50,305; 2030: 51,600; 2031: 52,116; 2032: 52,632; 2033: 53,148; 2034: 53,664; 2035: 54,180; 2036: 54,696; 2037: 55,212; 2038: 55,728; 2039: 56,244; 2040: 56,760; 2041: 57,276; 2042: 57,792; 2043: 58,308; 2044: 58,824; 2045: 59,340; 2046: 59,856; 2047: 60,372; 2048: 60,888; 2049: 61,404; 2050: 61,920	2.00	Non-Traversable Median	10.00
21	Four-lane Freeway	Urban	763+00.000	766+00.000	300.00	0.0568	2023: 42,535; 2024: 43,830; 2025: 45,125; 2026: 46,420; 2027: 47,715; 2028: 49,010; 2029: 50,305; 2030: 51,600; 2031: 52,116; 2032: 52,632; 2033: 53,148; 2034: 53,664; 2035: 54,180; 2036: 54,696; 2037: 55,212; 2038: 55,728; 2039: 56,244; 2040: 56,760; 2041: 57,276; 2042: 57,792; 2043: 58,308; 2044: 58,824; 2045: 59,340; 2046: 59,856; 2047: 60,372; 2048: 60,888; 2049: 61,404; 2050: 61,920	2.00	Non-Traversable Median	10.00
22	Four-lane Freeway	Urban	766+00.000	767+50.000	150.00	0.0284	2023: 42,535; 2024: 43,830; 2025: 45,125; 2026: 46,420; 2027: 47,715; 2028: 49,010; 2029: 50,305; 2030: 51,600; 2031: 52,116; 2032: 52,632; 2033: 53,148; 2034: 53,664; 2035: 54,180; 2036: 54,696; 2037: 55,212; 2038: 55,728; 2039: 56,244; 2040: 56,760; 2041: 57,276; 2042: 57,792; 2043: 58,308; 2044: 58,824; 2045: 59,340; 2046: 59,856; 2047: 60,372; 2048: 60,888; 2049: 61,404; 2050: 61,920	2.00	Non-Traversable Median	10.00
23	Four-lane Freeway	Urban	767+50.000	784+15.700	1,665.70	0.3155	2023: 42,535; 2024: 43,830; 2025: 45,125; 2026: 46,420; 2027: 47,715; 2028: 49,010; 2029: 50,305; 2030: 51,600; 2031: 52,116; 2032: 52,632; 2033: 53,148; 2034: 53,664; 2035: 54,180; 2036: 54,696; 2037: 55,212; 2038: 55,728; 2039: 56,244; 2040: 56,760; 2041: 57,276; 2042: 57,792; 2043: 58,308; 2044: 58,824; 2045: 59,340; 2046: 59,856; 2047: 60,372; 2048: 60,888; 2049: 61,404; 2050: 61,920	2.00	Non-Traversable Median	10.00
24	Four-lane Freeway	Urban	784+15.700	785+77.800	162.10	0.0307	2023: 42,535; 2024: 43,830; 2025: 45,125; 2026: 46,420; 2027: 47,715; 2028: 49,010; 2029: 50,305; 2030: 51,600; 2031: 52,116; 2032: 52,632; 2033: 53,148; 2034: 53,664; 2035: 54,180; 2036: 54,696; 2037: 55,212; 2038: 55,728; 2039: 56,244; 2040: 56,760; 2041: 57,276; 2042: 57,792; 2043: 58,308; 2044: 58,824; 2045: 59,340; 2046: 59,856; 2047: 60,372; 2048: 60,888; 2049: 61,404; 2050: 61,920	2.00	Non-Traversable Median	10.00
25	Five-lane Freeway	Urban	785+77.800	788+32.930	255.13	0.0483	2023: 43,290; 2024: 44,607; 2025: 45,924; 2026: 47,241; 2027: 48,558; 2028: 49,875; 2029: 51,192; 2030: 52,510; 2031: 53,035; 2032: 53,561; 2033: 54,086; 2034: 54,612; 2035: 55,137; 2036: 55,663; 2037: 56,188; 2038: 56,714; 2039: 57,239; 2040: 57,765; 2041: 58,290; 2042: 58,816; 2043: 59,341; 2044: 59,867; 2045: 60,392; 2046: 60,918; 2047: 61,443; 2048: 61,969; 2049: 62,494; 2050: 63,020	2.00	Non-Traversable Median	10.00
26	Four-lane Freeway	Urban	788+32.930	816+80.000	2,847.07	0.5392	2023: 43,290; 2024: 44,607; 2025: 45,924; 2026: 47,241; 2027: 48,558; 2028: 49,875; 2029: 51,192; 2030: 52,510; 2031: 53,035; 2032: 53,561; 2033: 54,086; 2034: 54,612; 2035: 55,137; 2036: 55,663; 2037: 56,188; 2038: 56,714; 2039: 57,239; 2040: 57,765; 2041: 58,290; 2042: 58,816; 2043: 59,341; 2044: 59,867; 2045: 60,392; 2046: 60,918; 2047: 61,443; 2048: 61,969; 2049: 62,494; 2050: 63,020	2.00	Non-Traversable Median	10.00
27	Four-lane Freeway	Urban	816+80.000	827+50.000	1,070.00	0.2027	2023: 43,290; 2024: 44,607; 2025: 45,924; 2026: 47,241; 2027: 48,558; 2028: 49,875; 2029: 51,192; 2030: 52,510; 2031: 53,035; 2032: 53,561; 2033: 54,086; 2034: 54,612; 2035: 55,137; 2036: 55,663; 2037: 56,188; 2038: 56,714; 2039: 57,239; 2040: 57,765; 2041: 58,290; 2042: 58,816; 2043: 59,341; 2044: 59,867; 2045: 60,392; 2046: 60,918; 2047: 61,443; 2048: 61,969; 2049: 62,494; 2050: 63,020	2.00	Non-Traversable Median	10.00
28	Four-lane Freeway	Urban	827+50.000	836+50.000	900.00	0.1705	2023: 43,290; 2024: 44,607; 2025: 45,924; 2026: 47,241; 2027: 48,558; 2028: 49,875; 2029: 51,192; 2030: 52,510; 2031: 53,035; 2032: 53,561; 2033: 54,086; 2034: 54,612; 2035: 55,137; 2036: 55,663; 2037: 56,188; 2038: 56,714; 2039: 57,239; 2040: 57,765; 2041: 58,290; 2042: 58,816; 2043: 59,341; 2044: 59,867; 2045: 60,392; 2046: 60,918; 2047: 61,443; 2048: 61,969; 2049: 62,494; 2050: 63,020	2.00	Non-Traversable Median	10.00
29	Four-lane Freeway	Urban	836+50.000	849+12.766	1,262.77	0.2392	2023: 43,290; 2024: 44,607; 2025: 45,924; 2026: 47,241; 2027: 48,558; 2028: 49,875; 2029: 51,192; 2030: 52,510; 2031: 53,035; 2032: 53,561; 2033: 54,086; 2034: 54,612; 2035: 55,137; 2036: 55,663; 2037: 56,188; 2038: 56,714; 2039: 57,239; 2040: 57,765; 2041: 58,290; 2042: 58,816; 2043: 59,341; 2044: 59,867; 2045: 60,392; 2046: 60,918; 2047: 61,443; 2048: 61,969; 2049: 62,494; 2050: 63,020	2.00	Non-Traversable Median	10.00
30	Four-lane Freeway	Rural	849+12.766	875+00.000	2,587.23	0.4900	2023: 43,290; 2024: 44,607; 2025: 45,924; 2026: 47,241; 2027: 48,558; 2028: 49,875; 2029: 51,192; 2030: 52,510; 2031: 53,035; 2032: 53,561; 2033: 54,086; 2034: 54,612; 2035: 55,137; 2036: 55,663; 2037: 56,188; 2038: 56,714; 2039: 57,239; 2040: 57,765; 2041: 58,290; 2042: 58,816; 2043: 59,341; 2044: 59,867; 2045: 60,392; 2046: 60,918; 2047: 61,443; 2048: 61,969; 2049: 62,494; 2050: 63,020	2.00	Non-Traversable Median	10.00
31	Four-lane Freeway	Rural	875+00.000	988+99.100	11,399.10	2.1589	2023: 43,290; 2024: 44,607; 2025: 45,924; 2026: 47,241; 2027: 48,558; 2028: 49,875; 2029: 51,192; 2030: 52,510; 2031: 53,035; 2032: 53,561; 2033: 54,086; 2034: 54,612; 2035: 55,137; 2036: 55,663; 2037: 56,188; 2038: 56,714; 2039: 57,239; 2040: 57,765; 2041: 58,290; 2042: 58,816; 2043: 59,341; 2044: 59,867; 2045: 60,392; 2046: 60,918; 2047: 61,443; 2048: 61,969; 2049: 62,494; 2050: 63,020	2.00	Non-Traversable Median	10.00

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)
32	Four-lane Freeway	Rural	988+99.100	999+11.000	1,011.90	0.1916	2023: 41,810; 2024: 43,148; 2025: 44,487; 2026: 45,825; 2027: 47,164; 2028: 48,502; 2029: 49,841; 2030: 51,180; 2031: 51,692; 2032: 52,204; 2033: 52,716; 2034: 53,228; 2035: 53,740; 2036: 54,252; 2037: 54,764; 2038: 55,276; 2039: 55,788; 2040: 56,300; 2041: 56,812; 2042: 57,324; 2043: 57,836; 2044: 58,348; 2045: 58,860; 2046: 59,372; 2047: 59,884; 2048: 60,396; 2049: 60,908; 2050: 61,420	2.00	Non-Traversable Median	10.00
33	Five-lane Freeway	Rural	999+11.000	1003+85.880	474.88	0.0899	2023: 41,810; 2024: 43,148; 2025: 44,487; 2026: 45,825; 2027: 47,164; 2028: 48,502; 2029: 49,841; 2030: 51,180; 2031: 51,692; 2032: 52,204; 2033: 52,716; 2034: 53,228; 2035: 53,740; 2036: 54,252; 2037: 54,764; 2038: 55,276; 2039: 55,788; 2040: 56,300; 2041: 56,812; 2042: 57,324; 2043: 57,836; 2044: 58,348; 2045: 58,860; 2046: 59,372; 2047: 59,884; 2048: 60,396; 2049: 60,908; 2050: 61,420	2.00	Non-Traversable Median	10.00
34	Four-lane Freeway	Rural	1003+85.880	1009+86.210	600.33	0.1137	2023: 41,810; 2024: 43,148; 2025: 44,487; 2026: 45,825; 2027: 47,164; 2028: 48,502; 2029: 49,841; 2030: 51,180; 2031: 51,692; 2032: 52,204; 2033: 52,716; 2034: 53,228; 2035: 53,740; 2036: 54,252; 2037: 54,764; 2038: 55,276; 2039: 55,788; 2040: 56,300; 2041: 56,812; 2042: 57,324; 2043: 57,836; 2044: 58,348; 2045: 58,860; 2046: 59,372; 2047: 59,884; 2048: 60,396; 2049: 60,908; 2050: 61,420	2.00	Non-Traversable Median	10.00
35	Five-lane Freeway	Rural	1009+86.210	1011+90.500	204.29	0.0387	2023: 41,810; 2024: 43,148; 2025: 44,487; 2026: 45,825; 2027: 47,164; 2028: 48,502; 2029: 49,841; 2030: 51,180; 2031: 51,692; 2032: 52,204; 2033: 52,716; 2034: 53,228; 2035: 53,740; 2036: 54,252; 2037: 54,764; 2038: 55,276; 2039: 55,788; 2040: 56,300; 2041: 56,812; 2042: 57,324; 2043: 57,836; 2044: 58,348; 2045: 58,860; 2046: 59,372; 2047: 59,884; 2048: 60,396; 2049: 60,908; 2050: 61,420	2.00	Non-Traversable Median	10.00
36	Four-lane Freeway	Rural	1011+90.500	1038+52.000	2,661.50	0.5041	2023: 41,810; 2024: 43,148; 2025: 44,487; 2026: 45,825; 2027: 47,164; 2028: 48,502; 2029: 49,841; 2030: 51,180; 2031: 51,692; 2032: 52,204; 2033: 52,716; 2034: 53,228; 2035: 53,740; 2036: 54,252; 2037: 54,764; 2038: 55,276; 2039: 55,788; 2040: 56,300; 2041: 56,812; 2042: 57,324; 2043: 57,836; 2044: 58,348; 2045: 58,860; 2046: 59,372; 2047: 59,884; 2048: 60,396; 2049: 60,908; 2050: 61,420	2.00	Non-Traversable Median	10.00
37	Four-lane Freeway	Rural	1038+52.000	1190+30.490	15,178.49	2.8747	2023: 42,110; 2024: 43,454; 2025: 44,798; 2026: 46,142; 2027: 47,487; 2028: 48,831; 2029: 50,175; 2030: 51,520; 2031: 52,035; 2032: 52,550; 2033: 53,065; 2034: 53,580; 2035: 54,095; 2036: 54,610; 2037: 55,125; 2038: 55,640; 2039: 56,155; 2040: 56,670; 2041: 57,185; 2042: 57,700; 2043: 58,215; 2044: 58,730; 2045: 59,245; 2046: 59,760; 2047: 60,275; 2048: 60,790; 2049: 61,305; 2050: 61,820	2.00	Non-Traversable Median	10.00
38	Five-lane Freeway	Rural	1190+30.490	1196+53.790	623.30	0.1180	2023: 42,110; 2024: 43,454; 2025: 44,798; 2026: 46,142; 2027: 47,487; 2028: 48,831; 2029: 50,175; 2030: 51,520; 2031: 52,035; 2032: 52,550; 2033: 53,065; 2034: 53,580; 2035: 54,095; 2036: 54,610; 2037: 55,125; 2038: 55,640; 2039: 56,155; 2040: 56,670; 2041: 57,185; 2042: 57,700; 2043: 58,215; 2044: 58,730; 2045: 59,245; 2046: 59,760; 2047: 60,275; 2048: 60,790; 2049: 61,305; 2050: 61,820	2.00	Non-Traversable Median	10.00
39	Four-lane Freeway	Rural	1196+53.790	1213+00.000	1,646.21	0.3118	2023: 42,110; 2024: 43,454; 2025: 44,798; 2026: 46,142; 2027: 47,487; 2028: 48,831; 2029: 50,175; 2030: 51,520; 2031: 52,035; 2032: 52,550; 2033: 53,065; 2034: 53,580; 2035: 54,095; 2036: 54,610; 2037: 55,125; 2038: 55,640; 2039: 56,155; 2040: 56,670; 2041: 57,185; 2042: 57,700; 2043: 58,215; 2044: 58,730; 2045: 59,245; 2046: 59,760; 2047: 60,275; 2048: 60,790; 2049: 61,305; 2050: 61,820	2.00	Non-Traversable Median	10.00
40	Four-lane Freeway	Rural	1213+00.000	1235+84.647	2,284.65	0.4327	2023: 23,020; 2024: 23,200; 2025: 23,380; 2026: 23,560; 2027: 23,740; 2028: 23,920; 2029: 24,100; 2030: 24,280; 2031: 24,523; 2032: 24,766; 2033: 25,009; 2034: 25,252; 2035: 25,495; 2036: 25,738; 2037: 25,981; 2038: 26,224; 2039: 26,467; 2040: 26,710; 2041: 26,953; 2042: 27,196; 2043: 27,439; 2044: 27,682; 2045: 27,925; 2046: 28,168; 2047: 28,411; 2048: 28,654; 2049: 28,897; 2050: 29,140	2.00	Non-Traversable Median	10.75

Table 2. Predicted Freeway Crash Rates and Frequencies Summary (Section 1)

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Effective Length (mi)	**12.9157**
Average Future Road AADT (vpd)	**54,971**
Predicted Crashes	
Total Crashes	**5,455.55**
Fatal and Injury Crashes	**1,520.46**
Property-Damage-Only Crashes	**3,935.09**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**28**
Percent Property-Damage-Only Crashes (%)	**72**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**15.0856**
FI Crash Rate (crashes/mi/yr)	**4.2044**
PDO Crash Rate (crashes/mi/yr)	**10.8813**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**7,256.11**
Travel Crash Rate (crashes/million veh-mi)	**0.75**
Travel FI Crash Rate (crashes/million veh-mi)	**0.21**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.54**

Note: *Effective Length* is the *segment length* minus the length of the *speed change lanes* if present.
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 3. Predicted Crash Frequencies and Rates by Freeway Segment/Intersection (Section 1)

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	553+89.850	565+28.850	0.2157	85.231	3.0439	0.8838	2.1602	14.1107	0.64
2	565+28.850	570+30.000	0.0949	57.074	2.0384	0.5808	1.4576	21.4757	0.98
3	570+30.000	632+75.000	1.1828	629.007	22.4645	6.4233	16.0413	18.9932	0.86
4	632+75.000	644+00.000	0.2131	93.028	3.3224	0.9726	2.3498	15.5932	0.71
5	644+00.000	675+46.700	0.5960	322.381	11.5136	3.3215	8.1921	19.3192	0.88
6	675+46.700	676+82.480	0.0257	11.550	0.4125	0.1194	0.2931	16.0402	0.76
7	676+82.480	680+11.200	0.0623	28.098	1.0035	0.3029	0.7006	16.1183	0.76
8	680+11.200	686+00.000	0.1115	44.664	1.5952	0.4575	1.1377	14.3044	0.68
9	686+00.000	686+28.200	0.0053	2.412	0.0861	0.0249	0.0612	16.1292	0.76
10	686+28.200	687+50.000	0.0231	13.905	0.4966	0.1511	0.3455	21.5275	1.02
11	687+50.000	690+00.000	0.0473	27.164	0.9701	0.2939	0.6762	20.4893	0.97
12	690+00.000	690+41.600	0.0079	3.905	0.1395	0.0428	0.0966	17.7009	0.84
13	690+41.600	691+25.000	0.0158	8.116	0.2898	0.0856	0.2043	18.3498	0.87
14	691+25.000	698+11.400	0.1300	53.281	1.9029	0.5641	1.3388	14.6376	0.69
15	698+11.400	700+00.000	0.0357	18.226	0.6509	0.1949	0.4560	18.2229	0.85
16	700+00.000	749+82.380	0.9436	568.880	20.3171	5.8066	14.5106	21.5308	1.01
17	749+82.380	752+69.100	0.0543	26.480	0.9457	0.2879	0.6578	17.4157	0.82
18	752+69.100	754+40.350	0.0324	13.497	0.4820	0.1424	0.3397	14.8618	0.75
19	754+40.350	761+00.000	0.1249	44.556	1.5913	0.4601	1.1312	12.7370	0.64
20	761+00.000	763+00.000	0.0379	15.788	0.5639	0.1623	0.4015	14.8861	0.75
21	763+00.000	766+00.000	0.0568	25.336	0.9049	0.2574	0.6475	15.9256	0.81
22	766+00.000	767+50.000	0.0284	11.011	0.3932	0.1136	0.2797	13.8420	0.70
23	767+50.000	784+15.700	0.3155	100.641	3.5943	1.0602	2.5341	11.3934	0.58
24	784+15.700	785+77.800	0.0307	12.230	0.4368	0.1324	0.3044	14.2277	0.72
25	785+77.800	788+32.930	0.0483	20.521	0.7329	0.2327	0.5002	15.1677	0.75
26	788+32.930	816+80.000	0.5392	186.944	6.6766	1.9770	4.6995	12.3820	0.61
27	816+80.000	827+50.000	0.2027	98.097	3.5035	1.0069	2.4966	17.2882	0.86
28	827+50.000	836+50.000	0.1705	73.002	2.6072	0.7396	1.8676	15.2957	0.76
29	836+50.000	849+12.766	0.2392	132.332	4.7261	1.3680	3.3581	19.7614	0.98
30	849+12.766	875+00.000	0.4900	154.411	5.5147	1.4682	4.0465	11.2543	0.56
31	875+00.000	988+99.100	2.1589	876.019	31.2864	8.3671	22.9193	14.4917	0.72
32	988+99.100	999+11.000	0.1916	62.775	2.2420	0.5885	1.6534	11.6983	0.60
33	999+11.000	1003+85.880	0.0899	34.795	1.2427	0.3463	0.8964	13.8171	0.70
34	1003+85.880	1009+86.210	0.1137	44.504	1.5894	0.4253	1.1641	13.9794	0.71
35	1009+86.210	1011+90.500	0.0387	15.210	0.5432	0.1514	0.3918	14.0402	0.72
36	1011+90.500	1038+52.000	0.5041	178.071	6.3597	1.6766	4.6830	12.6166	0.64
37	1038+52.000	1190+30.490	2.8747	1,118.494	39.9462	10.6440	29.3022	13.8957	0.70
38	1190+30.490	1196+53.790	0.1180	42.708	1.5253	0.4202	1.1051	12.9208	0.66
39	1196+53.790	1213+00.000	0.3118	120.444	4.3016	1.1479	3.1537	13.7967	0.70
40	1213+00.000	1235+84.647	0.4327	80.761	2.8843	0.9005	1.9839	6.6659	0.70
Total			12.9157	5,455.550	194.8411	54.3021	140.5389	15.0856	0.75

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 4. Predicted Crash Frequencies and Rates by Horizontal Design Element (Section 1)

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	553+89.850	565+28.527	0.2157	85.206	3.0431	0.8835	2.1596	14.1107	0.64
Simple Curve 1	565+28.527	582+00.593	0.3167	175.002	6.2501	1.7850	4.4650	19.7363	0.90
Tangent	582+00.593	588+13.846	0.1161	61.768	2.2060	0.6308	1.5752	18.9932	0.86
Simple Curve 2	588+13.846	594+46.549	0.1198	63.727	2.2760	0.6508	1.6252	18.9932	0.86
Tangent	594+46.549	596+42.927	0.0372	19.779	0.7064	0.2020	0.5044	18.9932	0.86
Simple Curve 3	596+42.927	608+29.783	0.2248	119.542	4.2694	1.2207	3.0486	18.9932	0.86
Tangent	608+29.783	621+29.232	0.2461	130.883	4.6744	1.3365	3.3378	18.9932	0.86
Simple Curve 4	621+29.232	628+15.126	0.1299	69.085	2.4673	0.7055	1.7618	18.9932	0.86
Tangent	628+15.126	638+61.243	0.1981	94.796	3.3856	0.9798	2.4058	17.0879	0.78
Simple Curve 5	638+61.243	645+42.101	0.1290	59.109	2.1110	0.6158	1.4953	16.3708	0.75
Tangent	645+42.101	652+38.147	0.1318	71.310	2.5468	0.7347	1.8121	19.3192	0.88
Simple Curve 6	652+38.147	675+46.052	0.4371	236.446	8.4445	2.4361	6.0084	19.3192	0.88
Tangent	675+46.052	684+55.505	0.1722	73.417	2.6220	0.7682	1.8539	15.2227	0.72
Simple Curve 7	684+55.505	694+42.593	0.1869	91.115	3.2541	0.9716	2.2825	17.4064	0.82
Tangent	694+42.593	703+14.800	0.1652	82.797	2.9570	0.8649	2.0922	17.9008	0.84
Simple Curve 8	703+14.800	711+54.209	0.1590	95.842	3.4229	0.9783	2.4447	21.5308	1.01
Tangent	711+54.209	712+76.243	0.0231	13.934	0.4976	0.1422	0.3554	21.5308	1.01
Simple Curve 9	712+76.243	723+64.635	0.2061	124.271	4.4382	1.2684	3.1698	21.5308	1.01
Tangent	723+64.635	729+08.311	0.1030	62.076	2.2170	0.6336	1.5834	21.5308	1.01
Simple Curve 10	729+08.311	743+13.097	0.2661	160.396	5.7284	1.6372	4.0913	21.5308	1.01
Tangent	743+13.097	815+08.378	1.3627	522.153	18.6483	5.4868	13.1616	13.6844	0.68
Simple Curve 11	815+08.378	825+51.135	0.1975	91.135	3.2548	0.9389	2.3159	16.4807	0.82
Tangent	825+51.135	835+70.195	0.1930	84.761	3.0272	0.8612	2.1660	15.6845	0.78
Simple Curve 12	835+70.195	850+69.213	0.2839	148.142	5.2908	1.5224	3.7684	18.6358	0.93
Tangent	850+69.213	891+45.426	0.7720	271.525	9.6973	2.5872	7.1102	12.5611	0.62
Simple Curve 13	891+45.426	913+56.808	0.4188	169.944	6.0694	1.6232	4.4463	14.4917	0.72
Tangent	913+56.808	925+54.993	0.2269	92.080	3.2886	0.8795	2.4091	14.4917	0.72
Simple Curve 14	925+54.993	930+80.990	0.0996	40.423	1.4437	0.3861	1.0576	14.4917	0.72
Tangent	930+80.990	940+22.129	0.1782	72.326	2.5831	0.6908	1.8923	14.4917	0.72
Simple Curve 15	940+22.129	973+05.929	0.6219	252.359	9.0128	2.4104	6.6025	14.4917	0.72
Tangent	973+05.929	1038+86.652	1.2463	460.344	16.4409	4.3820	12.0589	13.1912	0.67
Simple Curve 16	1038+86.652	1058+17.251	0.3656	142.265	5.0809	1.3538	3.7270	13.8957	0.70
Tangent	1058+17.251	1064+23.590	0.1148	44.681	1.5957	0.4252	1.1705	13.8957	0.70
Simple Curve 17	1064+23.590	1077+16.675	0.2449	95.287	3.4031	0.9068	2.4963	13.8957	0.70
Tangent	1077+16.675	1085+83.062	0.1641	63.843	2.2801	0.6076	1.6726	13.8957	0.70
Simple Curve 18	1085+83.062	1107+79.665	0.4160	161.867	5.7809	1.5404	4.2406	13.8957	0.70
Tangent	1107+79.665	1171+23.463	1.2015	467.471	16.6954	4.4486	12.2468	13.8957	0.70
Simple Curve 19	1171+23.463	1176+81.636	0.1057	41.132	1.4690	0.3914	1.0776	13.8957	0.70
Tangent	1176+81.636	1209+03.406	0.6102	233.532	8.3404	2.2374	6.1030	13.6687	0.69
Simple Curve 20	1209+03.406	1226+73.378	0.3352	77.565	2.7702	0.8178	1.9523	8.2637	0.70
Simple Curve 21	1226+73.378	1235+84.647	0.1726	32.213	1.1505	0.3592	0.7913	6.6659	0.70

Table 5. Predicted Crash Frequencies by Year (Section 1)

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	147.25	42.96	29.177	104.29	70.823
2024	152.20	44.18	29.026	108.02	70.974
2025	157.20	45.40	28.878	111.80	71.122
2026	162.25	46.62	28.733	115.63	71.266
2027	167.37	47.85	28.592	119.51	71.408
2028	172.53	49.09	28.453	123.44	71.547
2029	177.74	50.33	28.317	127.41	71.683
2030	183.01	51.58	28.183	131.44	71.817
2031	185.22	52.10	28.129	133.12	71.871
2032	187.44	52.62	28.075	134.81	71.925
2033	189.66	53.15	28.022	136.52	71.978
2034	191.90	53.67	27.969	138.23	72.031
2035	194.14	54.20	27.917	139.94	72.083
2036	196.40	54.73	27.864	141.67	72.135
2037	198.66	55.25	27.813	143.41	72.187
2038	200.93	55.78	27.762	145.15	72.239
2039	203.21	56.31	27.710	146.90	72.290
2040	205.50	56.84	27.660	148.66	72.340
2041	207.80	57.37	27.610	150.43	72.390
2042	210.11	57.91	27.560	152.20	72.440
2043	212.42	58.44	27.510	153.99	72.490
2044	214.75	58.97	27.461	155.78	72.539
2045	217.08	59.51	27.412	157.58	72.588
2046	219.43	60.04	27.364	159.38	72.636
2047	221.78	60.58	27.316	161.20	72.684
2048	224.14	61.12	27.267	163.03	72.733
2049	226.51	61.66	27.220	164.86	72.780
2050	228.90	62.20	27.173	166.70	72.827
Total	5,455.55	1,520.46	27.870	3,935.09	72.130
Average	194.84	54.30	27.870	140.54	72.130

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 Freeway Segment (Section 1)

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	0.5758	1.5074	8.3419	14.3203	60.4852
2	0.4095	1.1266	5.6722	9.0537	40.8122
3	4.6025	12.2666	63.3530	99.6293	449.1559
4	0.7287	1.9075	9.8067	14.7897	65.7949
5	2.5134	6.6985	33.5992	50.1912	229.3783
6	0.0836	0.2153	1.1678	1.8752	8.2078
7	0.2123	0.5464	2.9639	4.7594	19.6156
8	0.3545	0.9061	4.6930	6.8553	31.8554
9	0.0200	0.0534	0.2591	0.3650	1.7145
10	0.1168	0.3144	1.5424	2.2579	9.6734
11	0.2215	0.5998	2.9640	4.4444	18.9340
12	0.0344	0.0918	0.4453	0.6272	2.7062
13	0.0689	0.1836	0.8902	1.2539	5.7191
14	0.4503	1.1597	5.8618	8.3223	37.4869
15	0.1366	0.3516	1.9073	3.0627	12.7675
16	4.2918	11.4169	58.1117	88.7636	406.2957
17	0.2018	0.5194	2.8172	4.5237	18.4184
18	0.1067	0.2703	1.4388	2.1704	9.5104
19	0.3447	0.8734	4.6498	7.0142	31.6737
20	0.0992	0.2634	1.4835	2.6994	11.2427
21	0.1572	0.4176	2.3518	4.2793	18.1302
22	0.0778	0.2013	1.0990	1.8019	7.8306
23	0.8483	2.1159	11.0552	15.6661	70.9555
24	0.1059	0.2641	1.3801	1.9557	8.5246
25	0.1862	0.4645	2.4267	3.4389	14.0051
26	1.5949	3.9866	20.6886	29.0869	131.5870
27	0.8427	2.1971	10.6770	14.4767	69.9039
28	0.5045	1.3148	7.1389	11.7517	52.2924
29	1.1006	2.9339	14.2282	20.0419	94.0274
30	1.5763	3.7732	16.0360	19.7230	113.3029
31	8.4859	21.2700	88.8682	115.6552	641.7399
32	0.5962	1.4425	6.2669	8.1734	46.2957
33	0.3412	0.8313	3.6418	4.8833	25.0979
34	0.4045	0.9941	4.4007	6.1096	32.5955
35	0.1440	0.3540	1.5670	2.1754	10.9701
36	1.5917	3.9137	17.3338	24.1062	131.1253
37	10.7770	26.7801	113.0545	147.4199	820.4629
38	0.3787	0.9431	4.2407	6.2023	30.9435
39	1.0778	2.7010	11.7915	16.5698	88.3037
40	0.9710	2.4734	9.7981	11.9705	55.5484
Total	47.3357	120.6443	560.0134	792.4665	3,935.0903

Table 7. Predicted Freeway Crash Type Distribution (Section 1)

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	6.03	0.1	107.10	2.0	113.13	2.1
Highway Segment	Collision with Fixed Object	535.84	9.8	1,576.14	28.9	2,111.97	38.7
Highway Segment	Collision with Other Object	33.82	0.6	310.68	5.7	344.50	6.3
Highway Segment	Other Single-vehicle Collision	245.56	4.5	323.43	5.9	568.99	10.4
Highway Segment	Collision with Parked Vehicle	16.58	0.3	46.79	0.9	63.37	1.2
Highway Segment	Total Single Vehicle Crashes	837.82	15.4	2,364.14	43.3	3,201.96	58.7
Highway Segment	Right-Angle Collision	28.32	0.5	36.86	0.7	65.18	1.2
Highway Segment	Head-on Collision	8.32	0.2	4.57	0.1	12.90	0.2
Highway Segment	Other Multi-vehicle Collision	29.18	0.5	76.33	1.4	105.50	1.9
Highway Segment	Rear-end Collision	477.64	8.8	953.79	17.5	1,431.42	26.2
Highway Segment	Sideswipe, Same Direction Collision	139.19	2.6	499.41	9.2	638.60	11.7
Highway Segment	Total Multiple Vehicle Crashes	682.64	12.5	1,570.95	28.8	2,253.59	41.3
Highway Segment	Total Highway Segment Crashes	1,520.46	27.9	3,935.09	72.1	5,455.55	100.0
	Total Crashes	1,520.46	27.9	3,935.09	72.1	5,455.55	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
553+89.850	565+28.850	Information: for segment #1 (553+89.850 to 565+28.850), 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.
553+89.850	565+28.850	Information: for segment #1 (553+89.850 to 565+28.850), 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.
553+89.850	565+28.850	Information: for segment #1 (553+89.850 to 565+28.850), 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.
553+89.850	565+28.850	Information: for segment #1 (553+89.850 to 565+28.850), 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.
565+28.850	570+30.000	Information: for segment #2 (565+28.850 to 570+30.000), 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.
565+28.850	570+30.000	Information: for segment #2 (565+28.850 to 570+30.000), 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.
565+28.850	570+30.000	Information: for segment #2 (565+28.850 to 570+30.000), 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.
565+28.850	570+30.000	Information: for segment #2 (565+28.850 to 570+30.000), 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.
570+30.000	632+75.000	Information: for segment #3 (570+30.000 to 632+75.000), 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.
570+30.000	632+75.000	Information: for segment #3 (570+30.000 to 632+75.000), 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.
570+30.000	632+75.000	Information: for segment #3 (570+30.000 to 632+75.000), 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.
570+30.000	632+75.000	Information: for segment #3 (570+30.000 to 632+75.000), 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.
570+30.000	632+75.000	Information: for segment #3 (570+30.000 to 632+75.000), 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.
632+75.000	644+00.000	Information: for segment #4 (632+75.000 to 644+00.000), 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.
632+75.000	644+00.000	Information: for segment #4 (632+75.000 to 644+00.000), 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.
644+00.000	675+46.700	Information: for segment #5 (644+00.000 to 675+46.700), 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.
644+00.000	675+46.700	Information: for segment #5 (644+00.000 to 675+46.700), 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.
644+00.000	675+46.700	Information: for segment #5 (644+00.000 to 675+46.700), 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.
644+00.000	675+46.700	Information: for segment #5 (644+00.000 to 675+46.700), 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.
675+46.700	676+82.480	Information: for segment #6 (675+46.700 to 676+82.480), 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.
675+46.700	676+82.480	Information: for segment #6 (675+46.700 to 676+82.480), 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.
676+82.480	680+11.200	Information: for segment #7 (676+82.480 to 680+11.200), 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
676+82.480	680+11.200	Information: for segment #7 (676+82.480 to 680+11.200), 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.
680+11.200	686+00.000	Information: for segment #8 (680+11.200 to 686+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.
686+00.000	686+28.200	Information: for segment #9 (686+00.000 to 686+28.200), 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.
686+28.200	687+50.000	Information: for segment #10 (686+28.200 to 687+50.000), 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.
686+28.200	687+50.000	Information: for segment #10 (686+28.200 to 687+50.000), 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.
687+50.000	690+00.000	Information: for segment #11 (687+50.000 to 690+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.
687+50.000	690+00.000	Information: for segment #11 (687+50.000 to 690+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.
687+50.000	690+00.000	Information: for segment #11 (687+50.000 to 690+00.000), 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.
690+00.000	690+41.600	Information: for segment #12 (690+00.000 to 690+41.600), 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.
690+00.000	690+41.600	Information: for segment #12 (690+00.000 to 690+41.600), 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.
690+41.600	691+25.000	Information: for segment #13 (690+41.600 to 691+25.000), 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.
690+41.600	691+25.000	Information: for segment #13 (690+41.600 to 691+25.000), 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.
691+25.000	698+11.400	Information: for segment #14 (691+25.000 to 698+11.400), 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.
698+11.400	700+00.000	Information: for segment #15 (698+11.400 to 700+00.000), 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.
698+11.400	700+00.000	Information: for segment #15 (698+11.400 to 700+00.000), 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.
700+00.000	749+82.380	Information: for segment #16 (700+00.000 to 749+82.380), 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.
700+00.000	749+82.380	Information: for segment #16 (700+00.000 to 749+82.380), 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.
700+00.000	749+82.380	Information: for segment #16 (700+00.000 to 749+82.380), 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.
700+00.000	749+82.380	Information: for segment #16 (700+00.000 to 749+82.380), 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.
749+82.380	752+69.100	Information: for segment #17 (749+82.380 to 752+69.100), 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.
749+82.380	752+69.100	Information: for segment #17 (749+82.380 to 752+69.100), 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.
752+69.100	754+40.350	Information: for segment #18 (752+69.100 to 754+40.350), 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.
754+40.350	761+00.000	Information: for segment #19 (754+40.350 to 761+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.

