Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

February 13, 2023

SRF

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Report Overview

Report Generated: Feb 13, 2023 7:24 PM
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Evaluation Date: Mon Feb 13 19:23:52 CST 2023
IHSDM Version: v17.0.0 (Sep 22, 2021)
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User Name: Matt Flanagan
Organization Name: SRF Consulting
Phone:
E-Mail: mflanagan@srfconsulting.com

Project Title: RAISE Grants
Project Comment: Created Mon May 10 16:54:52 CDT 2021
Project Unit System: U.S. Customary

Site Set: US 169 & CSAH 4 - Existing Conditions
Site Set Comment: Created Tue May 11 10:01:12 CDT 2021
Site Set Version: v3

Evaluation Title: Existing Conditions (1 of 1) - 2025-2060
Evaluation Comment: Created Mon Feb 13 19:20:49 CST 2023
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration

First Year of Analysis: 2025
Last Year of Analysis: 2060
Empirical-Bayes Analysis: None

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

Rural MultiLane Site Set CPM Evaluation

Site Type

Type: 4SG
Calibration Factor: 1

Table 1. Evaluation and Crash Data (CSD) (if applicable) Intersection Sites

Site No.	Type	Highway	Site Description	Major AADT	Minor AADT	Presence of Lighting
1	4SG	US 169 & CSAH 4	Rural-Multi Lane; Four-Legged Signalized Intersection	2025: 26209; 2026: 26510; 2027: 26812; 2028: 27113; 2029: 27415; 2030: 27716; 2031: 28017; 2032: 28319; 2033: 28620; 2034: 28921; 2035: 29223; 2036: 29524; 2037: 29825; 2038: 30127; 2039: 30428; 2040: 30730; 2041: 31031; 2042: 31332; 2043: 31634; 2044: 31935; 2045: 32236; 2046: 32538; 2047: 32839; 2048: 33140; 2049: 33442; 2050: 33743; 2051: 34044; 2052: 34346; 2053: 34647; 2054: 34948; 2055: 35250; 2056: 35551; 2057: 35852; 2058: 36154; 2059: 36455; 2060: 36757	2025: 11228; 2026: 11403; 2027: 11579; 2028: 11754; 2029: 11930; 2030: 12105; 2031: 12280; 2032: 12456; 2033: 12631; 2034: 12807; 2035: 12982; 2036: 13158; 2037: 13333; 2038: 13509; 2039: 13684; 2040: 13860; 2041: 14035; 2042: 14210; 2043: 14386; 2044: 14561; 2045: 14737; 2046: 14912; 2047: 15088; 2048: 15263; 2049: 15439; 2050: 15614; 2051: 15789; 2052: 15965; 2053: 16140; 2054: 16316; 2055: 16491; 2056: 16667; 2057: 16842; 2058: 17018; 2059: 17193; 2060: 17369	

Table 2. Predicted Crash Frequencies and Rates by Site

Site No.	Type	Highway	Site Description	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted FI no/C Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Intersection Travel Crash Rate (crashes/million veh)	Intersection Crash Rate (crashes/yr)
1	4SG	US 169 & CSAH 4	Rural-Multi Lane; Four-Legged Signalized Intersection	1,216.909	33.8030	11.4035	5.5669	22.3995	2.02	33.8030
		Total	Total	1,216.909	33.8030	11.4035	5.5669	22.3995	2.02	33.8030

Table 3. Predicted Crash Frequencies by Year (4SG)

