

8 Safety (Crash) Analysis

The proposed improvements are likely to have a positive impact on crash occurrence. As part of this study a safety analysis was conducted based on the required procedures and methodology for an Interchange Modification Report (IMR) per the FDOT Systems Implementation Office Interchange Access Request Users Guide (IARUG) dated January 2018 that follows the criteria contained in the Highway Safety Manual (HSM). The safety analysis will be based on the following methodology:

- Identifying the Crash Type & Crash Severity
- Calculation of Crash Rates
- Development of Crash Diagrams
- Description of Existing Crash Trends
- Development of Safety Performance Functions (SPF's)
- Development of Empirical Bayes Method
- Development of Crash Reduction Estimations (CMF's)
- Benefit Cost Analysis
- Documentation of Results

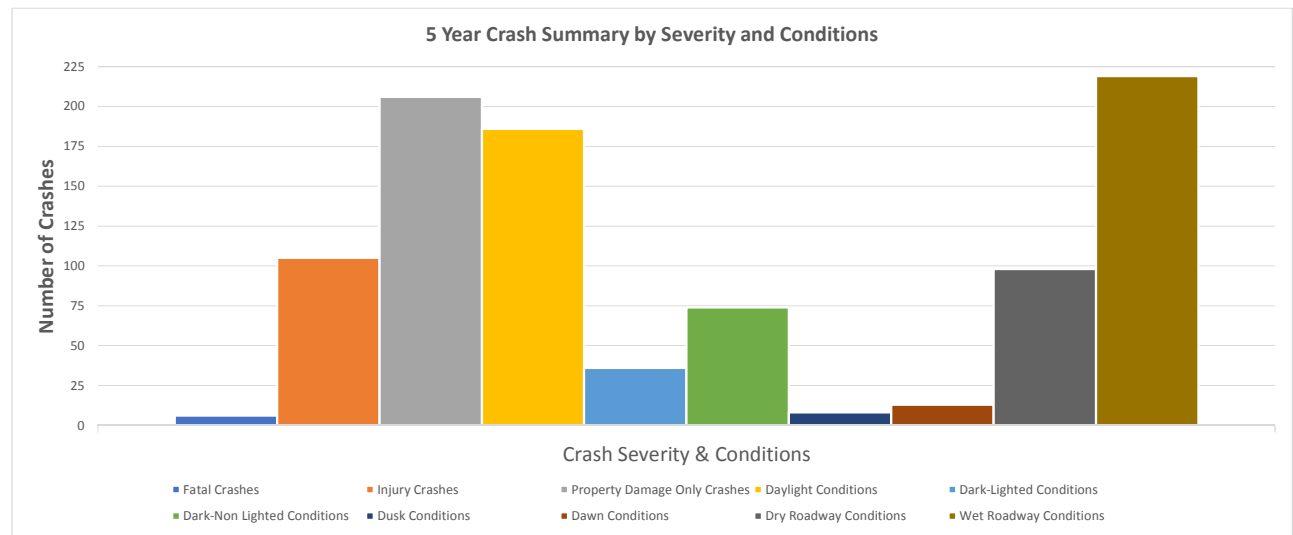
8.1 Existing Crash Data Information

Crash statistics along I-4 and SR 557 were obtained from the FDOT statewide crash database (CARS) and Signal Four Analytics based on the latest available five (5) years of crash data (from January 1, 2012 to December 31, 2016). **Table 29** summarizes the crash severity and conditions for the freeway mainline, ramp merge/diverge areas, ramp segments and ramp terminal intersections based on the segmentation process utilized for this IMR study. The specific segmentation process used for this study is shown below:

- Eastbound & Westbound I-4 Freeway Segment (West of SR 557)
- Eastbound I-4 Diverge to SR 557
- Eastbound I-4 and SR 557 Ramp Terminal
- Eastbound I-4 Merge from SR 557
- Eastbound & Westbound I-4 Freeway Segment (East of SR 557)
- Westbound I-4 Diverge to SR 557
- Westbound I-4 and SR 557 Ramp Terminal
- Westbound I-4 Merge from SR 557
- Eastbound & Westbound On & Off Ramp Segments