Start Location (Sta. ft)	End Location (Sta. ft)	Message
761+00.000	763+00.000	Information: for segment #20 (761+00.000 to 763+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.
761+00.000	763+00.000	Information: for segment #20 (761+00.000 to 763+00.000), 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.
761+00.000	763+00.000	Information: for segment #20 (761+00.000 to 763+00.000), 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.
763+00.000	766+00.000	Information: for segment #21 (763+00.000 to 766+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.
763+00.000	766+00.000	Information: for segment #21 (763+00.000 to 766+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.
763+00.000	766+00.000	Information: for segment #21 (763+00.000 to 766+00.000), 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.
763+00.000	766+00.000	Information: for segment #21 (763+00.000 to 766+00.000), 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.
766+00.000	767+50.000	Information: for segment #22 (766+00.000 to 767+50.000), 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.
766+00.000	767+50.000	Information: for segment #22 (766+00.000 to 767+50.000), 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.
766+00.000	767+50.000	Information: for segment #22 (766+00.000 to 767+50.000), 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.
816+80.000	827+50.000	Information: for segment #27 (816+80.000 to 827+50.000), 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.
827+50.000	836+50.000	Information: for segment #28 (827+50.000 to 836+50.000), 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.
827+50.000	836+50.000	Information: for segment #28 (827+50.000 to 836+50.000), 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.
827+50.000	836+50.000	Information: for segment #28 (827+50.000 to 836+50.000), 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.
836+50.000	849+12.766	Information: for segment #29 (836+50.000 to 849+12.766), 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.
836+50.000	849+12.766	Information: for segment #29 (836+50.000 to 849+12.766), 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.
849+12.766	875+00.000	Information: for segment #30 (849+12.766 to 875+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.
849+12.766	875+00.000	Information: for segment #30 (849+12.766 to 875+00.000), 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.
849+12.766	875+00.000	Information: for segment #30 (849+12.766 to 875+00.000), 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.
875+00.000	988+99.100	Information: for segment #31 (875+00.000 to 988+99.100), 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.
875+00.000	988+99.100	Information: for segment #31 (875+00.000 to 988+99.100), 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.
875+00.000	988+99.100	Information: for segment #31 (875+00.000 to 988+99.100), 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.
875+00.000	988+99.100	Information: for segment #31 (875+00.000 to 988+99.100), 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
875+00.000	988+99.100	Information: for segment #31 (875+00.000 to 988+99.100), 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.
875+00.000	988+99.100	Information: for segment #31 (875+00.000 to 988+99.100), 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.
988+99.100	999+11.000	Information: for segment #32 (988+99.100 to 999+11.000), 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.
988+99.100	999+11.000	Information: for segment #32 (988+99.100 to 999+11.000), 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.
999+11.000	1003+85.880	Information: for segment #33 (999+11.000 to 1003+85.880), 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.
999+11.000	1003+85.880	Information: for segment #33 (999+11.000 to 1003+85.880), 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.
999+11.000	1003+85.880	Information: for segment #33 (999+11.000 to 1003+85.880), 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.
1003+85.880	1009+86.210	Information: for segment #34 (1003+85.880 to 1009+86.210), 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.
1003+85.880	1009+86.210	Information: for segment #34 (1003+85.880 to 1009+86.210), 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.
1003+85.880	1009+86.210	Information: for segment #34 (1003+85.880 to 1009+86.210), 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.
1009+86.210	1011+90.500	Information: for segment #35 (1009+86.210 to 1011+90.500), 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.
1009+86.210	1011+90.500	Information: for segment #35 (1009+86.210 to 1011+90.500), 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.
1009+86.210	1011+90.500	Information: for segment #35 (1009+86.210 to 1011+90.500), 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.
1011+90.500	1038+52.000	Information: for segment #36 (1011+90.500 to 1038+52.000), 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.
1011+90.500	1038+52.000	Information: for segment #36 (1011+90.500 to 1038+52.000), 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.
1011+90.500	1038+52.000	Information: for segment #36 (1011+90.500 to 1038+52.000), 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.
1011+90.500	1038+52.000	Information: for segment #36 (1011+90.500 to 1038+52.000), 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.
1038+52.000	1190+30.490	Information: for segment #37 (1038+52.000 to 1190+30.490), 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.
1038+52.000	1190+30.490	Information: for segment #37 (1038+52.000 to 1190+30.490), 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.
1038+52.000	1190+30.490	Information: for segment #37 (1038+52.000 to 1190+30.490), 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.
1038+52.000	1190+30.490	Information: for segment #37 (1038+52.000 to 1190+30.490), 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.
1038+52.000	1190+30.490	Information: for segment #37 (1038+52.000 to 1190+30.490), 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.
1038+52.000	1190+30.490	Information: for segment #37 (1038+52.000 to 1190+30.490), 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
1038+52.000	1190+30.490	Information: for segment #37 (1038+52.000 to 1190+30.490), 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.
1190+30.490	1196+53.790	Information: for segment #38 (1190+30.490 to 1196+53.790), 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.
1190+30.490	1196+53.790	Information: for segment #38 (1190+30.490 to 1196+53.790), 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.
1190+30.490	1196+53.790	Information: for segment #38 (1190+30.490 to 1196+53.790), 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.
1190+30.490	1196+53.790	Information: for segment #38 (1190+30.490 to 1196+53.790), 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.
1196+53.790	1213+00.000	Information: for segment #39 (1196+53.790 to 1213+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.
1196+53.790	1213+00.000	Information: for segment #39 (1196+53.790 to 1213+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.
1196+53.790	1213+00.000	Information: for segment #39 (1196+53.790 to 1213+00.000), 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.
1196+53.790	1213+00.000	Information: for segment #39 (1196+53.790 to 1213+00.000), 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.
1213+00.000	1235+84.647	Information: for segment #40 (1213+00.000 to 1235+84.647), 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.
1213+00.000	1235+84.647	Information: for segment #40 (1213+00.000 to 1235+84.647), 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.
1213+00.000	1235+84.647	Information: for segment #40 (1213+00.000 to 1235+84.647), 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.
1213+00.000	1235+84.647	Information: for segment #40 (1213+00.000 to 1235+84.647), 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.
1213+00.000	1235+84.647	Information: for segment #40 (1213+00.000 to 1235+84.647), 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.
676+82.480	680+11.200	Information: for segment #7 (676+82.480 to 680+11.200), Freeway Segment of type Five-lane Freeway is using unbalanced lane processing with types Four-lane Freeway and Six-lane Freeway
686+28.200	687+50.000	Information: for segment #10 (686+28.200 to 687+50.000), Freeway Segment of type Five-lane Freeway is using unbalanced lane processing with types Four-lane Freeway and Six-lane Freeway
687+50.000	690+00.000	Information: for segment #11 (687+50.000 to 690+00.000), Freeway Segment of type Five-lane Freeway is using unbalanced lane processing with types Four-lane Freeway and Six-lane Freeway
690+00.000	690+41.600	Information: for segment #12 (690+00.000 to 690+41.600), Freeway Segment of type Five-lane Freeway is using unbalanced lane processing with types Four-lane Freeway and Six-lane Freeway
749+82.380	752+69.100	Information: for segment #17 (749+82.380 to 752+69.100), Freeway Segment of type Five-lane Freeway is using unbalanced lane processing with types Four-lane Freeway and Six-lane Freeway
785+77.800	788+32.930	Information: for segment #25 (785+77.800 to 788+32.930), Freeway Segment of type Five-lane Freeway is using unbalanced lane processing with types Four-lane Freeway and Six-lane Freeway
999+11.000	1003+85.880	Information: for segment #33 (999+11.000 to 1003+85.880), Freeway Segment of type Five-lane Freeway is using unbalanced lane processing with types Four-lane Freeway and Six-lane Freeway
1009+86.210	1011+90.500	Information: for segment #35 (1009+86.210 to 1011+90.500), Freeway Segment of type Five-lane Freeway is using unbalanced lane processing with types Four-lane Freeway and Six-lane Freeway
1190+30.490	1196+53.790	Information: for segment #38 (1190+30.490 to 1196+53.790), Freeway Segment of type Five-lane Freeway is using unbalanced lane processing with types Four-lane Freeway and Six-lane Freeway

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Overview

Report Generated: Jun 21, 2024 10:39 AM
Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Fri Jun 21 10:14:53 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Lockwood Interchange - Existing Conditions
Project Comment: Created Tue May 07 14:58:58 PDT 2024
Project Unit System: U.S. Customary

Highway Title: Alignment LW EB Off Existing
Highway Comment: Lockwood Existing EB Off Ramp
Highway Version: 1

Evaluation Title: Evaluation 4
Evaluation Comment: Created Fri Jun 21 10:14:33 PDT 2024

Minimum Location: 0.000
Maximum Location: 9+84.894

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

First Year of Analysis: 2023
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

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- 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.]*

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Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 0.000
Evaluation End Location: 9+84.894
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;

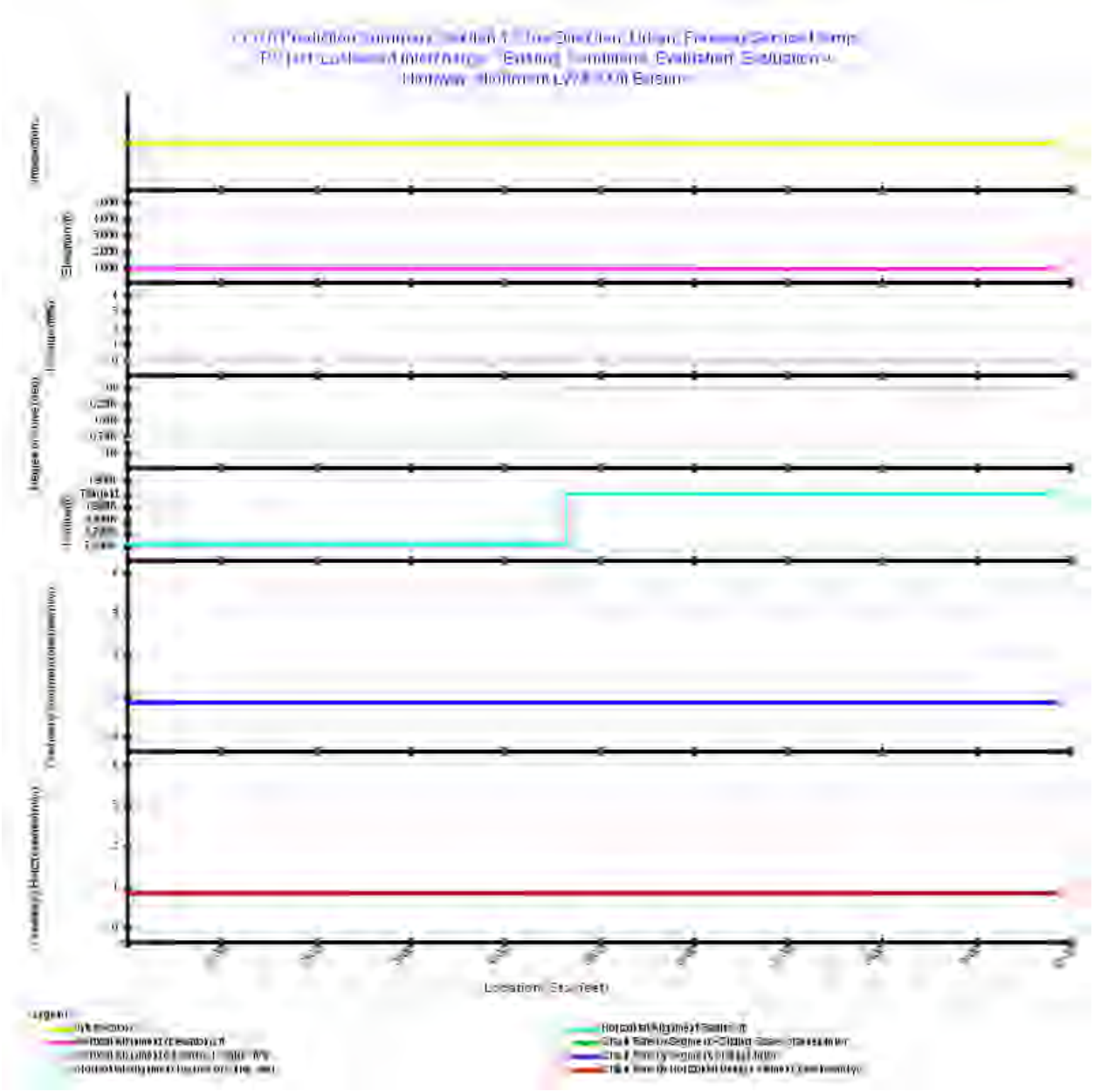

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	9+84.894	984.89	0.1865	2023: 1,410; 2024: 1,387; 2025: 1,364; 2026: 1,341; 2027: 1,318; 2028: 1,295; 2029: 1,272; 2030: 1,250; 2031: 1,262; 2032: 1,274; 2033: 1,286; 2034: 1,298; 2035: 1,310; 2036: 1,322; 2037: 1,334; 2038: 1,346; 2039: 1,358; 2040: 1,370; 2041: 1,382; 2042: 1,394; 2043: 1,406; 2044: 1,418; 2045: 1,430; 2046: 1,442; 2047: 1,454; 2048: 1,466; 2049: 1,478; 2050: 1,490

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.1865**
Average Future Road AADT (vpd)	**1,363**
Predicted Crashes	
Total Crashes	**4.48**
Fatal and Injury Crashes	**2.34**
Property-Damage-Only Crashes	**2.14**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**52**
Percent Property-Damage-Only Crashes (%)	**48**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**0.8581**
FI Crash Rate (crashes/mi/yr)	**0.4487**
PDO Crash Rate (crashes/mi/yr)	**0.4093**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**2.60**
Travel Crash Rate (crashes/million veh-mi)	**1.73**
Travel FI Crash Rate (crashes/million veh-mi)	**0.90**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.82**

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	9+84.894	0.1865	4.482	0.1601	0.0837	0.0764	0.8581	1.73
Total			0.1865	4.482	0.1601	0.0837	0.0764	0.8581	

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	4+65.758	0.0882	2.119	0.0757	0.0396	0.0361	0.8581	1.73
Tangent	4+65.758	9+84.894	0.0983	2.362	0.0844	0.0441	0.0402	0.8581	1.73

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.16	0.09	52.298	0.08	47.702
2024	0.16	0.09	52.297	0.08	47.703
2025	0.16	0.08	52.296	0.08	47.704
2026	0.16	0.08	52.295	0.08	47.705
2027	0.16	0.08	52.294	0.07	47.706
2028	0.15	0.08	52.292	0.07	47.708
2029	0.15	0.08	52.291	0.07	47.709
2030	0.15	0.08	52.289	0.07	47.711
2031	0.15	0.08	52.290	0.07	47.710
2032	0.15	0.08	52.291	0.07	47.709
2033	0.15	0.08	52.292	0.07	47.708
2034	0.15	0.08	52.292	0.07	47.708
2035	0.16	0.08	52.293	0.07	47.707
2036	0.16	0.08	52.294	0.07	47.706
2037	0.16	0.08	52.294	0.07	47.706
2038	0.16	0.08	52.295	0.08	47.705
2039	0.16	0.08	52.296	0.08	47.704
2040	0.16	0.08	52.296	0.08	47.704
2041	0.16	0.09	52.297	0.08	47.703
2042	0.16	0.09	52.297	0.08	47.703
2043	0.16	0.09	52.298	0.08	47.702
2044	0.17	0.09	52.298	0.08	47.702
2045	0.17	0.09	52.299	0.08	47.701
2046	0.17	0.09	52.299	0.08	47.701
2047	0.17	0.09	52.300	0.08	47.700
2048	0.17	0.09	52.300	0.08	47.700
2049	0.17	0.09	52.301	0.08	47.699
2050	0.17	0.09	52.301	0.08	47.699
Total	4.48	2.34	52.296	2.14	47.704
Average	0.16	0.08	52.296	0.08	47.704

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	0.0637	0.1931	0.8242	1.2627	2.1379

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.01	0.2	0.04	1.0	0.05	1.2
Highway Segment	Collision with Fixed Object	1.63	36.4	1.47	32.8	3.10	69.2
Highway Segment	Collision with Other Object	0.12	2.6	0.28	6.4	0.40	8.9
Highway Segment	Other Single-vehicle Collision	0.47	10.5	0.22	4.9	0.69	15.4
Highway Segment	Collision with Parked Vehicle	0.03	0.8	0.03	0.7	0.07	1.5
Highway Segment	Total Single Vehicle Crashes	2.26	50.4	2.05	45.8	4.31	96.2
Highway Segment	Right-Angle Collision	0.00	0.1	0.00	0.0	0.00	0.1
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	0.0	0.01	0.1
Highway Segment	Rear-end Collision	0.06	1.4	0.06	1.3	0.12	2.7
Highway Segment	Sideswipe, Same Direction Collision	0.01	0.3	0.02	0.5	0.04	0.8
Highway Segment	Total Multiple Vehicle Crashes	0.08	1.9	0.09	1.9	0.17	3.8
Highway Segment	Total Highway Segment Crashes	2.34	52.3	2.14	47.7	4.48	100.0
	Total Crashes	2.34	52.3	2.14	47.7	4.48	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	9+84.894	Warning: for segment #1 (0.000 to 9+84.894), The ramp type for Ramp Alignment LW EB Off Existing is set at the Ramp Connection (Exit) and in the Ramp (Exit). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Overview

Report Generated: Jun 21, 2024 10:40 AM
Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Fri Jun 21 10:35:03 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Lockwood Interchange - Existing Conditions
Project Comment: Created Tue May 07 14:58:58 PDT 2024
Project Unit System: U.S. Customary

Highway Title: Alignment LW EB On Existing
Highway Comment: Lockwood Existing EB On Ramp
Highway Version: 1

Evaluation Title: Evaluation 3
Evaluation Comment: Created Fri Jun 21 10:34:39 PDT 2024

Minimum Location: 0.000
Maximum Location: 8+18.795

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

First Year of Analysis: 2023
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

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Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 0.000
Evaluation End Location: 8+18.795
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;

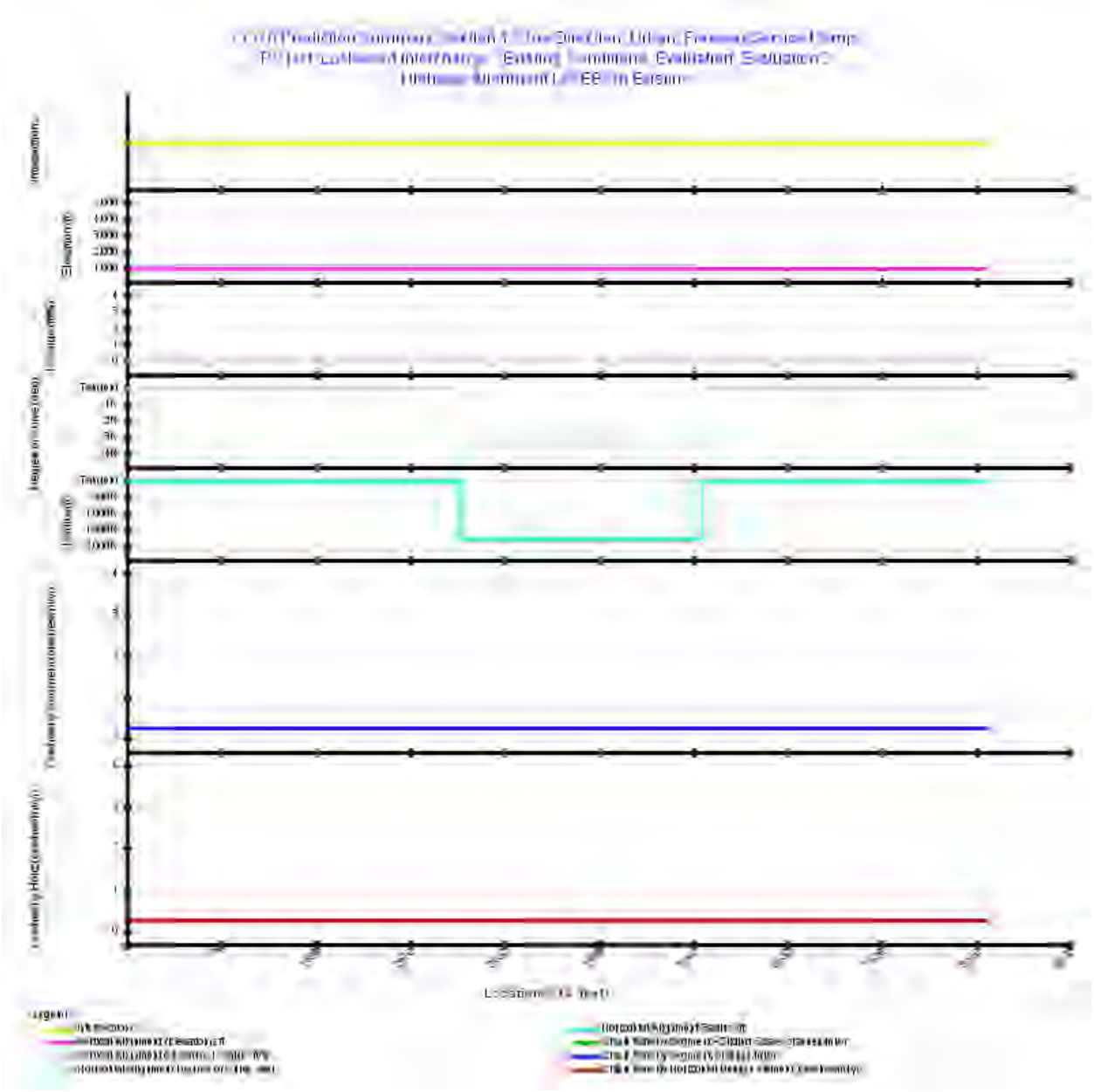

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	8+18.795	818.80	0.1551	2023: 230; 2024: 232; 2025: 235; 2026: 238; 2027: 241; 2028: 244; 2029: 247; 2030: 250; 2031: 252; 2032: 255; 2033: 257; 2034: 260; 2035: 262; 2036: 265; 2037: 267; 2038: 270; 2039: 272; 2040: 275; 2041: 277; 2042: 280; 2043: 282; 2044: 285; 2045: 287; 2046: 290; 2047: 292; 2048: 295; 2049: 297; 2050: 300

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.1551**
Average Future Road AADT (vpd)	**266**
Predicted Crashes	
Total Crashes	**1.07**
Fatal and Injury Crashes	**0.57**
Property-Damage-Only Crashes	**0.51**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**53**
Percent Property-Damage-Only Crashes (%)	**47**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**0.2474**
FI Crash Rate (crashes/mi/yr)	**0.1308**
PDO Crash Rate (crashes/mi/yr)	**0.1167**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**0.42**
Travel Crash Rate (crashes/million veh-mi)	**2.55**
Travel FI Crash Rate (crashes/million veh-mi)	**1.35**
Travel PDO Crash Rate (crashes/million veh-mi)	**1.20**

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	8+18.795	0.1551	1.074	0.0384	0.0203	0.0181	0.2474	2.55
Total			0.1551	1.074	0.0384	0.0203	0.0181	0.2474	

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	3+18.233	0.0603	0.418	0.0149	0.0079	0.0070	0.2474	2.55
Simple Curve 1	3+18.233	5+48.784	0.0437	0.302	0.0108	0.0057	0.0051	0.2474	2.55
Tangent	5+48.784	8+18.795	0.0511	0.354	0.0127	0.0067	0.0060	0.2474	2.55

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.04	0.02	52.994	0.02	47.006
2024	0.04	0.02	52.986	0.02	47.014
2025	0.04	0.02	52.974	0.02	47.026
2026	0.04	0.02	52.962	0.02	47.038
2027	0.04	0.02	52.950	0.02	47.050
2028	0.04	0.02	52.938	0.02	47.062
2029	0.04	0.02	52.927	0.02	47.073
2030	0.04	0.02	52.916	0.02	47.084
2031	0.04	0.02	52.908	0.02	47.092
2032	0.04	0.02	52.897	0.02	47.103
2033	0.04	0.02	52.889	0.02	47.111
2034	0.04	0.02	52.878	0.02	47.122
2035	0.04	0.02	52.871	0.02	47.129
2036	0.04	0.02	52.860	0.02	47.140
2037	0.04	0.02	52.853	0.02	47.147
2038	0.04	0.02	52.842	0.02	47.158
2039	0.04	0.02	52.835	0.02	47.165
2040	0.04	0.02	52.825	0.02	47.175
2041	0.04	0.02	52.818	0.02	47.182
2042	0.04	0.02	52.807	0.02	47.193
2043	0.04	0.02	52.800	0.02	47.200
2044	0.04	0.02	52.790	0.02	47.210
2045	0.04	0.02	52.783	0.02	47.217
2046	0.04	0.02	52.773	0.02	47.227
2047	0.04	0.02	52.767	0.02	47.233
2048	0.04	0.02	52.757	0.02	47.243
2049	0.04	0.02	52.750	0.02	47.250
2050	0.04	0.02	52.740	0.02	47.260
Total	1.07	0.57	52.856	0.51	47.144
Average	0.04	0.02	52.856	0.02	47.144

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	0.0104	0.0314	0.2057	0.3205	0.5065

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.00	0.2	0.01	1.0	0.01	1.1
Highway Segment	Collision with Fixed Object	0.32	29.9	0.34	32.0	0.67	61.9
Highway Segment	Collision with Other Object	0.02	2.1	0.07	6.2	0.09	8.3
Highway Segment	Other Single-vehicle Collision	0.09	8.6	0.05	4.8	0.14	13.4
Highway Segment	Collision with Parked Vehicle	0.01	0.6	0.01	0.7	0.01	1.3
Highway Segment	Total Single Vehicle Crashes	0.45	41.5	0.48	44.7	0.93	86.1
Highway Segment	Right-Angle Collision	0.00	0.4	0.00	0.0	0.00	0.4
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	0.4	0.00	0.1	0.00	0.4
Highway Segment	Rear-end Collision	0.09	8.5	0.02	1.7	0.11	10.2
Highway Segment	Sideswipe, Same Direction Collision	0.02	2.0	0.01	0.7	0.03	2.7
Highway Segment	Total Multiple Vehicle Crashes	0.12	11.4	0.03	2.5	0.15	13.9
Highway Segment	Total Highway Segment Crashes	0.57	52.9	0.51	47.1	1.07	100.0
	Total Crashes	0.57	52.9	0.51	47.1	1.07	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	8+18.795	Warning: for segment #1 (0.000 to 8+18.795), The ramp type for Ramp Alignment LW EB On Existing is set at the Ramp Connection (Entrance) and in the Ramp (Entrance). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Overview

Report Generated: Jun 21, 2024 10:42 AM
Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Fri Jun 21 10:42:17 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Lockwood Interchange - Existing Conditions
Project Comment: Created Tue May 07 14:58:58 PDT 2024
Project Unit System: U.S. Customary

Highway Title: Alignment LW WB Off Existing
Highway Comment: Lockwood Existing WB Off Ramp
Highway Version: 1

Evaluation Title: Evaluation 4
Evaluation Comment: Created Fri Jun 21 10:41:42 PDT 2024

Minimum Location: 0.000
Maximum Location: 5+53.672

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

First Year of Analysis: 2023
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: 5+53.672
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;

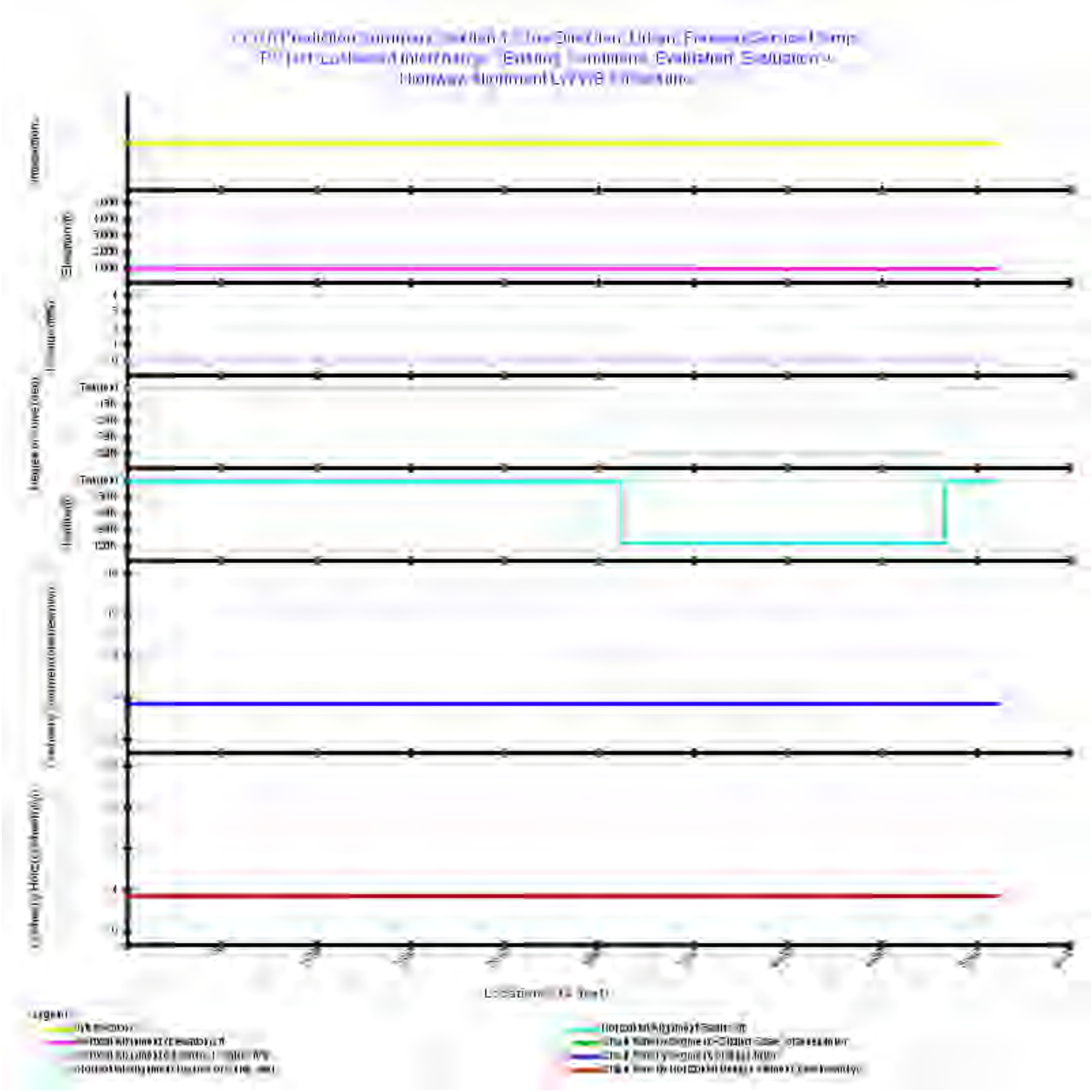

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	5+53.672	553.67	0.1049	2023: 200; 2024: 207; 2025: 214; 2026: 221; 2027: 228; 2028: 235; 2029: 242; 2030: 250; 2031: 252; 2032: 255; 2033: 257; 2034: 260; 2035: 262; 2036: 265; 2037: 267; 2038: 270; 2039: 272; 2040: 275; 2041: 277; 2042: 280; 2043: 282; 2044: 285; 2045: 287; 2046: 290; 2047: 292; 2048: 295; 2049: 297; 2050: 300

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.1049**
Average Future Road AADT (vpd)	**261**
Predicted Crashes	
Total Crashes	**9.87**
Fatal and Injury Crashes	**4.43**
Property-Damage-Only Crashes	**5.45**
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)	**3.3627**
FI Crash Rate (crashes/mi/yr)	**1.5075**
PDO Crash Rate (crashes/mi/yr)	**1.8553**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**0.28**
Travel Crash Rate (crashes/million veh-mi)	**35.26**
Travel FI Crash Rate (crashes/million veh-mi)	**15.80**
Travel PDO Crash Rate (crashes/million veh-mi)	**19.45**

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	5+53.672	0.1049	9.873	0.3526	0.1581	0.1945	3.3627	35.26
Total			0.1049	9.873	0.3526	0.1581	0.1945	3.3627	

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	3+13.713	0.0594	5.594	0.1998	0.0896	0.1102	3.3627	35.26
Simple Curve 1	3+13.713	5+20.680	0.0392	3.691	0.1318	0.0591	0.0727	3.3627	35.26
Tangent	5+20.680	5+53.672	0.0062	0.588	0.0210	0.0094	0.0116	3.3627	35.26

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.29	0.13	44.669	0.16	55.331
2024	0.30	0.13	44.689	0.17	55.311
2025	0.31	0.14	44.709	0.17	55.291
2026	0.31	0.14	44.728	0.17	55.272
2027	0.32	0.14	44.746	0.18	55.254
2028	0.33	0.15	44.764	0.18	55.236
2029	0.34	0.15	44.782	0.18	55.218
2030	0.34	0.15	44.801	0.19	55.199
2031	0.34	0.15	44.806	0.19	55.194
2032	0.35	0.16	44.813	0.19	55.187
2033	0.35	0.16	44.817	0.19	55.183
2034	0.35	0.16	44.824	0.19	55.176
2035	0.35	0.16	44.829	0.20	55.171
2036	0.36	0.16	44.836	0.20	55.164
2037	0.36	0.16	44.840	0.20	55.160
2038	0.36	0.16	44.847	0.20	55.153
2039	0.36	0.16	44.851	0.20	55.149
2040	0.37	0.16	44.857	0.20	55.143
2041	0.37	0.17	44.862	0.20	55.138
2042	0.37	0.17	44.868	0.20	55.132
2043	0.37	0.17	44.872	0.20	55.128
2044	0.38	0.17	44.879	0.21	55.121
2045	0.38	0.17	44.883	0.21	55.117
2046	0.38	0.17	44.889	0.21	55.111
2047	0.38	0.17	44.893	0.21	55.107
2048	0.38	0.17	44.899	0.21	55.101
2049	0.39	0.17	44.903	0.21	55.097
2050	0.39	0.17	44.909	0.21	55.091
Total	9.87	4.43	44.829	5.45	55.171
Average	0.35	0.16	44.829	0.20	55.171

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	0.1382	0.4191	1.7426	2.1263	5.4473

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.02	0.2	0.12	1.2	0.14	1.4
Highway Segment	Collision with Fixed Object	3.14	31.8	3.89	39.4	7.03	71.2
Highway Segment	Collision with Other Object	0.22	2.2	0.75	7.6	0.98	9.9
Highway Segment	Other Single-vehicle Collision	0.91	9.2	0.58	5.9	1.49	15.0
Highway Segment	Collision with Parked Vehicle	0.07	0.7	0.09	0.9	0.15	1.5
Highway Segment	Total Single Vehicle Crashes	4.35	44.1	5.43	55.0	9.78	99.0
Highway Segment	Right-Angle Collision	0.00	0.0	0.00	0.0	0.00	0.0
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	0.0	0.00	0.0	0.00	0.0
Highway Segment	Rear-end Collision	0.06	0.6	0.01	0.1	0.07	0.7
Highway Segment	Sideswipe, Same Direction Collision	0.01	0.1	0.01	0.1	0.02	0.2
Highway Segment	Total Multiple Vehicle Crashes	0.08	0.8	0.02	0.2	0.10	1.0
Highway Segment	Total Highway Segment Crashes	4.43	44.8	5.45	55.2	9.87	100.0
	Total Crashes	4.43	44.8	5.45	55.2	9.87	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	5+53.672	Warning: for segment #1 (0.000 to 5+53.672), The ramp type for Ramp Alignment LW WB Off Existing is set at the Ramp Connection (Exit) and in the Ramp (Exit). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Overview

Report Generated: Jun 21, 2024 10:37 AM
Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Fri Jun 21 10:11:59 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Lockwood Interchange - Existing Conditions
Project Comment: Created Tue May 07 14:58:58 PDT 2024
Project Unit System: U.S. Customary

Highway Title: Alignment LW WB On Existing
Highway Comment: Lockwood Existing WB On Ramp
Highway Version: 1

Evaluation Title: Evaluation 4
Evaluation Comment: Created Fri Jun 21 10:11:22 PDT 2024

Minimum Location: 0.000
Maximum Location: 7+05.264

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

First Year of Analysis: 2023
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

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Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 0.000
Evaluation End Location: 7+05.264
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;

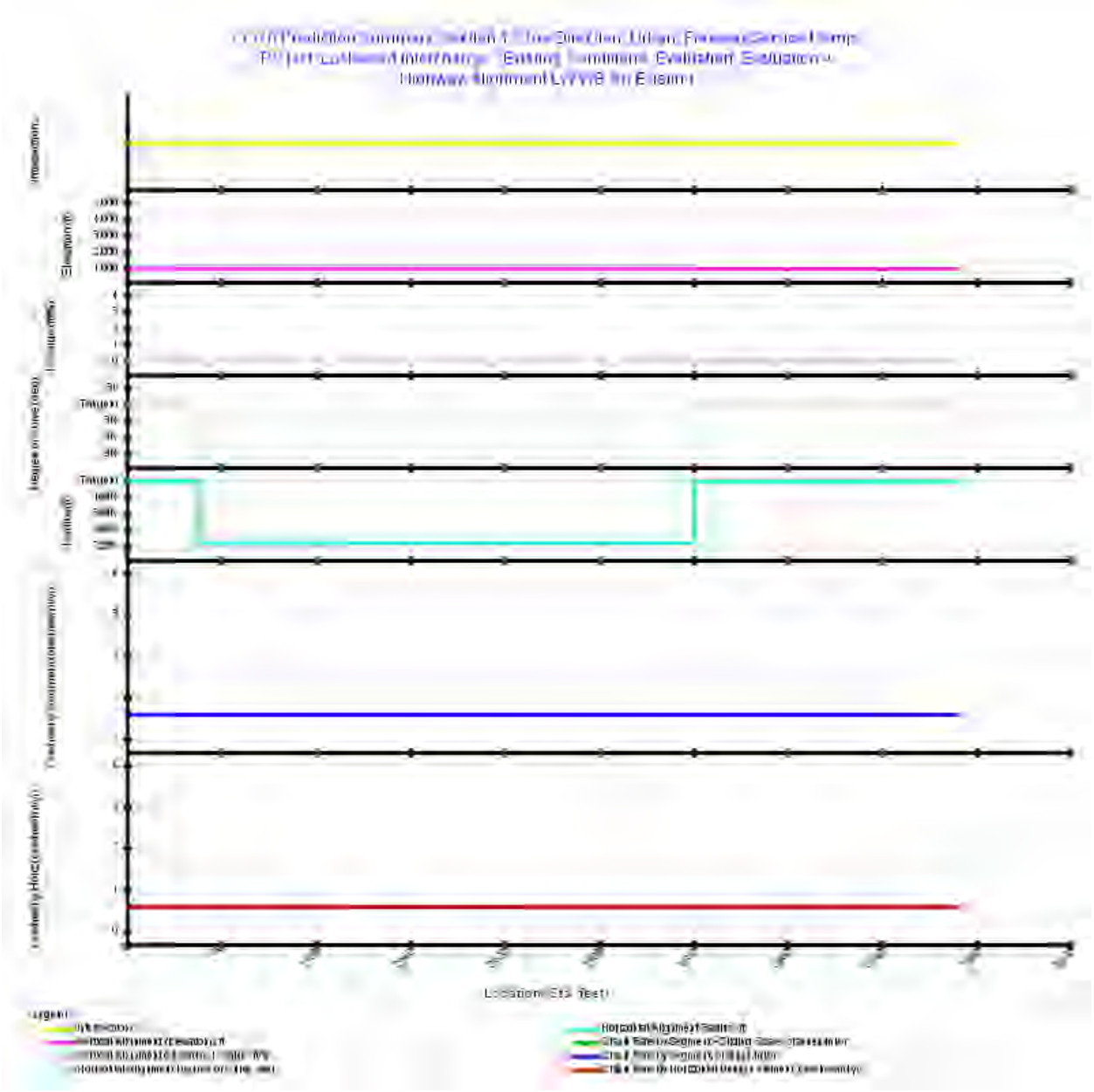

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	7+05.264	705.26	0.1336	2023: 840; 2024: 828; 2025: 817; 2026: 805; 2027: 794; 2028: 782; 2029: 771; 2030: 760; 2031: 768; 2032: 776; 2033: 784; 2034: 792; 2035: 800; 2036: 808; 2037: 816; 2038: 824; 2039: 832; 2040: 840; 2041: 848; 2042: 856; 2043: 864; 2044: 872; 2045: 880; 2046: 888; 2047: 896; 2048: 904; 2049: 912; 2050: 920

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.1336**
Average Future Road AADT (vpd)	**831**
Predicted Crashes	
Total Crashes	**2.14**
Fatal and Injury Crashes	**1.05**
Property-Damage-Only Crashes	**1.09**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**49**
Percent Property-Damage-Only Crashes (%)	**51**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**0.5721**
FI Crash Rate (crashes/mi/yr)	**0.2803**
PDO Crash Rate (crashes/mi/yr)	**0.2918**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**1.13**
Travel Crash Rate (crashes/million veh-mi)	**1.89**
Travel FI Crash Rate (crashes/million veh-mi)	**0.92**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.96**

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	7+05.264	0.1336	2.140	0.0764	0.0374	0.0390	0.5721	1.89
Total			0.1336	2.140	0.0764	0.0374	0.0390	0.5721	

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	62.298	0.0118	0.189	0.0068	0.0033	0.0034	0.5721	1.89
Simple Curve 1	62.298	4+80.381	0.0792	1.268	0.0453	0.0222	0.0231	0.5721	1.89
Tangent	4+80.381	7+05.264	0.0426	0.682	0.0244	0.0119	0.0124	0.5721	1.89

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.08	0.04	48.993	0.04	51.007
2024	0.08	0.04	49.005	0.04	50.995
2025	0.07	0.04	49.016	0.04	50.984
2026	0.07	0.04	49.029	0.04	50.971
2027	0.07	0.04	49.040	0.04	50.960
2028	0.07	0.04	49.053	0.04	50.947
2029	0.07	0.04	49.065	0.04	50.935
2030	0.07	0.04	49.076	0.04	50.924
2031	0.07	0.04	49.068	0.04	50.932
2032	0.07	0.04	49.059	0.04	50.941
2033	0.07	0.04	49.051	0.04	50.949
2034	0.07	0.04	49.042	0.04	50.958
2035	0.07	0.04	49.034	0.04	50.966
2036	0.07	0.04	49.026	0.04	50.974
2037	0.07	0.04	49.017	0.04	50.983
2038	0.08	0.04	49.009	0.04	50.991
2039	0.08	0.04	49.001	0.04	50.999
2040	0.08	0.04	48.993	0.04	51.007
2041	0.08	0.04	48.985	0.04	51.015
2042	0.08	0.04	48.977	0.04	51.023
2043	0.08	0.04	48.969	0.04	51.031
2044	0.08	0.04	48.961	0.04	51.039
2045	0.08	0.04	48.954	0.04	51.046
2046	0.08	0.04	48.946	0.04	51.054
2047	0.08	0.04	48.938	0.04	51.062
2048	0.08	0.04	48.931	0.04	51.069
2049	0.08	0.04	48.923	0.04	51.077
2050	0.08	0.04	48.915	0.04	51.085
Total	2.14	1.05	49.001	1.09	50.999
Average	0.08	0.04	49.001	0.04	50.999

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	0.0224	0.0678	0.4316	0.5267	1.0912

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.00	0.2	0.02	1.0	0.03	1.2
Highway Segment	Collision with Fixed Object	0.64	29.8	0.72	33.9	1.36	63.6
Highway Segment	Collision with Other Object	0.04	2.1	0.14	6.6	0.19	8.7
Highway Segment	Other Single-vehicle Collision	0.18	8.6	0.11	5.1	0.29	13.6
Highway Segment	Collision with Parked Vehicle	0.01	0.6	0.02	0.8	0.03	1.4
Highway Segment	Total Single Vehicle Crashes	0.88	41.2	1.01	47.3	1.89	88.5
Highway Segment	Right-Angle Collision	0.01	0.2	0.00	0.1	0.01	0.3
Highway Segment	Head-on Collision	0.00	0.1	0.00	0.0	0.00	0.1
Highway Segment	Other Multi-vehicle Collision	0.01	0.2	0.00	0.1	0.01	0.3
Highway Segment	Rear-end Collision	0.12	5.8	0.06	2.5	0.18	8.4
Highway Segment	Sideswipe, Same Direction Collision	0.03	1.4	0.02	1.0	0.05	2.4
Highway Segment	Total Multiple Vehicle Crashes	0.17	7.8	0.08	3.7	0.25	11.5
Highway Segment	Total Highway Segment Crashes	1.05	49.0	1.09	51.0	2.14	100.0
	Total Crashes	1.05	49.0	1.09	51.0	2.14	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	7+05.264	Warning: for segment #1 (0.000 to 7+05.264), The ramp type for Ramp Alignment LW WB On Existing is set at the Ramp Connection (Entrance) and in the Ramp (Entrance). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Overview

Report Generated: Jun 21, 2024 10:44 AM
Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Fri Jun 21 10:44:34 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Mustang Interchange - Existing Conditions
Project Comment: Created Tue May 07 15:01:57 PDT 2024
Project Unit System: U.S. Customary

Highway Title: Alignment M EB Off Existing
Highway Comment: Mustang Existing EB Off Ramp
Highway Version: 1

Evaluation Title: Evaluation 5
Evaluation Comment: Created Fri Jun 21 10:44:13 PDT 2024

Minimum Location: 0.000
Maximum Location: 11+08.502

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

First Year of Analysis: 2023
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.
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- 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: 11+08.502
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;

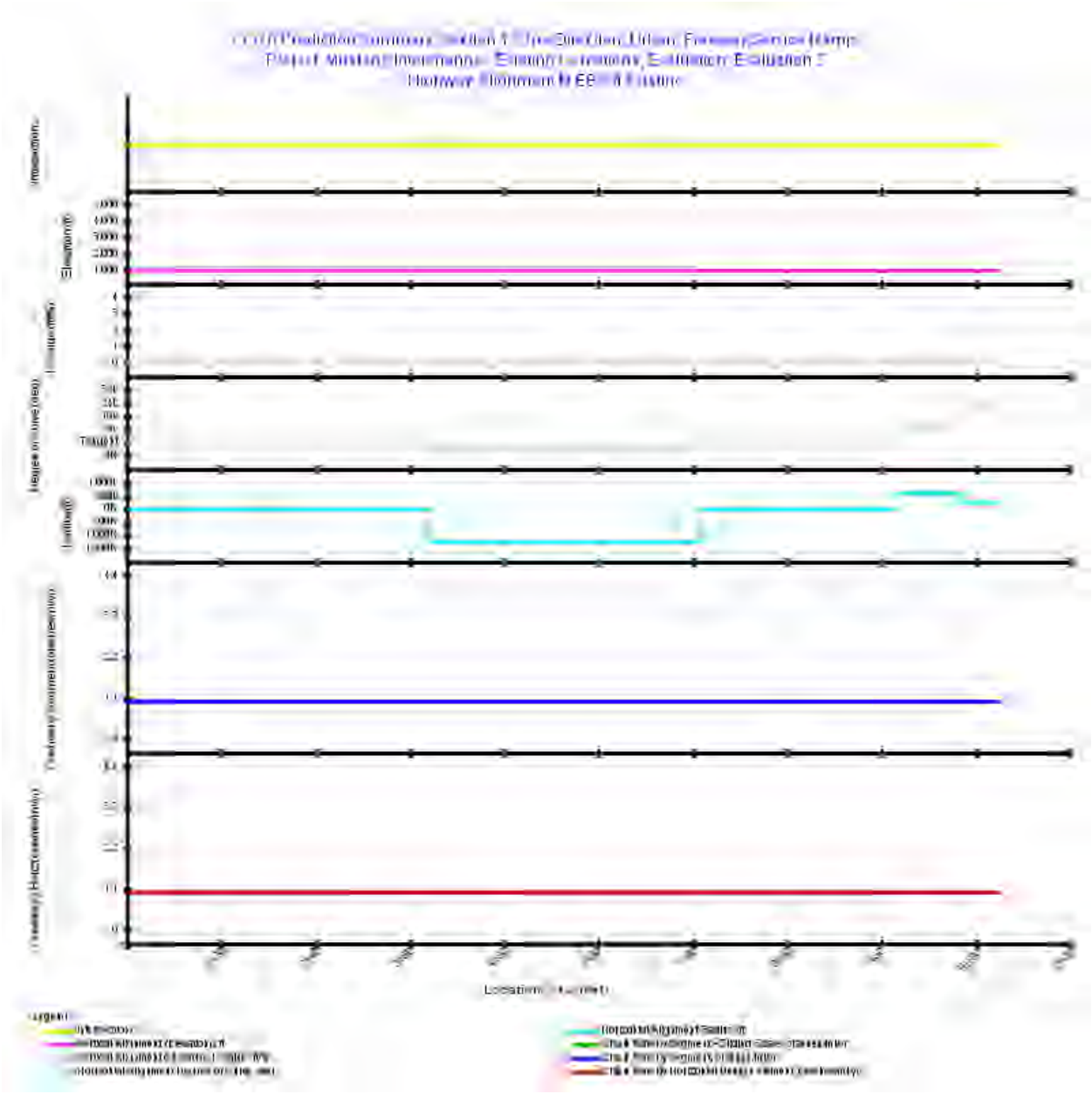

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	11+08.502	1,108.50	0.2099	2023: 2,220; 2024: 2,181; 2025: 2,142; 2026: 2,104; 2027: 2,065; 2028: 2,027; 2029: 1,988; 2030: 1,950; 2031: 1,969; 2032: 1,989; 2033: 2,008; 2034: 2,028; 2035: 2,047; 2036: 2,067; 2037: 2,086; 2038: 2,106; 2039: 2,125; 2040: 2,145; 2041: 2,164; 2042: 2,184; 2043: 2,203; 2044: 2,223; 2045: 2,242; 2046: 2,262; 2047: 2,281; 2048: 2,301; 2049: 2,320; 2050: 2,340