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2025	27.29	9.60	35.174	17.69	64.826
2026	27.66	9.70	35.084	17.95	64.916
2027	28.03	9.81	34.994	18.22	65.006
2028	28.40	9.91	34.906	18.49	65.094
2029	28.77	10.02	34.819	18.75	65.181
2030	29.14	10.12	34.734	19.02	65.266
2031	29.51	10.23	34.651	19.29	65.350
2032	29.88	10.33	34.568	19.55	65.432
2033	30.25	10.43	34.486	19.82	65.514
2034	30.63	10.54	34.406	20.09	65.594
2035	31.00	10.64	34.327	20.36	65.673
2036	31.37	10.74	34.249	20.63	65.751
2037	31.74	10.85	34.172	20.89	65.828
2038	32.12	10.95	34.097	21.17	65.903
2039	32.49	11.05	34.022	21.43	65.978
2040	32.86	11.16	33.948	21.71	66.052
2041	33.23	11.26	33.876	21.98	66.124
2042	33.61	11.36	33.804	22.25	66.196
2043	33.98	11.46	33.733	22.52	66.266
2044	34.35	11.56	33.664	22.79	66.336
2045	34.73	11.67	33.595	23.06	66.405
2046	35.10	11.77	33.527	23.33	66.473
2047	35.48	11.87	33.460	23.61	66.540
2048	35.85	11.97	33.394	23.88	66.606
2049	36.22	12.07	33.328	24.15	66.672
2050	36.60	12.17	33.264	24.42	66.736
2051	36.97	12.28	33.200	24.70	66.800
2052	37.35	12.38	33.137	24.97	66.863
2053	37.72	12.48	33.075	25.25	66.925
2054	38.10	12.58	33.013	25.52	66.987
2055	38.47	12.68	32.952	25.80	67.048
2056	38.85	12.78	32.892	26.07	67.108
2057	39.22	12.88	32.833	26.35	67.167
2058	39.60	12.98	32.774	26.62	67.226
2059	39.98	13.08	32.716	26.90	67.284
2060	40.35	13.18	32.658	27.17	67.342
Total	1,216.91	410.53	33.735	806.38	66.265
Average	33.80	11.40	33.735	22.40	66.265

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 4. Predicted 4SG Crash Type Distribution

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Intersection	Single	16.83	1.4	62.09	5.1	75.45	6.2
Intersection	Total Single Vehicle Crashes	16.83	1.4	62.09	5.1	75.45	6.2
Intersection	Angle Collision	129.32	10.6	173.37	14.2	311.53	25.6
Intersection	Head-on Collision	34.07	2.8	27.42	2.3	65.71	5.4
Intersection	Rear-end Collision	193.77	15.9	407.22	33.5	598.72	49.2
Intersection	Sideswipe	19.30	1.6	118.54	9.7	128.99	10.6
Intersection	Total Multiple Vehicle Crashes	376.45	30.9	726.55	59.7	1,104.95	90.8
Intersection	Total Intersection Crashes	410.12	33.7	807.19	66.3	1,216.91	100.0
Intersection	Other Collision	16.83	1.4	18.55	1.5	36.51	3.0
	Total Crashes	410.12	33.7	807.19	66.3	1,216.91	100.0

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Evaluation Date: Mon Feb 13 19:27:29 CST 2023
IHSDM Version: v17.0.0 (Sep 22, 2021)
Site Set Crash Prediction Module: v|ModuleInfo.moduleVersion| (|ModuleInfo.moduleDate|)

User Name: Matt Flanagan
Organization Name: SRF Consulting
Phone:
E-Mail: mflanagan@srfconsulting.com

Project Title: RAISE Grants
Project Comment: Created Mon May 10 16:54:52 CDT 2021
Project Unit System: U.S. Customary

Site Set: Node 10 - Build RAB
Site Set Comment: Created Thu Jan 26 11:55:48 CST 2023
Site Set Version: v5

Evaluation Title: Node 10 - Build RAB (2025-2060)
Evaluation Comment: Created Mon Feb 13 19:27:16 CST 2023
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration

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Last Year of Analysis: 2060
Empirical-Bayes Analysis: None

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Section Types

Roundabout Site Set CPM Evaluation

Site Type

Type: Roundabout RML 41R
Calibration Factor: RML 41R = 1.0

Table 1. Evaluation and Crash Data (CSD) (if applicable) Roundabout - Homogeneous Sites

