

Hazard Elimination Project Evaluation

Order # 41000018261

Hazard Elimination Project W-4845

**Evaluation of the Rumble Strip Installation
Freeway Segments of I-26 & US-25 – Three Sections for 36.464 Miles
Henderson & Polk Counties**

Documents Prepared By:

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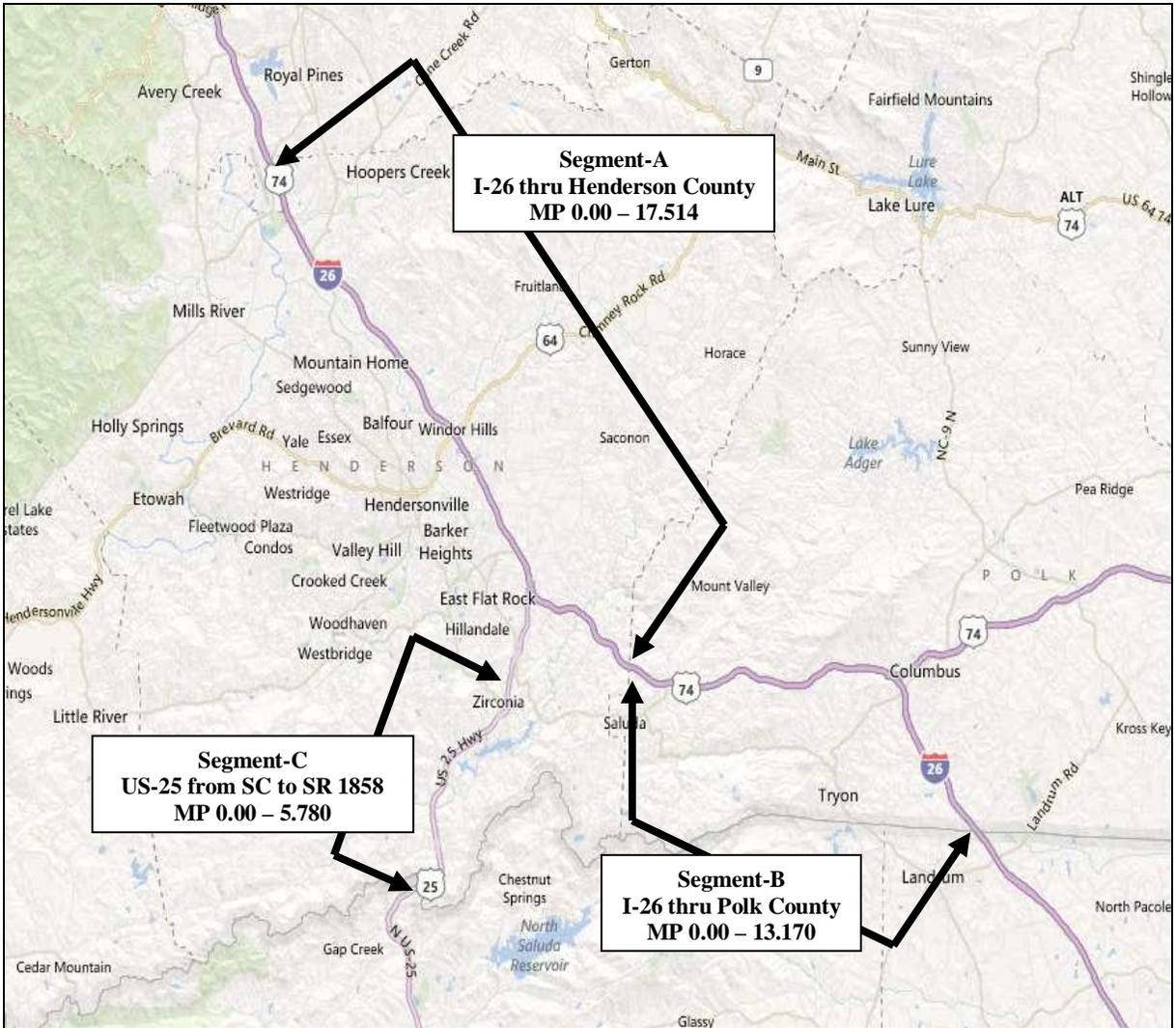
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6-13-2012
Date

Hazard Elimination Project Evaluation Documentation

Subject Location

Evaluation of Hazard Elimination Project Number W-4845 located along US-25 from the South Carolina State Line to SR 1858 in Henderson County and all of Interstate 26 through the Counties of Henderson and Polk. Total distance of 36.464 miles of access controlled freeways.