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.2099**
Average Future Road AADT (vpd)	**2,135**
Predicted Crashes	
Total Crashes	**5.94**
Fatal and Injury Crashes	**2.93**
Property-Damage-Only Crashes	**3.01**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**49**
Percent Property-Damage-Only Crashes (%)	**51**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**1.0105**
FI Crash Rate (crashes/mi/yr)	**0.4984**
PDO Crash Rate (crashes/mi/yr)	**0.5122**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**4.58**
Travel Crash Rate (crashes/million veh-mi)	**1.30**
Travel FI Crash Rate (crashes/million veh-mi)	**0.64**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.66**

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	11+08.502	0.2099	5.940	0.2122	0.1046	0.1075	1.0105	1.30
Total			0.2099	5.940	0.2122	0.1046	0.1075	1.0105	

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	3+84.628	0.0728	2.061	0.0736	0.0363	0.0373	1.0105	1.30
Simple Curve 1	3+84.628	7+30.463	0.0655	1.853	0.0662	0.0326	0.0335	1.0105	1.30
Tangent	7+30.463	9+76.754	0.0466	1.320	0.0471	0.0232	0.0239	1.0105	1.30
Simple Curve 2	9+76.754	10+61.301	0.0160	0.453	0.0162	0.0080	0.0082	1.0105	1.30
Simple Curve 3	10+61.301	11+08.502	0.0089	0.253	0.0090	0.0045	0.0046	1.0105	1.30

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.22	0.11	49.319	0.11	50.681
2024	0.22	0.11	49.317	0.11	50.683
2025	0.21	0.10	49.316	0.11	50.684
2026	0.21	0.10	49.315	0.11	50.685
2027	0.21	0.10	49.313	0.10	50.687
2028	0.20	0.10	49.312	0.10	50.688
2029	0.20	0.10	49.310	0.10	50.690
2030	0.20	0.10	49.308	0.10	50.692
2031	0.20	0.10	49.309	0.10	50.691
2032	0.20	0.10	49.310	0.10	50.690
2033	0.20	0.10	49.311	0.10	50.689
2034	0.20	0.10	49.312	0.10	50.688
2035	0.21	0.10	49.312	0.10	50.688
2036	0.21	0.10	49.313	0.10	50.687
2037	0.21	0.10	49.314	0.11	50.686
2038	0.21	0.10	49.315	0.11	50.685
2039	0.21	0.10	49.315	0.11	50.685
2040	0.21	0.10	49.316	0.11	50.684
2041	0.21	0.11	49.317	0.11	50.683
2042	0.22	0.11	49.317	0.11	50.683
2043	0.22	0.11	49.318	0.11	50.682
2044	0.22	0.11	49.319	0.11	50.681
2045	0.22	0.11	49.319	0.11	50.681
2046	0.22	0.11	49.320	0.11	50.680
2047	0.22	0.11	49.320	0.11	50.680
2048	0.22	0.11	49.321	0.11	50.679
2049	0.23	0.11	49.321	0.11	50.679
2050	0.23	0.11	49.322	0.12	50.678
Total	5.94	2.93	49.316	3.01	50.684
Average	0.21	0.10	49.316	0.11	50.684

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	0.0915	0.2774	1.1534	1.4073	3.0108

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.01	0.2	0.06	1.1	0.07	1.3
Highway Segment	Collision with Fixed Object	2.05	34.5	2.06	34.7	4.11	69.2
Highway Segment	Collision with Other Object	0.14	2.4	0.40	6.7	0.55	9.2
Highway Segment	Other Single-vehicle Collision	0.59	9.9	0.31	5.2	0.90	15.1
Highway Segment	Collision with Parked Vehicle	0.04	0.7	0.05	0.8	0.09	1.5
Highway Segment	Total Single Vehicle Crashes	2.84	47.8	2.88	48.5	5.72	96.3
Highway Segment	Right-Angle Collision	0.00	0.0	0.00	0.0	0.01	0.1
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	0.0	0.00	0.1	0.01	0.1
Highway Segment	Rear-end Collision	0.07	1.2	0.09	1.5	0.16	2.7
Highway Segment	Sideswipe, Same Direction Collision	0.02	0.3	0.04	0.6	0.05	0.9
Highway Segment	Total Multiple Vehicle Crashes	0.09	1.5	0.13	2.2	0.22	3.7
Highway Segment	Total Highway Segment Crashes	2.93	49.3	3.01	50.7	5.94	100.0
	Total Crashes	2.93	49.3	3.01	50.7	5.94	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	11+08.502	Warning: for segment #1 (0.000 to 11+08.502), The ramp type for Ramp Alignment M EB Off Existing is set at the Ramp Connection (Exit) and in the Ramp (Exit). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Overview

Report Generated: Jun 21, 2024 10:46 AM
Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Fri Jun 21 10:46:13 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Mustang Interchange - Existing Conditions
Project Comment: Created Tue May 07 15:01:57 PDT 2024
Project Unit System: U.S. Customary

Highway Title: Alignment M EB On Existing
Highway Comment: Mustang Existing EB On Ramp
Highway Version: 1

Evaluation Title: Evaluation 3
Evaluation Comment: Created Fri Jun 21 10:45:34 PDT 2024

Minimum Location: 0.000
Maximum Location: 5+48.251

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

First Year of Analysis: 2023
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

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Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 0.000
Evaluation End Location: 5+48.251
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;

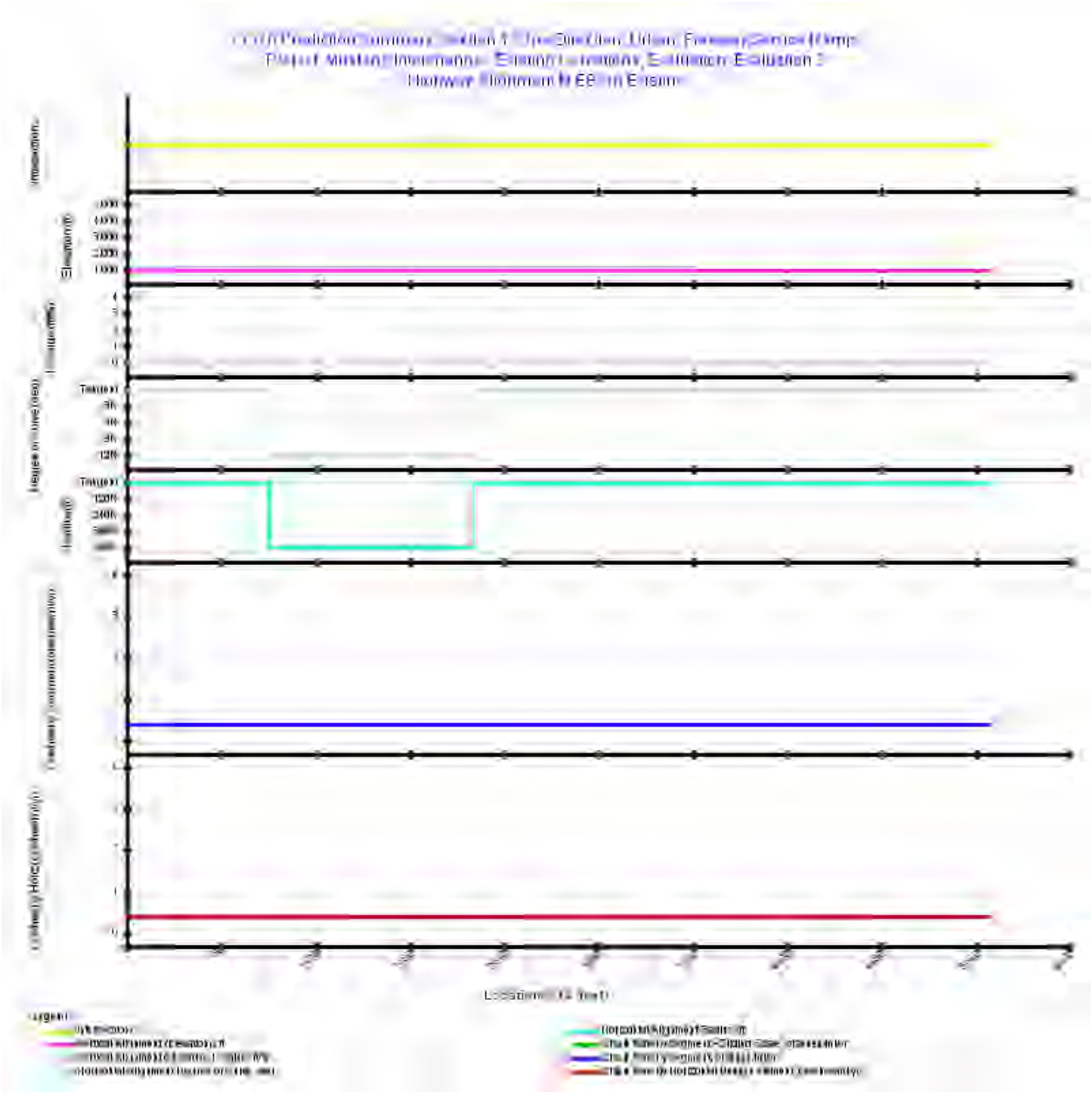

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	5+48.251	548.25	0.1038	2023: 530; 2024: 525; 2025: 521; 2026: 517; 2027: 512; 2028: 508; 2029: 504; 2030: 500; 2031: 505; 2032: 510; 2033: 515; 2034: 520; 2035: 525; 2036: 530; 2037: 535; 2038: 540; 2039: 545; 2040: 550; 2041: 555; 2042: 560; 2043: 565; 2044: 570; 2045: 575; 2046: 580; 2047: 585; 2048: 590; 2049: 595; 2050: 600

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.1038**
Average Future Road AADT (vpd)	**542**
Predicted Crashes	
Total Crashes	**1.11**
Fatal and Injury Crashes	**0.55**
Property-Damage-Only Crashes	**0.57**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**49**
Percent Property-Damage-Only Crashes (%)	**51**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**0.3829**
FI Crash Rate (crashes/mi/yr)	**0.1876**
PDO Crash Rate (crashes/mi/yr)	**0.1953**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**0.57**
Travel Crash Rate (crashes/million veh-mi)	**1.94**
Travel FI Crash Rate (crashes/million veh-mi)	**0.95**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.99**

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	5+48.251	0.1038	1.113	0.0398	0.0195	0.0203	0.3829	1.94
Total			0.1038	1.113	0.0398	0.0195	0.0203	0.3829	

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	90.095	0.0171	0.183	0.0065	0.0032	0.0033	0.3829	1.94
Simple Curve 1	90.095	2+20.133	0.0246	0.264	0.0094	0.0046	0.0048	0.3829	1.94
Tangent	2+20.133	5+48.251	0.0621	0.666	0.0238	0.0117	0.0121	0.3829	1.94

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.04	0.02	49.013	0.02	50.987
2024	0.04	0.02	49.020	0.02	50.980
2025	0.04	0.02	49.026	0.02	50.974
2026	0.04	0.02	49.032	0.02	50.968
2027	0.04	0.02	49.040	0.02	50.960
2028	0.04	0.02	49.047	0.02	50.953
2029	0.04	0.02	49.053	0.02	50.947
2030	0.04	0.02	49.059	0.02	50.941
2031	0.04	0.02	49.051	0.02	50.949
2032	0.04	0.02	49.043	0.02	50.957
2033	0.04	0.02	49.036	0.02	50.964
2034	0.04	0.02	49.028	0.02	50.972
2035	0.04	0.02	49.020	0.02	50.980
2036	0.04	0.02	49.013	0.02	50.987
2037	0.04	0.02	49.005	0.02	50.995
2038	0.04	0.02	48.998	0.02	51.002
2039	0.04	0.02	48.990	0.02	51.010
2040	0.04	0.02	48.983	0.02	51.017
2041	0.04	0.02	48.976	0.02	51.024
2042	0.04	0.02	48.968	0.02	51.032
2043	0.04	0.02	48.961	0.02	51.039
2044	0.04	0.02	48.954	0.02	51.046
2045	0.04	0.02	48.947	0.02	51.053
2046	0.04	0.02	48.940	0.02	51.060
2047	0.04	0.02	48.933	0.02	51.067
2048	0.04	0.02	48.926	0.02	51.074
2049	0.04	0.02	48.919	0.02	51.081
2050	0.04	0.02	48.912	0.02	51.088
Total	1.11	0.55	48.994	0.57	51.006
Average	0.04	0.02	48.994	0.02	51.006

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	0.0116	0.0353	0.2245	0.2740	0.5678

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.00	0.2	0.01	1.1	0.01	1.2
Highway Segment	Collision with Fixed Object	0.33	29.3	0.38	34.3	0.71	63.6
Highway Segment	Collision with Other Object	0.02	2.1	0.07	6.7	0.10	8.7
Highway Segment	Other Single-vehicle Collision	0.09	8.4	0.06	5.1	0.15	13.6
Highway Segment	Collision with Parked Vehicle	0.01	0.6	0.01	0.8	0.01	1.4
Highway Segment	Total Single Vehicle Crashes	0.45	40.6	0.53	47.9	0.98	88.5
Highway Segment	Right-Angle Collision	0.00	0.3	0.00	0.1	0.00	0.3
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	0.1	0.00	0.3
Highway Segment	Rear-end Collision	0.07	6.3	0.02	2.1	0.09	8.5
Highway Segment	Sideswipe, Same Direction Collision	0.02	1.5	0.01	0.8	0.03	2.3
Highway Segment	Total Multiple Vehicle Crashes	0.09	8.4	0.03	3.1	0.13	11.5
Highway Segment	Total Highway Segment Crashes	0.55	49.0	0.57	51.0	1.11	100.0
	Total Crashes	0.55	49.0	0.57	51.0	1.11	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	5+48.251	Warning: for segment #1 (0.000 to 5+48.251), The ramp type for Ramp Alignment M EB On Existing is set at the Ramp Connection (Entrance) and in the Ramp (Entrance). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Overview

Report Generated: Jun 21, 2024 10:48 AM
Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Fri Jun 21 10:48:06 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Mustang Interchange - Existing Conditions
Project Comment: Created Tue May 07 15:01:57 PDT 2024
Project Unit System: U.S. Customary

Highway Title: Alignment M WB Off Existing
Highway Comment: Mustang Existing WB Off Ramp
Highway Version: 1

Evaluation Title: Evaluation 3
Evaluation Comment: Created Fri Jun 21 10:47:21 PDT 2024

Minimum Location: 0.000
Maximum Location: 7+88.001

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

First Year of Analysis: 2023
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: 7+88.001
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;

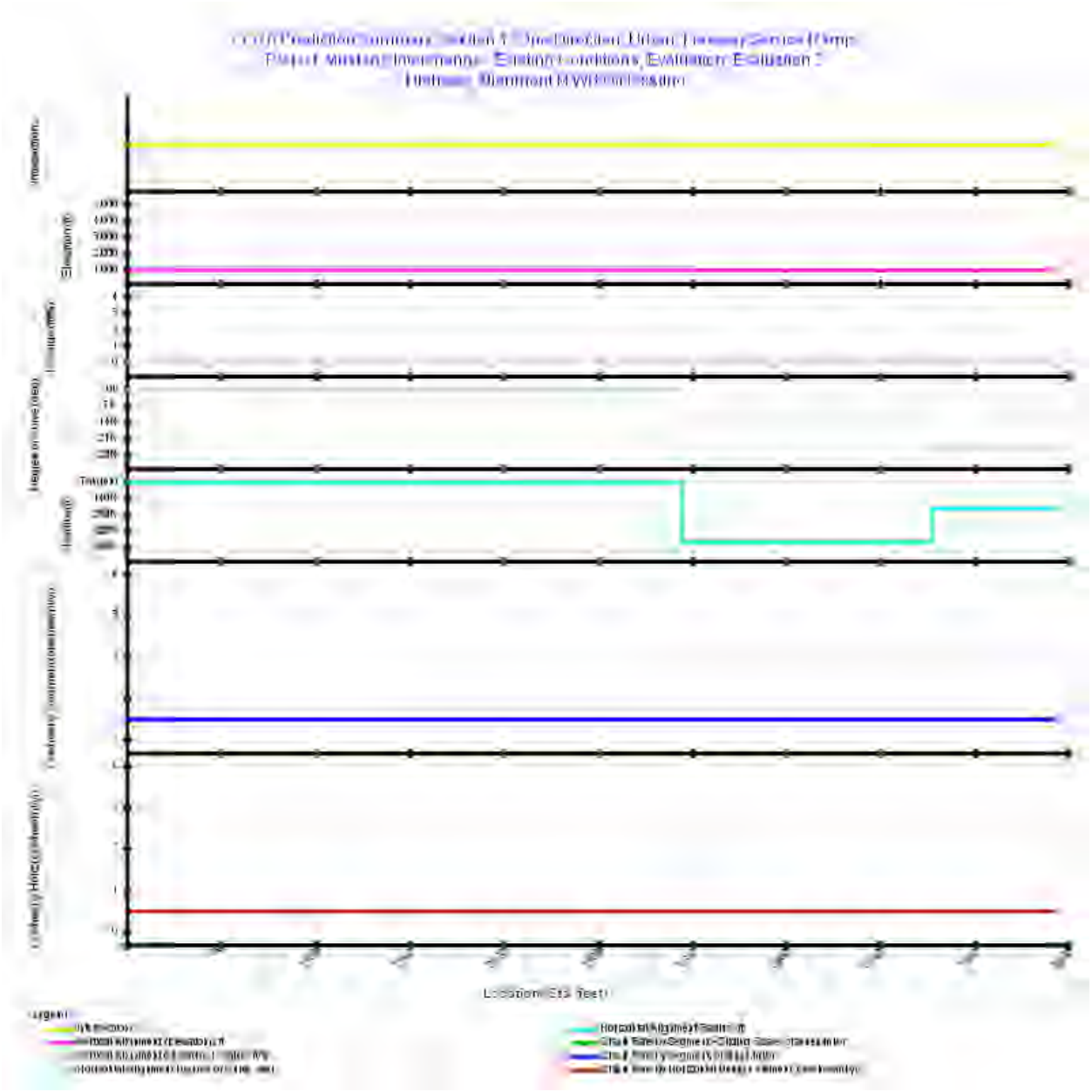

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	7+88.001	788.00	0.1492	2023-2030: 410; 2031: 414; 2032: 419; 2033: 423; 2034: 428; 2035: 432; 2036: 437; 2037: 441; 2038: 446; 2039: 450; 2040: 455; 2041: 459; 2042: 464; 2043: 468; 2044: 473; 2045: 477; 2046: 482; 2047: 486; 2048: 491; 2049: 495; 2050: 500

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.1492**
Average Future Road AADT (vpd)	**444**
Predicted Crashes	
Total Crashes	**1.96**
Fatal and Injury Crashes	**0.95**
Property-Damage-Only Crashes	**1.02**
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)	**0.4698**
FI Crash Rate (crashes/mi/yr)	**0.2263**
PDO Crash Rate (crashes/mi/yr)	**0.2434**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**0.68**
Travel Crash Rate (crashes/million veh-mi)	**2.90**
Travel FI Crash Rate (crashes/million veh-mi)	**1.40**
Travel PDO Crash Rate (crashes/million veh-mi)	**1.50**

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	7+88.001	0.1492	1.963	0.0701	0.0338	0.0363	0.4698	2.90
Total			0.1492	1.963	0.0701	0.0338	0.0363	0.4698	

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+71.122	0.0892	1.174	0.0419	0.0202	0.0217	0.4698	2.90
Simple Curve 1	4+71.122	6+82.893	0.0401	0.528	0.0188	0.0091	0.0098	0.4698	2.90
Simple Curve 2	6+82.893	7+88.001	0.0199	0.262	0.0094	0.0045	0.0048	0.4698	2.90

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.07	0.03	48.148	0.03	51.852
2024	0.07	0.03	48.148	0.03	51.852
2025	0.07	0.03	48.148	0.03	51.852
2026	0.07	0.03	48.148	0.03	51.852
2027	0.07	0.03	48.148	0.03	51.852
2028	0.07	0.03	48.148	0.03	51.852
2029	0.07	0.03	48.148	0.03	51.852
2030	0.07	0.03	48.148	0.03	51.852
2031	0.07	0.03	48.152	0.04	51.848
2032	0.07	0.03	48.157	0.04	51.843
2033	0.07	0.03	48.161	0.04	51.839
2034	0.07	0.03	48.166	0.04	51.834
2035	0.07	0.03	48.169	0.04	51.831
2036	0.07	0.03	48.174	0.04	51.826
2037	0.07	0.03	48.178	0.04	51.822
2038	0.07	0.03	48.182	0.04	51.818
2039	0.07	0.03	48.185	0.04	51.815
2040	0.07	0.03	48.190	0.04	51.810
2041	0.07	0.04	48.193	0.04	51.807
2042	0.07	0.04	48.198	0.04	51.802
2043	0.07	0.04	48.201	0.04	51.799
2044	0.07	0.04	48.205	0.04	51.795
2045	0.07	0.04	48.208	0.04	51.792
2046	0.07	0.04	48.212	0.04	51.788
2047	0.07	0.04	48.216	0.04	51.784
2048	0.07	0.04	48.220	0.04	51.780
2049	0.08	0.04	48.223	0.04	51.777
2050	0.08	0.04	48.227	0.04	51.773
Total	1.96	0.95	48.180	1.02	51.820
Average	0.07	0.03	48.180	0.04	51.820

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	0.0295	0.0896	0.3724	0.4544	1.0173

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.00	0.2	0.02	1.1	0.03	1.3
Highway Segment	Collision with Fixed Object	0.66	33.7	0.72	36.6	1.38	70.3
Highway Segment	Collision with Other Object	0.05	2.4	0.14	7.1	0.19	9.5
Highway Segment	Other Single-vehicle Collision	0.19	9.7	0.11	5.5	0.30	15.2
Highway Segment	Collision with Parked Vehicle	0.01	0.7	0.02	0.8	0.03	1.5
Highway Segment	Total Single Vehicle Crashes	0.92	46.7	1.00	51.1	1.92	97.7
Highway Segment	Right-Angle Collision	0.00	0.0	0.00	0.0	0.00	0.1
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	0.0	0.00	0.0	0.00	0.1
Highway Segment	Rear-end Collision	0.02	1.1	0.01	0.5	0.03	1.6
Highway Segment	Sideswipe, Same Direction Collision	0.01	0.3	0.00	0.2	0.01	0.5
Highway Segment	Total Multiple Vehicle Crashes	0.03	1.5	0.01	0.7	0.04	2.3
Highway Segment	Total Highway Segment Crashes	0.95	48.2	1.02	51.8	1.96	100.0
	Total Crashes	0.95	48.2	1.02	51.8	1.96	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	7+88.001	Warning: for segment #1 (0.000 to 7+88.001), The ramp type for Ramp Alignment M WB Off Existing is set at the Ramp Connection (Exit) and in the Ramp (Exit). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Overview

Report Generated: Jun 21, 2024 10:49 AM
Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Fri Jun 21 10:49:35 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Mustang Interchange - Existing Conditions
Project Comment: Created Tue May 07 15:01:57 PDT 2024
Project Unit System: U.S. Customary

Highway Title: Alignment M WB On Existing
Highway Comment: Mustang Existing WB On Ramp
Highway Version: 1

Evaluation Title: Evaluation 3
Evaluation Comment: Created Fri Jun 21 10:49:16 PDT 2024

Minimum Location: 0.000
Maximum Location: 7+87.812

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

First Year of Analysis: 2023
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

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- 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.]*

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Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 0.000
Evaluation End Location: 7+87.812
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;

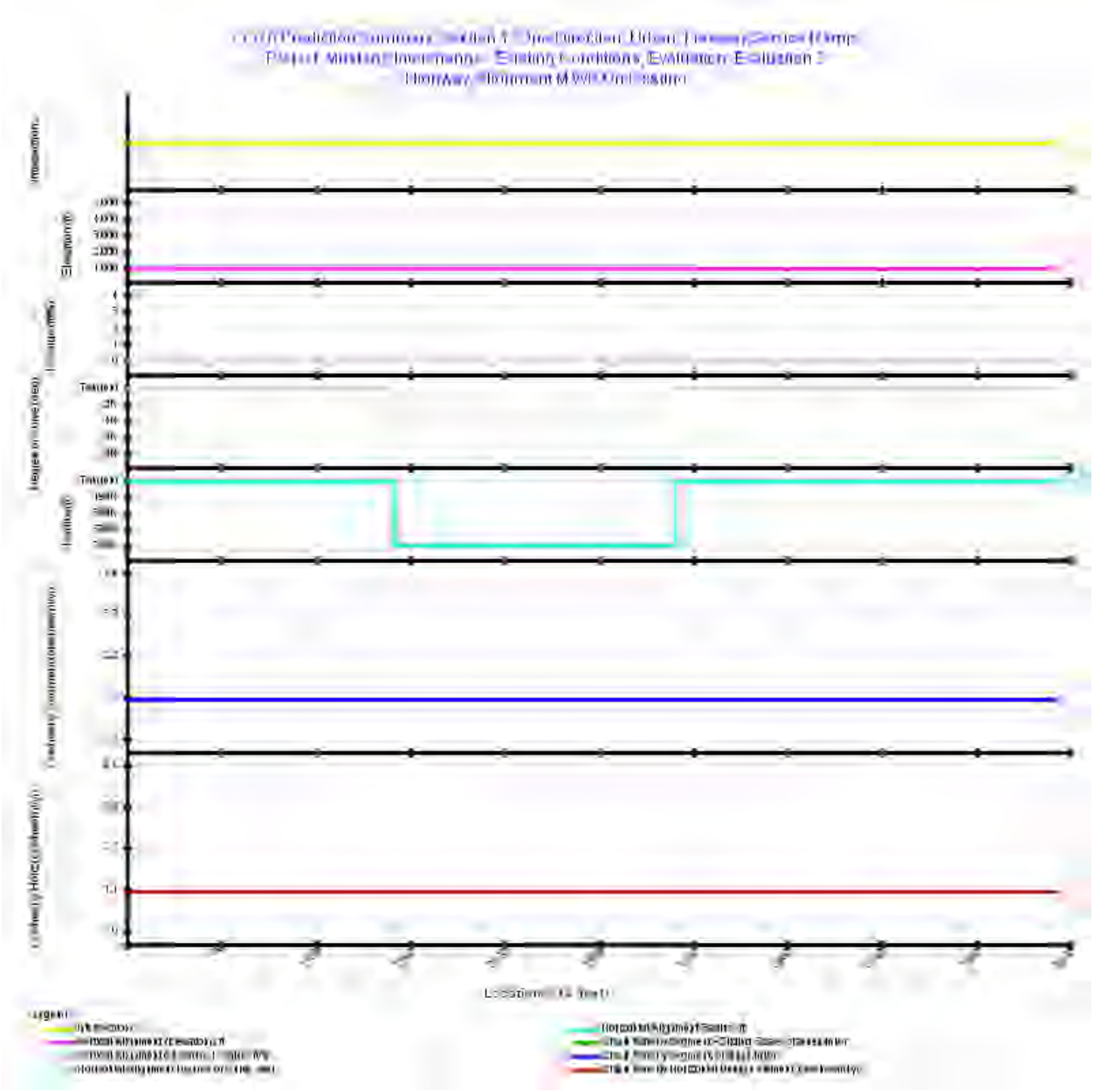

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	7+87.812	787.81	0.1492	2023: 2,170; 2024: 2,145; 2025: 2,121; 2026: 2,097; 2027: 2,072; 2028: 2,048; 2029: 2,024; 2030: 2,000; 2031: 2,020; 2032: 2,040; 2033: 2,060; 2034: 2,080; 2035: 2,100; 2036: 2,120; 2037: 2,140; 2038: 2,160; 2039: 2,180; 2040: 2,200; 2041: 2,220; 2042: 2,240; 2043: 2,260; 2044: 2,280; 2045: 2,300; 2046: 2,320; 2047: 2,340; 2048: 2,360; 2049: 2,380; 2050: 2,400

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.1492**
Average Future Road AADT (vpd)	**2,174**
Predicted Crashes	
Total Crashes	**4.39**
Fatal and Injury Crashes	**2.20**
Property-Damage-Only Crashes	**2.19**
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)	**1.0515**
FI Crash Rate (crashes/mi/yr)	**0.5266**
PDO Crash Rate (crashes/mi/yr)	**0.5249**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**3.32**
Travel Crash Rate (crashes/million veh-mi)	**1.32**
Travel FI Crash Rate (crashes/million veh-mi)	**0.66**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.66**

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	7+87.812	0.1492	4.393	0.1569	0.0786	0.0783	1.0515	1.32
Total			0.1492	4.393	0.1569	0.0786	0.0783	1.0515	

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	2+26.714	0.0429	1.264	0.0451	0.0226	0.0225	1.0515	1.32
Simple Curve 1	2+26.714	4+64.940	0.0451	1.328	0.0474	0.0238	0.0237	1.0515	1.32
Tangent	4+64.940	7+87.812	0.0611	1.800	0.0643	0.0322	0.0321	1.0515	1.32

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.16	0.08	50.084	0.08	49.916
2024	0.15	0.08	50.083	0.08	49.917
2025	0.15	0.08	50.083	0.08	49.917
2026	0.15	0.08	50.082	0.08	49.918
2027	0.15	0.08	50.081	0.08	49.919
2028	0.15	0.07	50.080	0.07	49.920
2029	0.15	0.07	50.079	0.07	49.921
2030	0.15	0.07	50.078	0.07	49.922
2031	0.15	0.07	50.079	0.07	49.921
2032	0.15	0.07	50.080	0.07	49.920
2033	0.15	0.08	50.081	0.07	49.919
2034	0.15	0.08	50.081	0.08	49.919
2035	0.15	0.08	50.082	0.08	49.918
2036	0.15	0.08	50.083	0.08	49.917
2037	0.15	0.08	50.083	0.08	49.917
2038	0.16	0.08	50.084	0.08	49.916
2039	0.16	0.08	50.084	0.08	49.916
2040	0.16	0.08	50.085	0.08	49.915
2041	0.16	0.08	50.085	0.08	49.915
2042	0.16	0.08	50.086	0.08	49.914
2043	0.16	0.08	50.086	0.08	49.914
2044	0.16	0.08	50.087	0.08	49.913
2045	0.16	0.08	50.087	0.08	49.913
2046	0.16	0.08	50.088	0.08	49.912
2047	0.17	0.08	50.088	0.08	49.912
2048	0.17	0.08	50.089	0.08	49.911
2049	0.17	0.08	50.089	0.08	49.911
2050	0.17	0.08	50.089	0.08	49.911
Total	4.39	2.20	50.084	2.19	49.916
Average	0.16	0.08	50.084	0.08	49.916

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	0.0687	0.2083	0.8662	1.0569	2.1928

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.01	0.2	0.05	1.0	0.06	1.2
Highway Segment	Collision with Fixed Object	1.54	35.0	1.50	34.2	3.04	69.2
Highway Segment	Collision with Other Object	0.11	2.5	0.29	6.6	0.40	9.1
Highway Segment	Other Single-vehicle Collision	0.44	10.1	0.22	5.1	0.67	15.2
Highway Segment	Collision with Parked Vehicle	0.03	0.7	0.03	0.8	0.07	1.5
Highway Segment	Total Single Vehicle Crashes	2.13	48.5	2.10	47.7	4.23	96.2
Highway Segment	Right-Angle Collision	0.00	0.0	0.00	0.0	0.00	0.1
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	0.0	0.00	0.1	0.00	0.1
Highway Segment	Rear-end Collision	0.05	1.2	0.07	1.5	0.12	2.7
Highway Segment	Sideswipe, Same Direction Collision	0.01	0.3	0.03	0.6	0.04	0.9
Highway Segment	Total Multiple Vehicle Crashes	0.07	1.6	0.10	2.2	0.17	3.8
Highway Segment	Total Highway Segment Crashes	2.20	50.1	2.19	49.9	4.39	100.0
	Total Crashes	2.20	50.1	2.19	49.9	4.39	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	7+87.812	Warning: for segment #1 (0.000 to 7+87.812), The ramp type for Ramp Alignment M WB On Existing is set at the Ramp Connection (Entrance) and in the Ramp (Exit). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Overview

Report Generated: Jun 21, 2024 10:51 AM
Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Fri Jun 21 10:51:52 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Patrick Interchange - Existing Conditions
Project Comment: Created Tue May 07 15:07:17 PDT 2024
Project Unit System: U.S. Customary

Highway Title: Alignment WT EB Off Existing
Highway Comment: Waltham Existing EB Off Ramp
Highway Version: 1

Evaluation Title: Evaluation 5
Evaluation Comment: Created Fri Jun 21 10:51:19 PDT 2024

Minimum Location: 0.000
Maximum Location: 12+67.493

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

First Year of Analysis: 2023
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

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Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 0.000
Evaluation End Location: 12+67.493
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;

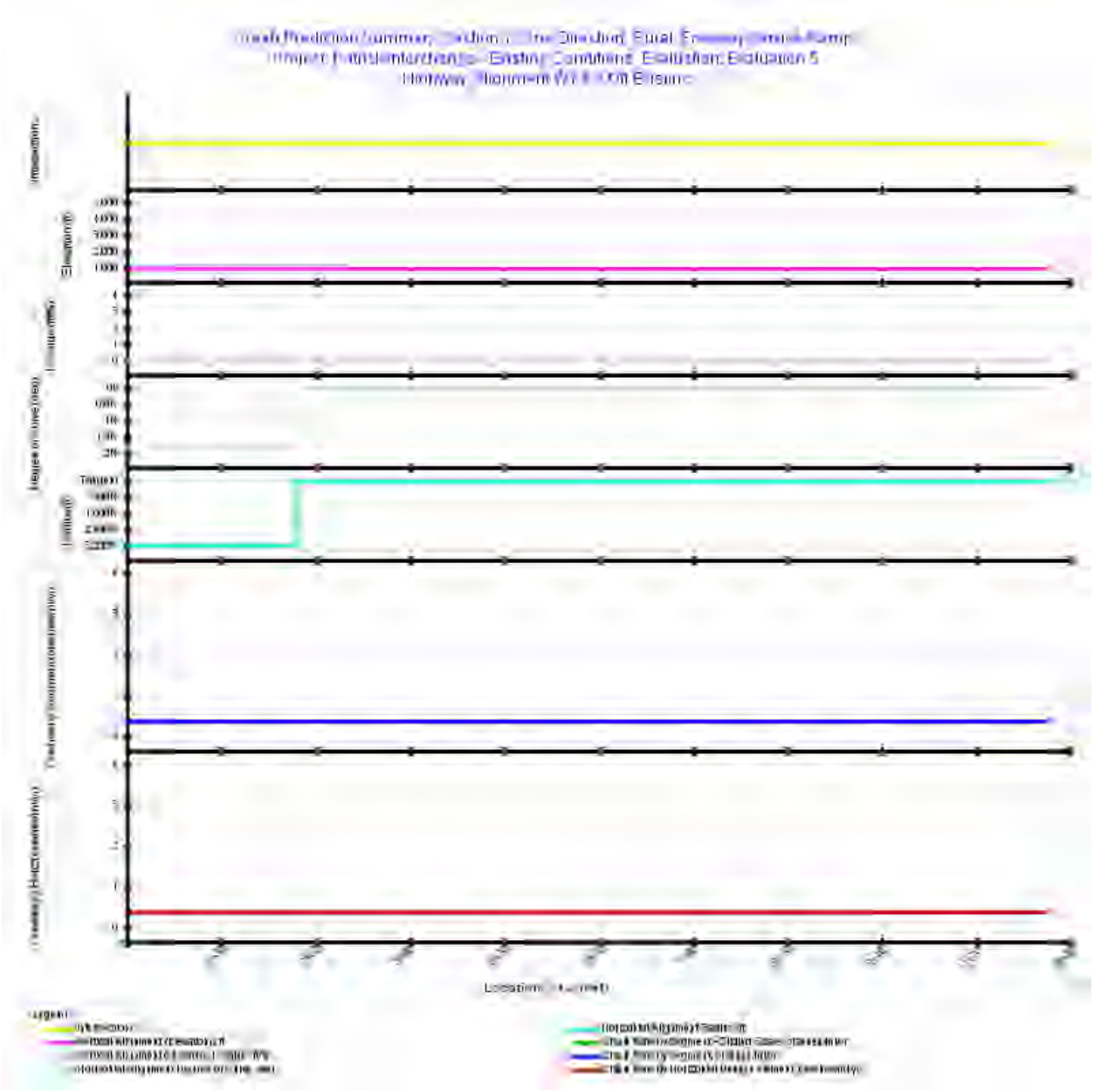

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	Rural	0.000	12+67.493	1,267.49	0.2401	2023: 860; 2024: 844; 2025: 828; 2026: 812; 2027: 797; 2028: 781; 2029: 765; 2030: 750; 2031: 757; 2032: 765; 2033: 772; 2034: 780; 2035: 787; 2036: 795; 2037: 802; 2038: 810; 2039: 817; 2040: 825; 2041: 832; 2042: 840; 2043: 847; 2044: 855; 2045: 862; 2046: 870; 2047: 877; 2048: 885; 2049: 892; 2050: 900

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.2401**
Average Future Road AADT (vpd)	**822**
Predicted Crashes	
Total Crashes	**2.66**
Fatal and Injury Crashes	**1.34**
Property-Damage-Only Crashes	**1.32**
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)	**0.3958**
FI Crash Rate (crashes/mi/yr)	**0.1990**
PDO Crash Rate (crashes/mi/yr)	**0.1968**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**2.02**
Travel Crash Rate (crashes/million veh-mi)	**1.32**
Travel FI Crash Rate (crashes/million veh-mi)	**0.66**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.66**

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	12+67.493	0.2401	2.660	0.0950	0.0478	0.0472	0.3958	1.32
Total			0.2401	2.660	0.0950	0.0478	0.0472	0.3958	

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	2+31.159	0.0438	0.485	0.0173	0.0087	0.0086	0.3958	1.32
Tangent	2+31.159	12+67.493	0.1963	2.175	0.0777	0.0390	0.0386	0.3958	1.32

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.10	0.05	50.276	0.05	49.724
2024	0.10	0.05	50.273	0.05	49.727
2025	0.10	0.05	50.270	0.05	49.730
2026	0.09	0.05	50.267	0.05	49.733
2027	0.09	0.05	50.264	0.05	49.736
2028	0.09	0.05	50.260	0.05	49.740
2029	0.09	0.04	50.257	0.04	49.743
2030	0.09	0.04	50.253	0.04	49.747
2031	0.09	0.04	50.255	0.04	49.745
2032	0.09	0.04	50.257	0.04	49.743
2033	0.09	0.05	50.258	0.04	49.742
2034	0.09	0.05	50.260	0.05	49.740
2035	0.09	0.05	50.261	0.05	49.739
2036	0.09	0.05	50.263	0.05	49.737
2037	0.09	0.05	50.265	0.05	49.735
2038	0.09	0.05	50.266	0.05	49.734
2039	0.10	0.05	50.268	0.05	49.732
2040	0.10	0.05	50.269	0.05	49.731
2041	0.10	0.05	50.270	0.05	49.730
2042	0.10	0.05	50.272	0.05	49.728
2043	0.10	0.05	50.273	0.05	49.727
2044	0.10	0.05	50.275	0.05	49.725
2045	0.10	0.05	50.276	0.05	49.724
2046	0.10	0.05	50.277	0.05	49.723
2047	0.10	0.05	50.278	0.05	49.722
2048	0.10	0.05	50.280	0.05	49.720
2049	0.10	0.05	50.281	0.05	49.719
2050	0.10	0.05	50.282	0.05	49.718
Total	2.66	1.34	50.268	1.32	49.732
Average	0.10	0.05	50.268	0.05	49.732

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	0.0501	0.1519	0.6619	0.4733	1.3230

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.01	0.5	0.08	3.1	0.10	3.6
Highway Segment	Collision with Fixed Object	0.75	28.3	0.80	29.9	1.55	58.2
Highway Segment	Collision with Other Object	0.04	1.5	0.16	6.0	0.20	7.5
Highway Segment	Other Single-vehicle Collision	0.49	18.3	0.21	7.8	0.69	26.1
Highway Segment	Collision with Parked Vehicle	0.03	1.2	0.03	1.1	0.06	2.3
Highway Segment	Total Single Vehicle Crashes	1.33	49.9	1.27	47.8	2.60	97.7
Highway Segment	Right-Angle Collision	0.00	0.0	0.00	0.1	0.00	0.1
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	0.0	0.00	0.1	0.01	0.2
Highway Segment	Rear-end Collision	0.01	0.3	0.03	1.0	0.03	1.2
Highway Segment	Sideswipe, Same Direction Collision	0.00	0.1	0.02	0.7	0.02	0.8
Highway Segment	Total Multiple Vehicle Crashes	0.01	0.4	0.05	1.9	0.06	2.3
Highway Segment	Total Highway Segment Crashes	1.34	50.3	1.32	49.7	2.66	100.0
	Total Crashes	1.34	50.3	1.32	49.7	2.66	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	12+67.493	Warning: for segment #1 (0.000 to 12+67.493), The ramp type for Ramp Alignment WT EB Off Existing is set at the Ramp Connection (Exit) and in the Ramp (Exit). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Overview