Site No.	Type	Roundabout	Site Description	Area Type	Entering AADT
1	41R - Roundabout with 4 legs and a single circulating lane	Node 10	RAB	Rural	Leg 1:2025: 2226; 2026: 2252; 2027: 2278; 2028: 2304; 2029: 2330; 2030: 2356; 2031: 2382; 2032: 2408; 2033: 2434; 2034: 2460; 2035: 2486; 2036: 2512; 2037: 2538; 2038: 2564; 2039: 2590; 2040: 2616; 2041: 2642; 2042: 2668; 2043: 2694; 2044: 2720; 2045: 2746; 2046: 2772; 2047: 2798; 2048: 2824; 2049: 2850; 2050: 2876; 2051: 2902; 2052: 2928; 2053: 2954; 2054: 2980; 2055: 3006; 2056: 3032; 2057: 3058; 2058: 3084; 2059: 3110; 2060: 3136; Leg 2:2025: 8136; 2026: 8276; 2027: 8417; 2028: 8558; 2029: 8698; 2030: 8839; 2031: 8980; 2032: 9120; 2033: 9261; 2034: 9402; 2035: 9542; 2036: 9683; 2037: 9824; 2038: 9964; 2039: 10105; 2040: 10246; 2041: 10391; 2042: 10536; 2043: 10681; 2044: 10826; 2045: 10971; 2046: 11116; 2047: 11262; 2048: 11407; 2049: 11552; 2050: 11697; 2051: 11842; 2052: 11987; 2053: 12132; 2054: 12278; 2055: 12423; 2056: 12568; 2057: 12713; 2058: 12858; 2059: 13003; 2060: 13149; Leg 3:2025-2060: 0; Leg 4:2025: 6611; 2026: 6717; 2027: 6822; 2028: 6928; 2029: 7034; 2030: 7139; 2031: 7245; 2032: 7351; 2033: 7457; 2034: 7562; 2035: 7668; 2036: 7774; 2037: 7879; 2038: 7985; 2039: 8091; 2040: 8197; 2041: 8163; 2042: 8130; 2043: 8096; 2044: 8063; 2045: 8029; 2046: 7996; 2047: 7962; 2048: 7929; 2049: 7895; 2050: 7862; 2051: 7828; 2052: 7795; 2053: 7761; 2054: 7728; 2055: 7694; 2056: 7661; 2057: 7627; 2058: 7594; 2059: 7560; 2060: 7527

Table 2. Predicted Crash Frequencies and Rates by Site

Site No.	Type	Roundabout	Site Description	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 Intersection Travel Crash Rate (crashes/million veh)	Intersection Crash Rate (crashes/yr)
1	41R - Roundabout with 4 legs and a single circulating lane	Node 10	RAB	88.536	2.4593	0.1713	2.2881	0.64	2.4593
		Total	Total	88.536	2.4593	0.1713	2.2881	0.64	2.4593

Table 3. Predicted Crash Frequencies by Year (Roundabout RML 41R)