Table 29
Interstate 4 and SR 557 IMR
5 Year Crash Summary by Severity and Conditions (January 2012-December 2016)

Crash Segment	5 Year Crash Type Summary										
	Total Crashes	Fatal Crashes	Injury Crashes	Property Damage Only Crashes	Daylight Condition Crashes	Dark with Lighted Condition Crashes	Dark without Lighted Condition Crashes	Dusk Condition Crashes	Dawn Condition Crashes	Dry Condition Crashes	Wet Condition Crashes
I-4 Freeway West of SR 557	162	1	44	117	102	26	23	4	7	43	119
I-4 Freeway East of SR 557	38	0	16	22	19	2	15	0	2	10	28
EB I-4 Diverge to SR 557	26	1	9	16	15	1	9	0	1	12	14
EB I-4 Merge from SR 557	20	1	7	12	10	2	5	2	1	8	12
WB I-4 Diverge to SR 557	27	0	9	18	17	2	8	0	0	13	14
WB I-4 Merge from SR 557	10	1	5	4	4	1	3	1	1	3	7
EB Ramp Terminal	30	1	12	17	17	1	10	1	1	8	22
WB Ramp Terminal	4	1	3	0	2	1	1	0	0	1	3
EB Off Ramp Segment	0	0	0	0	0	0	0	0	0	0	0
EB On Ramp Segment	0	0	0	0	0	0	0	0	0	0	0
WB Off Ramp Segment	0	0	0	0	0	0	0	0	0	0	0
WB On Ramp Segment	0	0	0	0	0	0	0	0	0	0	0
TOTALS	317	6	105	206	186	36	74	8	13	98	219
PERCENT CRASHES		1.89%	33.12%	64.98%	58.68%	11.36%	23.34%	2.52%	4.10%	30.91%	69.09%



As shown in **Table 29**, a total of 317 crashes occurred during the five (5) year analysis period from January 2012 to December 2016. Out of the 317 total crashes there were a total of 6 fatal crashes (2.0%), 105 injury crashes (33.1%) and 206 property damage only crashes (64.9%). A total of 186 crashes occurred during the daylight hours (about 58.7% of total crashes) and 131 (about 41.3%) crashes were reported to have occurred during dark conditions (at night, dawn and dusk). In addition, a total of 98 (30.9%) crashes occurred during dry roadway conditions with the remaining 219 (69.1%) occurring during wet conditions.

For the unsignalized ramp terminal intersections, over the five years analyzed, there were a total of 30 crashes that occurred at the eastbound ramp terminal intersection and four (4) at the westbound ramp terminal intersection. A total of two (2) fatalities were reported between the year 2012 and year 2016. A total of 15 crashes resulted in injuries and 17 crashes were reported with property damage only.

For the eastbound and westbound on and off ramp segments, per the crash records obtained from FDOT CARS database and Signal4Analytics crash reporting system, no crashes or accidents were found to be along the ramp segments. All accidents for the ramp segments were found to be at the merge and diverge areas or at the ramp terminal intersections.