Project Information and Background from the Project File Folder

The hazard elimination project improvement chosen for the subject locations were the installation of milled rumble strips along the inside and outside shoulders of these freeway segments.

I-26 is mostly a four-lane interstate with four foot paved median shoulders and ten foot paved outside shoulders. US-25 is a four-lane fully-controlled access primary route with four foot paved median and outside shoulders. Median protection exists along the entire section of I-26 and varies between three-strand cable, w-beam guardrail, or concrete barrier wall. The speed limits on these routes vary between 55-mph and 65-mph.

The original statement of problem mentioned that vehicles were running off the road resulting in fatalities, serious injuries, and property damage. Casual factors for vehicles leaving the roadway include driver fatigue and/or inattention. Rumble strips provide both noise and vibration as a warning to motorists that they are leaving the travel lane.

The initial crash analysis was completed from July 1, 2000 to June 30, 2003 with 700 reported crashes, with 336 crashes considered correctable Ran-Off Road collisions. The improvement was completed on September 1, 2007 with a total cost of \$209,000. The projected B/C Ratio was 64.14.

Naive Before and After Analysis

After reviewing the project file folder along with all the crashes along the subject segment, the crash data omitted from this analysis to consider for an adequate construction period were the months of June through September 2007. The before period consisted of reported crashes from February 1, 2003 through May 31, 2007 (4 years, 4 months); and the after period consisted of reported crashes from October 1, 2007 through January 31, 2012 (4 years, 4 months). The ending date for this analysis was determined by the date of available crash data at the time of analysis.

The treatment data consisted of all crashes along I-26 / US-25 with a zero (0) foot y-line (No Ramps). *Please see attached location map for further details.*

The following data table depicts the Naive Before and After Analysis for the treatment location. Please note that Interstate Lane Departure Crashes were the target crashes for the applied countermeasure. The Freeway Lane Departure Crash types considered are as follows: Angle; Fixed Object; Head-On; Jackknife; Overturn/Rollover; Parked Motor Vehicle; Ran-Off Roadway (Right, Left, Straight); and Sideswipe (Same and Opposite Direction). All Lane Departure Crashes were independently verified by examining the crash reports.

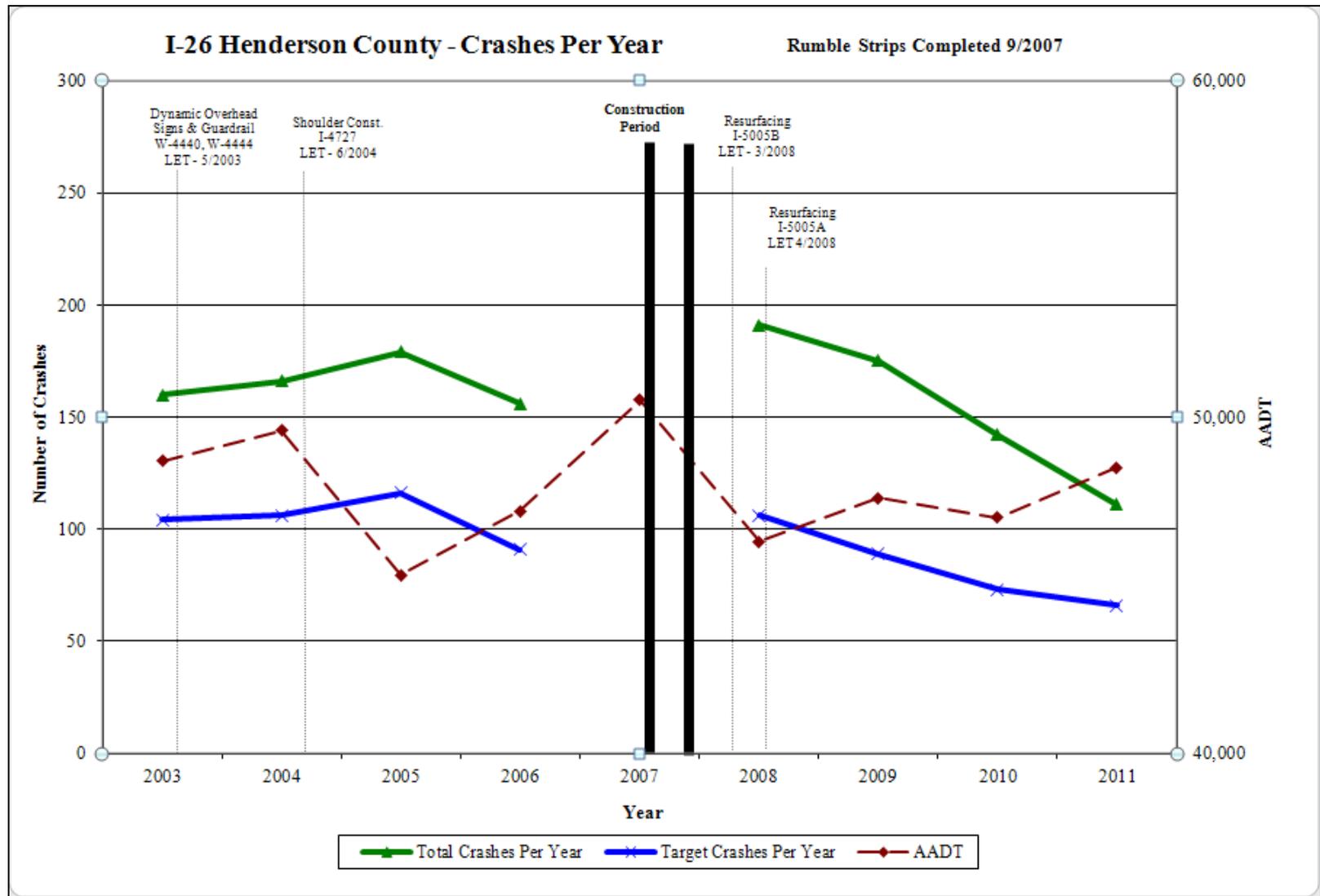
<u>Treatment Information – All Routes</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes – Both Directions	1102	1122	1.8 %
Total Severity Index	4.97	4.88	- 1.8 %
LD Crashes – Both Directions	741	655	- 11.6 %
Lane Departure Severity Index	5.00	5.43	8.6 %