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2025	2.11	0.14	6.506	1.98	93.494
2026	2.14	0.14	6.530	2.00	93.470
2027	2.16	0.14	6.554	2.02	93.446
2028	2.19	0.14	6.578	2.04	93.422
2029	2.21	0.15	6.601	2.06	93.399
2030	2.23	0.15	6.624	2.08	93.376
2031	2.26	0.15	6.647	2.11	93.353
2032	2.28	0.15	6.669	2.13	93.331
2033	2.30	0.15	6.691	2.15	93.309
2034	2.33	0.16	6.713	2.17	93.287
2035	2.35	0.16	6.734	2.19	93.266
2036	2.38	0.16	6.755	2.21	93.245
2037	2.40	0.16	6.776	2.23	93.224
2038	2.42	0.17	6.797	2.26	93.203
2039	2.44	0.17	6.817	2.28	93.183
2040	2.47	0.17	6.837	2.30	93.163
2041	2.48	0.17	6.870	2.31	93.130
2042	2.49	0.17	6.902	2.32	93.098
2043	2.50	0.17	6.934	2.33	93.066
2044	2.52	0.17	6.966	2.34	93.034
2045	2.53	0.18	6.997	2.35	93.003
2046	2.54	0.18	7.028	2.36	92.972
2047	2.55	0.18	7.059	2.37	92.941
2048	2.56	0.18	7.090	2.38	92.910
2049	2.58	0.18	7.120	2.39	92.880
2050	2.59	0.18	7.150	2.40	92.850
2051	2.60	0.19	7.180	2.41	92.820
2052	2.61	0.19	7.209	2.42	92.791
2053	2.62	0.19	7.238	2.43	92.762
2054	2.64	0.19	7.267	2.44	92.733
2055	2.65	0.19	7.296	2.45	92.704
2056	2.66	0.20	7.324	2.46	92.676
2057	2.67	0.20	7.353	2.48	92.647
2058	2.68	0.20	7.380	2.48	92.620
2059	2.69	0.20	7.408	2.50	92.592
2060	2.71	0.20	7.436	2.50	92.564
Total	88.54	6.17	6.965	82.37	93.035
Average	2.46	0.17	6.965	2.29	93.035

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 4. Predicted Roundabout RML 41R Crash Severity

Site 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	0.0340	0.3379	2.1738	3.6207	82.3701
Total	0.0340	0.3379	2.1738	3.6207	82.3701

Table 5. Predicted Roundabout RML 41R Crash Type Distribution

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Intersection	Collision with Animal	0.00	0.0	1.15	1.3	1.15	1.3
Intersection	Collision with Fixed Object	1.33	1.5	21.50	24.3	22.83	25.8
Intersection	Collision with Other Object	0.00	0.0	0.00	0.0	0.00	0.0
Intersection	Other Single-vehicle Collision	1.29	1.5	9.55	10.8	10.84	12.2
Intersection	Collision with Parked Vehicle	0.01	0.0	0.25	0.3	0.26	0.3
Intersection	Total Single Vehicle Crashes	2.63	3.0	32.45	36.6	35.09	39.6
Intersection	Angle Collision	0.71	0.8	12.27	13.8	12.98	14.7
Intersection	Head-on Collision	0.07	0.1	0.33	0.4	0.40	0.4
Intersection	Other Multiple-vehicle Collision	0.44	0.5	5.77	6.5	6.20	7.0
Intersection	Rear-end Collision	1.84	2.1	20.43	23.1	22.27	25.1
Intersection	Sideswipe	0.48	0.5	11.20	12.6	11.68	13.2
Intersection	Total Multiple Vehicle Crashes	3.53	4.0	50.00	56.4	53.53	60.4
Intersection	Total Intersection Crashes	6.17	7.0	82.45	93.0	88.62	100.0
	Total Crashes	6.17	7.0	82.45	93.0	88.62	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.

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Report Overview

Report Generated: Feb 13, 2023 7:31 PM
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Evaluation Date: Mon Feb 13 19:30:48 CST 2023
IHSDM Version: v17.0.0 (Sep 22, 2021)
Site Set Crash Prediction Module: v|ModuleInfo.moduleVersion| (|ModuleInfo.moduleDate|)

User Name: Matt Flanagan
Organization Name: SRF Consulting
Phone:
E-Mail: mflanagan@srfconsulting.com

Project Title: RAISE Grants
Project Comment: Created Mon May 10 16:54:52 CDT 2021
Project Unit System: U.S. Customary

Site Set: Node 20 - Build RAB
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Evaluation Title: Node 20 - Build RAB (2025-2060)
Evaluation Comment: Created Mon Feb 13 19:30:34 CST 2023
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration

First Year of Analysis: 2025
Last Year of Analysis: 2060
Empirical-Bayes Analysis: None