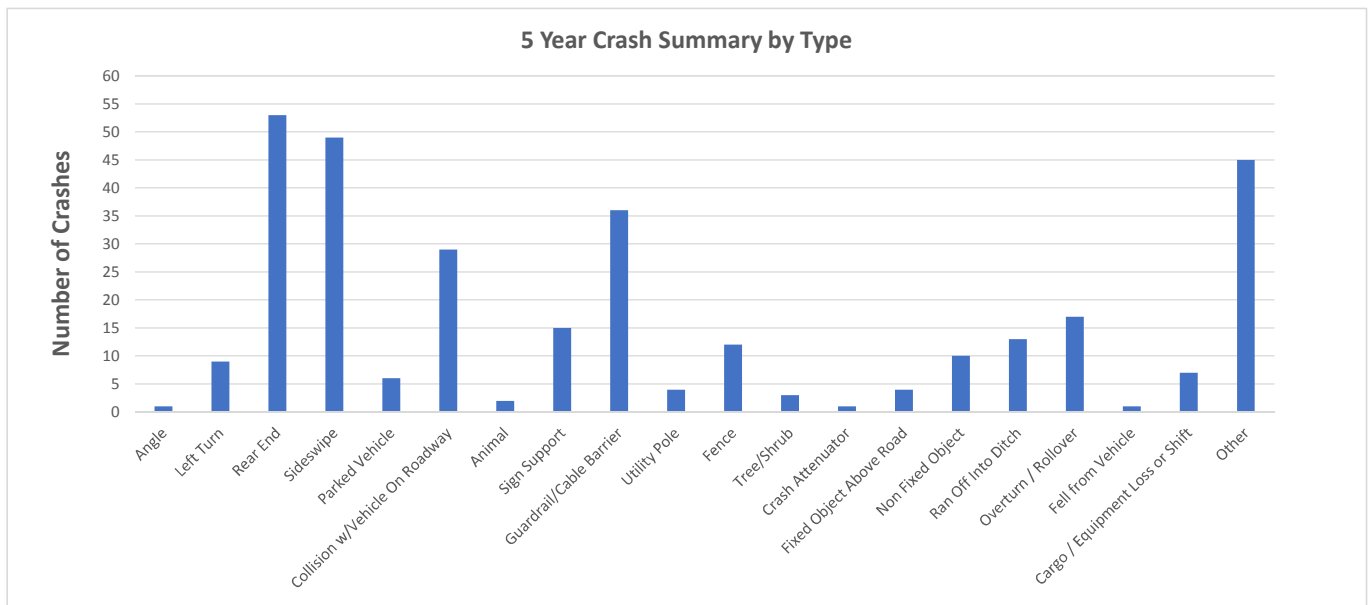
8.2 Crash Summary by Crash Type

Table 30 shows the summary of the crashes by crash types. Per the summary, Rear End crashes accounted for most crashes (about 16.72% of total) within the study area of influence, followed by Sideswipe (about 15.46% of total), Guardrail/Cable barrier (about 11.36% of total) and Collision with Motor Vehicle in Transport along Roadway (about 9.15% of total).

Table 30
Interstate 4 and SR 557 IMR
5 Year Crash Summary by Type (January 2012-December 2016)

Crash Segment	5 Year Crash Type Summary									
	Angle	Left Turn	Rear End	Sideswipe	Parked Vehicle	Collision w/Vehicle On Roadway	Animal	Sign Support	Guardrail/Cable Barrier	Utility Pole
I-4 Freeway West of SR 557	0	0	31	25	2	15	1	2	22	3
I-4 Freeway East of SR 557	0	0	12	8	1	0	1	0	7	0
EB I-4 Diverge to SR 557	0	0	0	4	0	5	0	4	3	0
EB I-4 Merge from SR 557	0	0	0	8	1	2	0	1	1	0
WB I-4 Diverge to SR 557	0	0	0	1	0	4	0	7	2	1
WB I-4 Merge from SR 557	0	0	0	3	0	3	0	0	1	0
EB Ramp Terminal	1	6	10	0	2	0	0	1	0	0
WB Ramp Terminal	0	3	0	0	0	0	0	0	0	0
TOTALS	1	9	53	49	6	29	2	15	36	4
Percentages	0.32%	2.84%	16.72%	15.46%	1.89%	9.15%	0.63%	4.73%	11.36%	1.26%