<u>Seg-A: I-26 thru Henderson County</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes – Both Directions	710	673	- 5.2 %
Total Severity Index	5.16	4.88	- 5.4 %
LD Crashes – Both Directions	451	370	- 18.0 %
Lane Departure Severity Index	4.83	5.01	3.7 %
Volume (2005, 2009)	45,300	47,600	5.1 %
Total Crash Rate (100 Million Vehicle Miles)	56.60	50.96	- 10.0 %
Injury Crashes			
Fatal Injury Crashes	6	11	83.3 %
Class-A Injury Crashes	14	8	- 42.9 %
Class-B Injury Crashes	69	58	- 15.9 %
Class-C Injury Crashes	125	100	- 20.0 %
Property Damage Only Crashes	496	496	0.0 %
Contributing Factors			
Night Crashes	197	187	- 5.1 %
Animal Crashes	8	25	212.5 %
Wet Road Crashes	174	135	- 22.4 %
Alcohol / Drug Related	26	36	38.5 %

<u>I-26 Henderson Eastbound Only</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
EB Total Crashes	364	309	- 15.1 %
EB Total Severity Index	5.22	4.61	- 11.7 %
EB Lane Departure Crashes	246	178	- 27.6 %
EB Lane Departure Severity Index	4.68	4.49	- 4.1 %

<u>I-26 Henderson Westbound Only</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
WB Total Crashes	346	364	5.2 %
WB Total Severity Index	5.09	5.10	0.2 %
WB Lane Departure Crashes	205	192	- 6.3 %
WB Lane Departure Severity Index	5.01	5.50	9.8 %

Segment-A (I-26 segment through Henderson County) experienced a 5 percent decrease in total crashes and an 18 percent reduction in lane departure crashes. However, Severe Injury Collisions (Fatales and A-injury) remained consistent with twenty (20) in the before period and nineteen (19) in the after period. The eastbound direction experienced the greatest benefit with a 15 percent reduction in crashes, while the westbound saw a 5 percent increase in total crashes.



Segment-A Graph indicating Total and Lane Departure Crash Progression with respect to the Section ADT.