Report Generated: Jun 21, 2024 10:56 AM
Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Thu May 23 16:25:55 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Patrick Interchange - Existing Conditions
Project Comment: Created Tue May 07 15:07:17 PDT 2024
Project Unit System: U.S. Customary

Highway Title: Alignment WT EB On Existing
Highway Comment: Waltham Existing EB nf Ramp
Highway Version: 1

Evaluation Title: Evaluation 2
Evaluation Comment: Created Thu May 23 16:25:37 PDT 2024

Minimum Location: 0.000
Maximum Location: 14+00.408

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

First Year of Analysis: 2023
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: 14+00.408
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;

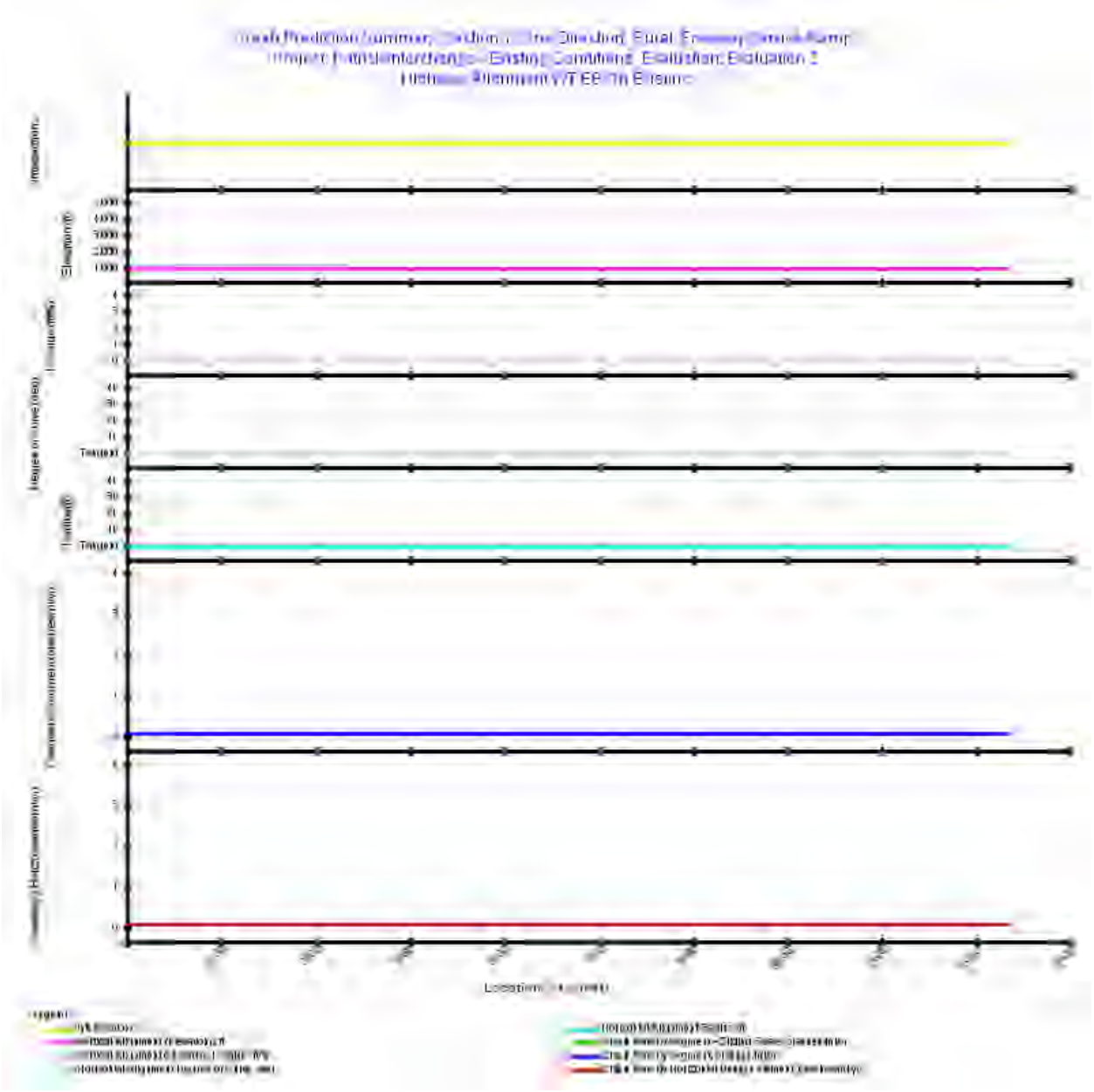

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	Rural	0.000	14+00.408	1,400.41	0.2652	2023: 160; 2024: 162; 2025: 165; 2026: 168; 2027: 171; 2028: 174; 2029: 177; 2030: 180; 2031: 181; 2032: 183; 2033: 184; 2034: 186; 2035: 187; 2036: 189; 2037: 190; 2038: 192; 2039: 193; 2040: 195; 2041: 196; 2042: 198; 2043: 199; 2044: 201; 2045: 202; 2046: 204; 2047: 205; 2048: 207; 2049: 208; 2050: 210

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.2652**
Average Future Road AADT (vpd)	**188**
Predicted Crashes	
Total Crashes	**0.62**
Fatal and Injury Crashes	**0.28**
Property-Damage-Only Crashes	**0.34**
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)	**0.0832**
FI Crash Rate (crashes/mi/yr)	**0.0378**
PDO Crash Rate (crashes/mi/yr)	**0.0454**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**0.51**
Travel Crash Rate (crashes/million veh-mi)	**1.21**
Travel FI Crash Rate (crashes/million veh-mi)	**0.55**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.66**

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	14+00.408	0.2652	0.618	0.0221	0.0100	0.0120	0.0832	1.21
Total			0.2652	0.618	0.0221	0.0100	0.0120	0.0832	

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	14+00.408	0.2652	0.618	0.0221	0.0100	0.0120	0.0832	1.21

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.02	0.01	45.466	0.01	54.534
2024	0.02	0.01	45.462	0.01	54.538
2025	0.02	0.01	45.457	0.01	54.543
2026	0.02	0.01	45.452	0.01	54.548
2027	0.02	0.01	45.446	0.01	54.554
2028	0.02	0.01	45.441	0.01	54.559
2029	0.02	0.01	45.436	0.01	54.564
2030	0.02	0.01	45.430	0.01	54.570
2031	0.02	0.01	45.429	0.01	54.571
2032	0.02	0.01	45.425	0.01	54.575
2033	0.02	0.01	45.423	0.01	54.577
2034	0.02	0.01	45.420	0.01	54.580
2035	0.02	0.01	45.418	0.01	54.582
2036	0.02	0.01	45.414	0.01	54.586
2037	0.02	0.01	45.413	0.01	54.587
2038	0.02	0.01	45.409	0.01	54.591
2039	0.02	0.01	45.407	0.01	54.593
2040	0.02	0.01	45.404	0.01	54.596
2041	0.02	0.01	45.402	0.01	54.598
2042	0.02	0.01	45.398	0.01	54.602
2043	0.02	0.01	45.396	0.01	54.604
2044	0.02	0.01	45.393	0.01	54.607
2045	0.02	0.01	45.391	0.01	54.609
2046	0.02	0.01	45.388	0.01	54.612
2047	0.02	0.01	45.386	0.01	54.614
2048	0.02	0.01	45.382	0.01	54.618
2049	0.02	0.01	45.380	0.01	54.620
2050	0.02	0.01	45.377	0.01	54.623
Total	0.62	0.28	45.414	0.34	54.586
Average	0.02	0.01	45.414	0.01	54.586

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	0.0078	0.0237	0.1550	0.0943	0.3374

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.00	0.4	0.02	3.3	0.02	3.8
Highway Segment	Collision with Fixed Object	0.15	24.2	0.20	32.2	0.35	56.4
Highway Segment	Collision with Other Object	0.01	1.3	0.04	6.4	0.05	7.8
Highway Segment	Other Single-vehicle Collision	0.10	15.7	0.05	8.3	0.15	24.1
Highway Segment	Collision with Parked Vehicle	0.01	1.0	0.01	1.2	0.01	2.2
Highway Segment	Total Single Vehicle Crashes	0.26	42.7	0.32	51.5	0.58	94.2
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	0.1
Highway Segment	Other Multi-vehicle Collision	0.00	0.2	0.00	0.2	0.00	0.4
Highway Segment	Rear-end Collision	0.01	1.7	0.01	1.6	0.02	3.3
Highway Segment	Sideswipe, Same Direction Collision	0.00	0.6	0.01	1.2	0.01	1.8
Highway Segment	Total Multiple Vehicle Crashes	0.02	2.7	0.02	3.1	0.04	5.8
Highway Segment	Total Highway Segment Crashes	0.28	45.4	0.34	54.6	0.62	100.0
	Total Crashes	0.28	45.4	0.34	54.6	0.62	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	14+00.408	Warning: for segment #1 (0.000 to 14+00.408), The ramp type for Ramp Alignment WT EB On Existing is set at the Ramp Connection (Entrance) and in the Ramp (Entrance). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Fri Jun 21 10:55:31 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Patrick Interchange - Existing Conditions
Project Comment: Created Tue May 07 15:07:17 PDT 2024
Project Unit System: U.S. Customary

Highway Title: Alignment WT WB Off Existing
Highway Comment: Waltham Existing WB Off Ramp
Highway Version: 1

Evaluation Title: Evaluation 3
Evaluation Comment: Created Fri Jun 21 10:55:12 PDT 2024

Minimum Location: 0.000
Maximum Location: 5+65.945

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

First Year of Analysis: 2023
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

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- Roundabouts: completed in 2018 under NCHRP Project 17-70, the new methods will provide improved outcomes for the safety analysis of roundabouts.
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- 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: 5+65.945
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;

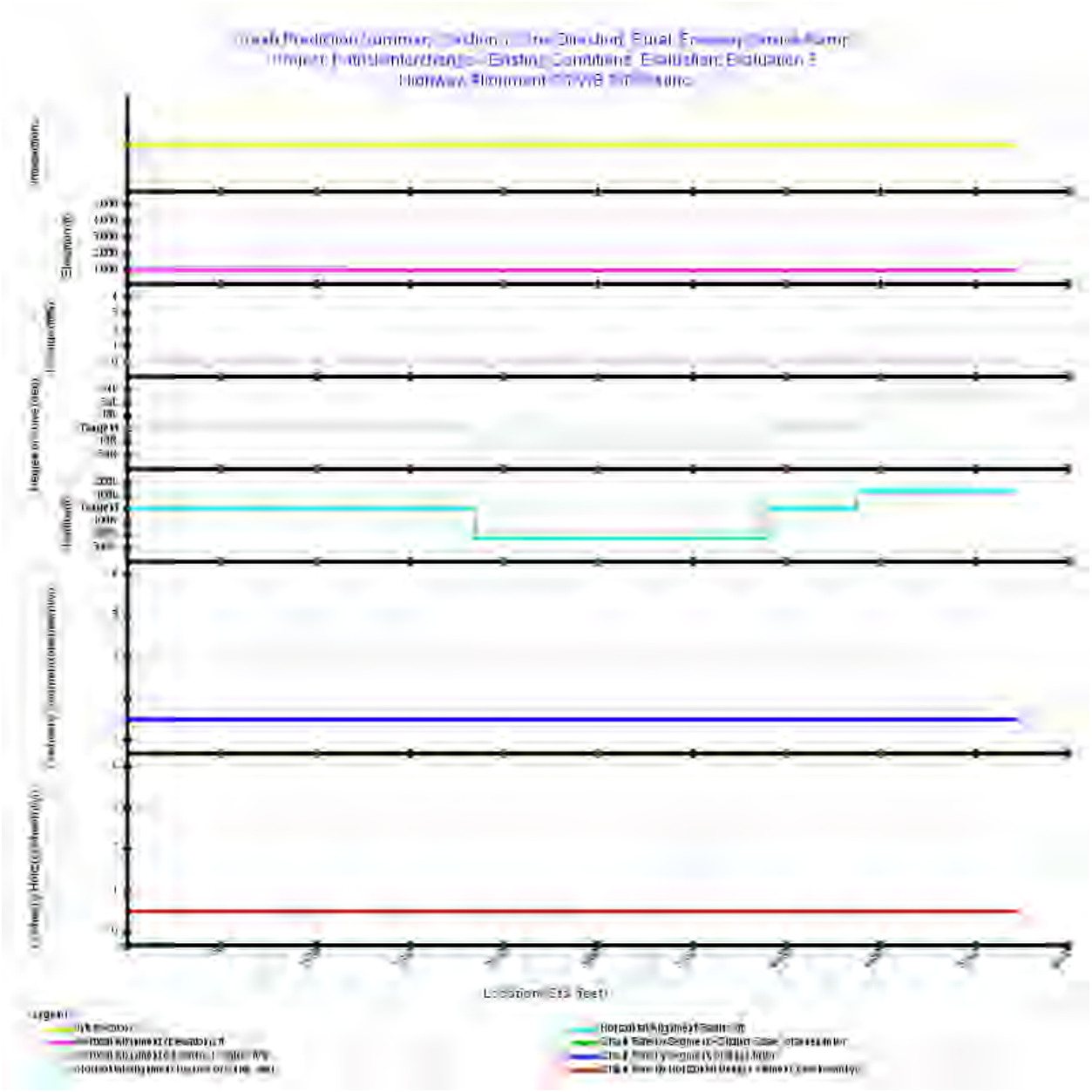

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	Rural	0.000	5+65.945	565.95	0.1072	2023: 140; 2024: 142; 2025: 145; 2026: 148; 2027: 151; 2028: 154; 2029: 157; 2030: 160; 2031: 161; 2032: 163; 2033: 164; 2034: 166; 2035: 167; 2036: 169; 2037: 170; 2038: 172; 2039: 173; 2040: 175; 2041: 176; 2042: 178; 2043: 179; 2044: 181; 2045: 182; 2046: 184; 2047: 185; 2048: 187; 2049: 188; 2050: 190

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.1072**
Average Future Road AADT (vpd)	**168**
Predicted Crashes	
Total Crashes	**1.49**
Fatal and Injury Crashes	**0.68**
Property-Damage-Only Crashes	**0.81**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**46**
Percent Property-Damage-Only Crashes (%)	**54**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**0.4953**
FI Crash Rate (crashes/mi/yr)	**0.2267**
PDO Crash Rate (crashes/mi/yr)	**0.2686**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**0.18**
Travel Crash Rate (crashes/million veh-mi)	**8.07**
Travel FI Crash Rate (crashes/million veh-mi)	**3.69**
Travel PDO Crash Rate (crashes/million veh-mi)	**4.38**

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	5+65.945	0.1072	1.486	0.0531	0.0243	0.0288	0.4953	8.07
Total			0.1072	1.486	0.0531	0.0243	0.0288	0.4953	

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	2+21.181	0.0419	0.581	0.0207	0.0095	0.0113	0.4953	8.07
Simple Curve 1	2+21.181	4+07.440	0.0353	0.489	0.0175	0.0080	0.0095	0.4953	8.07
Tangent	4+07.440	4+65.679	0.0110	0.153	0.0055	0.0025	0.0030	0.4953	8.07
Simple Curve 2	4+65.679	5+65.945	0.0190	0.263	0.0094	0.0043	0.0051	0.4953	8.07

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.05	0.02	45.654	0.03	54.346
2024	0.05	0.02	45.663	0.03	54.337
2025	0.05	0.02	45.676	0.03	54.324
2026	0.05	0.02	45.689	0.03	54.311
2027	0.05	0.02	45.701	0.03	54.299
2028	0.05	0.02	45.714	0.03	54.286
2029	0.05	0.02	45.726	0.03	54.274
2030	0.05	0.02	45.737	0.03	54.263
2031	0.05	0.02	45.741	0.03	54.259
2032	0.05	0.02	45.749	0.03	54.251
2033	0.05	0.02	45.753	0.03	54.247
2034	0.05	0.02	45.760	0.03	54.240
2035	0.05	0.02	45.764	0.03	54.236
2036	0.05	0.02	45.771	0.03	54.229
2037	0.05	0.03	45.775	0.03	54.225
2038	0.05	0.03	45.782	0.03	54.218
2039	0.05	0.03	45.786	0.03	54.214
2040	0.06	0.03	45.793	0.03	54.207
2041	0.06	0.03	45.796	0.03	54.204
2042	0.06	0.03	45.803	0.03	54.197
2043	0.06	0.03	45.807	0.03	54.193
2044	0.06	0.03	45.814	0.03	54.186
2045	0.06	0.03	45.817	0.03	54.183
2046	0.06	0.03	45.824	0.03	54.176
2047	0.06	0.03	45.827	0.03	54.173
2048	0.06	0.03	45.834	0.03	54.166
2049	0.06	0.03	45.837	0.03	54.163
2050	0.06	0.03	45.843	0.03	54.157
Total	1.49	0.68	45.769	0.81	54.231
Average	0.05	0.02	45.769	0.03	54.231

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	0.0273	0.0829	0.3545	0.2156	0.8061

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.01	0.5	0.05	3.5	0.06	4.0
Highway Segment	Collision with Fixed Object	0.38	25.8	0.50	33.7	0.89	59.5
Highway Segment	Collision with Other Object	0.02	1.4	0.10	6.7	0.12	8.2
Highway Segment	Other Single-vehicle Collision	0.25	16.8	0.13	8.7	0.38	25.5
Highway Segment	Collision with Parked Vehicle	0.02	1.1	0.02	1.2	0.04	2.3
Highway Segment	Total Single Vehicle Crashes	0.68	45.5	0.80	53.9	1.48	99.5
Highway Segment	Right-Angle Collision	0.00	0.0	0.00	0.0	0.00	0.0
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	0.0	0.00	0.0	0.00	0.0
Highway Segment	Rear-end Collision	0.00	0.2	0.00	0.2	0.01	0.3
Highway Segment	Sideswipe, Same Direction Collision	0.00	0.1	0.00	0.1	0.00	0.2
Highway Segment	Total Multiple Vehicle Crashes	0.00	0.2	0.00	0.3	0.01	0.5
Highway Segment	Total Highway Segment Crashes	0.68	45.8	0.81	54.2	1.49	100.0
	Total Crashes	0.68	45.8	0.81	54.2	1.49	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	5+65.945	Warning: for segment #1 (0.000 to 5+65.945), The ramp type for Ramp Alignment WT WB Off Existing is set at the Ramp Connection (Exit) and in the Ramp (Exit). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Overview

Report Generated: Jun 21, 2024 10:57 AM
Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Fri Jun 21 10:57:04 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Patrick Interchange - Existing Conditions
Project Comment: Created Tue May 07 15:07:17 PDT 2024
Project Unit System: U.S. Customary

Highway Title: Alignment WT WB On Existing
Highway Comment: Waltham Existing WB On Ramp
Highway Version: 1

Evaluation Title: Evaluation 3
Evaluation Comment: Created Fri Jun 21 10:56:42 PDT 2024

Minimum Location: 0.000
Maximum Location: 6+74.844

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

First Year of Analysis: 2023
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: 6+74.844
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;

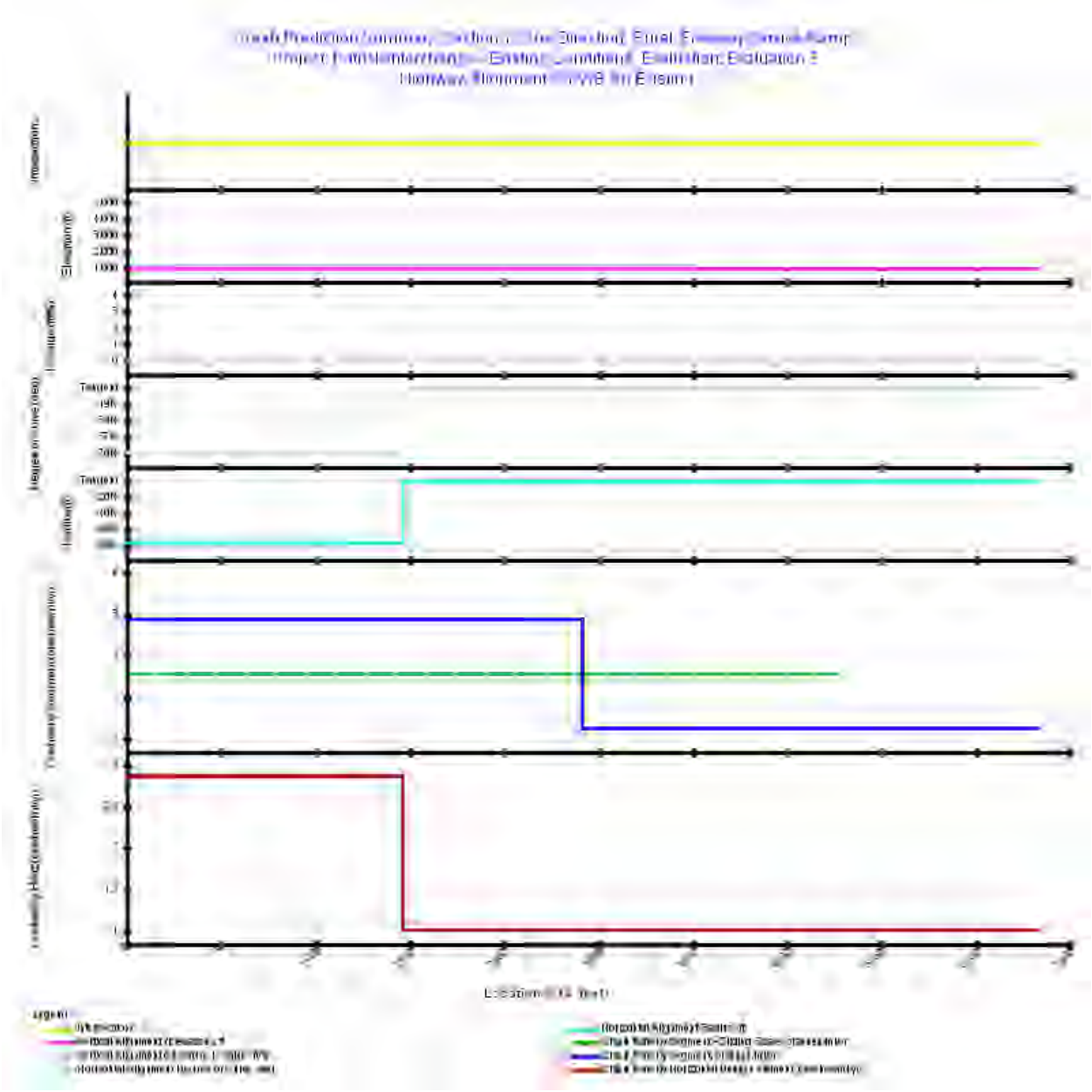

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	Rural	0.000	3+38.000	338.00	0.0640	2023: 620; 2024: 614; 2025: 608; 2026: 602; 2027: 597; 2028: 591; 2029: 585; 2030: 580; 2031: 586; 2032: 592; 2033: 598; 2034: 604; 2035: 610; 2036: 616; 2037: 622; 2038: 628; 2039: 634; 2040: 640; 2041: 646; 2042: 652; 2043: 658; 2044: 664; 2045: 670; 2046: 676; 2047: 682; 2048: 688; 2049: 694; 2050: 700
2	Freeway Ramp and C-D Road One-lane Ramp Entrance	Rural	3+38.000	6+74.844	336.84	0.0638	2023: 620; 2024: 614; 2025: 608; 2026: 602; 2027: 597; 2028: 591; 2029: 585; 2030: 580; 2031: 586; 2032: 592; 2033: 598; 2034: 604; 2035: 610; 2036: 616; 2037: 622; 2038: 628; 2039: 634; 2040: 640; 2041: 646; 2042: 652; 2043: 658; 2044: 664; 2045: 670; 2046: 676; 2047: 682; 2048: 688; 2049: 694; 2050: 700

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.1278**
Average Future Road AADT (vpd)	**631**
Predicted Crashes	
Total Crashes	**5.62**
Fatal and Injury Crashes	**2.35**
Property-Damage-Only Crashes	**3.27**
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)	**1.5714**
FI Crash Rate (crashes/mi/yr)	**0.6568**
PDO Crash Rate (crashes/mi/yr)	**0.9145**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**0.82**
Travel Crash Rate (crashes/million veh-mi)	**6.83**
Travel FI Crash Rate (crashes/million veh-mi)	**2.85**
Travel PDO Crash Rate (crashes/million veh-mi)	**3.97**

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	3+38.000	0.0640	5.168	0.1846	0.0764	0.1082	2.8829	12.53
2	3+38.000	6+74.844	0.0638	0.456	0.0163	0.0076	0.0087	0.2553	1.11
Total			0.1278	5.623	0.2008	0.0840	0.1169	1.5714	

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	2+04.724	0.0388	3.130	0.1118	0.0463	0.0655	2.8829	12.53
Tangent	2+04.724	6+74.844	0.0890	2.494	0.0891	0.0377	0.0514	1.0002	4.34

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.20	0.08	41.798	0.12	58.202
2024	0.20	0.08	41.796	0.12	58.204
2025	0.20	0.08	41.794	0.11	58.206
2026	0.19	0.08	41.793	0.11	58.207
2027	0.19	0.08	41.791	0.11	58.209
2028	0.19	0.08	41.789	0.11	58.211
2029	0.19	0.08	41.787	0.11	58.213
2030	0.19	0.08	41.786	0.11	58.214
2031	0.19	0.08	41.788	0.11	58.212
2032	0.19	0.08	41.789	0.11	58.211
2033	0.19	0.08	41.791	0.11	58.209
2034	0.20	0.08	41.793	0.11	58.207
2035	0.20	0.08	41.795	0.11	58.205
2036	0.20	0.08	41.797	0.12	58.203
2037	0.20	0.08	41.799	0.12	58.201
2038	0.20	0.08	41.800	0.12	58.200
2039	0.20	0.08	41.802	0.12	58.198
2040	0.20	0.09	41.804	0.12	58.196
2041	0.20	0.09	41.805	0.12	58.195
2042	0.21	0.09	41.807	0.12	58.193
2043	0.21	0.09	41.809	0.12	58.191
2044	0.21	0.09	41.810	0.12	58.190
2045	0.21	0.09	41.812	0.12	58.188
2046	0.21	0.09	41.813	0.12	58.187
2047	0.21	0.09	41.815	0.12	58.185
2048	0.21	0.09	41.816	0.12	58.184
2049	0.21	0.09	41.817	0.12	58.183
2050	0.22	0.09	41.819	0.13	58.181
Total	5.62	2.35	41.801	3.27	58.199
Average	0.20	0.08	41.801	0.12	58.199

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	0.0595	0.1803	1.1805	0.7181	3.0291
2	0.0058	0.0175	0.1154	0.0736	0.2437
Total	0.0652	0.1978	1.2958	0.7918	3.2728

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.02	0.4	0.21	3.7	0.23	4.1
Highway Segment	Collision with Fixed Object	1.30	23.2	1.98	35.2	3.28	58.4
Highway Segment	Collision with Other Object	0.07	1.3	0.40	7.0	0.47	8.3
Highway Segment	Other Single-vehicle Collision	0.85	15.0	0.51	9.1	1.36	24.2
Highway Segment	Collision with Parked Vehicle	0.06	1.0	0.07	1.3	0.13	2.3
Highway Segment	Total Single Vehicle Crashes	2.30	40.9	3.17	56.3	5.47	97.2
Highway Segment	Right-Angle Collision	0.00	0.1	0.00	0.1	0.01	0.1
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	0.1	0.01	0.2
Highway Segment	Rear-end Collision	0.03	0.6	0.05	1.0	0.09	1.5
Highway Segment	Sideswipe, Same Direction Collision	0.01	0.2	0.04	0.7	0.05	0.9
Highway Segment	Total Multiple Vehicle Crashes	0.05	0.9	0.11	1.9	0.16	2.8
Highway Segment	Total Highway Segment Crashes	2.35	41.8	3.27	58.2	5.62	100.0
	Total Crashes	2.35	41.8	3.27	58.2	5.62	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	3+38.000	Warning: for segment #1 (0.000 to 3+38.000), The ramp type for Ramp Alignment WT WB On Existing is set at the Ramp Connection (Entrance) and in the Ramp (Entrance). The Ramp value takes precedence.
3+38.000	6+74.844	Warning: for segment #2 (3+38.000 to 6+74.844), The ramp type for Ramp Alignment WT WB On Existing is set at the Ramp Connection (Entrance) and in the Ramp (Entrance). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Overview

Report Generated: Jun 21, 2024 10:05 AM
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Evaluation Date: Fri Jun 21 10:04:59 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: I 80 Vista Boulevard Interchange to USA Parkway Interchange
Project Comment: Created Fri Apr 26 14:41:46 PDT 2024
Project Unit System: U.S. Customary

Highway Title: I-80 Capacity Improvements - 2050 Build
Highway Comment: I-80 2050 Build
Highway Version: 1

Evaluation Title: Evaluation 5
Evaluation Comment: Created Fri Jun 21 10:04:22 PDT 2024

Minimum Location: 553+89.850
Maximum Location: 1235+84.647

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

First Year of Analysis: 2023
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

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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 1 Evaluation

Section: Section 1
Evaluation Start Location: 553+89.850
Evaluation End Location: 1235+84.647
Functional Class: Freeway
Type of Alignment: Divided, Multilane
Model Category: Freeway Segment
Calibration Factor: FI_MV=1.0; FI_SV=1.0; PDO_MV=1.0; PDO_SV=1.0;

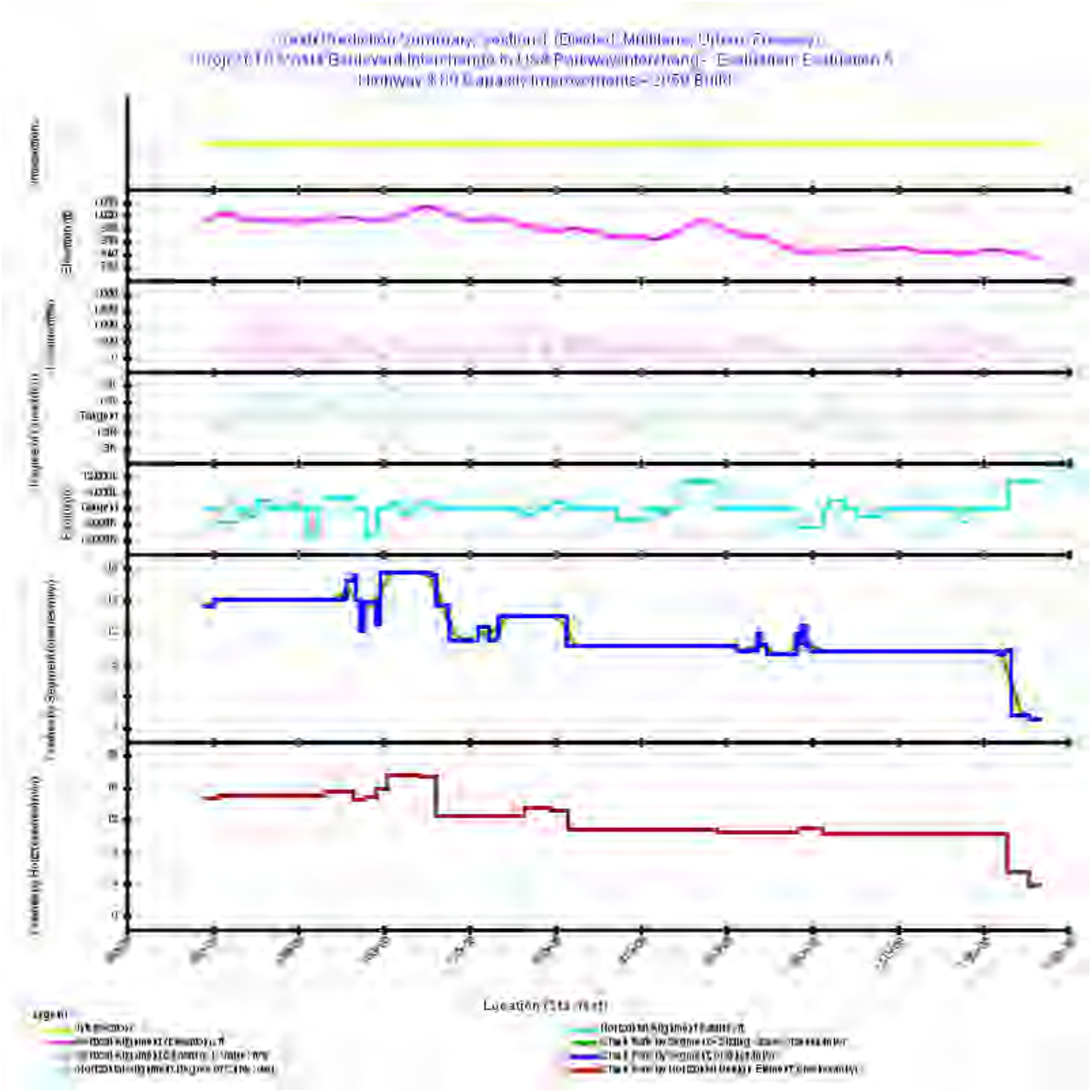

Figure 1. Crash Prediction Summary (Section 1)

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

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	Six-lane Freeway	Urban	553+89.850	560+00.000	610.15	0.1156	2023: 48,560; 2024: 49,774; 2025: 50,988; 2026: 52,202; 2027: 53,417; 2028: 54,631; 2029: 55,845; 2030: 57,060; 2031: 57,630; 2032: 58,201; 2033: 58,771; 2034: 59,342; 2035: 59,912; 2036: 60,483; 2037: 61,053; 2038: 61,624; 2039: 62,194; 2040: 62,765; 2041: 63,335; 2042: 63,906; 2043: 64,476; 2044: 65,047; 2045: 65,617; 2046: 66,188; 2047: 66,758; 2048: 67,329; 2049: 67,899; 2050: 68,470	4.00	Non-Traversable Median	24.00
2	Six-lane Freeway	Urban	560+00.000	666+81.410	10,681.41	2.0230	2023: 48,560; 2024: 49,774; 2025: 50,988; 2026: 52,202; 2027: 53,417; 2028: 54,631; 2029: 55,845; 2030: 57,060; 2031: 57,630; 2032: 58,201; 2033: 58,771; 2034: 59,342; 2035: 59,912; 2036: 60,483; 2037: 61,053; 2038: 61,624; 2039: 62,194; 2040: 62,765; 2041: 63,335; 2042: 63,906; 2043: 64,476; 2044: 65,047; 2045: 65,617; 2046: 66,188; 2047: 66,758; 2048: 67,329; 2049: 67,899; 2050: 68,470	4.00	Non-Traversable Median	24.00
3	Seven-lane Freeway	Urban	666+81.410	669+78.320	296.91	0.0562	2023: 48,560; 2024: 49,774; 2025: 50,988; 2026: 52,202; 2027: 53,417; 2028: 54,631; 2029: 55,845; 2030: 57,060; 2031: 57,630; 2032: 58,201; 2033: 58,771; 2034: 59,342; 2035: 59,912; 2036: 60,483; 2037: 61,053; 2038: 61,624; 2039: 62,194; 2040: 62,765; 2041: 63,335; 2042: 63,906; 2043: 64,476; 2044: 65,047; 2045: 65,617; 2046: 66,188; 2047: 66,758; 2048: 67,329; 2049: 67,899; 2050: 68,470	4.00	Non-Traversable Median	24.00
4	Six-lane Freeway	Urban	669+78.320	675+46.700	568.38	0.1076	2023: 48,560; 2024: 49,774; 2025: 50,988; 2026: 52,202; 2027: 53,417; 2028: 54,631; 2029: 55,845; 2030: 57,060; 2031: 57,630; 2032: 58,201; 2033: 58,771; 2034: 59,342; 2035: 59,912; 2036: 60,483; 2037: 61,053; 2038: 61,624; 2039: 62,194; 2040: 62,765; 2041: 63,335; 2042: 63,906; 2043: 64,476; 2044: 65,047; 2045: 65,617; 2046: 66,188; 2047: 66,758; 2048: 67,329; 2049: 67,899; 2050: 68,470	4.00	Non-Traversable Median	24.00
5	Six-lane Freeway	Urban	675+46.700	677+75.320	228.62	0.0433	2023: 46,310; 2024: 47,558; 2025: 48,807; 2026: 50,055; 2027: 51,304; 2028: 52,552; 2029: 53,801; 2030: 55,050; 2031: 55,600; 2032: 56,151; 2033: 56,701; 2034: 57,252; 2035: 57,802; 2036: 58,353; 2037: 58,903; 2038: 59,454; 2039: 60,004; 2040: 60,555; 2041: 61,105; 2042: 61,656; 2043: 62,206; 2044: 62,757; 2045: 63,307; 2046: 63,858; 2047: 64,408; 2048: 64,959; 2049: 65,509; 2050: 66,060	4.00	Non-Traversable Median	24.00
6	Six-lane Freeway	Urban	677+75.320	680+11.540	236.22	0.0447	2023: 46,310; 2024: 47,558; 2025: 48,807; 2026: 50,055; 2027: 51,304; 2028: 52,552; 2029: 53,801; 2030: 55,050; 2031: 55,600; 2032: 56,151; 2033: 56,701; 2034: 57,252; 2035: 57,802; 2036: 58,353; 2037: 58,903; 2038: 59,454; 2039: 60,004; 2040: 60,555; 2041: 61,105; 2042: 61,656; 2043: 62,206; 2044: 62,757; 2045: 63,307; 2046: 63,858; 2047: 64,408; 2048: 64,959; 2049: 65,509; 2050: 66,060	4.00	Non-Traversable Median	24.00
7	Six-lane Freeway	Urban	680+11.540	683+37.700	326.16	0.0618	2023: 46,310; 2024: 47,558; 2025: 48,807; 2026: 50,055; 2027: 51,304; 2028: 52,552; 2029: 53,801; 2030: 55,050; 2031: 55,600; 2032: 56,151; 2033: 56,701; 2034: 57,252; 2035: 57,802; 2036: 58,353; 2037: 58,903; 2038: 59,454; 2039: 60,004; 2040: 60,555; 2041: 61,105; 2042: 61,656; 2043: 62,206; 2044: 62,757; 2045: 63,307; 2046: 63,858; 2047: 64,408; 2048: 64,959; 2049: 65,509; 2050: 66,060	4.00	Non-Traversable Median	24.00
8	Six-lane Freeway	Urban	683+37.700	694+42.590	1,104.89	0.2093	2023: 46,310; 2024: 47,558; 2025: 48,807; 2026: 50,055; 2027: 51,304; 2028: 52,552; 2029: 53,801; 2030: 55,050; 2031: 55,600; 2032: 56,151; 2033: 56,701; 2034: 57,252; 2035: 57,802; 2036: 58,353; 2037: 58,903; 2038: 59,454; 2039: 60,004; 2040: 60,555; 2041: 61,105; 2042: 61,656; 2043: 62,206; 2044: 62,757; 2045: 63,307; 2046: 63,858; 2047: 64,408; 2048: 64,959; 2049: 65,509; 2050: 66,060	4.00	Non-Traversable Median	24.00
9	Seven-lane Freeway	Urban	694+42.590	697+39.130	296.54	0.0562	2023: 46,310; 2024: 47,558; 2025: 48,807; 2026: 50,055; 2027: 51,304; 2028: 52,552; 2029: 53,801; 2030: 55,050; 2031: 55,600; 2032: 56,151; 2033: 56,701; 2034: 57,252; 2035: 57,802; 2036: 58,353; 2037: 58,903; 2038: 59,454; 2039: 60,004; 2040: 60,555; 2041: 61,105; 2042: 61,656; 2043: 62,206; 2044: 62,757; 2045: 63,307; 2046: 63,858; 2047: 64,408; 2048: 64,959; 2049: 65,509; 2050: 66,060	4.00	Non-Traversable Median	24.00
10	Seven-lane Freeway	Urban	697+39.130	697+76.160	37.03	0.0070	2023: 46,310; 2024: 47,558; 2025: 48,807; 2026: 50,055; 2027: 51,304; 2028: 52,552; 2029: 53,801; 2030: 55,050; 2031: 55,600; 2032: 56,151; 2033: 56,701; 2034: 57,252; 2035: 57,802; 2036: 58,353; 2037: 58,903; 2038: 59,454; 2039: 60,004; 2040: 60,555; 2041: 61,105; 2042: 61,656; 2043: 62,206; 2044: 62,757; 2045: 63,307; 2046: 63,858; 2047: 64,408; 2048: 64,959; 2049: 65,509; 2050: 66,060	4.00	Non-Traversable Median	24.00
11	Six-lane Freeway	Urban	697+76.160	698+11.400	35.24	0.0067	2023: 46,310; 2024: 47,558; 2025: 48,807; 2026: 50,055; 2027: 51,304; 2028: 52,552; 2029: 53,801; 2030: 55,050; 2031: 55,600; 2032: 56,151; 2033: 56,701; 2034: 57,252; 2035: 57,802; 2036: 58,353; 2037: 58,903; 2038: 59,454; 2039: 60,004; 2040: 60,555; 2041: 61,105; 2042: 61,656; 2043: 62,206; 2044: 62,757; 2045: 63,307; 2046: 63,858; 2047: 64,408; 2048: 64,959; 2049: 65,509; 2050: 66,060	4.00	Non-Traversable Median	24.00
12	Six-lane Freeway	Urban	698+11.400	739+49.080	4,137.68	0.7837	2023: 46,740; 2024: 47,998; 2025: 49,257; 2026: 50,515; 2027: 51,774; 2028: 53,032; 2029: 54,291; 2030: 55,550; 2031: 56,105; 2032: 56,661; 2033: 57,216; 2034: 57,772; 2035: 58,327; 2036: 58,883; 2037: 59,438; 2038: 59,994; 2039: 60,549; 2040: 61,105; 2041: 61,660; 2042: 62,216; 2043: 62,771; 2044: 63,327; 2045: 63,882; 2046: 64,438; 2047: 64,993; 2048: 65,549; 2049: 66,104; 2050: 66,660	4.00	Non-Traversable Median	24.00
13	Seven-lane Freeway	Urban	739+49.080	743+13.100	364.02	0.0689	2023: 46,740; 2024: 47,998; 2025: 49,257; 2026: 50,515; 2027: 51,774; 2028: 53,032; 2029: 54,291; 2030: 55,550; 2031: 56,105; 2032: 56,661; 2033: 57,216; 2034: 57,772; 2035: 58,327; 2036: 58,883; 2037: 59,438; 2038: 59,994; 2039: 60,549; 2040: 61,105; 2041: 61,660; 2042: 62,216; 2043: 62,771; 2044: 63,327; 2045: 63,882; 2046: 64,438; 2047: 64,993; 2048: 65,549; 2049: 66,104; 2050: 66,660	4.00	Non-Traversable Median	24.00
14	Six-lane Freeway	Urban	743+13.100	752+69.100	956.00	0.1811	2023: 46,740; 2024: 47,998; 2025: 49,257; 2026: 50,515; 2027: 51,774; 2028: 53,032; 2029: 54,291; 2030: 55,550; 2031: 56,105; 2032: 56,661; 2033: 57,216; 2034: 57,772; 2035: 58,327; 2036: 58,883; 2037: 59,438; 2038: 59,994; 2039: 60,549; 2040: 61,105; 2041: 61,660; 2042: 62,216; 2043: 62,771; 2044: 63,327; 2045: 63,882; 2046: 64,438; 2047: 64,993; 2048: 65,549; 2049: 66,104; 2050: 66,660	4.00	Non-Traversable Median	24.00
15	Six-lane Freeway	Urban	752+69.100	753+63.640	94.54	0.0179	2023: 42,535; 2024: 43,830; 2025: 45,125; 2026: 46,420; 2027: 47,715; 2028: 49,010; 2029: 50,305; 2030: 51,600; 2031: 52,116; 2032: 52,632; 2033: 53,148; 2034: 53,664; 2035: 54,180; 2036: 54,696; 2037: 55,212; 2038: 55,728; 2039: 56,244; 2040: 56,760; 2041: 57,276; 2042: 57,792; 2043: 58,308; 2044: 58,824; 2045: 59,340; 2046: 59,856; 2047: 60,372; 2048: 60,888; 2049: 61,404; 2050: 61,920	4.00	Non-Traversable Median	24.00