Crash Segment	5 Year Crash Type Summary									
	Fence	Tree/Shrub	Crash Attenuator	Fixed Object Above Road	Non Fixed Object	Ran Off Into Ditch	Overturn / Rollover	Fell from Vehicle	Cargo / Equipment Loss or Shift	Other
I-4 Freeway West of SR 557	6	1	0	3	7	5	10	0	4	25
I-4 Freeway East of SR 557	1	1	0	0	2	0	2	0	0	3
EB I-4 Diverge to SR 557	1	1	1	0	0	4	1	1	0	1
EB I-4 Merge from SR 557	2	0	0	0	0	1	0	0	1	3
WB I-4 Diverge to SR 557	1	0	0	1	0	0	3	0	1	6
WB I-4 Merge from SR 557	0	0	0	0	0	1	1	0	0	1
EB Ramp Terminal	1	0	0	0	1	2	0	0	1	5
WB Ramp Terminal	0	0	0	0	0	0	0	0	0	1
TOTALS	12	3	1	4	10	13	17	1	7	45
Percentages	3.79%	0.95%	0.32%	1.26%	3.15%	4.10%	5.36%	0.32%	2.21%	14.20%



8.3 Crash Frequency & Crash Rate Development

Based on the required procedures and methodology for an IMR per the FDOT Systems Implementation Office crash rates and frequencies along the area of influence were developed based on the five (5) year crash information. **Table 31** summarizes the crash frequency and rates for each safety analysis segmentation for the study area.

The crash rates for the mainline segments are expressed as the number of crashes per million vehicle-miles traveled; the crash rates for the intersections are expressed as number of crashes per million entering vehicles. The following equations were utilized to develop the crash frequency and crash rates for this study:

$$\text{Crash Rate of Segment} = \frac{\text{Total Number of Crashes} \times 1,000,000}{\text{AADT} \times 365 \times \text{Number of Years} \times \text{Length of Roadway Segment}}$$

$$\text{Crash Rate of Intersections} = \frac{\text{Total Number of Crashes} \times 1,000,000}{\text{AADT} \times 365 \times \text{Number of Years}}$$

8.3.1 Crash Rate Comparison

In addition to developing the 5-year existing crash rates a comparison of these actual crash rates with the FDOT D1 Polk Countywide and Statewide crash rates was conducted based on the most current FDOT CAR reporting database. **Table 32** summarizes the comparison. As shown in **Table 32**, for Interstate 4 (I-4) the freeway segment west of SR 557 with an existing crash rate of 0.475 was found to have a similar crash rate compared to the FDOT D1 Polk Countywide crash rate of 0.473 and for the FDOT Statewide crash rate of 0.439. For the I-4 freeway segment east of SR 557 it was found that the existing crash rate 0.210 is below the FDOT D1 Polk Countywide (0.473) and FDOT Statewide (0.439) average crash rates.

For the ramp terminal intersections, the eastbound and westbound ramp terminal intersections with existing crash rates of 0.443 (eastbound ramp terminal) and 0.094 (westbound ramp terminal) were found to have a lower crash rate than the FDOT D1 Polk Countywide at 1.702 and FDOT Statewide at 1.507.

Note that for the merge and diverge segments, based on discussions with FDOT Central Office (Crash Records and Research Department) the current FDOT CAR reporting system does not specially factor in the merging and diverging segments or segment the merge and diverge areas. The reporting system summarizes the crash information for the merge and diverge areas under the mainline segment group. With this reporting condition, the merge and diverge crash rates shown in the current FDOT CAR reporting system, are combined within the appropriate mainline segment. However, based on the Safety Analysis methods utilized for this study, the merge and diverge segments are to be segmented out for the analysis. Therefore, based on the FDOT combined crash rate the crash rate comparison for the merge and diverge areas are Not an Applicable comparison.