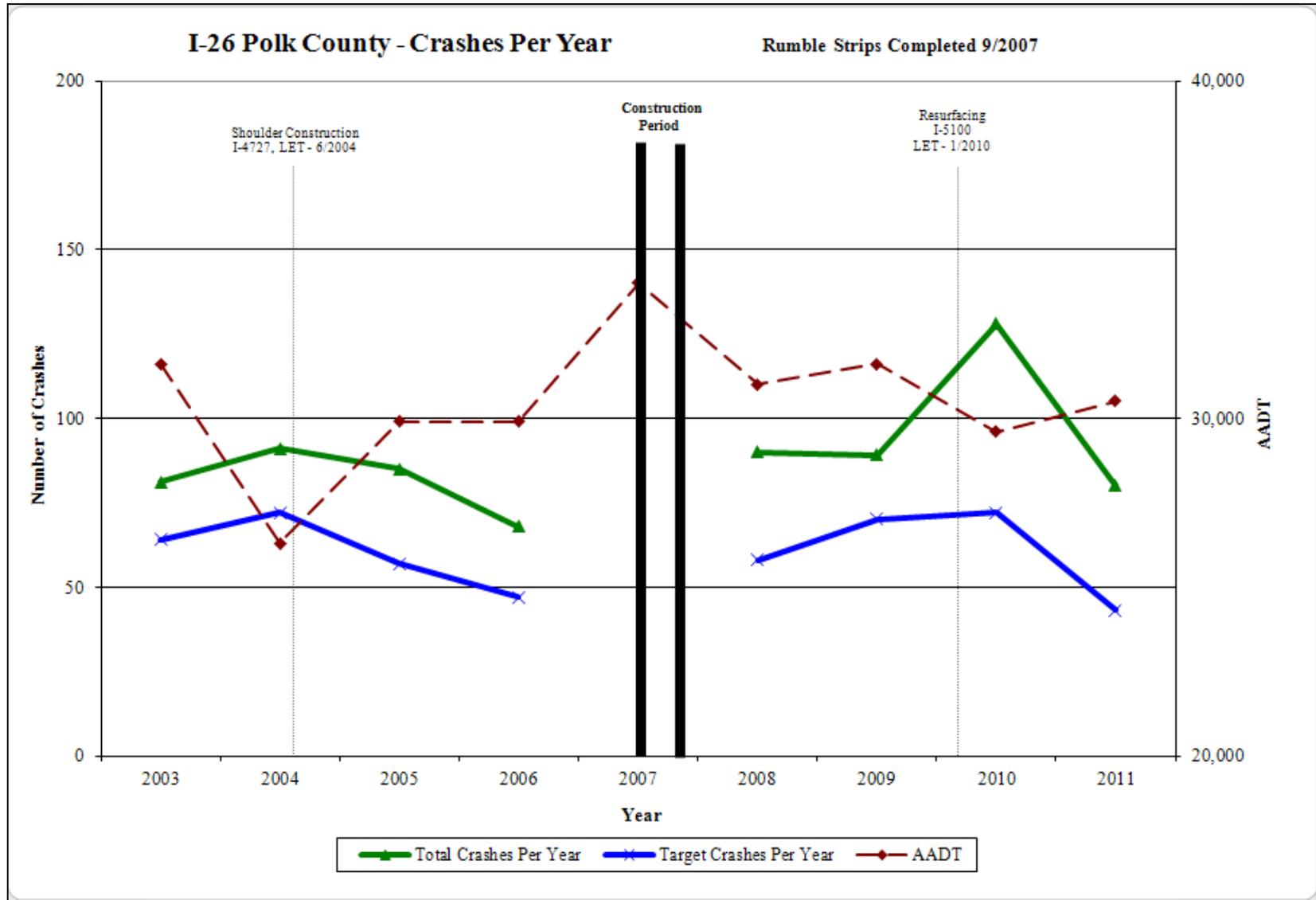
Also highlighted are other TIP Projects discovered to have been completed along this section during the study periods.

<u>Seg-B: I-26 thru Polk County</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes – Both Directions	345	408	18.3 %
Total Severity Index	4.46	4.56	2.2 %
LD Crashes – Both Directions	252	258	2.4 %
Lane Departure Severity Index	5.10	5.42	6.3 %
Volume (2005, 2009)	29,900	31,600	5.7 %
Total Crash Rate (100 Million Vehicle Miles)	55.42	61.89	11.7 %
Injury Crashes			
Fatal Injury Crashes	2	5	150.0 %
Class-A Injury Crashes	4	4	0.0 %
Class-B Injury Crashes	38	37	- 2.6 %
Class-C Injury Crashes	62	67	8.1 %
Property Damage Only Crashes	239	295	23.4 %
Contributing Factors			
Night Crashes	94	114	21.3 %
Animal Crashes	12	38	216.7 %
Wet Road Crashes	97	124	27.8 %
Alcohol / Drug Related	13	20	53.8 %