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)
16	Six-lane Freeway	Urban	753+63.640	777+48.970	2,385.33	0.4518	2023: 42,535; 2024: 43,830; 2025: 45,125; 2026: 46,420; 2027: 47,715; 2028: 49,010; 2029: 50,305; 2030: 51,600; 2031: 52,116; 2032: 52,632; 2033: 53,148; 2034: 53,664; 2035: 54,180; 2036: 54,696; 2037: 55,212; 2038: 55,728; 2039: 56,244; 2040: 56,760; 2041: 57,276; 2042: 57,792; 2043: 58,308; 2044: 58,824; 2045: 59,340; 2046: 59,856; 2047: 60,372; 2048: 60,888; 2049: 61,404; 2050: 61,920	4.00	Non-Traversable Median	24.00
17	Six-lane Freeway	Urban	777+48.970	785+77.800	828.83	0.1570	2023: 42,535; 2024: 43,830; 2025: 45,125; 2026: 46,420; 2027: 47,715; 2028: 49,010; 2029: 50,305; 2030: 51,600; 2031: 52,116; 2032: 52,632; 2033: 53,148; 2034: 53,664; 2035: 54,180; 2036: 54,696; 2037: 55,212; 2038: 55,728; 2039: 56,244; 2040: 56,760; 2041: 57,276; 2042: 57,792; 2043: 58,308; 2044: 58,824; 2045: 59,340; 2046: 59,856; 2047: 60,372; 2048: 60,888; 2049: 61,404; 2050: 61,920	4.00	Non-Traversable Median	24.00
18	Six-lane Freeway	Urban	785+77.800	786+41.310	63.51	0.0120	2023: 43,290; 2024: 44,607; 2025: 45,924; 2026: 47,241; 2027: 48,558; 2028: 49,875; 2029: 51,192; 2030: 52,510; 2031: 53,035; 2032: 53,561; 2033: 54,086; 2034: 54,612; 2035: 55,137; 2036: 55,663; 2037: 56,188; 2038: 56,714; 2039: 57,239; 2040: 57,765; 2041: 58,290; 2042: 58,816; 2043: 59,341; 2044: 59,867; 2045: 60,392; 2046: 60,918; 2047: 61,443; 2048: 61,969; 2049: 62,494; 2050: 63,020	4.00	Non-Traversable Median	24.00
19	Seven-lane Freeway	Urban	786+41.310	791+41.310	500.00	0.0947	2023: 43,290; 2024: 44,607; 2025: 45,924; 2026: 47,241; 2027: 48,558; 2028: 49,875; 2029: 51,192; 2030: 52,510; 2031: 53,035; 2032: 53,561; 2033: 54,086; 2034: 54,612; 2035: 55,137; 2036: 55,663; 2037: 56,188; 2038: 56,714; 2039: 57,239; 2040: 57,765; 2041: 58,290; 2042: 58,816; 2043: 59,341; 2044: 59,867; 2045: 60,392; 2046: 60,918; 2047: 61,443; 2048: 61,969; 2049: 62,494; 2050: 63,020	4.00	Non-Traversable Median	24.00
20	Six-lane Freeway	Urban	791+41.310	794+41.440	300.13	0.0568	2023: 43,290; 2024: 44,607; 2025: 45,924; 2026: 47,241; 2027: 48,558; 2028: 49,875; 2029: 51,192; 2030: 52,510; 2031: 53,035; 2032: 53,561; 2033: 54,086; 2034: 54,612; 2035: 55,137; 2036: 55,663; 2037: 56,188; 2038: 56,714; 2039: 57,239; 2040: 57,765; 2041: 58,290; 2042: 58,816; 2043: 59,341; 2044: 59,867; 2045: 60,392; 2046: 60,918; 2047: 61,443; 2048: 61,969; 2049: 62,494; 2050: 63,020	4.00	Non-Traversable Median	24.00
21	Six-lane Freeway	Urban	794+41.440	849+12.766	5,471.33	1.0362	2023: 43,290; 2024: 44,607; 2025: 45,924; 2026: 47,241; 2027: 48,558; 2028: 49,875; 2029: 51,192; 2030: 52,510; 2031: 53,035; 2032: 53,561; 2033: 54,086; 2034: 54,612; 2035: 55,137; 2036: 55,663; 2037: 56,188; 2038: 56,714; 2039: 57,239; 2040: 57,765; 2041: 58,290; 2042: 58,816; 2043: 59,341; 2044: 59,867; 2045: 60,392; 2046: 60,918; 2047: 61,443; 2048: 61,969; 2049: 62,494; 2050: 63,020	4.00	Non-Traversable Median	24.00
22	Six-lane Freeway	Rural	849+12.766	988+99.100	13,986.33	2.6489	2023: 43,290; 2024: 44,607; 2025: 45,924; 2026: 47,241; 2027: 48,558; 2028: 49,875; 2029: 51,192; 2030: 52,510; 2031: 53,035; 2032: 53,561; 2033: 54,086; 2034: 54,612; 2035: 55,137; 2036: 55,663; 2037: 56,188; 2038: 56,714; 2039: 57,239; 2040: 57,765; 2041: 58,290; 2042: 58,816; 2043: 59,341; 2044: 59,867; 2045: 60,392; 2046: 60,918; 2047: 61,443; 2048: 61,969; 2049: 62,494; 2050: 63,020	4.00	Non-Traversable Median	24.00
23	Six-lane Freeway	Rural	988+99.100	999+58.470	1,059.37	0.2006	2023: 41,810; 2024: 43,148; 2025: 44,487; 2026: 45,825; 2027: 47,164; 2028: 48,502; 2029: 49,841; 2030: 51,180; 2031: 51,692; 2032: 52,204; 2033: 52,716; 2034: 53,228; 2035: 53,740; 2036: 54,252; 2037: 54,764; 2038: 55,276; 2039: 55,788; 2040: 56,300; 2041: 56,812; 2042: 57,324; 2043: 57,836; 2044: 58,348; 2045: 58,860; 2046: 59,372; 2047: 59,884; 2048: 60,396; 2049: 60,908; 2050: 61,420	4.00	Non-Traversable Median	24.00
24	Seven-lane Freeway	Rural	999+58.470	1004+58.470	500.00	0.0947	2023: 41,810; 2024: 43,148; 2025: 44,487; 2026: 45,825; 2027: 47,164; 2028: 48,502; 2029: 49,841; 2030: 51,180; 2031: 51,692; 2032: 52,204; 2033: 52,716; 2034: 53,228; 2035: 53,740; 2036: 54,252; 2037: 54,764; 2038: 55,276; 2039: 55,788; 2040: 56,300; 2041: 56,812; 2042: 57,324; 2043: 57,836; 2044: 58,348; 2045: 58,860; 2046: 59,372; 2047: 59,884; 2048: 60,396; 2049: 60,908; 2050: 61,420	4.00	Non-Traversable Median	24.00
25	Six-lane Freeway	Rural	1004+58.470	1008+58.460	399.99	0.0758	2023: 41,810; 2024: 43,148; 2025: 44,487; 2026: 45,825; 2027: 47,164; 2028: 48,502; 2029: 49,841; 2030: 51,180; 2031: 51,692; 2032: 52,204; 2033: 52,716; 2034: 53,228; 2035: 53,740; 2036: 54,252; 2037: 54,764; 2038: 55,276; 2039: 55,788; 2040: 56,300; 2041: 56,812; 2042: 57,324; 2043: 57,836; 2044: 58,348; 2045: 58,860; 2046: 59,372; 2047: 59,884; 2048: 60,396; 2049: 60,908; 2050: 61,420	4.00	Non-Traversable Median	24.00
26	Six-lane Freeway	Rural	1008+58.460	1012+58.530	400.07	0.0758	2023: 41,810; 2024: 43,148; 2025: 44,487; 2026: 45,825; 2027: 47,164; 2028: 48,502; 2029: 49,841; 2030: 51,180; 2031: 51,692; 2032: 52,204; 2033: 52,716; 2034: 53,228; 2035: 53,740; 2036: 54,252; 2037: 54,764; 2038: 55,276; 2039: 55,788; 2040: 56,300; 2041: 56,812; 2042: 57,324; 2043: 57,836; 2044: 58,348; 2045: 58,860; 2046: 59,372; 2047: 59,884; 2048: 60,396; 2049: 60,908; 2050: 61,420	4.00	Non-Traversable Median	24.00
27	Six-lane Freeway	Rural	1012+58.530	1037+53.090	2,494.56	0.4725	2023: 41,810; 2024: 43,148; 2025: 44,487; 2026: 45,825; 2027: 47,164; 2028: 48,502; 2029: 49,841; 2030: 51,180; 2031: 51,692; 2032: 52,204; 2033: 52,716; 2034: 53,228; 2035: 53,740; 2036: 54,252; 2037: 54,764; 2038: 55,276; 2039: 55,788; 2040: 56,300; 2041: 56,812; 2042: 57,324; 2043: 57,836; 2044: 58,348; 2045: 58,860; 2046: 59,372; 2047: 59,884; 2048: 60,396; 2049: 60,908; 2050: 61,420	4.00	Non-Traversable Median	24.00
28	Six-lane Freeway	Rural	1037+53.090	1038+52.000	98.91	0.0187	2023: 41,810; 2024: 43,148; 2025: 44,487; 2026: 45,825; 2027: 47,164; 2028: 48,502; 2029: 49,841; 2030: 51,180; 2031: 51,692; 2032: 52,204; 2033: 52,716; 2034: 53,228; 2035: 53,740; 2036: 54,252; 2037: 54,764; 2038: 55,276; 2039: 55,788; 2040: 56,300; 2041: 56,812; 2042: 57,324; 2043: 57,836; 2044: 58,348; 2045: 58,860; 2046: 59,372; 2047: 59,884; 2048: 60,396; 2049: 60,908; 2050: 61,420	4.00	Non-Traversable Median	24.00
29	Six-lane Freeway	Rural	1038+52.000	1041+16.190	264.19	0.0500	2023: 42,110; 2024: 43,454; 2025: 44,798; 2026: 46,142; 2027: 47,487; 2028: 48,831; 2029: 50,175; 2030: 51,520; 2031: 52,035; 2032: 52,550; 2033: 53,065; 2034: 53,580; 2035: 54,095; 2036: 54,610; 2037: 55,125; 2038: 55,640; 2039: 56,155; 2040: 56,670; 2041: 57,185; 2042: 57,700; 2043: 58,215; 2044: 58,730; 2045: 59,245; 2046: 59,760; 2047: 60,275; 2048: 60,790; 2049: 61,305; 2050: 61,820	4.00	Non-Traversable Median	24.00
30	Six-lane Freeway	Rural	1041+16.190	1045+20.090	403.90	0.0765	2023: 42,110; 2024: 43,454; 2025: 44,798; 2026: 46,142; 2027: 47,487; 2028: 48,831; 2029: 50,175; 2030: 51,520; 2031: 52,035; 2032: 52,550; 2033: 53,065; 2034: 53,580; 2035: 54,095; 2036: 54,610; 2037: 55,125; 2038: 55,640; 2039: 56,155; 2040: 56,670; 2041: 57,185; 2042: 57,700; 2043: 58,215; 2044: 58,730; 2045: 59,245; 2046: 59,760; 2047: 60,275; 2048: 60,790; 2049: 61,305; 2050: 61,820	4.00	Non-Traversable Median	24.00
31	Seven-lane Freeway	Rural	1045+20.090	1048+19.090	299.00	0.0566	2023: 42,110; 2024: 43,454; 2025: 44,798; 2026: 46,142; 2027: 47,487; 2028: 48,831; 2029: 50,175; 2030: 51,520; 2031: 52,035; 2032: 52,550; 2033: 53,065; 2034: 53,580; 2035: 54,095; 2036: 54,610; 2037: 55,125; 2038: 55,640; 2039: 56,155; 2040: 56,670; 2041: 57,185; 2042: 57,700; 2043: 58,215; 2044: 58,730; 2045: 59,245; 2046: 59,760; 2047: 60,275; 2048: 60,790; 2049: 61,305; 2050: 61,820	4.00	Non-Traversable Median	24.00

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)
32	Six-lane Freeway	Rural	1048+19.090	1201+78.720	15,359.63	2.9090	2023: 42,110; 2024: 43,454; 2025: 44,798; 2026: 46,142; 2027: 47,487; 2028: 48,831; 2029: 50,175; 2030: 51,520; 2031: 52,035; 2032: 52,550; 2033: 53,065; 2034: 53,580; 2035: 54,095; 2036: 54,610; 2037: 55,125; 2038: 55,640; 2039: 56,155; 2040: 56,670; 2041: 57,185; 2042: 57,700; 2043: 58,215; 2044: 58,730; 2045: 59,245; 2046: 59,760; 2047: 60,275; 2048: 60,790; 2049: 61,305; 2050: 61,820	4.00	Non-Traversable Median	24.00
33	Seven-lane Freeway	Rural	1201+78.720	1206+78.720	500.00	0.0947	2023: 42,110; 2024: 43,454; 2025: 44,798; 2026: 46,142; 2027: 47,487; 2028: 48,831; 2029: 50,175; 2030: 51,520; 2031: 52,035; 2032: 52,550; 2033: 53,065; 2034: 53,580; 2035: 54,095; 2036: 54,610; 2037: 55,125; 2038: 55,640; 2039: 56,155; 2040: 56,670; 2041: 57,185; 2042: 57,700; 2043: 58,215; 2044: 58,730; 2045: 59,245; 2046: 59,760; 2047: 60,275; 2048: 60,790; 2049: 61,305; 2050: 61,820	4.00	Non-Traversable Median	24.00
34	Six-lane Freeway	Rural	1206+78.720	1209+03.410	224.69	0.0426	2023: 42,110; 2024: 43,454; 2025: 44,798; 2026: 46,142; 2027: 47,487; 2028: 48,831; 2029: 50,175; 2030: 51,520; 2031: 52,035; 2032: 52,550; 2033: 53,065; 2034: 53,580; 2035: 54,095; 2036: 54,610; 2037: 55,125; 2038: 55,640; 2039: 56,155; 2040: 56,670; 2041: 57,185; 2042: 57,700; 2043: 58,215; 2044: 58,730; 2045: 59,245; 2046: 59,760; 2047: 60,275; 2048: 60,790; 2049: 61,305; 2050: 61,820	4.00	Non-Traversable Median	24.00
35	Five-lane Freeway	Rural	1209+03.410	1213+00.000	396.59	0.0751	2023: 42,110; 2024: 43,454; 2025: 44,798; 2026: 46,142; 2027: 47,487; 2028: 48,831; 2029: 50,175; 2030: 51,520; 2031: 52,035; 2032: 52,550; 2033: 53,065; 2034: 53,580; 2035: 54,095; 2036: 54,610; 2037: 55,125; 2038: 55,640; 2039: 56,155; 2040: 56,670; 2041: 57,185; 2042: 57,700; 2043: 58,215; 2044: 58,730; 2045: 59,245; 2046: 59,760; 2047: 60,275; 2048: 60,790; 2049: 61,305; 2050: 61,820	4.00	Non-Traversable Median	24.00
36	Five-lane Freeway	Rural	1213+00.000	1226+73.000	1,373.00	0.2600	2023: 23,020; 2024: 23,200; 2025: 23,380; 2026: 23,560; 2027: 23,740; 2028: 23,920; 2029: 24,100; 2030: 24,280; 2031: 24,523; 2032: 24,766; 2033: 25,009; 2034: 25,252; 2035: 25,495; 2036: 25,738; 2037: 25,981; 2038: 26,224; 2039: 26,467; 2040: 26,710; 2041: 26,953; 2042: 27,196; 2043: 27,439; 2044: 27,682; 2045: 27,925; 2046: 28,168; 2047: 28,411; 2048: 28,654; 2049: 28,897; 2050: 29,140	4.00	Non-Traversable Median	24.00
37	Five-lane Freeway	Rural	1226+73.000	1227+27.500	54.50	0.0103	2023: 23,020; 2024: 23,200; 2025: 23,380; 2026: 23,560; 2027: 23,740; 2028: 23,920; 2029: 24,100; 2030: 24,280; 2031: 24,523; 2032: 24,766; 2033: 25,009; 2034: 25,252; 2035: 25,495; 2036: 25,738; 2037: 25,981; 2038: 26,224; 2039: 26,467; 2040: 26,710; 2041: 26,953; 2042: 27,196; 2043: 27,439; 2044: 27,682; 2045: 27,925; 2046: 28,168; 2047: 28,411; 2048: 28,654; 2049: 28,897; 2050: 29,140	4.32	Non-Traversable Median	24.33
38	Four-lane Freeway	Rural	1227+27.500	1227+56.850	29.35	0.0056	2023: 23,020; 2024: 23,200; 2025: 23,380; 2026: 23,560; 2027: 23,740; 2028: 23,920; 2029: 24,100; 2030: 24,280; 2031: 24,523; 2032: 24,766; 2033: 25,009; 2034: 25,252; 2035: 25,495; 2036: 25,738; 2037: 25,981; 2038: 26,224; 2039: 26,467; 2040: 26,710; 2041: 26,953; 2042: 27,196; 2043: 27,439; 2044: 27,682; 2045: 27,925; 2046: 28,168; 2047: 28,411; 2048: 28,654; 2049: 28,897; 2050: 29,140	4.83	Traversable Median	24.83
39	Four-lane Freeway	Rural	1227+56.850	1235+84.647	827.80	0.1568	2023: 23,020; 2024: 23,200; 2025: 23,380; 2026: 23,560; 2027: 23,740; 2028: 23,920; 2029: 24,100; 2030: 24,280; 2031: 24,523; 2032: 24,766; 2033: 25,009; 2034: 25,252; 2035: 25,495; 2036: 25,738; 2037: 25,981; 2038: 26,224; 2039: 26,467; 2040: 26,710; 2041: 26,953; 2042: 27,196; 2043: 27,439; 2044: 27,682; 2045: 27,925; 2046: 28,168; 2047: 28,411; 2048: 28,654; 2049: 28,897; 2050: 29,140	10.00	Traversable Median	30.00

Table 2. Predicted Freeway Crash Rates and Frequencies Summary (Section 1)

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Effective Length (mi)	**12.9157**
Average Future Road AADT (vpd)	**54,971**
Predicted Crashes	
Total Crashes	**4,354.39**
Fatal and Injury Crashes	**1,226.20**
Property-Damage-Only Crashes	**3,128.20**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**28**
Percent Property-Damage-Only Crashes (%)	**72**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**12.0407**
FI Crash Rate (crashes/mi/yr)	**3.3907**
PDO Crash Rate (crashes/mi/yr)	**8.6501**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**7,256.11**
Travel Crash Rate (crashes/million veh-mi)	**0.60**
Travel FI Crash Rate (crashes/million veh-mi)	**0.17**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.43**

Note: *Effective Length* is the *segment length* minus the length of the *speed change lanes* if present.
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 3. Predicted Crash Frequencies and Rates by Freeway Segment/Intersection (Section 1)

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	553+89.850	560+00.000	0.1156	46.583	1.6637	0.4553	1.2084	14.3969	0.66
2	560+00.000	666+81.410	2.0230	852.513	30.4469	8.9023	21.5446	15.0504	0.69
3	666+81.410	669+78.320	0.0562	23.880	0.8528	0.2737	0.5792	15.1664	0.69
4	669+78.320	675+46.700	0.1076	50.450	1.8018	0.5607	1.2411	16.7379	0.76
5	675+46.700	677+75.320	0.0433	20.952	0.7483	0.2177	0.5306	17.2815	0.82
6	677+75.320	680+11.540	0.0447	18.782	0.6708	0.1926	0.4782	14.9938	0.71
7	680+11.540	683+37.700	0.0618	20.990	0.7497	0.2097	0.5399	12.1357	0.57
8	683+37.700	694+42.590	0.2093	86.468	3.0881	0.9625	2.1256	14.7575	0.70
9	694+42.590	697+39.130	0.0562	19.960	0.7128	0.2058	0.5070	12.6924	0.60
10	697+39.130	697+76.160	0.0070	3.387	0.1210	0.0366	0.0844	17.2488	0.82
11	697+76.160	698+11.400	0.0067	3.290	0.1175	0.0342	0.0834	17.6074	0.83
12	698+11.400	739+49.080	0.7837	383.935	13.7120	4.0486	9.6634	17.4975	0.82
13	739+49.080	743+13.100	0.0689	33.433	1.1940	0.3763	0.8177	17.3189	0.81
14	743+13.100	752+69.100	0.1811	73.798	2.6356	0.7519	1.8838	14.5567	0.68
15	752+69.100	753+63.640	0.0179	6.536	0.2334	0.0684	0.1650	13.0361	0.66
16	753+63.640	777+48.970	0.4518	142.418	5.0863	1.4330	3.6534	11.2588	0.57
17	777+48.970	785+77.800	0.1570	55.089	1.9675	0.5727	1.3947	12.5336	0.63
18	785+77.800	786+41.310	0.0120	3.971	0.1418	0.0404	0.1014	11.7904	0.59
19	786+41.310	791+41.310	0.0947	29.701	1.0607	0.3117	0.7491	11.2014	0.56
20	791+41.310	794+41.440	0.0568	18.247	0.6517	0.1841	0.4676	11.4648	0.57
21	794+41.440	849+12.766	1.0362	391.883	13.9958	4.0798	9.9160	13.5064	0.67
22	849+12.766	988+99.100	2.6489	794.646	28.3802	7.6686	20.7116	10.7139	0.53
23	988+99.100	999+58.470	0.2006	57.224	2.0437	0.5215	1.5222	10.1860	0.52
24	999+58.470	1004+58.470	0.0947	27.416	0.9791	0.2630	0.7161	10.3395	0.53
25	1004+58.470	1008+58.460	0.0758	24.990	0.8925	0.2358	0.6567	11.7812	0.60
26	1008+58.460	1012+58.530	0.0758	22.975	0.8205	0.2149	0.6057	10.8292	0.55
27	1012+58.530	1037+53.090	0.4725	131.898	4.7106	1.1977	3.5130	9.9705	0.51
28	1037+53.090	1038+52.000	0.0187	6.195	0.2212	0.0592	0.1621	11.8106	0.60
29	1038+52.000	1041+16.190	0.0500	15.266	0.5452	0.1595	0.3857	10.8965	0.55
30	1041+16.190	1045+20.090	0.0765	26.902	0.9608	0.2874	0.6734	12.5600	0.64
31	1045+20.090	1048+19.090	0.0566	16.948	0.6053	0.1875	0.4178	10.6884	0.54
32	1048+19.090	1201+78.720	2.9090	834.190	29.7925	7.9402	21.8523	10.2414	0.52
33	1201+78.720	1206+78.720	0.0947	26.212	0.9362	0.2469	0.6893	9.8858	0.50
34	1206+78.720	1209+03.410	0.0426	12.111	0.4325	0.1098	0.3227	10.1638	0.52
35	1209+03.410	1213+00.000	0.0751	21.560	0.7700	0.2170	0.5529	10.2513	0.52
36	1213+00.000	1226+73.000	0.2600	30.792	1.0997	0.3538	0.7459	4.2291	0.45
37	1226+73.000	1227+27.500	0.0103	1.190	0.0425	0.0137	0.0288	4.1178	0.43
38	1227+27.500	1227+56.850	0.0056	0.659	0.0235	0.0073	0.0162	4.2325	0.45
39	1227+56.850	1235+84.647	0.1568	16.956	0.6056	0.1912	0.4144	3.8625	0.41
Total			12.9157	4,354.395	155.5141	43.7927	111.7214	12.0407	0.60

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 4. Predicted Crash Frequencies and Rates by Horizontal Design Element (Section 1)

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	553+89.850	565+28.527	0.2157	88.766	3.1702	0.8958	2.2745	14.7002	0.67
Simple Curve 1	565+28.527	582+00.593	0.3167	133.452	4.7662	1.3936	3.3726	15.0504	0.69
Tangent	582+00.593	588+13.846	0.1161	48.945	1.7480	0.5111	1.2369	15.0504	0.69
Simple Curve 2	588+13.846	594+46.549	0.1198	50.498	1.8035	0.5273	1.2762	15.0504	0.69
Tangent	594+46.549	596+42.927	0.0372	15.674	0.5598	0.1637	0.3961	15.0504	0.69
Simple Curve 3	596+42.927	608+29.783	0.2248	94.726	3.3831	0.9892	2.3939	15.0504	0.69
Tangent	608+29.783	621+29.232	0.2461	103.713	3.7040	1.0830	2.6210	15.0504	0.69
Simple Curve 4	621+29.232	628+15.126	0.1299	54.743	1.9551	0.5716	1.3835	15.0504	0.69
Tangent	628+15.126	638+61.243	0.1981	83.493	2.9819	0.8719	2.1100	15.0504	0.69
Simple Curve 5	638+61.243	645+42.101	0.1290	54.341	1.9408	0.5675	1.3733	15.0504	0.69
Tangent	645+42.101	652+38.147	0.1318	55.553	1.9840	0.5801	1.4039	15.0504	0.69
Simple Curve 6	652+38.147	675+46.052	0.4371	189.463	6.7666	2.0366	4.7299	15.4804	0.70
Tangent	675+46.052	684+55.505	0.1722	70.001	2.5001	0.7232	1.7768	14.5145	0.69
Simple Curve 7	684+55.505	694+42.593	0.1869	77.249	2.7589	0.8599	1.8990	14.7575	0.70
Tangent	694+42.593	703+14.800	0.1652	73.347	2.6196	0.7691	1.8505	15.8578	0.75
Simple Curve 8	703+14.800	711+54.209	0.1590	77.889	2.7817	0.8213	1.9604	17.4975	0.82
Tangent	711+54.209	712+76.243	0.0231	11.323	0.4044	0.1194	0.2850	17.4975	0.82
Simple Curve 9	712+76.243	723+64.635	0.2061	100.992	3.6069	1.0650	2.5419	17.4975	0.82
Tangent	723+64.635	729+08.311	0.1030	50.448	1.8017	0.5320	1.2697	17.4975	0.82
Simple Curve 10	729+08.311	743+13.097	0.2661	130.005	4.6430	1.3947	3.2484	17.4513	0.82
Tangent	743+13.097	815+08.378	1.3627	477.804	17.0644	4.9034	12.1610	12.5221	0.62
Simple Curve 11	815+08.378	825+51.135	0.1975	74.687	2.6674	0.7776	1.8899	13.5064	0.67
Tangent	825+51.135	835+70.195	0.1930	72.990	2.6068	0.7599	1.8469	13.5064	0.67
Simple Curve 12	835+70.195	850+69.213	0.2839	105.050	3.7518	1.0869	2.6649	13.2150	0.66
Tangent	850+69.213	891+45.426	0.7720	231.594	8.2712	2.2350	6.0363	10.7139	0.53
Simple Curve 13	891+45.426	913+56.808	0.4188	125.642	4.4872	1.2125	3.2747	10.7139	0.53
Tangent	913+56.808	925+54.993	0.2269	68.076	2.4313	0.6570	1.7743	10.7139	0.53
Simple Curve 14	925+54.993	930+80.990	0.0996	29.885	1.0673	0.2884	0.7789	10.7139	0.53
Tangent	930+80.990	940+22.129	0.1782	53.472	1.9097	0.5160	1.3937	10.7139	0.53
Simple Curve 15	940+22.129	973+05.929	0.6219	186.572	6.6633	1.8005	4.8628	10.7139	0.53
Tangent	973+05.929	1038+86.652	1.2463	363.216	12.9720	3.3865	9.5855	10.4080	0.53
Simple Curve 16	1038+86.652	1058+17.251	0.3656	111.324	3.9759	1.1295	2.8464	10.8736	0.55
Tangent	1058+17.251	1064+23.590	0.1148	32.931	1.1761	0.3134	0.8626	10.2414	0.52
Simple Curve 17	1064+23.590	1077+16.675	0.2449	70.228	2.5081	0.6685	1.8397	10.2414	0.52
Tangent	1077+16.675	1085+83.062	0.1641	47.054	1.6805	0.4479	1.2326	10.2414	0.52
Simple Curve 18	1085+83.062	1107+79.665	0.4160	119.299	4.2607	1.1355	3.1251	10.2414	0.52
Tangent	1107+79.665	1171+23.463	1.2015	344.535	12.3048	3.2794	9.0254	10.2414	0.52
Simple Curve 19	1171+23.463	1176+81.636	0.1057	30.315	1.0827	0.2885	0.7941	10.2414	0.52
Tangent	1176+81.636	1209+03.406	0.6102	173.941	6.2122	1.6475	4.5646	10.1808	0.52
Simple Curve 20	1209+03.406	1226+73.378	0.3352	52.361	1.8700	0.5709	1.2991	5.5785	0.46
Simple Curve 21	1226+73.378	1235+84.647	0.1726	18.796	0.6713	0.2120	0.4593	3.8895	0.41

Table 5. Predicted Crash Frequencies by Year (Section 1)

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	117.75	34.47	29.273	83.28	70.727
2024	121.68	35.46	29.145	86.22	70.855
2025	125.65	36.46	29.019	89.19	70.981
2026	129.67	37.47	28.896	92.20	71.104
2027	133.73	38.48	28.776	95.25	71.225
2028	137.82	39.50	28.657	98.33	71.343
2029	141.96	40.52	28.541	101.44	71.459
2030	146.14	41.55	28.427	104.60	71.573
2031	147.90	41.98	28.381	105.92	71.619
2032	149.65	42.41	28.336	107.25	71.664
2033	151.42	42.84	28.290	108.58	71.710
2034	153.19	43.27	28.245	109.92	71.755
2035	154.97	43.70	28.200	111.27	71.800
2036	156.76	44.14	28.156	112.62	71.844
2037	158.55	44.57	28.112	113.98	71.888
2038	160.35	45.01	28.068	115.34	71.932
2039	162.16	45.44	28.024	116.72	71.976
2040	163.97	45.88	27.981	118.09	72.019
2041	165.79	46.32	27.938	119.47	72.062
2042	167.62	46.76	27.895	120.86	72.105
2043	169.46	47.20	27.853	122.26	72.147
2044	171.30	47.64	27.811	123.66	72.189
2045	173.15	48.08	27.769	125.07	72.231
2046	175.01	48.52	27.727	126.48	72.273
2047	176.87	48.97	27.686	127.90	72.314
2048	178.74	49.41	27.645	129.33	72.355
2049	180.62	49.86	27.604	130.76	72.396
2050	182.50	50.30	27.563	132.20	72.437
Total	4,354.39	1,226.20	28.160	3,128.20	71.840
Average	155.51	43.79	28.160	111.72	71.840

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 Freeway Segment (Section 1)

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	0.2781	0.7388	4.1605	7.5703	33.8356
2	5.9228	16.0620	84.6717	142.6075	603.2487
3	0.1930	0.5308	2.6728	4.2662	16.2171
4	0.3953	1.0874	5.4759	8.7418	34.7499
5	0.1330	0.3532	1.9892	3.6194	14.8570
6	0.1261	0.3296	1.8219	3.1142	13.3907
7	0.1470	0.3783	2.0521	3.2952	15.1177
8	0.6734	1.8425	9.3697	15.0651	59.5173
9	0.1347	0.3523	1.9474	3.3288	14.1963
10	0.0224	0.0594	0.3344	0.6075	2.3635
11	0.0209	0.0554	0.3121	0.5679	2.3341
12	2.7587	7.5047	38.9390	64.1573	270.5756
13	0.2836	0.7680	3.7949	5.6903	22.8959
14	0.4922	1.2871	7.1137	12.1597	52.7451
15	0.0479	0.1234	0.6692	1.0746	4.6205
16	0.9932	2.5631	13.9458	22.6218	102.2938
17	0.4013	1.0331	5.6037	8.9983	39.0527
18	0.0283	0.0729	0.3955	0.6351	2.8390
19	0.2184	0.5622	3.0493	4.8965	20.9743
20	0.1290	0.3320	1.8011	2.8921	13.0932
21	2.8679	7.5986	39.8960	63.8722	277.6482
22	7.5839	19.0184	80.5717	107.5467	579.9257
23	0.4960	1.2190	5.3962	7.4917	42.6209
24	0.2501	0.6148	2.7214	3.7782	20.0509
25	0.2242	0.5510	2.4393	3.3866	18.3887
26	0.2119	0.5161	2.2604	3.0283	16.9583
27	1.1501	2.8200	12.4474	17.1173	98.3629
28	0.0599	0.1450	0.6301	0.8218	4.5380
29	0.1803	0.4498	1.7728	2.0634	10.7998
30	0.3108	0.7912	3.1311	3.8133	18.8559
31	0.2028	0.5163	2.0431	2.4883	11.6972
32	8.0373	19.8855	84.3581	110.0448	611.8643
33	0.2348	0.5770	2.5543	3.5462	19.2999
34	0.1044	0.2566	1.1360	1.5772	9.0363
35	0.2348	0.5975	2.3649	2.8801	15.4824
36	0.3997	1.0058	3.9275	4.5734	20.8860
37	0.0157	0.0394	0.1529	0.1749	0.8072
38	0.0084	0.0210	0.0816	0.0934	0.4543
39	0.2196	0.5503	2.1373	2.4452	11.6032
Total	36.1918	93.2097	440.1422	656.6526	3,128.1982

Table 7. Predicted Freeway Crash Type Distribution (Section 1)

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	4.52	0.1	85.70	2.0	90.22	2.1
Highway Segment	Collision with Fixed Object	413.42	9.5	1,294.53	29.7	1,707.95	39.2
Highway Segment	Collision with Other Object	26.26	0.6	254.99	5.9	281.25	6.5
Highway Segment	Other Single-vehicle Collision	185.59	4.3	262.25	6.0	447.84	10.3
Highway Segment	Collision with Parked Vehicle	12.56	0.3	37.99	0.9	50.55	1.2
Highway Segment	Total Single Vehicle Crashes	642.35	14.8	1,935.46	44.4	2,577.81	59.2
Highway Segment	Right-Angle Collision	23.89	0.5	27.57	0.6	51.46	1.2
Highway Segment	Head-on Collision	6.99	0.2	3.40	0.1	10.39	0.2
Highway Segment	Other Multi-vehicle Collision	24.58	0.6	56.10	1.3	80.68	1.9
Highway Segment	Rear-end Collision	410.09	9.4	730.39	16.8	1,140.48	26.2
Highway Segment	Sideswipe, Same Direction Collision	118.29	2.7	375.27	8.6	493.56	11.3
Highway Segment	Total Multiple Vehicle Crashes	583.84	13.4	1,192.74	27.4	1,776.58	40.8
Highway Segment	Total Highway Segment Crashes	1,226.20	28.2	3,128.20	71.8	4,354.39	100.0
	Total Crashes	1,226.20	28.2	3,128.20	71.8	4,354.39	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
553+89.850	560+00.000	Warning: for segment #1 (553+89.850 to 560+00.000), Median barrier offset (9.00 feet) is less than the right side inside shoulder width (10.00 feet). This indicates there is problem with the input data.
553+89.850	560+00.000	Warning: for segment #1 (553+89.850 to 560+00.000), Median barrier offset (8.00 feet) is less than the left side inside shoulder width (10.00 feet). This indicates there is problem with the input data.
553+89.850	560+00.000	Information: for segment #1 (553+89.850 to 560+00.000), 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.
553+89.850	560+00.000	Information: for segment #1 (553+89.850 to 560+00.000), 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.
560+00.000	666+81.410	Information: for segment #2 (560+00.000 to 666+81.410), 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.
560+00.000	666+81.410	Information: for segment #2 (560+00.000 to 666+81.410), 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.
560+00.000	666+81.410	Information: for segment #2 (560+00.000 to 666+81.410), 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.
560+00.000	666+81.410	Information: for segment #2 (560+00.000 to 666+81.410), 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.
666+81.410	669+78.320	Information: for segment #3 (666+81.410 to 669+78.320), 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.
666+81.410	669+78.320	Information: for segment #3 (666+81.410 to 669+78.320), 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.
666+81.410	669+78.320	Information: for segment #3 (666+81.410 to 669+78.320), 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.
666+81.410	669+78.320	Information: for segment #3 (666+81.410 to 669+78.320), 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.
669+78.320	675+46.700	Information: for segment #4 (669+78.320 to 675+46.700), 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.
669+78.320	675+46.700	Information: for segment #4 (669+78.320 to 675+46.700), 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.
669+78.320	675+46.700	Information: for segment #4 (669+78.320 to 675+46.700), 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.
669+78.320	675+46.700	Information: for segment #4 (669+78.320 to 675+46.700), 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.
675+46.700	677+75.320	Information: for segment #5 (675+46.700 to 677+75.320), 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.
675+46.700	677+75.320	Information: for segment #5 (675+46.700 to 677+75.320), 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.
675+46.700	677+75.320	Information: for segment #5 (675+46.700 to 677+75.320), 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.
675+46.700	677+75.320	Information: for segment #5 (675+46.700 to 677+75.320), 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.
677+75.320	680+11.540	Information: for segment #6 (677+75.320 to 680+11.540), 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.
677+75.320	680+11.540	Information: for segment #6 (677+75.320 to 680+11.540), 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.