Table 31: 5 Year Crash Frequency & Rate Summary

Segment / Intersection	Type of Crash	No of Crashes	Daily Volume	Segment Length	Total Crash Frequency	Total Crash Rate
I-4 Freeway West of SR 557	Total	162	93,400	2 Miles	32.4	0.475
	FI	45				
	PDO	117				
I-4 Freeway East of SR 557	Total	38	99,000	1 Mile	7.60	.210
	FI	15				
	PDO	23				
I-4 EB Diverge to SR 557	Total	26	46,700	1500 ft	5.20	1.074
	FI	10				
	PDO	16				
I-4 EB Merge from SR 557	Total	20	49,500	1500 ft	4.00	0.779
	FI	8				
	PDO	12				
I-4 WB Diverge to SR 557	Total	27	49,500	1500 ft	5.40	1.052
	FI	8				
	PDO	19				
I-4 WB Merge from SR 557	Total	10	46,700	1500 ft	2.00	0.413
	FI	5				
	PDO	5				
EB Ramp Terminal (intersections)	Total	30	37,100	-NA-	6.00	0.443
	FI	12				
	PDO	18				
WB Ramp Terminal (intersections)	Total	4	23,300	-NA-	0.80	0.094
	FI	4				
	PDO	0				

Table 32: Five Year Crash Rate Comparison

Segment / Intersection	Existing Crash Rate	FDOT D1 Polk Countywide	FDOT Statewide
I-4 Freeway West of SR 557	0.475	0.473	0.475
I-4 Freeway East of SR 557	.210	0.473	.210
I-4 EB Diverge to SR 557	1.074	-NA-	-NA-
I-4 EB Merge from SR 557	0.779	-NA-	-NA-
I-4 WB Diverge to SR 557	1.052	-NA-	-NA-
I-4 WB Merge from SR 557	0.413	-NA-	-NA-
EB Ramp Terminal (intersections)	0.443	1.702	1.507
WB Ramp Terminal (intersections)	0.094	1.702	1.507

8.4 Safety Performance Functions

Safety Performance Functions (SPF) are crash equations used to predict or calculate the expected number of crashes per year at a specific study roadway segment, ramp terminals and merge and diverge areas. These SPF factors are only required for specific roadway improvement alternatives being considered. For this study the two (2) Build Alternatives include converting the existing interchange to a diamond interchange with either signalized intersections at the end of the ramp terminals or teardrop roundabouts.

Calculating the SPF factors for each facility crash type has four (4) primary steps. These four steps utilized for this IMR study are summarized below:

1. Develop the Base Equation
2. Develop the SPF factors to be used in the Base Equation
3. Balancing the Fatal-Injury Crashes and Property Damage Only Crashes
4. Distribution of the appropriate Crash Severity or Crash Type

Table 33 summarizes the Safety Performance Functions (SPF's) expected crashes for the No-Build Condition. **Appendix L** contains the safety performance analysis worksheets and crash data utilized for this study.

Table 33: Safety Performance Function Expected Crash Summary

Study Segmentation	SPF No Build Summary		
	Fatal-Injury Crashes	Property Damage Only Crashes	Total Expected Crashes
Freeway Segment (I-4 West of SR 557)	7.930	18.646	26.576
Freeway Segment (I-4 East of SR 557)	4.221	10.156	14.377
I-4 EB Diverge to SR 557	0.118	0.238	0.356
I-4 EB Merge from SR 557	0.298	0.666	0.964
I-4 WB Diverge to SR 557	0.124	0.252	0.376
I-4 WB Merge from SR 557	0.313	0.808	1.122
EB Ramp Terminal	0.748	1.433	2.181
WB Ramp Terminal	1.441	1.926	3.367
EB Off Loop Ramp Segment	0.062	0.101	0.164
EB On Ramp Segment	0.129	0.305	0.435
WB Off Loop Ramp Segment	0.077	0.158	0.235
WB On Ramp Segment	0.080	0.187	0.266
Total	15.193	34.126	49.319

8.5 Empirical Bayes Method

Another step in the safety analysis is developing the expected crash frequency by the Empirical Bayes Method. This analysis method combines the Predicted Crash Frequency with the Observed Crash Frequency to obtain the Expected Crash Frequency. This method of analysis is implemented to improve the statistical liability of developing the future expected crash frequency. **Table 34** summarizes the Empirical Bayes analysis summary utilized for this study for the appropriate segments. **Appendix L** contains the Empirical Bayes Method analysis worksheets and crash data utilized for this study.