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

Roundabout Site Set CPM Evaluation

Site Type

Type: Roundabout RML 41R
Calibration Factor: RML 41R = 1.0

Table 1. Evaluation and Crash Data (CSD) (if applicable) Roundabout - Homogeneous Sites

Site No.	Type	Roundabout	Site Description	Area Type	Entering AADT
1	41R - Roundabout with 4 legs and a single circulating lane	Node 20	RAB	Rural	Leg 1:2025: 1561; 2026: 1568; 2027: 1575; 2028: 1583; 2029: 1590; 2030: 1597; 2031: 1605; 2032: 1612; 2033: 1619; 2034: 1627; 2035: 1634; 2036: 1641; 2037: 1649; 2038: 1656; 2039: 1663; 2040: 1671; 2041: 1675; 2042: 1679; 2043: 1683; 2044: 1687; 2045: 1691; 2046: 1695; 2047: 1699; 2048: 1703; 2049: 1707; 2050: 1711; 2051: 1715; 2052: 1719; 2053: 1723; 2054: 1727; 2055: 1731; 2056: 1735; 2057: 1739; 2058: 1743; 2059: 1747; 2060: 1751; Leg 2:2025: 5194; 2026: 5283; 2027: 5372; 2028: 5461; 2029: 5550; 2030: 5640; 2031: 5729; 2032: 5818; 2033: 5907; 2034: 5996; 2035: 6085; 2036: 6174; 2037: 6263; 2038: 6352; 2039: 6441; 2040: 6531; 2041: 6616; 2042: 6702; 2043: 6788; 2044: 6873; 2045: 6959; 2046: 7045; 2047: 7130; 2048: 7216; 2049: 7302; 2050: 7388; 2051: 7473; 2052: 7559; 2053: 7645; 2054: 7730; 2055: 7816; 2056: 7902; 2057: 7987; 2058: 8073; 2059: 8159; 2060: 8245; Leg 3:2025: 4081; 2026: 4152; 2027: 4223; 2028: 4294; 2029: 4365; 2030: 4435; 2031: 4506; 2032: 4577; 2033: 4648; 2034: 4719; 2035: 4790; 2036: 4861; 2037: 4932; 2038: 5003; 2039: 5074; 2040: 5145; 2041: 5215; 2042: 5286; 2043: 5357; 2044: 5428; 2045: 5499; 2046: 5570; 2047: 5641; 2048: 5712; 2049: 5783; 2050: 5854; 2051: 5924; 2052: 5995; 2053: 6066; 2054: 6137; 2055: 6208; 2056: 6279; 2057: 6350; 2058: 6421; 2059: 6492; 2060: 6563; Leg 4:2025: 4124; 2026: 4186; 2027: 4247; 2028: 4309; 2029: 4370; 2030: 4432; 2031: 4493; 2032: 4555; 2033: 4616; 2034: 4678; 2035: 4739; 2036: 4801; 2037: 4862; 2038: 4924; 2039: 4985; 2040: 5047; 2041: 5104; 2042: 5161; 2043: 5218; 2044: 5275; 2045: 5332; 2046: 5389; 2047: 5446; 2048: 5503; 2049: 5560; 2050: 5617; 2051: 5674; 2052: 5731; 2053: 5788; 2054: 5845; 2055: 5902; 2056: 5959; 2057: 6016; 2058: 6073; 2059: 6130; 2060: 6187

Table 2. Predicted Crash Frequencies and Rates by Site

Site No.	Type	Roundabout	Site Description	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 Intersection Travel Crash Rate (crashes/million veh)	Intersection Crash Rate (crashes/yr)
1	41R - Roundabout with 4 legs and a single circulating lane	Node 20	RAB	84.918	2.3588	0.2319	2.1270	0.68	2.3588
		Total	Total	84.918	2.3588	0.2319	2.1270	0.68	2.3588

Table 3. Predicted Crash Frequencies by Year (Roundabout RML 41R)