Start Location (Sta. ft)	End Location (Sta. ft)	Message
677+75.320	680+11.540	Information: for segment #6 (677+75.320 to 680+11.540), 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.
680+11.540	683+37.700	Information: for segment #7 (680+11.540 to 683+37.700), 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.
680+11.540	683+37.700	Information: for segment #7 (680+11.540 to 683+37.700), 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.
680+11.540	683+37.700	Information: for segment #7 (680+11.540 to 683+37.700), 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.
683+37.700	694+42.590	Information: for segment #8 (683+37.700 to 694+42.590), 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.
683+37.700	694+42.590	Information: for segment #8 (683+37.700 to 694+42.590), 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.
683+37.700	694+42.590	Information: for segment #8 (683+37.700 to 694+42.590), 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.
683+37.700	694+42.590	Information: for segment #8 (683+37.700 to 694+42.590), 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.
694+42.590	697+39.130	Information: for segment #9 (694+42.590 to 697+39.130), 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.
694+42.590	697+39.130	Information: for segment #9 (694+42.590 to 697+39.130), 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.
694+42.590	697+39.130	Information: for segment #9 (694+42.590 to 697+39.130), 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.
697+39.130	697+76.160	Information: for segment #10 (697+39.130 to 697+76.160), 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.
697+39.130	697+76.160	Information: for segment #10 (697+39.130 to 697+76.160), 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.
697+39.130	697+76.160	Information: for segment #10 (697+39.130 to 697+76.160), 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.
697+39.130	697+76.160	Information: for segment #10 (697+39.130 to 697+76.160), 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.
697+76.160	698+11.400	Information: for segment #11 (697+76.160 to 698+11.400), 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.
697+76.160	698+11.400	Information: for segment #11 (697+76.160 to 698+11.400), 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.
697+76.160	698+11.400	Information: for segment #11 (697+76.160 to 698+11.400), 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.
697+76.160	698+11.400	Information: for segment #11 (697+76.160 to 698+11.400), 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.
698+11.400	739+49.080	Information: for segment #12 (698+11.400 to 739+49.080), 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.
698+11.400	739+49.080	Information: for segment #12 (698+11.400 to 739+49.080), 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.
698+11.400	739+49.080	Information: for segment #12 (698+11.400 to 739+49.080), 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.
698+11.400	739+49.080	Information: for segment #12 (698+11.400 to 739+49.080), 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
739+49.080	743+13.100	Information: for segment #13 (739+49.080 to 743+13.100), 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.
739+49.080	743+13.100	Information: for segment #13 (739+49.080 to 743+13.100), 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.
739+49.080	743+13.100	Information: for segment #13 (739+49.080 to 743+13.100), 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.
743+13.100	752+69.100	Information: for segment #14 (743+13.100 to 752+69.100), 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.
743+13.100	752+69.100	Information: for segment #14 (743+13.100 to 752+69.100), 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.
743+13.100	752+69.100	Information: for segment #14 (743+13.100 to 752+69.100), 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.
752+69.100	753+63.640	Information: for segment #15 (752+69.100 to 753+63.640), 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.
752+69.100	753+63.640	Information: for segment #15 (752+69.100 to 753+63.640), 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.
753+63.640	777+48.970	Information: for segment #16 (753+63.640 to 777+48.970), 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.
753+63.640	777+48.970	Information: for segment #16 (753+63.640 to 777+48.970), 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.
753+63.640	777+48.970	Information: for segment #16 (753+63.640 to 777+48.970), 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.
777+48.970	785+77.800	Information: for segment #17 (777+48.970 to 785+77.800), 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.
777+48.970	785+77.800	Information: for segment #17 (777+48.970 to 785+77.800), 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.
785+77.800	786+41.310	Information: for segment #18 (785+77.800 to 786+41.310), 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.
785+77.800	786+41.310	Information: for segment #18 (785+77.800 to 786+41.310), 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.
786+41.310	791+41.310	Information: for segment #19 (786+41.310 to 791+41.310), 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.
786+41.310	791+41.310	Information: for segment #19 (786+41.310 to 791+41.310), 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.
791+41.310	794+41.440	Information: for segment #20 (791+41.310 to 794+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.
791+41.310	794+41.440	Information: for segment #20 (791+41.310 to 794+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.
794+41.440	849+12.766	Information: for segment #21 (794+41.440 to 849+12.766), 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.
794+41.440	849+12.766	Information: for segment #21 (794+41.440 to 849+12.766), 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.
794+41.440	849+12.766	Information: for segment #21 (794+41.440 to 849+12.766), 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.
794+41.440	849+12.766	Information: for segment #21 (794+41.440 to 849+12.766), 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
794+41.440	849+12.766	Information: for segment #21 (794+41.440 to 849+12.766), 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.
849+12.766	988+99.100	Information: for segment #22 (849+12.766 to 988+99.100), 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.
849+12.766	988+99.100	Information: for segment #22 (849+12.766 to 988+99.100), 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.
849+12.766	988+99.100	Information: for segment #22 (849+12.766 to 988+99.100), 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.
849+12.766	988+99.100	Information: for segment #22 (849+12.766 to 988+99.100), 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.
849+12.766	988+99.100	Information: for segment #22 (849+12.766 to 988+99.100), 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.
849+12.766	988+99.100	Information: for segment #22 (849+12.766 to 988+99.100), 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.
849+12.766	988+99.100	Information: for segment #22 (849+12.766 to 988+99.100), 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.
849+12.766	988+99.100	Information: for segment #22 (849+12.766 to 988+99.100), 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.
849+12.766	988+99.100	Information: for segment #22 (849+12.766 to 988+99.100), 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.
849+12.766	988+99.100	Information: for segment #22 (849+12.766 to 988+99.100), 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.
988+99.100	999+58.470	Information: for segment #23 (988+99.100 to 999+58.470), 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.
988+99.100	999+58.470	Information: for segment #23 (988+99.100 to 999+58.470), 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.
988+99.100	999+58.470	Information: for segment #23 (988+99.100 to 999+58.470), 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.
999+58.470	1004+58.470	Information: for segment #24 (999+58.470 to 1004+58.470), 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.
999+58.470	1004+58.470	Information: for segment #24 (999+58.470 to 1004+58.470), 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.
999+58.470	1004+58.470	Information: for segment #24 (999+58.470 to 1004+58.470), 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.
1004+58.470	1008+58.460	Information: for segment #25 (1004+58.470 to 1008+58.460), 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.
1004+58.470	1008+58.460	Information: for segment #25 (1004+58.470 to 1008+58.460), 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.
1004+58.470	1008+58.460	Information: for segment #25 (1004+58.470 to 1008+58.460), 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.
1008+58.460	1012+58.530	Information: for segment #26 (1008+58.460 to 1012+58.530), 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.
1008+58.460	1012+58.530	Information: for segment #26 (1008+58.460 to 1012+58.530), 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.
1008+58.460	1012+58.530	Information: for segment #26 (1008+58.460 to 1012+58.530), 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
1008+58.460	1012+58.530	Information: for segment #26 (1008+58.460 to 1012+58.530), 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.
1012+58.530	1037+53.090	Information: for segment #27 (1012+58.530 to 1037+53.090), 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.
1012+58.530	1037+53.090	Information: for segment #27 (1012+58.530 to 1037+53.090), 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.
1012+58.530	1037+53.090	Information: for segment #27 (1012+58.530 to 1037+53.090), 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.
1037+53.090	1038+52.000	Information: for segment #28 (1037+53.090 to 1038+52.000), 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.
1037+53.090	1038+52.000	Information: for segment #28 (1037+53.090 to 1038+52.000), 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.
1038+52.000	1041+16.190	Information: for segment #29 (1038+52.000 to 1041+16.190), 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.
1038+52.000	1041+16.190	Information: for segment #29 (1038+52.000 to 1041+16.190), 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.
1041+16.190	1045+20.090	Information: for segment #30 (1041+16.190 to 1045+20.090), 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.
1041+16.190	1045+20.090	Information: for segment #30 (1041+16.190 to 1045+20.090), 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.
1041+16.190	1045+20.090	Information: for segment #30 (1041+16.190 to 1045+20.090), 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.
1045+20.090	1048+19.090	Information: for segment #31 (1045+20.090 to 1048+19.090), 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.
1045+20.090	1048+19.090	Information: for segment #31 (1045+20.090 to 1048+19.090), 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.
1045+20.090	1048+19.090	Information: for segment #31 (1045+20.090 to 1048+19.090), 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.
1048+19.090	1201+78.720	Information: for segment #32 (1048+19.090 to 1201+78.720), 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.
1048+19.090	1201+78.720	Information: for segment #32 (1048+19.090 to 1201+78.720), 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.
1048+19.090	1201+78.720	Information: for segment #32 (1048+19.090 to 1201+78.720), 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.
1048+19.090	1201+78.720	Information: for segment #32 (1048+19.090 to 1201+78.720), 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.
1048+19.090	1201+78.720	Information: for segment #32 (1048+19.090 to 1201+78.720), 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.
1048+19.090	1201+78.720	Information: for segment #32 (1048+19.090 to 1201+78.720), 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.
1201+78.720	1206+78.720	Information: for segment #33 (1201+78.720 to 1206+78.720), 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.
1201+78.720	1206+78.720	Information: for segment #33 (1201+78.720 to 1206+78.720), 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.
1201+78.720	1206+78.720	Information: for segment #33 (1201+78.720 to 1206+78.720), 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
1206+78.720	1209+03.410	Information: for segment #34 (1206+78.720 to 1209+03.410), 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.
1206+78.720	1209+03.410	Information: for segment #34 (1206+78.720 to 1209+03.410), 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.
1206+78.720	1209+03.410	Information: for segment #34 (1206+78.720 to 1209+03.410), 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.
1209+03.410	1213+00.000	Information: for segment #35 (1209+03.410 to 1213+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.
1209+03.410	1213+00.000	Information: for segment #35 (1209+03.410 to 1213+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.
1209+03.410	1213+00.000	Information: for segment #35 (1209+03.410 to 1213+00.000), 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.
1213+00.000	1226+73.000	Information: for segment #36 (1213+00.000 to 1226+73.000), 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.
1213+00.000	1226+73.000	Information: for segment #36 (1213+00.000 to 1226+73.000), 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.
1213+00.000	1226+73.000	Information: for segment #36 (1213+00.000 to 1226+73.000), 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.
1226+73.000	1227+27.500	Warning: for segment #37 (1226+73.000 to 1227+27.500), Median barrier offset (9.87 feet) is less than the left side inside shoulder width (10.00 feet). This indicates there is problem with the input data.
1226+73.000	1227+27.500	Information: for segment #37 (1226+73.000 to 1227+27.500), Median barrier distance from edge of inside shoulder to barrier face (0.30 feet) is less than specified boundaries (0.75 feet); adjusted in CMF calculations.
1227+27.500	1227+56.850	Warning: for segment #38 (1227+27.500 to 1227+56.850), Median barrier offset (9.66 feet) is less than the left side inside shoulder width (10.00 feet). This indicates there is problem with the input data.
1227+56.850	1235+84.647	Warning: for segment #39 (1227+56.850 to 1235+84.647), Median barrier offset (7.54 feet) is less than the left side inside shoulder width (10.00 feet). This indicates there is problem with the input data.
666+81.410	669+78.320	Information: for segment #3 (666+81.410 to 669+78.320), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
694+42.590	697+39.130	Information: for segment #9 (694+42.590 to 697+39.130), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
697+39.130	697+76.160	Information: for segment #10 (697+39.130 to 697+76.160), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
739+49.080	743+13.100	Information: for segment #13 (739+49.080 to 743+13.100), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
786+41.310	791+41.310	Information: for segment #19 (786+41.310 to 791+41.310), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
999+58.470	1004+58.470	Information: for segment #24 (999+58.470 to 1004+58.470), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
1045+20.090	1048+19.090	Information: for segment #31 (1045+20.090 to 1048+19.090), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
1201+78.720	1206+78.720	Information: for segment #33 (1201+78.720 to 1206+78.720), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
1209+03.410	1213+00.000	Information: for segment #35 (1209+03.410 to 1213+00.000), Freeway Segment of type Five-lane Freeway is using unbalanced lane processing with types Four-lane Freeway and Six-lane Freeway
1213+00.000	1226+73.000	Information: for segment #36 (1213+00.000 to 1226+73.000), Freeway Segment of type Five-lane Freeway is using unbalanced lane processing with types Four-lane Freeway and Six-lane Freeway

Start Location (Sta. ft)	End Location (Sta. ft)	Message
1226+73.000	1227+27.500	Information: for segment #37 (1226+73.000 to 1227+27.500), Freeway Segment of type Five-lane Freeway is using unbalanced lane processing with types Four-lane Freeway and Six-lane Freeway

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Overview

Report Generated: Jun 21, 2024 11:07 AM
Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Fri Jun 21 11:07:42 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Lockwood Interchange - Build
Project Comment: Lockwood Interchange - Build
Project Unit System: U.S. Customary

Highway Title: LW1 EB Off Ramp 2050 Build
Highway Comment: Lockwood EB Off Ramp
Highway Version: 1

Evaluation Title: Evaluation 2
Evaluation Comment: Created Fri Jun 21 11:07:27 PDT 2024

Minimum Location: 4+65.510
Maximum Location: 14+94.601

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

First Year of Analysis: 2023
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: 4+65.510
Evaluation End Location: 14+94.601
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;

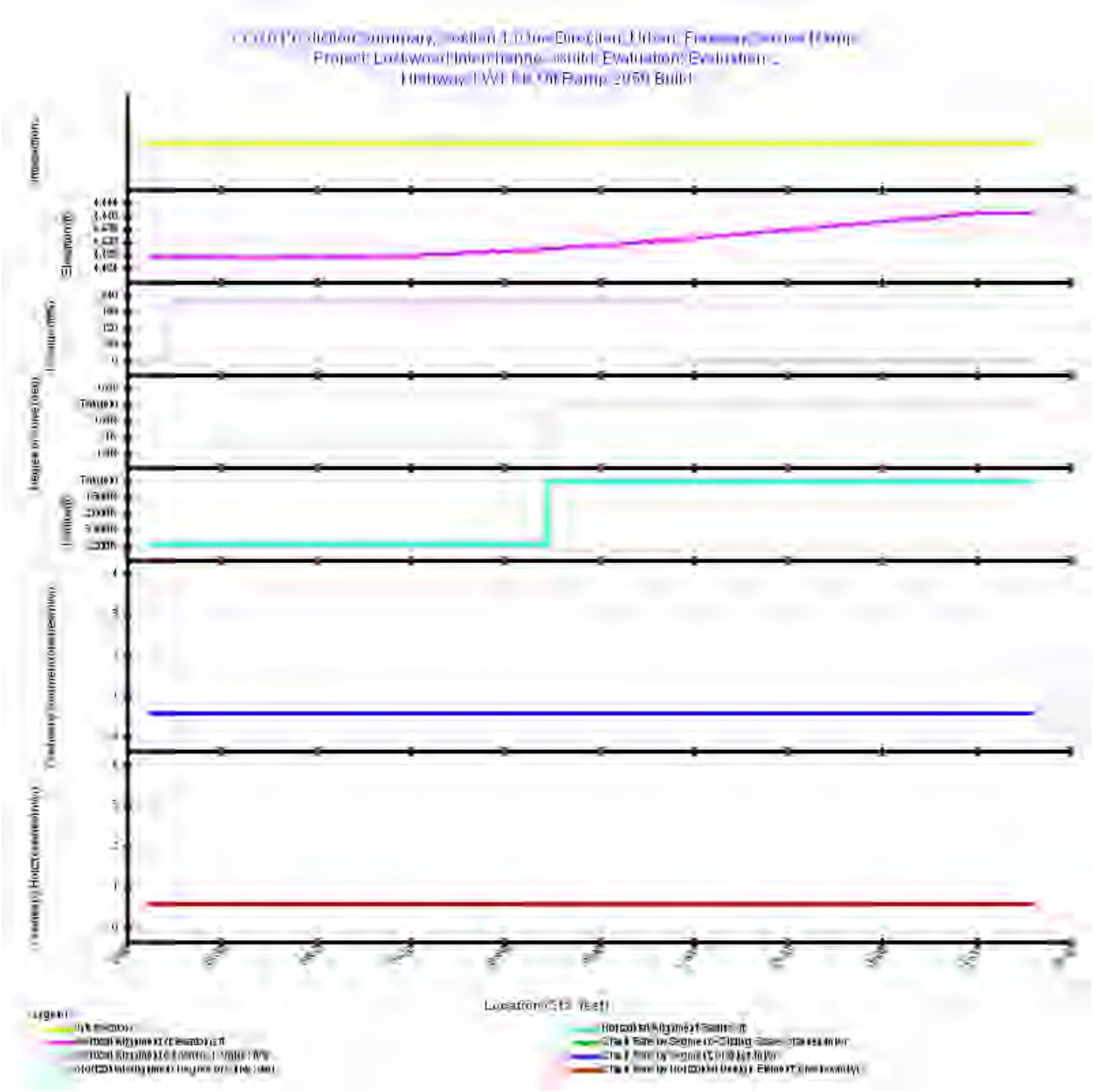

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	4+65.510	14+94.601	1,029.09	0.1949	2023: 1,410; 2024: 1,387; 2025: 1,364; 2026: 1,341; 2027: 1,318; 2028: 1,295; 2029: 1,272; 2030: 1,250; 2031: 1,262; 2032: 1,274; 2033: 1,286; 2034: 1,298; 2035: 1,310; 2036: 1,322; 2037: 1,334; 2038: 1,346; 2039: 1,358; 2040: 1,370; 2041: 1,382; 2042: 1,394; 2043: 1,406; 2044: 1,418; 2045: 1,430; 2046: 1,442; 2047: 1,454; 2048: 1,466; 2049: 1,478; 2050: 1,490

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.1949**
Average Future Road AADT (vpd)	**1,363**
Predicted Crashes	
Total Crashes	**3.25**
Fatal and Injury Crashes	**1.55**
Property-Damage-Only Crashes	**1.69**
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)	**0.5947**
FI Crash Rate (crashes/mi/yr)	**0.2843**
PDO Crash Rate (crashes/mi/yr)	**0.3104**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**2.71**
Travel Crash Rate (crashes/million veh-mi)	**1.20**
Travel FI Crash Rate (crashes/million veh-mi)	**0.57**
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)
1	4+65.510	14+94.601	0.1949	3.246	0.1159	0.0554	0.0605	0.5947	1.20
Total			0.1949	3.246	0.1159	0.0554	0.0605	0.5947	

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	4+65.510	9+30.307	0.0880	1.466	0.0524	0.0250	0.0273	0.5947	1.20
Tangent	9+30.307	14+94.601	0.1069	1.780	0.0636	0.0304	0.0332	0.5947	1.20

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.12	0.06	47.808	0.06	52.192
2024	0.12	0.06	47.807	0.06	52.193
2025	0.12	0.06	47.806	0.06	52.194
2026	0.12	0.06	47.805	0.06	52.195
2027	0.11	0.05	47.804	0.06	52.196
2028	0.11	0.05	47.802	0.06	52.198
2029	0.11	0.05	47.801	0.06	52.199
2030	0.11	0.05	47.799	0.06	52.201
2031	0.11	0.05	47.800	0.06	52.200
2032	0.11	0.05	47.801	0.06	52.199
2033	0.11	0.05	47.802	0.06	52.198
2034	0.11	0.05	47.802	0.06	52.198
2035	0.11	0.05	47.803	0.06	52.197
2036	0.11	0.05	47.804	0.06	52.196
2037	0.11	0.06	47.804	0.06	52.196
2038	0.12	0.06	47.805	0.06	52.195
2039	0.12	0.06	47.806	0.06	52.194
2040	0.12	0.06	47.806	0.06	52.194
2041	0.12	0.06	47.807	0.06	52.193
2042	0.12	0.06	47.807	0.06	52.193
2043	0.12	0.06	47.808	0.06	52.192
2044	0.12	0.06	47.809	0.06	52.191
2045	0.12	0.06	47.809	0.06	52.191
2046	0.12	0.06	47.810	0.06	52.190
2047	0.12	0.06	47.810	0.06	52.190
2048	0.12	0.06	47.810	0.06	52.190
2049	0.12	0.06	47.811	0.06	52.189
2050	0.12	0.06	47.811	0.06	52.189
Total	3.25	1.55	47.806	1.69	52.194
Average	0.12	0.06	47.806	0.06	52.194

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	0.0457	0.1386	0.5830	0.7843	1.6941

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.01	0.2	0.04	1.1	0.04	1.3
Highway Segment	Collision with Fixed Object	1.08	33.3	1.16	35.9	2.25	69.2
Highway Segment	Collision with Other Object	0.08	2.4	0.23	7.0	0.30	9.3
Highway Segment	Other Single-vehicle Collision	0.31	9.6	0.17	5.4	0.48	14.9
Highway Segment	Collision with Parked Vehicle	0.02	0.7	0.03	0.8	0.05	1.5
Highway Segment	Total Single Vehicle Crashes	1.50	46.1	1.63	50.1	3.12	96.2
Highway Segment	Right-Angle Collision	0.00	0.1	0.00	0.0	0.00	0.1
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	0.1	0.00	0.1
Highway Segment	Rear-end Collision	0.04	1.3	0.05	1.4	0.09	2.7
Highway Segment	Sideswipe, Same Direction Collision	0.01	0.3	0.02	0.6	0.03	0.9
Highway Segment	Total Multiple Vehicle Crashes	0.06	1.7	0.07	2.1	0.12	3.8
Highway Segment	Total Highway Segment Crashes	1.55	47.8	1.69	52.2	3.25	100.0
	Total Crashes	1.55	47.8	1.69	52.2	3.25	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
4+65.510	14+94.601	Warning: for segment #1 (4+65.510 to 14+94.601), The ramp type for Ramp LW1 EB Off Ramp 2050 Build is set at the Ramp Connection (Exit) and in the Ramp (Exit). The Ramp value takes precedence.

Interactive Highway Safety Design Model

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Report Overview

Report Generated: Jun 21, 2024 11:11 AM
Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Fri Jun 21 11:11:45 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Lockwood Interchange - Build
Project Comment: Lockwood Interchange - Build
Project Unit System: U.S. Customary

Highway Title: LW2 EB On Ramp 2050 Build
Highway Comment: Lockwood EB On Ramp
Highway Version: 1

Evaluation Title: Evaluation 2
Evaluation Comment: Created Fri Jun 21 11:11:28 PDT 2024

Minimum Location: 0.000
Maximum Location: 7+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: 2023
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.]*

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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: 7+00.000
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;

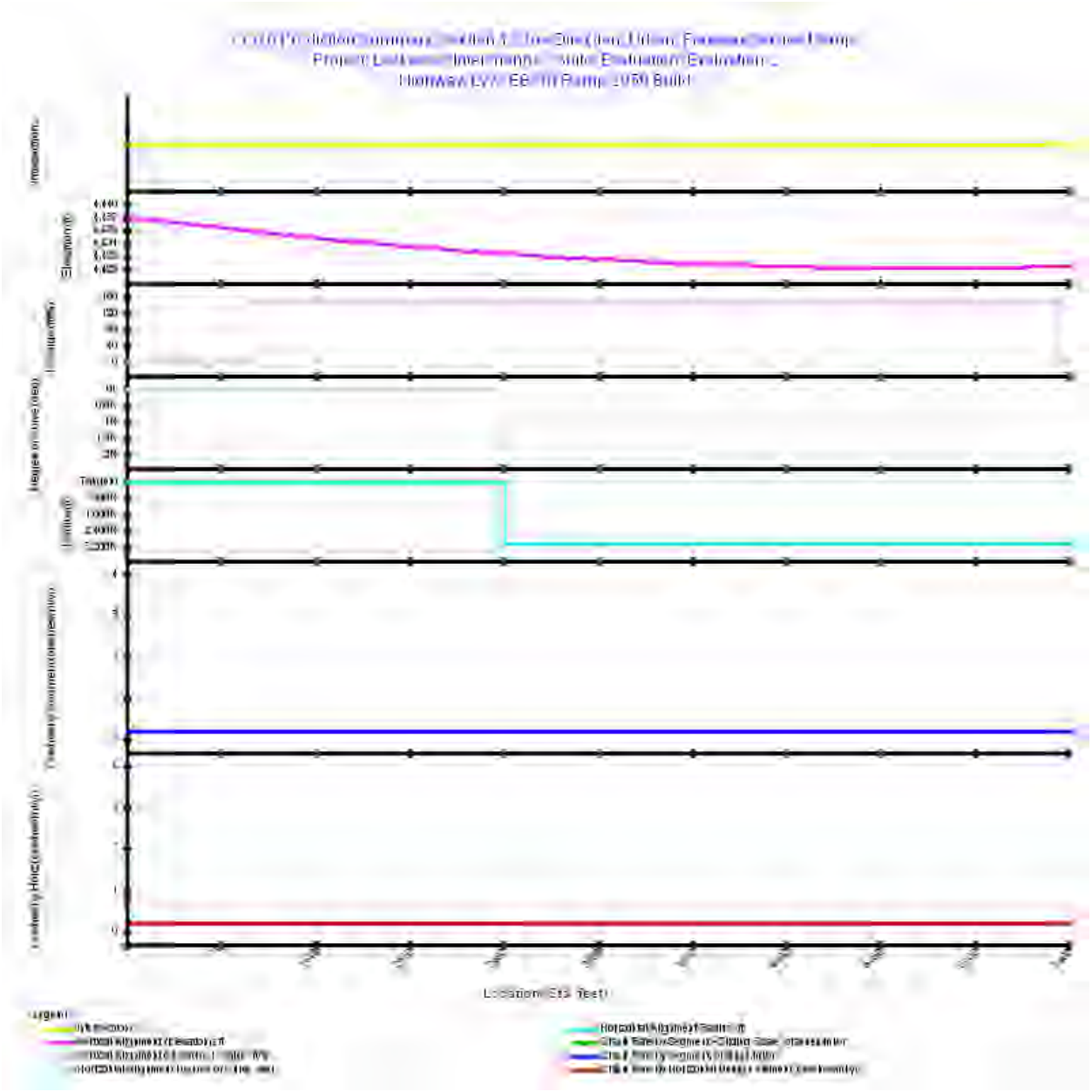

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	7+00.000	700.00	0.1326	2023: 230; 2024: 232; 2025: 235; 2026: 238; 2027: 241; 2028: 244; 2029: 247; 2030: 250; 2031: 252; 2032: 255; 2033: 257; 2034: 260; 2035: 262; 2036: 265; 2037: 267; 2038: 270; 2039: 272; 2040: 275; 2041: 277; 2042: 280; 2043: 282; 2044: 285; 2045: 287; 2046: 290; 2047: 292; 2048: 295; 2049: 297; 2050: 300

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.1326**
Average Future Road AADT (vpd)	**266**
Predicted Crashes	
Total Crashes	**0.68**
Fatal and Injury Crashes	**0.33**
Property-Damage-Only Crashes	**0.35**
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	**49**
Percent Property-Damage-Only Crashes (%)	**51**
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	**0.1839**
FI Crash Rate (crashes/mi/yr)	**0.0895**
PDO Crash Rate (crashes/mi/yr)	**0.0944**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**0.36**
Travel Crash Rate (crashes/million veh-mi)	**1.90**
Travel FI Crash Rate (crashes/million veh-mi)	**0.92**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.97**

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	7+00.000	0.1326	0.682	0.0244	0.0119	0.0125	0.1839	1.90
Total			0.1326	0.682	0.0244	0.0119	0.0125	0.1839	

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	2+80.874	0.0532	0.274	0.0098	0.0048	0.0050	0.1839	1.90
Simple Curve 1	2+80.874	7+00.000	0.0794	0.409	0.0146	0.0071	0.0075	0.1839	1.90

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.02	0.01	48.817	0.01	51.183
2024	0.02	0.01	48.809	0.01	51.191
2025	0.02	0.01	48.797	0.01	51.203
2026	0.02	0.01	48.785	0.01	51.215
2027	0.02	0.01	48.773	0.01	51.227
2028	0.02	0.01	48.761	0.01	51.239
2029	0.02	0.01	48.749	0.01	51.251
2030	0.02	0.01	48.737	0.01	51.263
2031	0.02	0.01	48.730	0.01	51.270
2032	0.02	0.01	48.718	0.01	51.282
2033	0.02	0.01	48.711	0.01	51.289
2034	0.02	0.01	48.700	0.01	51.300
2035	0.02	0.01	48.692	0.01	51.308
2036	0.02	0.01	48.681	0.01	51.319
2037	0.02	0.01	48.674	0.01	51.326
2038	0.03	0.01	48.663	0.01	51.337
2039	0.03	0.01	48.656	0.01	51.344
2040	0.03	0.01	48.645	0.01	51.355
2041	0.03	0.01	48.638	0.01	51.362
2042	0.03	0.01	48.627	0.01	51.373
2043	0.03	0.01	48.620	0.01	51.380
2044	0.03	0.01	48.610	0.01	51.390
2045	0.03	0.01	48.603	0.01	51.397
2046	0.03	0.01	48.593	0.01	51.407
2047	0.03	0.01	48.586	0.01	51.414
2048	0.03	0.01	48.576	0.01	51.424
2049	0.03	0.01	48.569	0.01	51.431
2050	0.03	0.01	48.559	0.01	51.441
Total	0.68	0.33	48.677	0.35	51.323
Average	0.02	0.01	48.677	0.01	51.323

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	0.0063	0.0191	0.1243	0.1825	0.3503

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.00	0.2	0.01	1.1	0.01	1.2
Highway Segment	Collision with Fixed Object	0.19	27.5	0.24	34.8	0.42	62.3
Highway Segment	Collision with Other Object	0.01	1.9	0.05	6.8	0.06	8.7
Highway Segment	Other Single-vehicle Collision	0.05	7.9	0.04	5.2	0.09	13.1
Highway Segment	Collision with Parked Vehicle	0.00	0.6	0.01	0.8	0.01	1.4
Highway Segment	Total Single Vehicle Crashes	0.26	38.1	0.33	48.6	0.59	86.7
Highway Segment	Right-Angle Collision	0.00	0.3	0.00	0.0	0.00	0.4
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	0.1	0.00	0.4
Highway Segment	Rear-end Collision	0.05	7.9	0.01	1.9	0.07	9.8
Highway Segment	Sideswipe, Same Direction Collision	0.01	1.9	0.01	0.7	0.02	2.6
Highway Segment	Total Multiple Vehicle Crashes	0.07	10.6	0.02	2.7	0.09	13.3
Highway Segment	Total Highway Segment Crashes	0.33	48.7	0.35	51.3	0.68	100.0
	Total Crashes	0.33	48.7	0.35	51.3	0.68	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	7+00.000	Warning: for segment #1 (0.000 to 7+00.000), The ramp type for Ramp LW2 EB On Ramp 2050 Build is set at the Ramp Connection (Entrance) and in the Ramp (Entrance). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Overview

Report Generated: Jun 21, 2024 11:02 AM
Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Fri Jun 21 11:02:50 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Lockwood Interchange - Build
Project Comment: Lockwood Interchange - Build
Project Unit System: U.S. Customary

Highway Title: LW WB Off Ramp 2050 Build
Highway Comment: Lockwood WB Off Ramp
Highway Version: 1

Evaluation Title: Evaluation 4
Evaluation Comment: Created Fri Jun 21 11:02:17 PDT 2024

Minimum Location: 9+37.109
Maximum Location: 13+23.485

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

First Year of Analysis: 2023
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

Disclaimer Regarding Crash Prediction Method

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- Roundabouts: completed in 2018 under NCHRP Project 17-70, the new methods will provide improved outcomes for the safety analysis of roundabouts.
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Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 9+37.109
Evaluation End Location: 13+23.485
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;

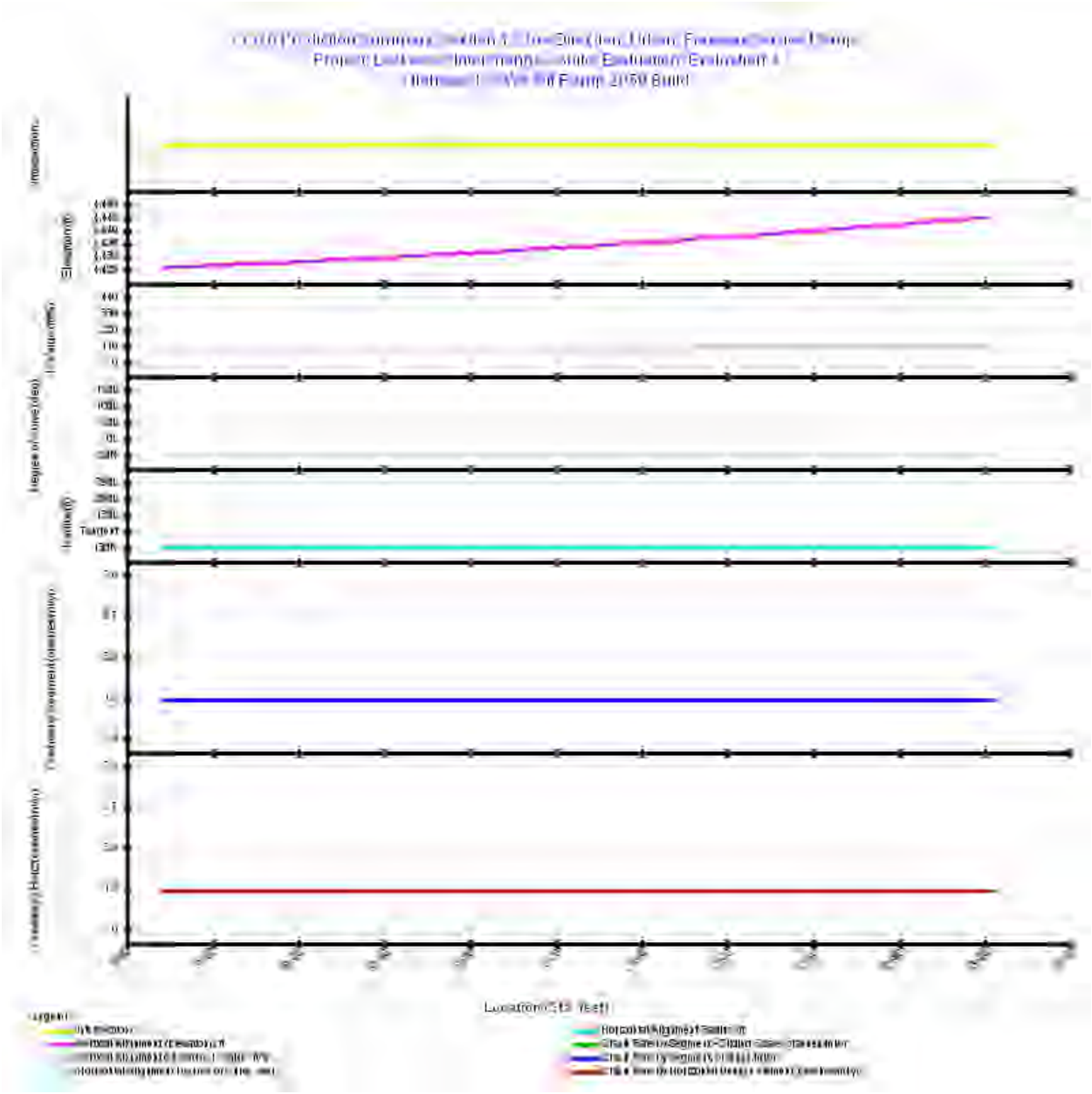

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	9+37.109	13+23.485	386.38	0.0732	2023: 200; 2024: 207; 2025: 214; 2026: 221; 2027: 228; 2028: 235; 2029: 242; 2030: 250; 2031: 252; 2032: 255; 2033: 257; 2034: 260; 2035: 262; 2036: 265; 2037: 267; 2038: 270; 2039: 272; 2040: 275; 2041: 277; 2042: 280; 2043: 282; 2044: 285; 2045: 287; 2046: 290; 2047: 292; 2048: 295; 2049: 297; 2050: 300

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.0732**
Average Future Road AADT (vpd)	**261**
Predicted Crashes	
Total Crashes	**3.72**
Fatal and Injury Crashes	**1.55**
Property-Damage-Only Crashes	**2.17**
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)	**1.8163**
FI Crash Rate (crashes/mi/yr)	**0.7565**
PDO Crash Rate (crashes/mi/yr)	**1.0597**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**0.20**
Travel Crash Rate (crashes/million veh-mi)	**19.04**
Travel FI Crash Rate (crashes/million veh-mi)	**7.93**
Travel PDO Crash Rate (crashes/million veh-mi)	**11.11**

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	9+37.109	13+23.485	0.0732	3.721	0.1329	0.0554	0.0775	1.8163	19.04
Total			0.0732	3.721	0.1329	0.0554	0.0775	1.8163	

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	9+37.109	13+23.485	0.0732	3.721	0.1329	0.0554	0.0775	1.8163	19.04

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.11	0.05	41.501	0.07	58.499
2024	0.11	0.05	41.521	0.07	58.479
2025	0.12	0.05	41.539	0.07	58.461
2026	0.12	0.05	41.558	0.07	58.442
2027	0.12	0.05	41.575	0.07	58.425
2028	0.12	0.05	41.593	0.07	58.407
2029	0.13	0.05	41.609	0.07	58.391
2030	0.13	0.05	41.627	0.07	58.373
2031	0.13	0.05	41.632	0.08	58.368
2032	0.13	0.05	41.639	0.08	58.361
2033	0.13	0.06	41.643	0.08	58.357
2034	0.13	0.06	41.650	0.08	58.350
2035	0.13	0.06	41.654	0.08	58.346
2036	0.13	0.06	41.660	0.08	58.340
2037	0.14	0.06	41.665	0.08	58.335
2038	0.14	0.06	41.671	0.08	58.329
2039	0.14	0.06	41.675	0.08	58.325
2040	0.14	0.06	41.681	0.08	58.319
2041	0.14	0.06	41.685	0.08	58.315
2042	0.14	0.06	41.691	0.08	58.309
2043	0.14	0.06	41.695	0.08	58.305
2044	0.14	0.06	41.701	0.08	58.299
2045	0.14	0.06	41.705	0.08	58.295
2046	0.14	0.06	41.711	0.08	58.289
2047	0.14	0.06	41.715	0.08	58.285
2048	0.14	0.06	41.721	0.08	58.279
2049	0.15	0.06	41.725	0.09	58.275
2050	0.15	0.06	41.730	0.09	58.270
Total	3.72	1.55	41.654	2.17	58.346
Average	0.13	0.06	41.654	0.08	58.346

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	0.0424	0.1287	0.5486	0.8304	2.1713

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.01	0.2	0.05	1.3	0.05	1.4
Highway Segment	Collision with Fixed Object	1.10	29.5	1.55	41.6	2.65	71.1
Highway Segment	Collision with Other Object	0.08	2.1	0.30	8.1	0.38	10.2
Highway Segment	Other Single-vehicle Collision	0.32	8.5	0.23	6.2	0.55	14.7
Highway Segment	Collision with Parked Vehicle	0.02	0.6	0.04	0.9	0.06	1.5
Highway Segment	Total Single Vehicle Crashes	1.52	40.9	2.16	58.1	3.68	99.0
Highway Segment	Right-Angle Collision	0.00	0.0	0.00	0.0	0.00	0.0
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	0.0	0.00	0.0	0.00	0.0
Highway Segment	Rear-end Collision	0.02	0.6	0.01	0.2	0.03	0.8
Highway Segment	Sideswipe, Same Direction Collision	0.01	0.1	0.00	0.1	0.01	0.2
Highway Segment	Total Multiple Vehicle Crashes	0.03	0.8	0.01	0.2	0.04	1.0
Highway Segment	Total Highway Segment Crashes	1.55	41.7	2.17	58.3	3.72	100.0
	Total Crashes	1.55	41.7	2.17	58.3	3.72	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
9+37.109	13+23.485	Warning: for segment #1 (9+37.109 to 13+23.485), The ramp type for Ramp LW WB Off Ramp 2050 Build is set at the Ramp Connection (Exit) and in the Ramp (Exit). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Overview

Report Generated: Jun 21, 2024 11:01 AM
Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Fri Jun 21 11:00:57 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Lockwood Interchange - Build
Project Comment: Lockwood Interchange - Build
Project Unit System: U.S. Customary

Highway Title: LW WB On Ramp 2050 Build
Highway Comment: Lockwood WB On Ramp
Highway Version: 1

Evaluation Title: Evaluation 4
Evaluation Comment: Created Fri Jun 21 11:00:37 PDT 2024

Minimum Location: 57.750
Maximum Location: 4+75.750

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

First Year of Analysis: 2023
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: 57.750
Evaluation End Location: 4+75.750
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;

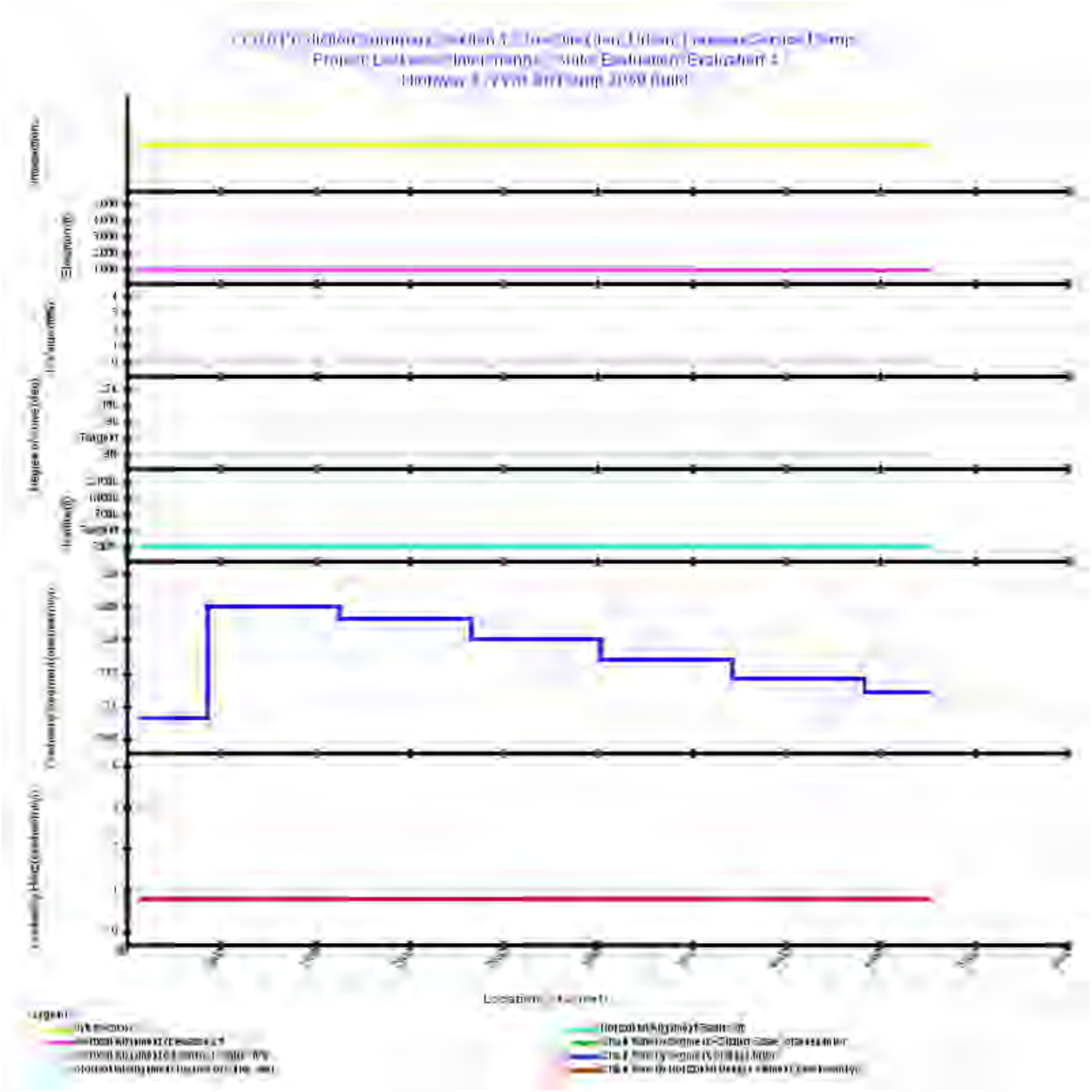

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	57.750	92.750	35.00	0.0066	2023: 840; 2024: 828; 2025: 817; 2026: 805; 2027: 794; 2028: 782; 2029: 771; 2030: 760; 2031: 768; 2032: 776; 2033: 784; 2034: 792; 2035: 800; 2036: 808; 2037: 816; 2038: 824; 2039: 832; 2040: 840; 2041: 848; 2042: 856; 2043: 864; 2044: 872; 2045: 880; 2046: 888; 2047: 896; 2048: 904; 2049: 912; 2050: 920
2	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	92.750	1+62.750	70.00	0.0133	2023: 840; 2024: 828; 2025: 817; 2026: 805; 2027: 794; 2028: 782; 2029: 771; 2030: 760; 2031: 768; 2032: 776; 2033: 784; 2034: 792; 2035: 800; 2036: 808; 2037: 816; 2038: 824; 2039: 832; 2040: 840; 2041: 848; 2042: 856; 2043: 864; 2044: 872; 2045: 880; 2046: 888; 2047: 896; 2048: 904; 2049: 912; 2050: 920
3	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	1+62.750	2+32.750	70.00	0.0133	2023: 840; 2024: 828; 2025: 817; 2026: 805; 2027: 794; 2028: 782; 2029: 771; 2030: 760; 2031: 768; 2032: 776; 2033: 784; 2034: 792; 2035: 800; 2036: 808; 2037: 816; 2038: 824; 2039: 832; 2040: 840; 2041: 848; 2042: 856; 2043: 864; 2044: 872; 2045: 880; 2046: 888; 2047: 896; 2048: 904; 2049: 912; 2050: 920
4	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	2+32.750	3+01.750	69.00	0.0131	2023: 840; 2024: 828; 2025: 817; 2026: 805; 2027: 794; 2028: 782; 2029: 771; 2030: 760; 2031: 768; 2032: 776; 2033: 784; 2034: 792; 2035: 800; 2036: 808; 2037: 816; 2038: 824; 2039: 832; 2040: 840; 2041: 848; 2042: 856; 2043: 864; 2044: 872; 2045: 880; 2046: 888; 2047: 896; 2048: 904; 2049: 912; 2050: 920
5	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	3+01.750	3+71.750	70.00	0.0133	2023: 840; 2024: 828; 2025: 817; 2026: 805; 2027: 794; 2028: 782; 2029: 771; 2030: 760; 2031: 768; 2032: 776; 2033: 784; 2034: 792; 2035: 800; 2036: 808; 2037: 816; 2038: 824; 2039: 832; 2040: 840; 2041: 848; 2042: 856; 2043: 864; 2044: 872; 2045: 880; 2046: 888; 2047: 896; 2048: 904; 2049: 912; 2050: 920
6	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	3+71.750	4+41.750	70.00	0.0133	2023: 840; 2024: 828; 2025: 817; 2026: 805; 2027: 794; 2028: 782; 2029: 771; 2030: 760; 2031: 768; 2032: 776; 2033: 784; 2034: 792; 2035: 800; 2036: 808; 2037: 816; 2038: 824; 2039: 832; 2040: 840; 2041: 848; 2042: 856; 2043: 864; 2044: 872; 2045: 880; 2046: 888; 2047: 896; 2048: 904; 2049: 912; 2050: 920
7	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	4+41.750	4+75.750	34.00	0.0064	2023: 840; 2024: 828; 2025: 817; 2026: 805; 2027: 794; 2028: 782; 2029: 771; 2030: 760; 2031: 768; 2032: 776; 2033: 784; 2034: 792; 2035: 800; 2036: 808; 2037: 816; 2038: 824; 2039: 832; 2040: 840; 2041: 848; 2042: 856; 2043: 864; 2044: 872; 2045: 880; 2046: 888; 2047: 896; 2048: 904; 2049: 912; 2050: 920