Table 34
I-4 at SR 557 IMR
Empirical Bayes Crash Method Analysis Summary

Crash Segmentation	Predicted Crashes		K Value		Weight (5 YR Study Period)		Observed Frequency		Expected Frequency	
	Fatal - Injury	PDO	Fatal - Injury	PDO	Fatal - Injury	PDO	Fatal - Injury	PDO	Fatal - Injury	PDO
Freeway Segment (I-4 West of SR 557)	7.930	18.646	-na-	-na-	-na-	-na-	9.000	23.400	8.356	21.208
Multiple Vehicle	3.959	10.299	0.028	0.027	0.640	0.422	5.400	12.600	4.478	11.629
Single Vehicle	3.970	8.348	0.017	0.024	0.752	0.498	3.600	10.800	3.878	9.579
Freeway Segment (I-4 East of SR 557)	4.221	10.156	-na-	-na-	-na-	-na-	3.200	4.400	3.864	7.028
Multiple Vehicle	2.159	5.764	0.057	0.053	0.620	0.395	1.800	2.800	2.023	3.970
Single Vehicle	2.061	4.392	0.033	0.048	0.745	0.485	1.200	1.800	1.842	3.058
I-4 EB Diverge to SR 557	0.118	0.238	0.562	0.633	0.751	0.570	2.000	3.200	0.587	1.511
I-4 EB Merge from SR 557	0.298	0.666	0.383	0.403	0.636	0.427	1.600	2.400	0.771	1.660
I-4 WB Diverge to SR 557	0.124	0.252	0.562	0.633	0.741	0.557	1.800	3.600	0.558	1.736
I-4 WB Merge from SR 557	0.313	0.808	0.274	0.288	0.700	0.462	1.200	0.800	0.580	0.804
EB Ramp Terminal	0.748	1.433	0.294	0.182	0.476	0.434	2.600	3.400	1.718	2.547
WB Ramp Terminal	1.441	1.926	0.294	0.182	0.321	0.363	0.800	0.000	1.005	0.699
EB Off Loop Ramp Segment	0.062	0.101	-na-	-na-	-na-	-na-	0.000	0.000	0.052	0.082
Multiple Vehicle	0.000	0.008	0.360	0.414	0.999	0.984	0.000	0.000	0.000	0.008
Single Vehicle	0.062	0.093	0.665	0.539	0.829	0.799	0.000	0.000	0.051	0.075
EB On Ramp Segment	0.129	0.305	-na-	-na-	-na-	-na-	0.000	0.000	0.107	0.246
Multiple Vehicle	0.006	0.088	0.190	0.219	0.994	0.912	0.000	0.000	0.006	0.081
Single Vehicle	0.123	0.217	0.351	0.284	0.822	0.764	0.000	0.000	0.101	0.166
WB Off Loop Ramp Segment	0.077	0.158	-na-	-na-	-na-	-na-	0.000	0.000	0.061	0.119
Multiple Vehicle	0.001	0.017	0.360	0.414	0.999	0.967	0.000	0.000	0.001	0.016
Single Vehicle	0.076	0.141	0.665	0.539	0.798	0.724	0.000	0.000	0.061	0.102
WB On Ramp Segment	0.080	0.187	-na-	-na-	-na-	-na-	0.000	0.000	0.071	0.160
Multiple Vehicle	0.004	0.042	0.190	0.219	0.997	0.956	0.000	0.000	0.004	0.040
Single Vehicle	0.076	0.144	0.351	0.284	0.882	0.830	0.000	0.000	0.067	0.120
TOTAL	15.542	34.877	-na-	-na-	-na-	-na-	22.200	41.200	17.732	37.799

8.6 Crash Reduction Estimations

One of the last steps in evaluating whether the improvements provide a safety benefit is developing the Crash Reduction Estimates to be utilized in the Benefit Cost analysis based on the proposed interchange modification improvements. For this IMR study the following two (2) Build Alternatives were analyzed:

- Build Alternative 1 (Diamond Interchange): This alternative represents the configuration approved in the original 2010 IMR study. This build condition represents a diamond interchange configuration with traffic signals at both ramp terminal intersections.
- Build Alternative 2 (Diamond Interchange Configuration with Teardrop Roundabouts): This alternative is similar to the Diamond Interchange Build Alternative 1 configuration with featured roundabout ramp termini using a teardrop configuration instead of utilizing traditional traffic signals at both the ramp terminal intersections.