<u>I-26 Polk Eastbound (South) Only</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
EB Total Crashes	162	225	38.9%
EB Total Severity Index	4.79	5.23	9.2 %
EB Lane Departure Crashes	127	154	21.3 %
EB Lane Departure Severity Index	5.54	5.83	5.2 %

<u>I-26 Polk Westbound (North) Only</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
WB Total Crashes	183	183	0.0 %
WB Total Severity Index	4.17	3.73	- 10.6 %
WB Lane Departure Crashes	125	104	- 16.8 %
WB Lane Departure Severity Index	4.64	4.81	3.7 %

Segment-B (I-26 segment through Polk County) experienced an 18 percent increase in total crashes and a 2 percent increase in lane departure crashes. Severe Injury Collisions (Fataals and A-injury) increased from six (6) in the before period to nine (9) in the after period. The eastbound direction experienced the greatest increase with 21 percent increase in Lane Departure Crashes, while the westbound saw a 17 percent reduction in lane departure collisions.



Segment-B Graph indicating Total and Lane Departure Crash Progression with respect to the Section ADT.

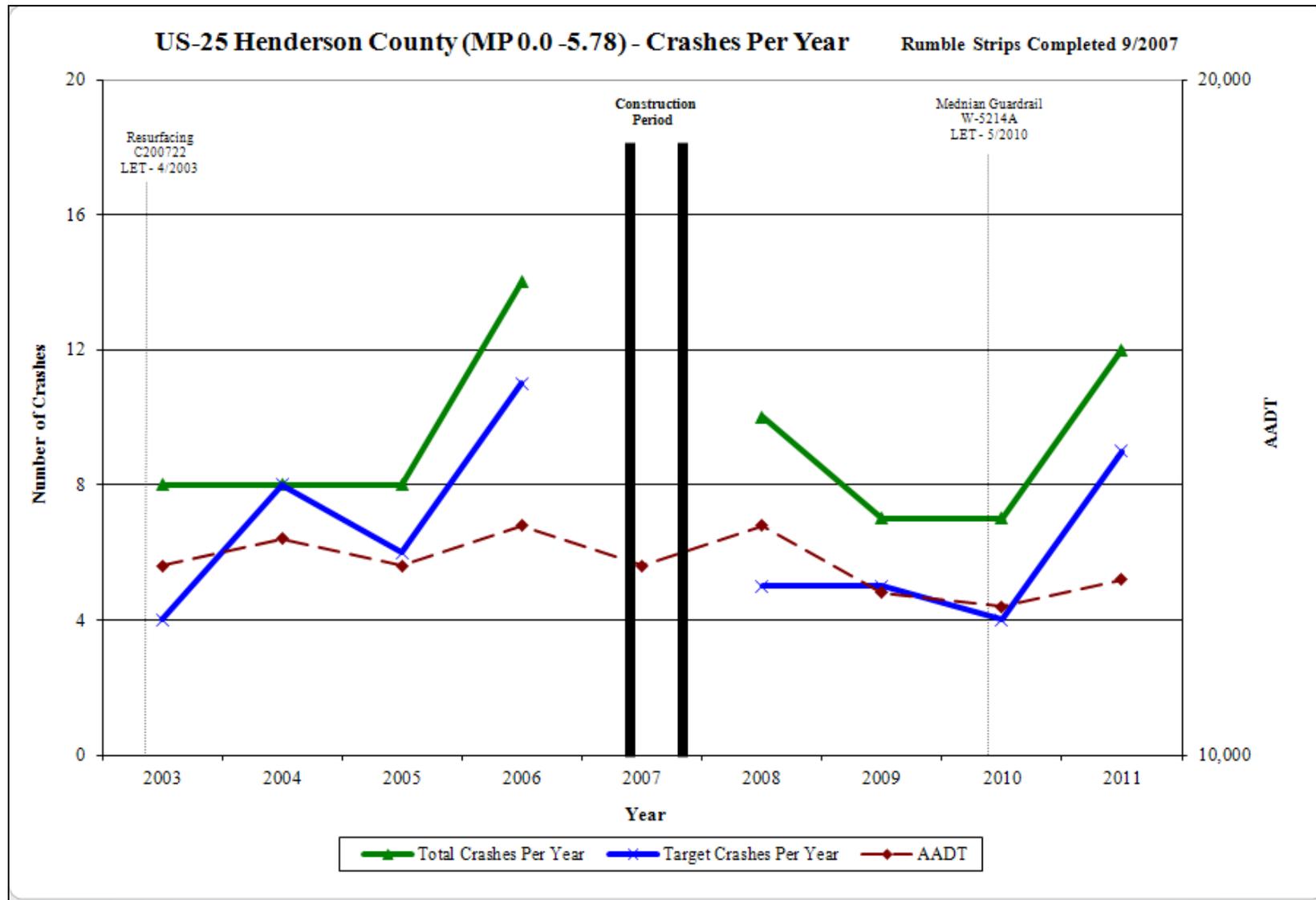
Also highlighted are other TIP Projects discovered to have been completed along this section during the study periods.