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.0792**
Average Future Road AADT (vpd)	**831**
Predicted Crashes	
Total Crashes	**1.74**
Fatal and Injury Crashes	**0.81**
Property-Damage-Only Crashes	**0.93**
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)	**0.7837**
FI Crash Rate (crashes/mi/yr)	**0.3646**
PDO Crash Rate (crashes/mi/yr)	**0.4192**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**0.67**
Travel Crash Rate (crashes/million veh-mi)	**2.58**
Travel FI Crash Rate (crashes/million veh-mi)	**1.20**
Travel PDO Crash Rate (crashes/million veh-mi)	**1.38**

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	57.750	92.750	0.0066	0.127	0.0045	0.0022	0.0024	0.6829	2.25
2	92.750	1+62.750	0.0133	0.316	0.0113	0.0054	0.0059	0.8523	2.81
3	1+62.750	2+32.750	0.0133	0.309	0.0110	0.0052	0.0058	0.8333	2.75
4	2+32.750	3+01.750	0.0131	0.293	0.0105	0.0049	0.0056	0.8015	2.64
5	3+01.750	3+71.750	0.0133	0.286	0.0102	0.0047	0.0055	0.7711	2.54
6	3+71.750	4+41.750	0.0133	0.275	0.0098	0.0044	0.0054	0.7417	2.44
7	4+41.750	4+75.750	0.0064	0.130	0.0046	0.0021	0.0026	0.7207	2.38
Total			0.0792	1.737	0.0620	0.0289	0.0332	0.7837	

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	57.750	4+75.750	0.0792	1.737	0.0620	0.0289	0.0332	0.7837	2.58

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.06	0.03	46.511	0.03	53.489
2024	0.06	0.03	46.520	0.03	53.480
2025	0.06	0.03	46.529	0.03	53.471
2026	0.06	0.03	46.538	0.03	53.462
2027	0.06	0.03	46.547	0.03	53.453
2028	0.06	0.03	46.557	0.03	53.443
2029	0.06	0.03	46.566	0.03	53.434
2030	0.06	0.03	46.575	0.03	53.425
2031	0.06	0.03	46.568	0.03	53.432
2032	0.06	0.03	46.562	0.03	53.438
2033	0.06	0.03	46.555	0.03	53.445
2034	0.06	0.03	46.549	0.03	53.451
2035	0.06	0.03	46.542	0.03	53.458
2036	0.06	0.03	46.536	0.03	53.464
2037	0.06	0.03	46.530	0.03	53.470
2038	0.06	0.03	46.523	0.03	53.477
2039	0.06	0.03	46.517	0.03	53.483
2040	0.06	0.03	46.511	0.03	53.489
2041	0.06	0.03	46.505	0.03	53.495
2042	0.06	0.03	46.498	0.03	53.502
2043	0.06	0.03	46.492	0.03	53.508
2044	0.06	0.03	46.486	0.03	53.514
2045	0.07	0.03	46.480	0.04	53.520
2046	0.07	0.03	46.474	0.04	53.526
2047	0.07	0.03	46.468	0.04	53.532
2048	0.07	0.03	46.462	0.04	53.538
2049	0.07	0.03	46.456	0.04	53.544
2050	0.07	0.03	46.451	0.04	53.549
Total	1.74	0.81	46.517	0.93	53.483
Average	0.06	0.03	46.517	0.03	53.483

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	0.0013	0.0039	0.0250	0.0305	0.0661
2	0.0028	0.0086	0.0562	0.0838	0.1649
3	0.0027	0.0082	0.0538	0.0814	0.1633
4	0.0025	0.0077	0.0502	0.0760	0.1568
5	0.0024	0.0074	0.0483	0.0731	0.1551
6	0.0023	0.0070	0.0457	0.0692	0.1511
7	0.0011	0.0033	0.0213	0.0323	0.0720
Total	0.0152	0.0462	0.3005	0.4462	0.9291

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.00	0.2	0.02	1.1	0.02	1.3
Highway Segment	Collision with Fixed Object	0.50	28.7	0.62	35.9	1.12	64.6
Highway Segment	Collision with Other Object	0.04	2.0	0.12	7.0	0.16	9.0
Highway Segment	Other Single-vehicle Collision	0.14	8.3	0.09	5.4	0.24	13.6
Highway Segment	Collision with Parked Vehicle	0.01	0.6	0.01	0.8	0.02	1.4
Highway Segment	Total Single Vehicle Crashes	0.69	39.8	0.87	50.1	1.56	89.9
Highway Segment	Right-Angle Collision	0.00	0.2	0.00	0.1	0.01	0.3
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	0.2	0.00	0.1	0.01	0.3
Highway Segment	Rear-end Collision	0.09	5.1	0.04	2.3	0.13	7.4
Highway Segment	Sideswipe, Same Direction Collision	0.02	1.2	0.01	0.9	0.04	2.1
Highway Segment	Total Multiple Vehicle Crashes	0.12	6.8	0.06	3.3	0.18	10.1
Highway Segment	Total Highway Segment Crashes	0.81	46.5	0.93	53.5	1.74	100.0
	Total Crashes	0.81	46.5	0.93	53.5	1.74	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
57.750	92.750	Warning: for segment #1 (57.750 to 92.750), The ramp type for Ramp LW WB On Ramp 2050 Build is set at the Ramp Connection (Entrance) and in the Ramp (Entrance). The Ramp value takes precedence.
92.750	1+62.750	Warning: for segment #2 (92.750 to 1+62.750), The ramp type for Ramp LW WB On Ramp 2050 Build is set at the Ramp Connection (Entrance) and in the Ramp (Entrance). The Ramp value takes precedence.
1+62.750	2+32.750	Warning: for segment #3 (1+62.750 to 2+32.750), The ramp type for Ramp LW WB On Ramp 2050 Build is set at the Ramp Connection (Entrance) and in the Ramp (Entrance). The Ramp value takes precedence.
2+32.750	3+01.750	Warning: for segment #4 (2+32.750 to 3+01.750), The ramp type for Ramp LW WB On Ramp 2050 Build is set at the Ramp Connection (Entrance) and in the Ramp (Entrance). The Ramp value takes precedence.
3+01.750	3+71.750	Warning: for segment #5 (3+01.750 to 3+71.750), The ramp type for Ramp LW WB On Ramp 2050 Build is set at the Ramp Connection (Entrance) and in the Ramp (Entrance). The Ramp value takes precedence.
3+71.750	4+41.750	Warning: for segment #6 (3+71.750 to 4+41.750), The ramp type for Ramp LW WB On Ramp 2050 Build is set at the Ramp Connection (Entrance) and in the Ramp (Entrance). The Ramp value takes precedence.
4+41.750	4+75.750	Warning: for segment #7 (4+41.750 to 4+75.750), The ramp type for Ramp LW WB On Ramp 2050 Build is set at the Ramp Connection (Entrance) and in the Ramp (Entrance). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Evaluation Date: Fri Jun 21 11:13:22 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Mustang Interchange - Build
Project Comment: Mustang Interchange - Build
Project Unit System: U.S. Customary

Highway Title: MS1 EB Off Ramp 2050 Build
Highway Comment: Mustang EB Off Ramp
Highway Version: 1

Evaluation Title: Evaluation 2
Evaluation Comment: Created Fri Jun 21 11:13:06 PDT 2024

Minimum Location: 10+50.000
Maximum Location: 21+20.824

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

First Year of Analysis: 2023
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

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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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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: 10+50.000
Evaluation End Location: 21+20.824
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;

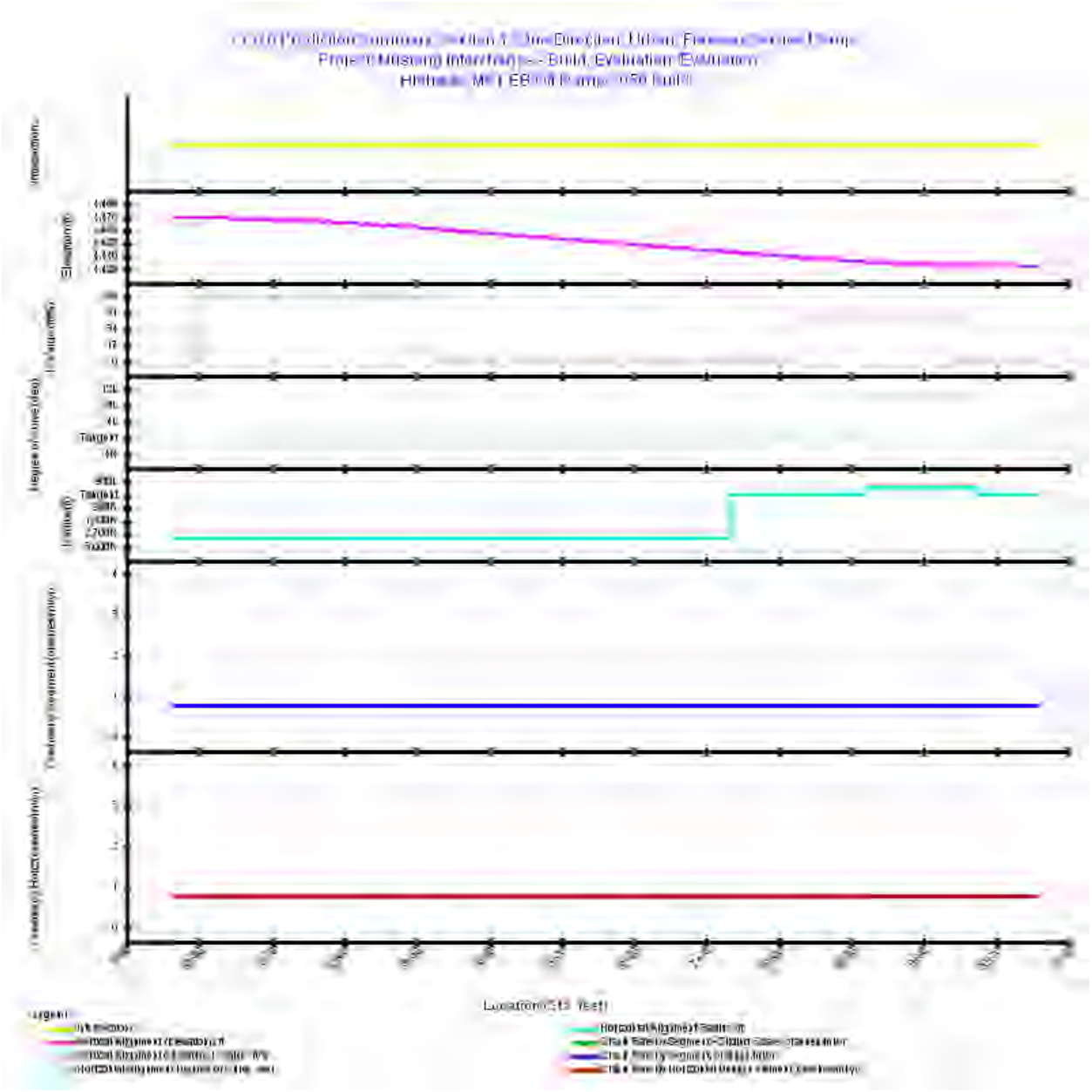

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	10+50.000	21+20.824	1,070.82	0.2028	2023: 2,220; 2024: 2,181; 2025: 2,142; 2026: 2,104; 2027: 2,065; 2028: 2,027; 2029: 1,988; 2030: 1,950; 2031: 1,969; 2032: 1,989; 2033: 2,008; 2034: 2,028; 2035: 2,047; 2036: 2,067; 2037: 2,086; 2038: 2,106; 2039: 2,125; 2040: 2,145; 2041: 2,164; 2042: 2,184; 2043: 2,203; 2044: 2,223; 2045: 2,242; 2046: 2,262; 2047: 2,281; 2048: 2,301; 2049: 2,320; 2050: 2,340

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.2028**
Average Future Road AADT (vpd)	**2,135**
Predicted Crashes	
Total Crashes	**4.43**
Fatal and Injury Crashes	**2.08**
Property-Damage-Only Crashes	**2.34**
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)	**0.7795**
FI Crash Rate (crashes/mi/yr)	**0.3668**
PDO Crash Rate (crashes/mi/yr)	**0.4127**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**4.42**
Travel Crash Rate (crashes/million veh-mi)	**1.00**
Travel FI Crash Rate (crashes/million veh-mi)	**0.47**
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	10+50.000	21+20.824	0.2028	4.427	0.1581	0.0744	0.0837	0.7795	1.00
Total			0.2028	4.427	0.1581	0.0744	0.0837	0.7795	

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	10+50.000	17+38.699	0.1304	2.847	0.1017	0.0478	0.0538	0.7795	1.00
Tangent	17+38.699	19+04.772	0.0315	0.686	0.0245	0.0115	0.0130	0.7795	1.00
Simple Curve 2	19+04.772	20+48.984	0.0273	0.596	0.0213	0.0100	0.0113	0.7795	1.00
Tangent	20+48.984	21+20.824	0.0136	0.297	0.0106	0.0050	0.0056	0.7795	1.00

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.16	0.08	47.059	0.09	52.941
2024	0.16	0.08	47.059	0.09	52.941
2025	0.16	0.07	47.059	0.08	52.941
2026	0.16	0.07	47.059	0.08	52.941
2027	0.15	0.07	47.058	0.08	52.942
2028	0.15	0.07	47.058	0.08	52.942
2029	0.15	0.07	47.057	0.08	52.943
2030	0.15	0.07	47.057	0.08	52.943
2031	0.15	0.07	47.057	0.08	52.943
2032	0.15	0.07	47.057	0.08	52.943
2033	0.15	0.07	47.058	0.08	52.942
2034	0.15	0.07	47.058	0.08	52.942
2035	0.15	0.07	47.058	0.08	52.942
2036	0.15	0.07	47.058	0.08	52.942
2037	0.16	0.07	47.059	0.08	52.941
2038	0.16	0.07	47.059	0.08	52.941
2039	0.16	0.07	47.059	0.08	52.941
2040	0.16	0.07	47.059	0.08	52.941
2041	0.16	0.07	47.059	0.09	52.941
2042	0.16	0.08	47.059	0.09	52.941
2043	0.16	0.08	47.059	0.09	52.941
2044	0.16	0.08	47.059	0.09	52.941
2045	0.16	0.08	47.059	0.09	52.941
2046	0.17	0.08	47.059	0.09	52.941
2047	0.17	0.08	47.059	0.09	52.941
2048	0.17	0.08	47.059	0.09	52.941
2049	0.17	0.08	47.059	0.09	52.941
2050	0.17	0.08	47.059	0.09	52.941
Total	4.43	2.08	47.059	2.34	52.941
Average	0.16	0.07	47.059	0.08	52.941

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	0.0651	0.1972	0.8201	1.0007	2.3436

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.01	0.2	0.05	1.1	0.06	1.3
Highway Segment	Collision with Fixed Object	1.45	32.9	1.60	36.1	3.05	69.0
Highway Segment	Collision with Other Object	0.10	2.3	0.31	7.0	0.41	9.3
Highway Segment	Other Single-vehicle Collision	0.42	9.5	0.24	5.4	0.66	14.9
Highway Segment	Collision with Parked Vehicle	0.03	0.7	0.04	0.8	0.07	1.5
Highway Segment	Total Single Vehicle Crashes	2.01	45.5	2.23	50.4	4.25	95.9
Highway Segment	Right-Angle Collision	0.00	0.0	0.00	0.0	0.00	0.1
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	0.0	0.00	0.1	0.01	0.1
Highway Segment	Rear-end Collision	0.05	1.2	0.08	1.7	0.13	2.9
Highway Segment	Sideswipe, Same Direction Collision	0.01	0.3	0.03	0.7	0.04	0.9
Highway Segment	Total Multiple Vehicle Crashes	0.07	1.6	0.11	2.5	0.18	4.1
Highway Segment	Total Highway Segment Crashes	2.08	47.1	2.34	52.9	4.43	100.0
	Total Crashes	2.08	47.1	2.34	52.9	4.43	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
10+50.000	21+20.824	Warning: for segment #1 (10+50.000 to 21+20.824), The ramp type for Ramp MS1 EB Off Ramp 2050 Build is set at the Ramp Connection (Exit) and in the Ramp (Exit). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

May 30, 2024

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Report Overview

Report Generated: May 30, 2024 1:28 PM
Report Template: System: Multi-Page, 508 Compliant [System] (mlcpm4, Dec 13, 2022 10:30 AM)

Evaluation Date: Thu May 23 16:44:02 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Mustang Interchange - Build
Project Comment: Mustang Interchange - Build
Project Unit System: U.S. Customary

Highway Title: MS3 EB On Ramp 2050 Build
Highway Comment: Mustang EB On Ramp
Highway Version: 1

Evaluation Title: Evaluation 1
Evaluation Comment: Created Thu May 23 16:43:44 PDT 2024

Minimum Location: 2+68.484
Maximum Location: 15+35.405

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

First Year of Analysis: 2023
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

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Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 2+68.484
Evaluation End Location: 15+35.405
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;

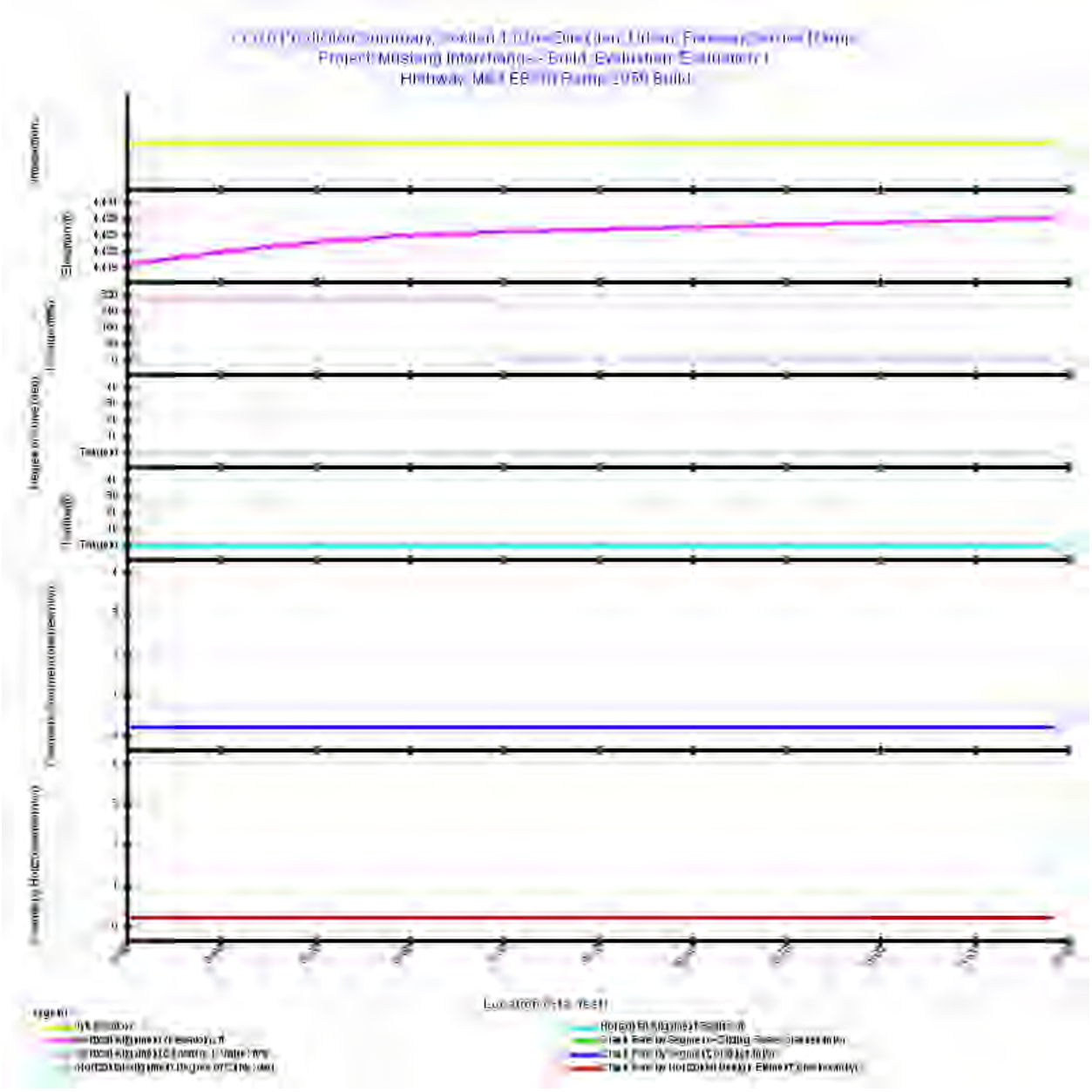

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	2+68.484	15+35.405	1,266.92	0.2399	2023: 530; 2024: 525; 2025: 521; 2026: 517; 2027: 512; 2028: 508; 2029: 504; 2030: 500; 2031: 505; 2032: 510; 2033: 515; 2034: 520; 2035: 525; 2036: 530; 2037: 535; 2038: 540; 2039: 545; 2040: 550; 2041: 555; 2042: 560; 2043: 565; 2044: 570; 2045: 575; 2046: 580; 2047: 585; 2048: 590; 2049: 595; 2050: 600

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.2399**
Average Future Road AADT (vpd)	**542**
Predicted Crashes	
Total Crashes	**1.56**
Fatal and Injury Crashes	**0.74**
Property-Damage-Only Crashes	**0.82**
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)	**0.2326**
FI Crash Rate (crashes/mi/yr)	**0.1109**
PDO Crash Rate (crashes/mi/yr)	**0.1216**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**1.33**
Travel Crash Rate (crashes/million veh-mi)	**1.18**
Travel FI Crash Rate (crashes/million veh-mi)	**0.56**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.61**

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	2+68.484	15+35.405	0.2399	1.562	0.0558	0.0266	0.0292	0.2326	1.18
Total			0.2399	1.562	0.0558	0.0266	0.0292	0.2326	

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	2+68.484	15+35.405	0.2399	1.562	0.0558	0.0266	0.0292	0.2326	1.18

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.06	0.03	47.731	0.03	52.269
2024	0.06	0.03	47.742	0.03	52.258
2025	0.05	0.03	47.751	0.03	52.249
2026	0.05	0.03	47.760	0.03	52.240
2027	0.05	0.03	47.771	0.03	52.229
2028	0.05	0.03	47.780	0.03	52.220
2029	0.05	0.03	47.789	0.03	52.211
2030	0.05	0.03	47.799	0.03	52.201
2031	0.05	0.03	47.787	0.03	52.213
2032	0.05	0.03	47.776	0.03	52.224
2033	0.05	0.03	47.764	0.03	52.236
2034	0.05	0.03	47.753	0.03	52.247
2035	0.06	0.03	47.742	0.03	52.258
2036	0.06	0.03	47.731	0.03	52.269
2037	0.06	0.03	47.720	0.03	52.280
2038	0.06	0.03	47.709	0.03	52.291
2039	0.06	0.03	47.698	0.03	52.302
2040	0.06	0.03	47.687	0.03	52.313
2041	0.06	0.03	47.676	0.03	52.324
2042	0.06	0.03	47.666	0.03	52.334
2043	0.06	0.03	47.655	0.03	52.345
2044	0.06	0.03	47.645	0.03	52.355
2045	0.06	0.03	47.634	0.03	52.366
2046	0.06	0.03	47.624	0.03	52.376
2047	0.06	0.03	47.614	0.03	52.386
2048	0.06	0.03	47.603	0.03	52.397
2049	0.06	0.03	47.593	0.03	52.407
2050	0.06	0.03	47.583	0.03	52.417
Total	1.56	0.74	47.704	0.82	52.296
Average	0.06	0.03	47.704	0.03	52.296

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	0.0159	0.0482	0.3069	0.3744	0.8171

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.00	0.2	0.02	1.1	0.02	1.2
Highway Segment	Collision with Fixed Object	0.43	27.5	0.54	34.5	0.97	62.0
Highway Segment	Collision with Other Object	0.03	1.9	0.10	6.7	0.14	8.6
Highway Segment	Other Single-vehicle Collision	0.12	7.9	0.08	5.2	0.20	13.1
Highway Segment	Collision with Parked Vehicle	0.01	0.6	0.01	0.8	0.02	1.3
Highway Segment	Total Single Vehicle Crashes	0.60	38.1	0.75	48.1	1.35	86.3
Highway Segment	Right-Angle Collision	0.01	0.3	0.00	0.1	0.01	0.4
Highway Segment	Head-on Collision	0.00	0.1	0.00	0.0	0.00	0.1
Highway Segment	Other Multi-vehicle Collision	0.01	0.3	0.00	0.1	0.01	0.4
Highway Segment	Rear-end Collision	0.11	7.2	0.04	2.9	0.16	10.0
Highway Segment	Sideswipe, Same Direction Collision	0.03	1.7	0.02	1.1	0.04	2.8
Highway Segment	Total Multiple Vehicle Crashes	0.15	9.6	0.07	4.2	0.21	13.7
Highway Segment	Total Highway Segment Crashes	0.74	47.7	0.82	52.3	1.56	100.0
	Total Crashes	0.74	47.7	0.82	52.3	1.56	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
2+68.484	15+35.405	Warning: for segment #1 (2+68.484 to 15+35.405), The ramp type for Ramp MS3 EB On Ramp 2050 Build is set at the Ramp Connection (Entrance) and in the Ramp (Entrance). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Overview

Report Generated: Jun 21, 2024 11:17 AM
Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Fri Jun 21 11:17:15 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Mustang Interchange - Build
Project Comment: Mustang Interchange - Build
Project Unit System: U.S. Customary

Highway Title: MS4 WB Off Ramp 2050 Build
Highway Comment: Mustang WB Off Ramp
Highway Version: 1

Evaluation Title: Evaluation 3
Evaluation Comment: Created Fri Jun 21 11:16:43 PDT 2024

Minimum Location: 13+92.483
Maximum Location: 15+47.024

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

First Year of Analysis: 2023
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: 13+92.483
Evaluation End Location: 15+47.024
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;

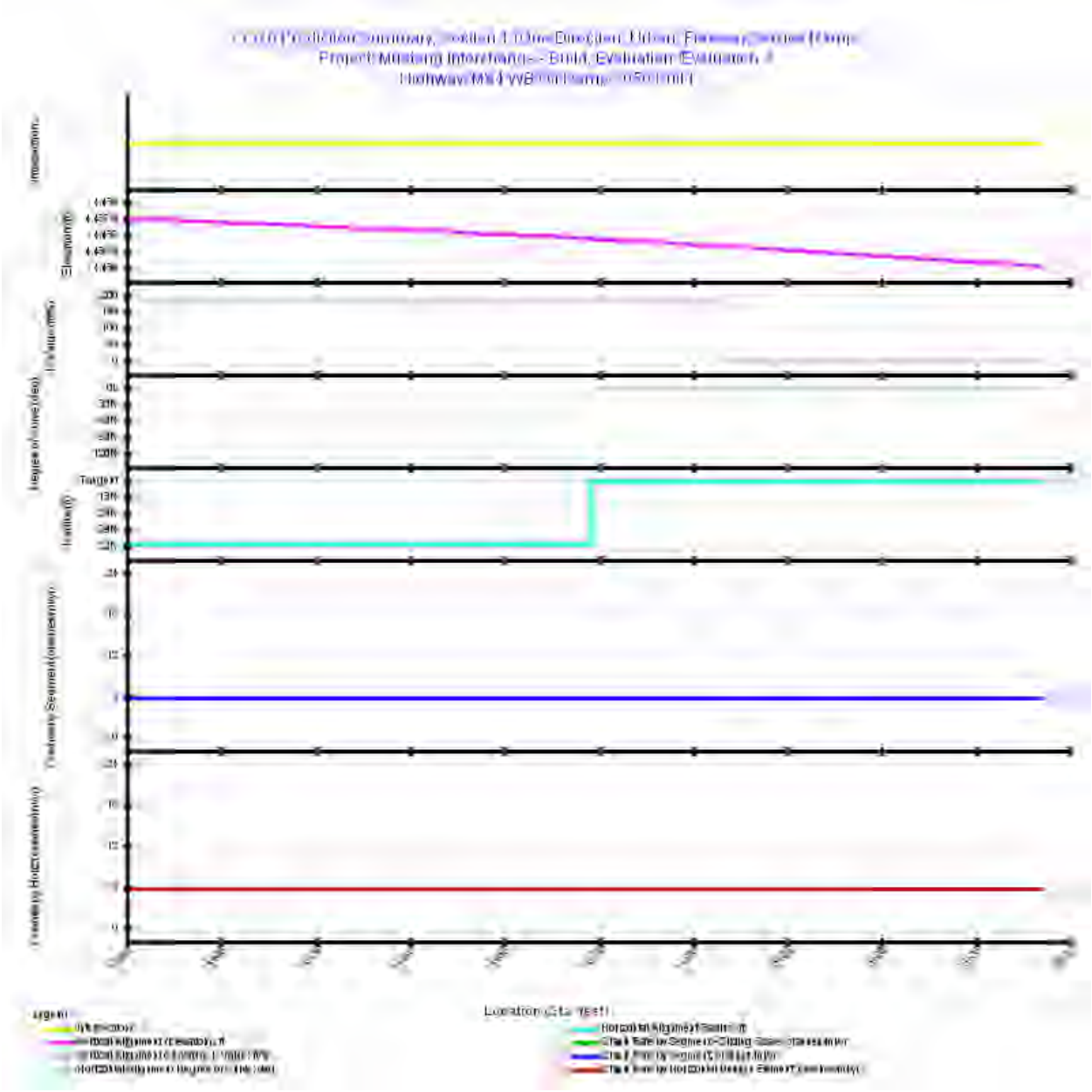

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	13+92.483	15+47.024	154.54	0.0293	2023-2030: 410; 2031: 414; 2032: 419; 2033: 423; 2034: 428; 2035: 432; 2036: 437; 2037: 441; 2038: 446; 2039: 450; 2040: 455; 2041: 459; 2042: 464; 2043: 468; 2044: 473; 2045: 477; 2046: 482; 2047: 486; 2048: 491; 2049: 495; 2050: 500

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.0293**
Average Future Road AADT (vpd)	**444**
Predicted Crashes	
Total Crashes	**4.61**
Fatal and Injury Crashes	**1.89**
Property-Damage-Only Crashes	**2.72**
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)	**5.6233**
FI Crash Rate (crashes/mi/yr)	**2.2998**
PDO Crash Rate (crashes/mi/yr)	**3.3235**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**0.13**
Travel Crash Rate (crashes/million veh-mi)	**34.73**
Travel FI Crash Rate (crashes/million veh-mi)	**14.21**
Travel PDO Crash Rate (crashes/million veh-mi)	**20.53**

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	13+92.483	15+47.024	0.0293	4.609	0.1646	0.0673	0.0973	5.6233	34.73
Total			0.0293	4.609	0.1646	0.0673	0.0973	5.6233	

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	13+92.483	14+70.894	0.0149	2.338	0.0835	0.0342	0.0494	5.6233	34.73
Tangent	14+70.894	15+47.024	0.0144	2.270	0.0811	0.0332	0.0479	5.6233	34.73

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.16	0.06	40.851	0.09	59.149
2024	0.16	0.06	40.851	0.09	59.149
2025	0.16	0.06	40.851	0.09	59.149
2026	0.16	0.06	40.851	0.09	59.149
2027	0.16	0.06	40.851	0.09	59.149
2028	0.16	0.06	40.851	0.09	59.149
2029	0.16	0.06	40.851	0.09	59.149
2030	0.16	0.06	40.851	0.09	59.149
2031	0.16	0.06	40.857	0.09	59.143
2032	0.16	0.07	40.864	0.09	59.136
2033	0.16	0.07	40.869	0.09	59.131
2034	0.16	0.07	40.876	0.10	59.124
2035	0.16	0.07	40.881	0.10	59.119
2036	0.16	0.07	40.888	0.10	59.112
2037	0.16	0.07	40.893	0.10	59.107
2038	0.17	0.07	40.900	0.10	59.100
2039	0.17	0.07	40.905	0.10	59.095
2040	0.17	0.07	40.911	0.10	59.089
2041	0.17	0.07	40.916	0.10	59.084
2042	0.17	0.07	40.923	0.10	59.077
2043	0.17	0.07	40.928	0.10	59.072
2044	0.17	0.07	40.934	0.10	59.066
2045	0.17	0.07	40.939	0.10	59.061
2046	0.17	0.07	40.945	0.10	59.055
2047	0.18	0.07	40.950	0.10	59.050
2048	0.18	0.07	40.956	0.10	59.044
2049	0.18	0.07	40.960	0.10	59.040
2050	0.18	0.07	40.966	0.11	59.034
Total	4.61	1.89	40.897	2.72	59.103
Average	0.17	0.07	40.897	0.10	59.103

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	0.0589	0.1785	0.7420	0.9054	2.7237

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.01	0.2	0.06	1.3	0.07	1.5
Highway Segment	Collision with Fixed Object	1.34	29.1	1.94	42.1	3.28	71.2
Highway Segment	Collision with Other Object	0.10	2.1	0.38	8.2	0.47	10.2
Highway Segment	Other Single-vehicle Collision	0.39	8.4	0.29	6.3	0.68	14.7
Highway Segment	Collision with Parked Vehicle	0.03	0.6	0.04	0.9	0.07	1.5
Highway Segment	Total Single Vehicle Crashes	1.86	40.3	2.71	58.8	4.57	99.1
Highway Segment	Right-Angle Collision	0.00	0.0	0.00	0.0	0.00	0.0
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	0.0	0.00	0.0	0.00	0.0
Highway Segment	Rear-end Collision	0.02	0.5	0.01	0.2	0.03	0.7
Highway Segment	Sideswipe, Same Direction Collision	0.01	0.1	0.00	0.1	0.01	0.2
Highway Segment	Total Multiple Vehicle Crashes	0.03	0.6	0.01	0.3	0.04	0.9
Highway Segment	Total Highway Segment Crashes	1.89	40.9	2.72	59.1	4.61	100.0
	Total Crashes	1.89	40.9	2.72	59.1	4.61	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
13+92.483	15+47.024	Warning: for segment #1 (13+92.483 to 15+47.024), The ramp type for Ramp MS4 WB Off Ramp 2050 Build is set at the Ramp Connection (Exit) and in the Ramp (Exit). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Overview

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Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Fri Jun 21 11:18:45 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Mustang Interchange - Build
Project Comment: Mustang Interchange - Build
Project Unit System: U.S. Customary

Highway Title: MS6 WB On Ramp 2050 Build
Highway Comment: Mustang WB On Ramp
Highway Version: 1

Evaluation Title: Evaluation 3
Evaluation Comment: Created Fri Jun 21 11:18:31 PDT 2024

Minimum Location: 1+66.450
Maximum Location: 4+10.355

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

First Year of Analysis: 2023
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

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- Roundabouts: completed in 2018 under NCHRP Project 17-70, the new methods will provide improved outcomes for the safety analysis of roundabouts.
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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: 1+66.450
Evaluation End Location: 4+10.355
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;

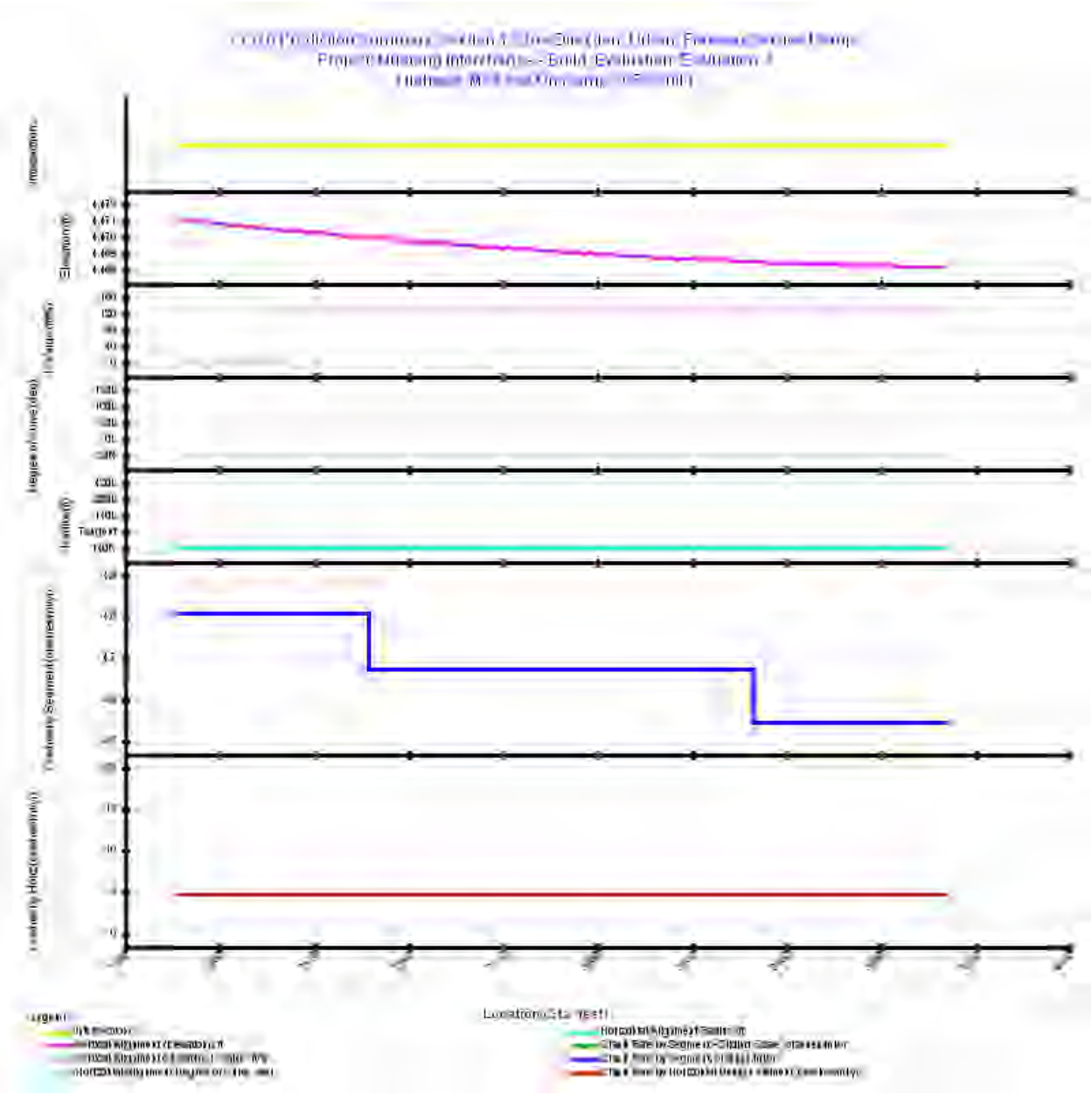

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	1+66.450	2+27.450	61.00	0.0116	2023: 2,170; 2024: 2,145; 2025: 2,121; 2026: 2,097; 2027: 2,072; 2028: 2,048; 2029: 2,024; 2030: 2,000; 2031: 2,020; 2032: 2,040; 2033: 2,060; 2034: 2,080; 2035: 2,100; 2036: 2,120; 2037: 2,140; 2038: 2,160; 2039: 2,180; 2040: 2,200; 2041: 2,220; 2042: 2,240; 2043: 2,260; 2044: 2,280; 2045: 2,300; 2046: 2,320; 2047: 2,340; 2048: 2,360; 2049: 2,380; 2050: 2,400
2	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	2+27.450	3+49.450	122.00	0.0231	2023: 2,170; 2024: 2,145; 2025: 2,121; 2026: 2,097; 2027: 2,072; 2028: 2,048; 2029: 2,024; 2030: 2,000; 2031: 2,020; 2032: 2,040; 2033: 2,060; 2034: 2,080; 2035: 2,100; 2036: 2,120; 2037: 2,140; 2038: 2,160; 2039: 2,180; 2040: 2,200; 2041: 2,220; 2042: 2,240; 2043: 2,260; 2044: 2,280; 2045: 2,300; 2046: 2,320; 2047: 2,340; 2048: 2,360; 2049: 2,380; 2050: 2,400
3	Freeway Ramp and C-D Road One-lane Ramp Entrance	Urban	3+49.450	4+10.355	60.91	0.0115	2023: 2,170; 2024: 2,145; 2025: 2,121; 2026: 2,097; 2027: 2,072; 2028: 2,048; 2029: 2,024; 2030: 2,000; 2031: 2,020; 2032: 2,040; 2033: 2,060; 2034: 2,080; 2035: 2,100; 2036: 2,120; 2037: 2,140; 2038: 2,160; 2039: 2,180; 2040: 2,200; 2041: 2,220; 2042: 2,240; 2043: 2,260; 2044: 2,280; 2045: 2,300; 2046: 2,320; 2047: 2,340; 2048: 2,360; 2049: 2,380; 2050: 2,400