The first step in developing the crash reduction estimates is to determine the crash modification factors (CMF's) for the proposed alternatives. This first step would include the interchange modification improvements to convert the existing partial cloverleaf interchange to diamond interchange with signals at the ramp terminal intersections (Build Alt 1) and convert the existing interchange to a diamond interchange with teardrop roundabouts instead of traffic signals at the ramp terminal intersections (Build Alt 2). In addition, reviewing the appropriate CMF's from the Crash Modification Factors Clearinghouse database to apply this reduction based on converting unsignalized intersections to signalized intersections and unsignalized intersections to roundabout intersections. Additional CMF's included modifying the length of the deceleration lanes, accelerations lanes and converting a loop ramp to a diamond straight ramp.

Based on the CMF Clearinghouse database, the CMF factor to convert a unsignalized intersection to a roundabout was determined to be 0.56. The CMF factor to convert an unsignalized intersection to a signalized intersection, is covered under the typical CMF factors obtained from the Highway Safety Manual (HSM) in converting the existing partial cloverleaf interchange to a diamond interchange with traffic signals. This CMF factor to convert the cloverleaf loop ramp to a diamond straight ramps was found to be 0.55 for the eastbound and westbound off loop ramps.

Table 35 summarizes the crash reduction estimations and analysis for this study. **Appendix L** contains the crash data and crash reduction analysis worksheets utilized for this study.