Year	Total Crashes	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)
2025	2.00	0.19	9.389	1.81	90.611
2026	2.02	0.19	9.416	1.83	90.584
2027	2.04	0.19	9.443	1.85	90.557
2028	2.06	0.20	9.470	1.87	90.530
2029	2.08	0.20	9.497	1.89	90.503
2030	2.10	0.20	9.523	1.90	90.477
2031	2.13	0.20	9.549	1.92	90.451
2032	2.15	0.21	9.575	1.94	90.425
2033	2.17	0.21	9.600	1.96	90.400
2034	2.19	0.21	9.625	1.98	90.375
2035	2.21	0.21	9.650	2.00	90.350
2036	2.23	0.22	9.674	2.02	90.326
2037	2.25	0.22	9.699	2.04	90.301
2038	2.27	0.22	9.723	2.05	90.277
2039	2.29	0.22	9.746	2.07	90.254
2040	2.32	0.23	9.770	2.09	90.230
2041	2.34	0.23	9.792	2.11	90.208
2042	2.36	0.23	9.814	2.12	90.186
2043	2.38	0.23	9.835	2.14	90.165
2044	2.40	0.24	9.857	2.16	90.143
2045	2.42	0.24	9.878	2.18	90.122
2046	2.43	0.24	9.899	2.19	90.101
2047	2.45	0.24	9.920	2.21	90.080
2048	2.47	0.25	9.941	2.23	90.059
2049	2.49	0.25	9.961	2.24	90.038
2050	2.51	0.25	9.982	2.26	90.018
2051	2.53	0.25	10.002	2.28	89.998
2052	2.55	0.26	10.022	2.29	89.978
2053	2.57	0.26	10.042	2.31	89.958
2054	2.59	0.26	10.061	2.33	89.939
2055	2.61	0.26	10.081	2.34	89.919
2056	2.63	0.27	10.100	2.36	89.900
2057	2.65	0.27	10.119	2.38	89.881
2058	2.66	0.27	10.138	2.39	89.862
2059	2.68	0.27	10.157	2.41	89.843
2060	2.70	0.28	10.176	2.43	89.824
Total	84.92	8.35	9.830	76.57	90.170
Average	2.36	0.23	9.830	2.13	90.170

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 4. Predicted Roundabout RML 41R Crash Severity

Site 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	0.0518	0.5149	3.3131	4.4674	76.5707
Total	0.0518	0.5149	3.3131	4.4674	76.5707

Table 5. Predicted Roundabout RML 41R Crash Type Distribution

Element Type	Crash Type	FI Crashes	Percent FI (%)	PDO Crashes	Percent PDO (%)	Total Crashes	Percent Total (%)
Intersection	Collision with Animal	0.00	0.0	1.07	1.3	1.07	1.3
Intersection	Collision with Fixed Object	1.80	2.1	19.98	23.5	21.79	25.6
Intersection	Collision with Other Object	0.00	0.0	0.00	0.0	0.00	0.0
Intersection	Other Single-vehicle Collision	1.75	2.1	8.88	10.4	10.63	12.5
Intersection	Collision with Parked Vehicle	0.02	0.0	0.23	0.3	0.25	0.3
Intersection	Total Single Vehicle Crashes	3.56	4.2	30.17	35.5	33.73	39.7
Intersection	Angle Collision	0.96	1.1	11.41	13.4	12.37	14.6
Intersection	Head-on Collision	0.09	0.1	0.31	0.4	0.40	0.5
Intersection	Other Multiple-vehicle Collision	0.59	0.7	5.36	6.3	5.95	7.0
Intersection	Rear-end Collision	2.49	2.9	18.99	22.3	21.48	25.3
Intersection	Sideswipe	0.65	0.8	10.41	12.3	11.06	13.0
Intersection	Total Multiple Vehicle Crashes	4.78	5.6	46.48	54.7	51.26	60.3
Intersection	Total Intersection Crashes	8.35	9.8	76.65	90.2	84.99	100.0
	Total Crashes	8.35	9.8	76.65	90.2	84.99	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.