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.0462**
Average Future Road AADT (vpd)	**2,174**
Predicted Crashes	
Total Crashes	**6.05**
Fatal and Injury Crashes	**2.49**
Property-Damage-Only Crashes	**3.56**
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)	**4.6755**
FI Crash Rate (crashes/mi/yr)	**1.9232**
PDO Crash Rate (crashes/mi/yr)	**2.7522**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**1.03**
Travel Crash Rate (crashes/million veh-mi)	**5.89**
Travel FI Crash Rate (crashes/million veh-mi)	**2.42**
Travel PDO Crash Rate (crashes/million veh-mi)	**3.47**

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+66.450	2+27.450	0.0116	1.555	0.0555	0.0231	0.0324	4.8077	6.06
2	2+27.450	3+49.450	0.0231	3.024	0.1080	0.0444	0.0636	4.6743	5.89
3	3+49.450	4+10.355	0.0115	1.468	0.0524	0.0213	0.0311	4.5453	5.73
Total			0.0462	6.047	0.2160	0.0888	0.1271	4.6755	

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	1+66.450	4+10.355	0.0462	6.047	0.2160	0.0888	0.1271	4.6755	5.89

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.22	0.09	41.135	0.13	58.865
2024	0.21	0.09	41.136	0.13	58.864
2025	0.21	0.09	41.136	0.12	58.864
2026	0.21	0.09	41.137	0.12	58.863
2027	0.21	0.09	41.137	0.12	58.863
2028	0.21	0.09	41.138	0.12	58.862
2029	0.20	0.08	41.138	0.12	58.862
2030	0.20	0.08	41.139	0.12	58.861
2031	0.20	0.08	41.138	0.12	58.862
2032	0.21	0.09	41.138	0.12	58.862
2033	0.21	0.09	41.138	0.12	58.862
2034	0.21	0.09	41.137	0.12	58.863
2035	0.21	0.09	41.137	0.12	58.863
2036	0.21	0.09	41.136	0.12	58.864
2037	0.21	0.09	41.136	0.13	58.864
2038	0.21	0.09	41.135	0.13	58.865
2039	0.22	0.09	41.135	0.13	58.865
2040	0.22	0.09	41.135	0.13	58.865
2041	0.22	0.09	41.134	0.13	58.866
2042	0.22	0.09	41.134	0.13	58.866
2043	0.22	0.09	41.133	0.13	58.867
2044	0.22	0.09	41.133	0.13	58.867
2045	0.23	0.09	41.132	0.13	58.868
2046	0.23	0.09	41.132	0.13	58.868
2047	0.23	0.09	41.132	0.13	58.868
2048	0.23	0.09	41.131	0.14	58.869
2049	0.23	0.10	41.131	0.14	58.869
2050	0.23	0.10	41.130	0.14	58.870
Total	6.05	2.49	41.135	3.56	58.865
Average	0.22	0.09	41.135	0.13	58.865

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	0.0138	0.0419	0.2666	0.3253	0.9077
2	0.0265	0.0804	0.5120	0.6248	1.7804
3	0.0127	0.0386	0.2455	0.2995	0.8717
Total	0.0531	0.1609	1.0241	1.2496	3.5598

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.01	0.2	0.07	1.2	0.08	1.4
Highway Segment	Collision with Fixed Object	1.65	27.2	2.42	40.1	4.07	67.3
Highway Segment	Collision with Other Object	0.12	1.9	0.47	7.8	0.59	9.7
Highway Segment	Other Single-vehicle Collision	0.47	7.8	0.36	6.0	0.84	13.8
Highway Segment	Collision with Parked Vehicle	0.03	0.6	0.05	0.9	0.09	1.5
Highway Segment	Total Single Vehicle Crashes	2.28	37.7	3.39	56.0	5.67	93.7
Highway Segment	Right-Angle Collision	0.01	0.1	0.00	0.1	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	0.01	0.1	0.00	0.1	0.01	0.2
Highway Segment	Rear-end Collision	0.15	2.6	0.12	2.0	0.27	4.5
Highway Segment	Sideswipe, Same Direction Collision	0.04	0.6	0.05	0.8	0.08	1.4
Highway Segment	Total Multiple Vehicle Crashes	0.21	3.4	0.17	2.8	0.38	6.3
Highway Segment	Total Highway Segment Crashes	2.49	41.1	3.56	58.9	6.05	100.0
	Total Crashes	2.49	41.1	3.56	58.9	6.05	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+66.450	2+27.450	Warning: for segment #1 (1+66.450 to 2+27.450), The ramp type for Ramp MS6 WB On Ramp 2050 Build is set at the Ramp Connection (Entrance) and in the Ramp (Entrance). The Ramp value takes precedence.
2+27.450	3+49.450	Warning: for segment #2 (2+27.450 to 3+49.450), The ramp type for Ramp MS6 WB On Ramp 2050 Build is set at the Ramp Connection (Entrance) and in the Ramp (Entrance). The Ramp value takes precedence.
3+49.450	4+10.355	Warning: for segment #3 (3+49.450 to 4+10.355), The ramp type for Ramp MS6 WB On Ramp 2050 Build is set at the Ramp Connection (Entrance) and in the Ramp (Entrance). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Overview

Report Generated: Jun 21, 2024 11:21 AM
Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Fri Jun 21 11:21:36 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Patrick Interchange - Build
Project Comment: Patrick Interchange - Build
Project Unit System: U.S. Customary

Highway Title: WT1a EB Off Ramp 2050 Build
Highway Comment: Patrick EB Off Ramp Build
Highway Version: 1

Evaluation Title: Evaluation 2
Evaluation Comment: Created Fri Jun 21 11:21:12 PDT 2024

Minimum Location: 8+00.000
Maximum Location: 19+99.070

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

First Year of Analysis: 2023
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

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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: 8+00.000
Evaluation End Location: 19+99.070
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;

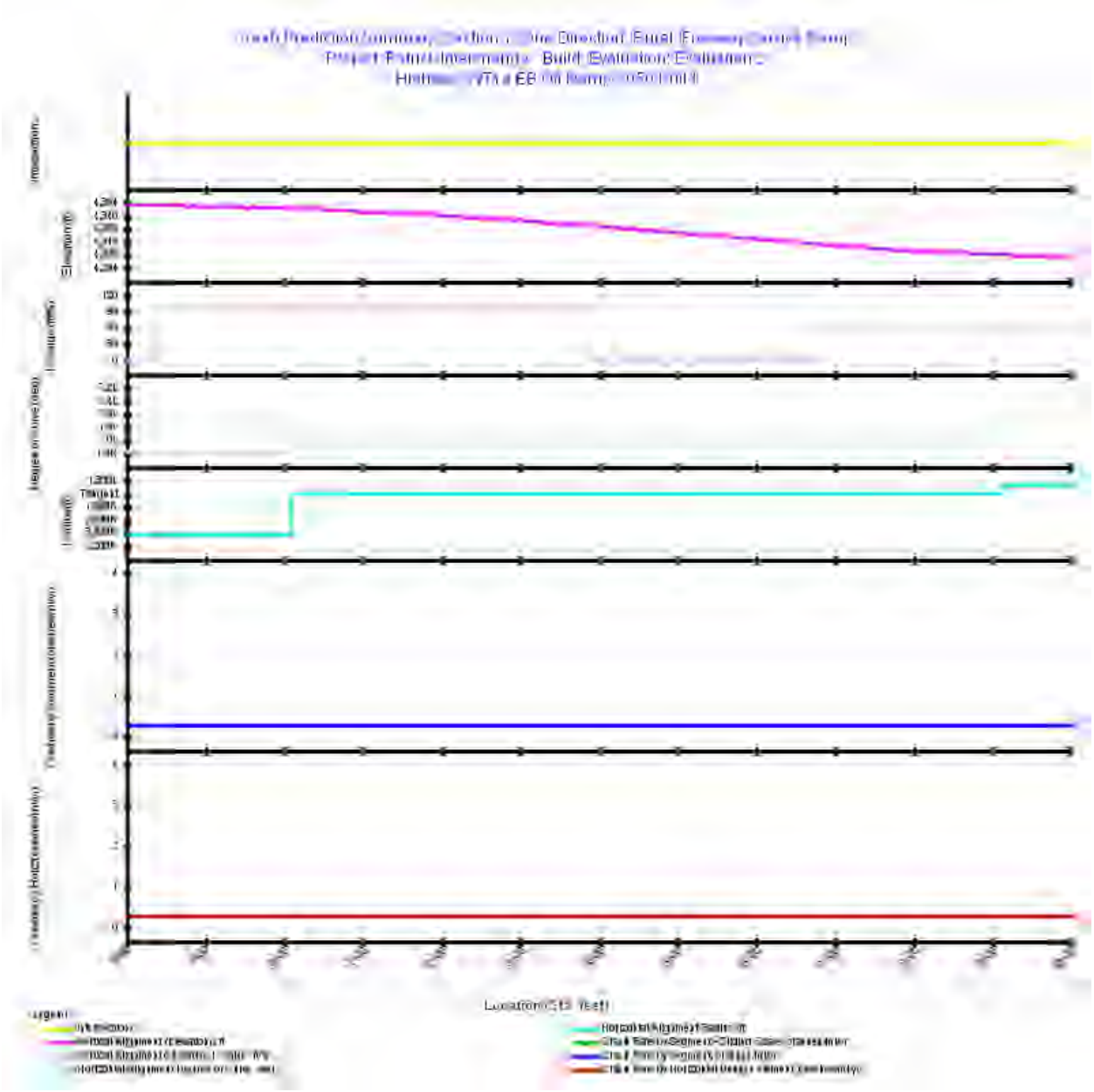

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	Rural	8+00.000	19+99.070	1,199.07	0.2271	2023: 860; 2024: 844; 2025: 828; 2026: 812; 2027: 797; 2028: 781; 2029: 765; 2030: 750; 2031: 757; 2032: 765; 2033: 772; 2034: 780; 2035: 787; 2036: 795; 2037: 802; 2038: 810; 2039: 817; 2040: 825; 2041: 832; 2042: 840; 2043: 847; 2044: 855; 2045: 862; 2046: 870; 2047: 877; 2048: 885; 2049: 892; 2050: 900

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.2271**
Average Future Road AADT (vpd)	**822**
Predicted Crashes	
Total Crashes	**1.90**
Fatal and Injury Crashes	**0.92**
Property-Damage-Only Crashes	**0.98**
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)	**0.2982**
FI Crash Rate (crashes/mi/yr)	**0.1443**
PDO Crash Rate (crashes/mi/yr)	**0.1539**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**1.91**
Travel Crash Rate (crashes/million veh-mi)	**0.99**
Travel FI Crash Rate (crashes/million veh-mi)	**0.48**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.51**

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	8+00.000	19+99.070	0.2271	1.896	0.0677	0.0328	0.0349	0.2982	0.99
Total			0.2271	1.896	0.0677	0.0328	0.0349	0.2982	

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	8+00.000	10+10.462	0.0399	0.333	0.0119	0.0058	0.0061	0.2982	0.99
Tangent	10+10.462	19+11.829	0.1707	1.425	0.0509	0.0246	0.0263	0.2982	0.99
Simple Curve 2	19+11.829	19+99.070	0.0165	0.138	0.0049	0.0024	0.0025	0.2982	0.99

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.07	0.03	48.401	0.04	51.599
2024	0.07	0.03	48.398	0.04	51.602
2025	0.07	0.03	48.395	0.04	51.605
2026	0.07	0.03	48.392	0.04	51.608
2027	0.07	0.03	48.389	0.03	51.611
2028	0.07	0.03	48.386	0.03	51.614
2029	0.06	0.03	48.382	0.03	51.618
2030	0.06	0.03	48.378	0.03	51.622
2031	0.06	0.03	48.380	0.03	51.620
2032	0.06	0.03	48.382	0.03	51.618
2033	0.07	0.03	48.383	0.03	51.617
2034	0.07	0.03	48.385	0.03	51.615
2035	0.07	0.03	48.387	0.03	51.613
2036	0.07	0.03	48.389	0.03	51.611
2037	0.07	0.03	48.390	0.03	51.610
2038	0.07	0.03	48.392	0.04	51.608
2039	0.07	0.03	48.393	0.04	51.607
2040	0.07	0.03	48.395	0.04	51.605
2041	0.07	0.03	48.396	0.04	51.604
2042	0.07	0.03	48.398	0.04	51.602
2043	0.07	0.03	48.399	0.04	51.601
2044	0.07	0.03	48.400	0.04	51.600
2045	0.07	0.03	48.401	0.04	51.599
2046	0.07	0.03	48.403	0.04	51.597
2047	0.07	0.03	48.404	0.04	51.596
2048	0.07	0.04	48.405	0.04	51.595
2049	0.07	0.04	48.406	0.04	51.594
2050	0.07	0.04	48.408	0.04	51.592
Total	1.90	0.92	48.394	0.98	51.606
Average	0.07	0.03	48.394	0.04	51.606

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	0.0369	0.1118	0.4781	0.2908	0.9785

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.01	0.5	0.06	3.2	0.07	3.7
Highway Segment	Collision with Fixed Object	0.52	27.2	0.59	31.0	1.10	58.2
Highway Segment	Collision with Other Object	0.03	1.5	0.12	6.2	0.15	7.7
Highway Segment	Other Single-vehicle Collision	0.34	17.7	0.15	8.0	0.49	25.7
Highway Segment	Collision with Parked Vehicle	0.02	1.2	0.02	1.1	0.04	2.3
Highway Segment	Total Single Vehicle Crashes	0.91	48.0	0.94	49.7	1.85	97.7
Highway Segment	Right-Angle Collision	0.00	0.0	0.00	0.1	0.00	0.1
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	0.0	0.00	0.2	0.00	0.2
Highway Segment	Rear-end Collision	0.01	0.2	0.02	1.0	0.02	1.2
Highway Segment	Sideswipe, Same Direction Collision	0.00	0.1	0.01	0.7	0.02	0.8
Highway Segment	Total Multiple Vehicle Crashes	0.01	0.4	0.04	2.0	0.04	2.3
Highway Segment	Total Highway Segment Crashes	0.92	48.4	0.98	51.6	1.90	100.0
	Total Crashes	0.92	48.4	0.98	51.6	1.90	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
8+00.000	19+99.070	Warning: for segment #1 (8+00.000 to 19+99.070), The ramp type for Ramp WT1a EB Off Ramp 2050 Build is set at the Ramp Connection (Exit) and in the Ramp (Exit). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Generated: Jun 21, 2024 11:27 AM
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Evaluation Date: Fri Jun 21 11:27:36 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Patrick Interchange - Build
Project Comment: Patrick Interchange - Build
Project Unit System: U.S. Customary

Highway Title: WT1b EB On Ramp 2050 Build
Highway Comment: Waltham EB On Ramp
Highway Version: 1

Evaluation Title: Evaluation 2
Evaluation Comment: Created Fri Jun 21 11:27:19 PDT 2024

Minimum Location: 19+99.070
Maximum Location: 33+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: 2023
Last Year of Analysis: 2050
Empirical-Bayes Analysis: None
First Year of Observed Crashes:
Last Year of Observed Crashes:

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- 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.

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Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 19+99.070
Evaluation End Location: 33+00.000
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;

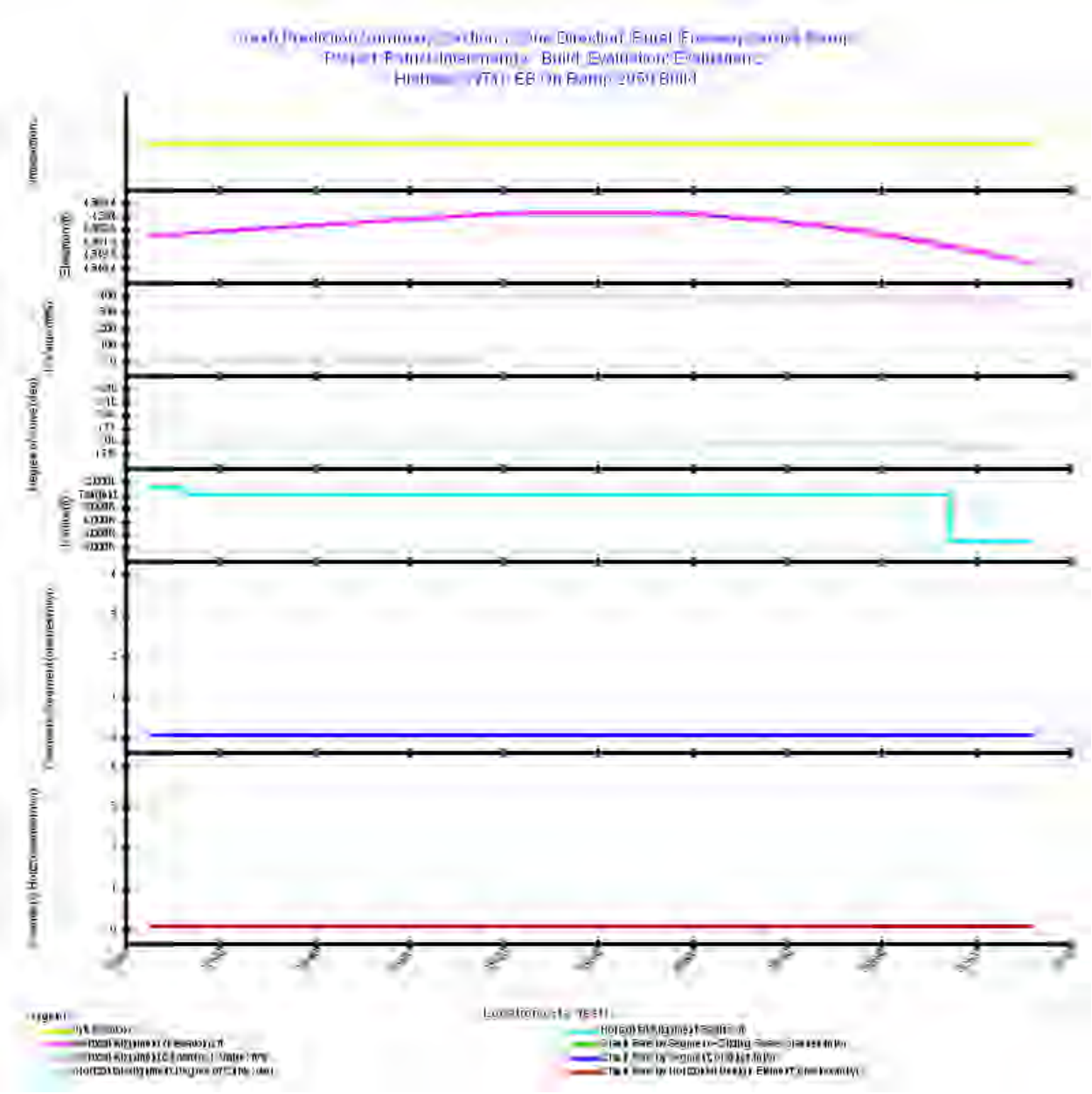

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	Rural	19+99.070	33+00.000	1,300.93	0.2464	2023: 160; 2024: 162; 2025: 165; 2026: 168; 2027: 171; 2028: 174; 2029: 177; 2030: 180; 2031: 181; 2032: 183; 2033: 184; 2034: 186; 2035: 187; 2036: 189; 2037: 190; 2038: 192; 2039: 193; 2040: 195; 2041: 196; 2042: 198; 2043: 199; 2044: 201; 2045: 202; 2046: 204; 2047: 205; 2048: 207; 2049: 208; 2050: 210

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.2464**
Average Future Road AADT (vpd)	**188**
Predicted Crashes	
Total Crashes	**0.58**
Fatal and Injury Crashes	**0.26**
Property-Damage-Only Crashes	**0.32**
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)	**0.0837**
FI Crash Rate (crashes/mi/yr)	**0.0380**
PDO Crash Rate (crashes/mi/yr)	**0.0457**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**0.47**
Travel Crash Rate (crashes/million veh-mi)	**1.22**
Travel FI Crash Rate (crashes/million veh-mi)	**0.55**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.67**

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	19+99.070	33+00.000	0.2464	0.577	0.0206	0.0094	0.0113	0.0837	1.22
Total			0.2464	0.577	0.0206	0.0094	0.0113	0.0837	

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	19+99.070	20+50.266	0.0097	0.023	0.0008	0.0004	0.0004	0.0837	1.22
Tangent	20+50.266	31+80.837	0.2141	0.502	0.0179	0.0081	0.0098	0.0837	1.22
Simple Curve 2	31+80.837	33+00.000	0.0226	0.053	0.0019	0.0009	0.0010	0.0837	1.22

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.02	0.01	45.431	0.01	54.569
2024	0.02	0.01	45.428	0.01	54.572
2025	0.02	0.01	45.422	0.01	54.578
2026	0.02	0.01	45.417	0.01	54.583
2027	0.02	0.01	45.412	0.01	54.588
2028	0.02	0.01	45.407	0.01	54.593
2029	0.02	0.01	45.401	0.01	54.599
2030	0.02	0.01	45.396	0.01	54.604
2031	0.02	0.01	45.395	0.01	54.605
2032	0.02	0.01	45.391	0.01	54.609
2033	0.02	0.01	45.389	0.01	54.611
2034	0.02	0.01	45.386	0.01	54.614
2035	0.02	0.01	45.384	0.01	54.616
2036	0.02	0.01	45.380	0.01	54.620
2037	0.02	0.01	45.379	0.01	54.621
2038	0.02	0.01	45.375	0.01	54.625
2039	0.02	0.01	45.373	0.01	54.627
2040	0.02	0.01	45.370	0.01	54.630
2041	0.02	0.01	45.368	0.01	54.632
2042	0.02	0.01	45.364	0.01	54.636
2043	0.02	0.01	45.363	0.01	54.637
2044	0.02	0.01	45.359	0.01	54.641
2045	0.02	0.01	45.357	0.01	54.643
2046	0.02	0.01	45.354	0.01	54.646
2047	0.02	0.01	45.352	0.01	54.648
2048	0.02	0.01	45.349	0.01	54.651
2049	0.02	0.01	45.347	0.01	54.653
2050	0.02	0.01	45.343	0.01	54.657
Total	0.58	0.26	45.380	0.32	54.620
Average	0.02	0.01	45.380	0.01	54.620

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	0.0073	0.0221	0.1446	0.0880	0.3153

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.00	0.4	0.02	3.4	0.02	3.8
Highway Segment	Collision with Fixed Object	0.14	24.2	0.19	32.2	0.33	56.4
Highway Segment	Collision with Other Object	0.01	1.3	0.04	6.4	0.04	7.8
Highway Segment	Other Single-vehicle Collision	0.09	15.7	0.05	8.4	0.14	24.1
Highway Segment	Collision with Parked Vehicle	0.01	1.0	0.01	1.2	0.01	2.2
Highway Segment	Total Single Vehicle Crashes	0.25	42.7	0.30	51.6	0.54	94.3
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	0.1
Highway Segment	Other Multi-vehicle Collision	0.00	0.2	0.00	0.2	0.00	0.4
Highway Segment	Rear-end Collision	0.01	1.7	0.01	1.6	0.02	3.2
Highway Segment	Sideswipe, Same Direction Collision	0.00	0.6	0.01	1.2	0.01	1.8
Highway Segment	Total Multiple Vehicle Crashes	0.01	2.7	0.02	3.1	0.03	5.7
Highway Segment	Total Highway Segment Crashes	0.26	45.4	0.32	54.6	0.58	100.0
	Total Crashes	0.26	45.4	0.32	54.6	0.58	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
19+99.070	33+00.000	Warning: for segment #1 (19+99.070 to 33+00.000), The ramp type for Ramp WT1b EB On Ramp 2050 Build is set at the Ramp Connection (Entrance) and in the Ramp (Entrance). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Overview

Report Generated: Jun 21, 2024 11:23 AM
Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Fri Jun 21 11:23:49 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Patrick Interchange - Build
Project Comment: Patrick Interchange - Build
Project Unit System: U.S. Customary

Highway Title: WT4a WB Off Ramp 2050 Build
Highway Comment: Patrick WB Off Ramp Build
Highway Version: 1

Evaluation Title: Evaluation 3
Evaluation Comment: Created Fri Jun 21 11:23:35 PDT 2024

Minimum Location: 0.000
Maximum Location: 16+70.340

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

First Year of Analysis: 2023
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

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Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 0.000
Evaluation End Location: 16+70.340
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;

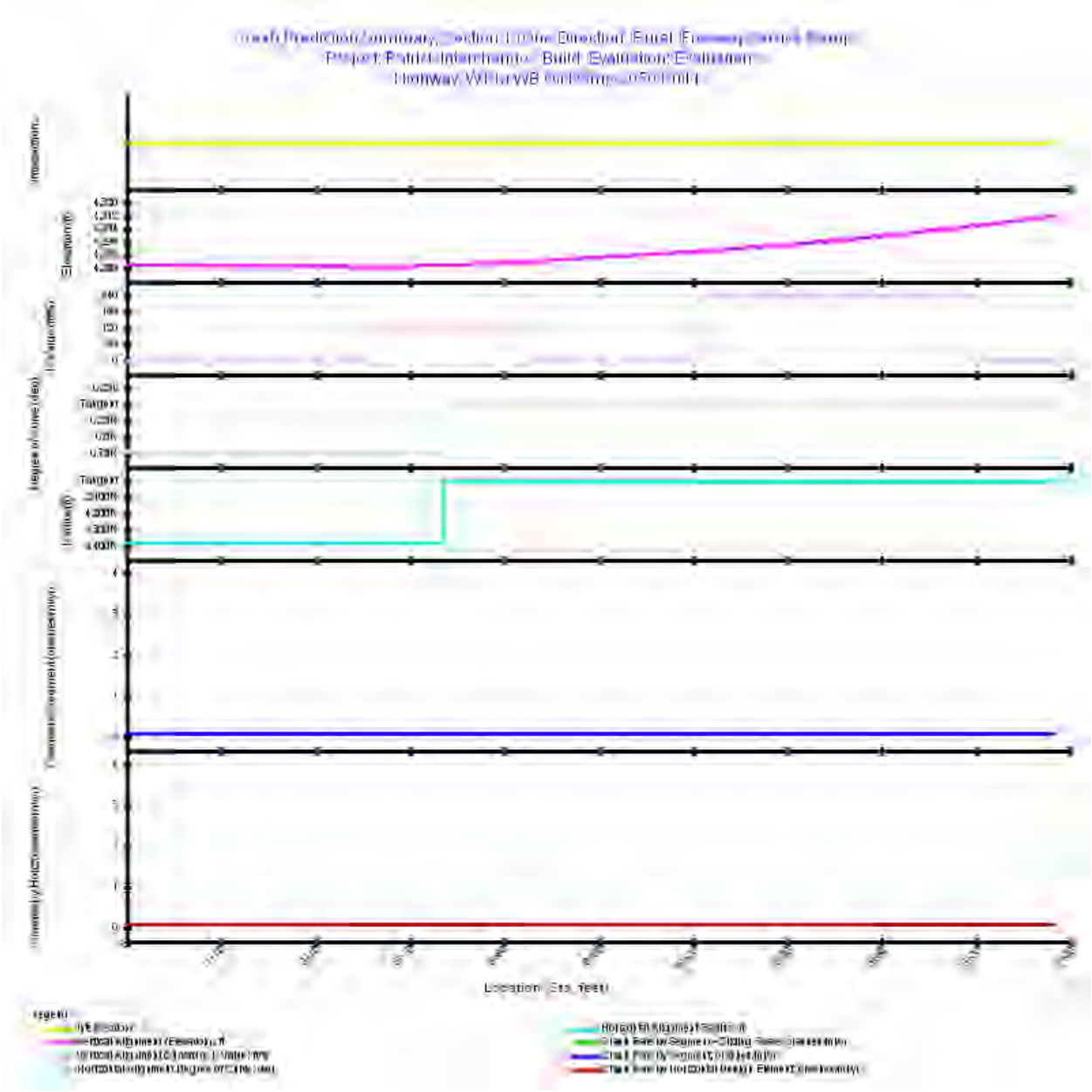

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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 One-lane Ramp Exit	Rural	0.000	16+70.340	1,670.34	0.3164	2023: 140; 2024: 142; 2025: 145; 2026: 148; 2027: 151; 2028: 154; 2029: 157; 2030: 160; 2031: 161; 2032: 163; 2033: 164; 2034: 166; 2035: 167; 2036: 169; 2037: 170; 2038: 172; 2039: 173; 2040: 175; 2041: 176; 2042: 178; 2043: 179; 2044: 181; 2045: 182; 2046: 184; 2047: 185; 2048: 187; 2049: 188; 2050: 190

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.3164**
Average Future Road AADT (vpd)	**168**
Predicted Crashes	
Total Crashes	**0.85**
Fatal and Injury Crashes	**0.41**
Property-Damage-Only Crashes	**0.44**
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)	**0.0956**
FI Crash Rate (crashes/mi/yr)	**0.0458**
PDO Crash Rate (crashes/mi/yr)	**0.0497**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**0.54**
Travel Crash Rate (crashes/million veh-mi)	**1.56**
Travel FI Crash Rate (crashes/million veh-mi)	**0.75**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.81**

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	16+70.340	0.3164	0.847	0.0302	0.0145	0.0157	0.0956	1.56
Total			0.3164	0.847	0.0302	0.0145	0.0157	0.0956	

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	5+67.276	0.1074	0.287	0.0103	0.0049	0.0053	0.0956	1.56
Tangent	5+67.276	16+70.340	0.2089	0.559	0.0200	0.0096	0.0104	0.0956	1.56

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.03	0.01	47.860	0.01	52.140
2024	0.03	0.01	47.867	0.01	52.133
2025	0.03	0.01	47.877	0.01	52.123
2026	0.03	0.01	47.886	0.01	52.114
2027	0.03	0.01	47.895	0.01	52.105
2028	0.03	0.01	47.905	0.01	52.095
2029	0.03	0.01	47.913	0.01	52.087
2030	0.03	0.01	47.922	0.01	52.078
2031	0.03	0.01	47.925	0.01	52.075
2032	0.03	0.01	47.931	0.01	52.069
2033	0.03	0.01	47.933	0.01	52.067
2034	0.03	0.01	47.939	0.02	52.061
2035	0.03	0.01	47.941	0.02	52.059
2036	0.03	0.01	47.947	0.02	52.053
2037	0.03	0.01	47.950	0.02	52.050
2038	0.03	0.01	47.955	0.02	52.045
2039	0.03	0.01	47.957	0.02	52.043
2040	0.03	0.01	47.962	0.02	52.038
2041	0.03	0.01	47.965	0.02	52.035
2042	0.03	0.01	47.970	0.02	52.030
2043	0.03	0.01	47.973	0.02	52.027
2044	0.03	0.01	47.977	0.02	52.023
2045	0.03	0.01	47.980	0.02	52.020
2046	0.03	0.01	47.985	0.02	52.015
2047	0.03	0.02	47.987	0.02	52.013
2048	0.03	0.02	47.992	0.02	52.008
2049	0.03	0.02	47.994	0.02	52.006
2050	0.03	0.02	47.999	0.02	52.001
Total	0.85	0.41	47.945	0.44	52.055
Average	0.03	0.01	47.945	0.02	52.055

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	0.0163	0.0495	0.2115	0.1286	0.4407

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.00	0.5	0.03	3.3	0.03	3.8
Highway Segment	Collision with Fixed Object	0.23	26.9	0.27	32.0	0.50	58.9
Highway Segment	Collision with Other Object	0.01	1.5	0.05	6.4	0.07	7.9
Highway Segment	Other Single-vehicle Collision	0.15	17.5	0.07	8.3	0.22	25.8
Highway Segment	Collision with Parked Vehicle	0.01	1.1	0.01	1.2	0.02	2.3
Highway Segment	Total Single Vehicle Crashes	0.40	47.4	0.43	51.2	0.83	98.7
Highway Segment	Right-Angle Collision	0.00	0.0	0.00	0.0	0.00	0.1
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	0.0	0.00	0.1	0.00	0.1
Highway Segment	Rear-end Collision	0.00	0.3	0.00	0.4	0.01	0.7
Highway Segment	Sideswipe, Same Direction Collision	0.00	0.1	0.00	0.3	0.00	0.4
Highway Segment	Total Multiple Vehicle Crashes	0.00	0.5	0.01	0.8	0.01	1.3
Highway Segment	Total Highway Segment Crashes	0.41	47.9	0.44	52.1	0.85	100.0
	Total Crashes	0.41	47.9	0.44	52.1	0.85	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	16+70.340	Warning: for segment #1 (0.000 to 16+70.340), The ramp type for Ramp WT4a WB Off Ramp 2050 Build is set at the Ramp Connection (Exit) and in the Ramp (Exit). The Ramp value takes precedence.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 21, 2024

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Report Overview

Report Generated: Jun 21, 2024 11:29 AM
Report Template: System: Single Page, 508 Compliant [System] (mlcpm5, Dec 13, 2022 10:30 AM)

Evaluation Date: Fri Jun 21 11:29:28 PDT 2024
IHSDM Version: v17.0.0 (Sep 22, 2021)
Crash Prediction Module: v12.0.0 (Sep 22, 2021)

User Name: jimc
Organization Name: CA Group
Phone:
E-Mail: Jim.Ceragioli@c-agroup.com

Project Title: Patrick Interchange - Build
Project Comment: Patrick Interchange - Build
Project Unit System: U.S. Customary

Highway Title: WT4b WB On Ramp 2050 Build
Highway Comment: Patrick WB On Ramp Build
Highway Version: 1

Evaluation Title: Evaluation 2
Evaluation Comment: Created Fri Jun 21 11:29:13 PDT 2024

Minimum Location: 16+70.340
Maximum Location: 32+73.811

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

First Year of Analysis: 2023
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: 16+70.340
Evaluation End Location: 32+73.811
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;

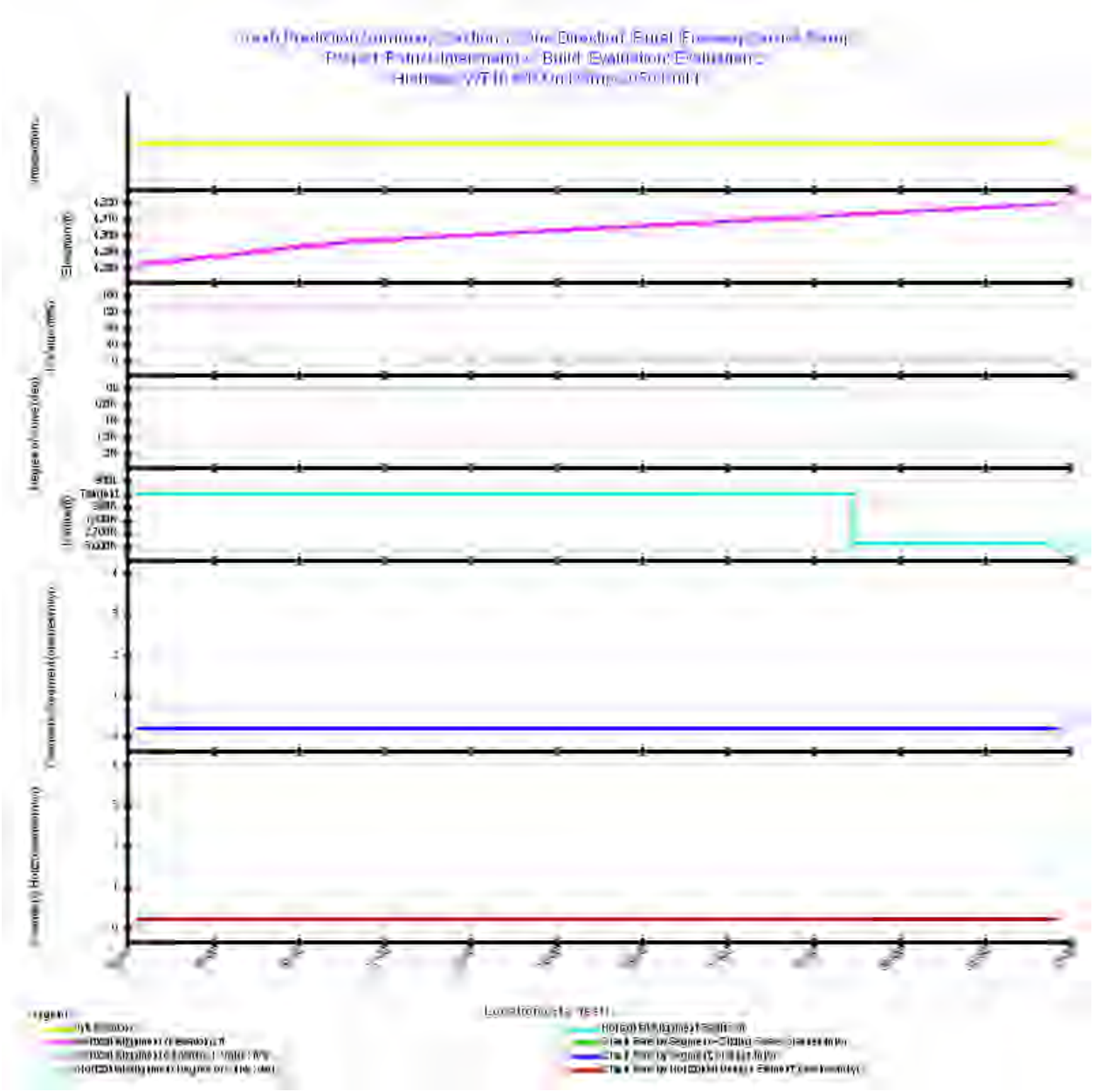

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

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	Rural	16+70.340	32+73.811	1,603.47	0.3037	2023: 620; 2024: 614; 2025: 608; 2026: 602; 2027: 597; 2028: 591; 2029: 585; 2030: 580; 2031: 586; 2032: 592; 2033: 598; 2034: 604; 2035: 610; 2036: 616; 2037: 622; 2038: 628; 2039: 634; 2040: 640; 2041: 646; 2042: 652; 2043: 658; 2044: 664; 2045: 670; 2046: 676; 2047: 682; 2048: 688; 2049: 694; 2050: 700

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

First Year of Analysis	**2023**
Last Year of Analysis	**2050**
Evaluated Length (mi)	**0.3037**
Average Future Road AADT (vpd)	**631**
Predicted Crashes	
Total Crashes	**1.71**
Fatal and Injury Crashes	**0.77**
Property-Damage-Only Crashes	**0.95**
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)	**0.2015**
FI Crash Rate (crashes/mi/yr)	**0.0899**
PDO Crash Rate (crashes/mi/yr)	**0.1116**
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	**1.96**
Travel Crash Rate (crashes/million veh-mi)	**0.88**
Travel FI Crash Rate (crashes/million veh-mi)	**0.39**
Travel PDO Crash Rate (crashes/million veh-mi)	**0.48**

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	16+70.340	32+73.811	0.3037	1.714	0.0612	0.0273	0.0339	0.2015	0.88
Total			0.3037	1.714	0.0612	0.0273	0.0339	0.2015	

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	16+70.340	29+19.349	0.2366	1.335	0.0477	0.0213	0.0264	0.2015	0.88
Simple Curve 1	29+19.349	32+73.811	0.0671	0.379	0.0135	0.0060	0.0075	0.2015	0.88

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

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2023	0.06	0.03	44.643	0.03	55.357
2024	0.06	0.03	44.652	0.03	55.348
2025	0.06	0.03	44.661	0.03	55.339
2026	0.06	0.03	44.670	0.03	55.330
2027	0.06	0.03	44.677	0.03	55.323
2028	0.06	0.03	44.686	0.03	55.314
2029	0.06	0.03	44.695	0.03	55.305
2030	0.06	0.03	44.703	0.03	55.297
2031	0.06	0.03	44.694	0.03	55.306
2032	0.06	0.03	44.685	0.03	55.315
2033	0.06	0.03	44.676	0.03	55.324
2034	0.06	0.03	44.667	0.03	55.333
2035	0.06	0.03	44.658	0.03	55.342
2036	0.06	0.03	44.649	0.03	55.351
2037	0.06	0.03	44.640	0.03	55.360
2038	0.06	0.03	44.631	0.03	55.369
2039	0.06	0.03	44.622	0.03	55.378
2040	0.06	0.03	44.614	0.03	55.386
2041	0.06	0.03	44.605	0.04	55.395
2042	0.06	0.03	44.596	0.04	55.404
2043	0.06	0.03	44.587	0.04	55.413
2044	0.06	0.03	44.578	0.04	55.422
2045	0.06	0.03	44.570	0.04	55.430
2046	0.06	0.03	44.561	0.04	55.439
2047	0.07	0.03	44.552	0.04	55.448
2048	0.07	0.03	44.544	0.04	55.456
2049	0.07	0.03	44.535	0.04	55.465
2050	0.07	0.03	44.526	0.04	55.474
Total	1.71	0.77	44.626	0.95	55.374
Average	0.06	0.03	44.626	0.03	55.374

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	0.0213	0.0645	0.4222	0.2568	0.9490

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

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Highway Segment	Collision with Animal	0.01	0.4	0.06	3.2	0.06	3.6
Highway Segment	Collision with Fixed Object	0.41	24.1	0.53	31.0	0.94	55.1
Highway Segment	Collision with Other Object	0.02	1.3	0.11	6.2	0.13	7.5
Highway Segment	Other Single-vehicle Collision	0.27	15.6	0.14	8.0	0.41	23.7
Highway Segment	Collision with Parked Vehicle	0.02	1.0	0.02	1.1	0.04	2.2
Highway Segment	Total Single Vehicle Crashes	0.73	42.5	0.85	49.6	1.58	92.0
Highway Segment	Right-Angle Collision	0.00	0.1	0.00	0.2	0.01	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	0.00	0.1	0.01	0.5	0.01	0.6
Highway Segment	Rear-end Collision	0.02	1.4	0.05	3.0	0.07	4.3
Highway Segment	Sideswipe, Same Direction Collision	0.01	0.5	0.04	2.2	0.05	2.7
Highway Segment	Total Multiple Vehicle Crashes	0.04	2.2	0.10	5.8	0.14	8.0
Highway Segment	Total Highway Segment Crashes	0.77	44.6	0.95	55.4	1.71	100.0
	Total Crashes	0.77	44.6	0.95	55.4	1.71	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.