Table 35
I-4 at SR 557 IMR
Crash Reduction Estimations

		I-4 Freeway Segments		SR 557 Interchange Ramps (Merge & Diverge Areas, Ramp Terminals, & Ramp Segments)										Total
		West of SR 557	East of SR 557	Eastbound Diverge to SR 557	Eastbound Merge from SR 557	Westbound Diverge to SR 557	Westbound Merge from SR 557	Eastbound Ramp Terminal	Westbound Ramp Terminal	EB Off Ramp Segment	EB On Ramp Segment	WB Off Ramp Segment	WB On Ramp Segment	
Existing Condition Expected Crash Frequency	Fatal - Injury (FI)	8.356	3.864	0.587	0.771	0.558	0.580	1.718	1.005	0.052	0.107	0.061	0.071	17.732
	Property Damage Only (PDO)	21.208	7.028	1.511	1.660	1.736	0.804	2.547	0.699	0.082	0.246	0.119	0.160	37.799
	Total	29.564	10.892	2.098	2.431	2.294	1.383	4.265	1.705	0.134	0.354	0.180	0.231	55.531
CMF's (Alternative 1)	Fatal - Injury (FI)	0.000	0.000	1.362	1.850	5.086	1.167	1.689	0.639	1.579	0.821	6.341	0.821	-na-
	Property Damage Only (PDO)	0.000	0.000	1.500	1.917	6.500	1.176	2.827	1.868	1.579	0.776	3.071	0.776	-na-
	Unsignalized Intersection to Signalized Intersection	0.000	0.000	0.000	0.000	0.000	0.000	0.656	0.656	0.000	0.000	0.000	0.000	-na-
	Change Length of Ramp Deceleration Lane	0.000	0.000	0.930	0.000	0.155	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-na-
	Convert Cloverleaf Ramp (Loop) to Straight Ramp	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.550	0.000	0.550	0.000	-na-
	Modify Length of Ramp Acceleration Lane	0.000	0.000	0.000	0.741	0.000	0.925	0.000	0.000	0.000	0.000	0.000	0.000	-na-
	Total	0.000	0.000	3.862	4.767	11.641	3.143	4.516	2.345	2.139	1.579	0.821	10.762	1.601
Proposed Condition Expected Crash Frequency (Alternative 1)	Fatal - Injury (FI)	8.356	3.864	0.743	1.058	0.440	0.625	1.904	0.421	0.045	0.088	0.214	0.058	17.818
	Property Damage Only (PDO)	21.208	7.028	2.108	2.359	1.749	0.874	4.723	0.857	0.072	0.191	0.200	0.124	41.492
	Total	29.564	10.892	2.851	3.417	2.189	1.499	6.627	1.278	0.117	0.279	0.415	0.182	59.311
CMF's (Alternative 2)	Fatal - Injury (FI)	0.000	0.000	1.362	1.850	5.086	1.167	0.883	0.323	1.579	0.821	6.341	0.821	-na-
	Property Damage Only (PDO)	0.000	0.000	1.500	1.917	6.500	1.176	0.932	0.538	1.579	0.776	3.071	0.776	-na-
	Unsignalized Intersection to Roundabout	0.000	0.000	0.000	0.000	0.000	0.000	0.560	0.560	0.000	0.000	0.000	0.000	-na-
	Change Length of Ramp Deceleration Lane	0.000	0.000	0.930	0.000	0.155	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-na-
	Convert Cloverleaf Ramp (Loop) to Straight Ramp	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.550	0.000	0.550	0.000	-na-
	Modify Length of Ramp Acceleration Lane	0.000	0.000	0.000	0.741	0.000	0.925	0.000	0.000	0.000	0.000	0.000	0.000	-na-
	Total	0.000	0.000	3.862	4.767	11.641	3.143	2.345	1.315	0.861	1.579	0.821	10.762	1.601
Proposed Condition Expected Crash Frequency (Alternative 2)	Fatal - Injury (FI)	8.356	3.864	0.743	1.058	0.440	0.625	0.850	0.182	0.045	0.088	0.214	0.058	16.524
	Property Damage Only (PDO)	21.208	7.028	2.108	2.359	1.749	0.874	1.329	0.211	0.072	0.191	0.200	0.124	37.452
	Total	29.564	10.892	2.851	3.417	2.189	1.499	2.179	0.393	0.117	0.279	0.415	0.182	53.977

8.7 Benefit Cost Analysis

The final step in the safety analysis is to conduct a Benefit Cost Analysis. The Benefit Cost Analysis utilizes Empirical Bayes Method crash predictions and an assigned dollar amount to prevented crashes. For this study the following was used to develop the benefit cost:

- Assigned Dollar Amount to Crash
 - 450,000 for Fatal/Injury Crash
 - 30,000 for Property Damage Only Crash

Table 36 summarized the benefit cost analysis for the two (2) Build Alternatives.

Table 36: Benefit Cost Analysis

Build Alternative 1	Fatal-Injury Crashes	Property Damage Only Crashes
Total Crash Reduction (Increase)	-0.1	-3.7
Total Crash Cost	\$450,000	\$30,000
Total Crash Reduction Cost	-\$45,000	-\$111,000

Build Alternative 2	Fatal-Injury Crashes	Property Damage Only Crashes
Total Crash Reduction	1.2	0.3
Total Crash Cost	\$450,000	\$30,000
Total Crash Reduction Cost	\$540,000	\$9,000

Notes:

1. Negative values shown reflect an increase in crashes and cost
2. Positive values shown reflect a decrease in crashes and cost

In summary, based on the Benefit Cost Analysis, the proposed Build Alternative 2 is anticipated to have a reduction in crash cost per year by \$549,000 with an overall total reduction of 1.5 crashes (1.2 Fatal-Injury, 0.3 PDO). In addition, the Build Alternative 1 was found to show an overall increase of 3.8 crashes (0.1 for Fatal-Injury, 3.7 PDO) amounting to an increase in crash cost per year by \$156,000. However, this increase in the number of crashes and cost is expected due to the ramp terminal intersections being converted from unsignalized to a signalized intersection. **Appendix L** contains the crash data utilized for this study.