<u>Seg-C: US-25 Henderson (5.78 miles)</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes – Both Directions	47	41	- 12.8 %
Total Severity Index	5.92	7.99	35.0%
LD Crashes – Both Directions			
LD Crashes – Both Directions	38	27	- 28.9 %
Lane Departure Severity Index	6.31	11.34	79.8 %
Volume (2005, 2009)			
Volume (2005, 2009)	12,800	12,400	- 3.1 %
Total Crash Rate (100 Million Vehicle Miles)	40.18	36.11	- 10.1 %
Injury Crashes			
Fatal Injury Crashes	1	1	0.0 %
Class-A Injury Crashes	0	2	200.0 %
Class-B Injury Crashes	11	3	- 72.7 %
Class-C Injury Crashes	10	5	- 50.0 %
Property Damage Only Crashes	25	30	20.0 %
Contributing Factors			
Night Crashes	14	16	14.3 %
Animal Crashes	3	9	200.0 %
Wet Road Crashes	12	9	- 25.0 %
Alcohol / Drug Related	2	1	- 50.0 %

<u>US-25 Henderson North (East) Only</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
EB Total Crashes	30	27	- 10.0 %
EB Total Severity Index	4.21	8.26	96.2 %
EB Lane Departure Crashes			
EB Lane Departure Crashes	25	20	- 20.0%
EB Lane Departure Severity Index	4.26	10.43	144.8 %

<u>US-25 Henderson South (West) Only</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
WB Total Crashes	17	14	- 17.6 %
WB Total Severity Index	8.94	7.47	- 16.4 %
WB Lane Departure Crashes			
WB Lane Departure Crashes	13	7	- 46.2 %
WB Lane Departure Severity Index	10.25	13.94	36.0 %

Segment-C (U-25 segment through Henderson County) experienced a 13 percent decrease in total crashes and a 29 percent decrease in lane departure crashes. Severe Injury Collisions (Fatals and A-injury) increased from one (1) in the before period to three (3) in the after period. The eastbound direction experienced a decrease in Lane Departure Crashes at 20 percent, while the westbound saw a 46 percent reduction in lane departure collisions.



Segment-B Graph indicating Total and Lane Departure Crash Progression with respect to the Section ADT.

Also highlighted are other TIP Projects discovered to have been completed along this section during the study periods.

Results and Discussion

Reviewing all the tables above, the overall lane departure crash reduction was 12 percent when all the crashes were combined from the segments. Each direction of the three routes experienced some reduction in lane departure crashes except for I-26 Eastbound through Polk County (Segment-B) which experienced a 21 percent increase. However, lane departure severe injury collisions (Fatales and A-injury) increased from seventeen (17) to twenty-two (22) throughout the evaluation period.

The calculated benefit to cost ratio for this project is **(-13.96) considering total crashes**. The benefit to cost ratio **considering only lane departure target crashes is (-13.59)**. The benefits are calculated using the change in annual crash costs from the before to the after period. Operational and other benefits related to the project are not considered in this analysis. The costs of the project include the actual construction costs as well as the increase in annual maintenance and utility costs.

The previous charts depict the number of Total and Target Crashes per year plotted in the before and after periods, along with the AADT. Take notice on Segment-C Chart that when median guardrail was installed along the entire route in late 2010 that total and target crashes per year nearly doubled. This is typical of sections we have placed median barrier on. A reportable crash is now more likely to occur since a fixed object is now placed in the median; versus a motorist being able to drive out of the median post a single vehicle lane departure incident.

As the Safety Evaluation Group completes additional safety reviews for this type of countermeasure, we will be able to provide objective and definite information regarding actual crash reduction factors for this type of roadway treatment.

BENEFIT-COST ANALYSIS WORKSHEET - Total Crashes All Segments

LOCATION: I-26 / US-25		BY: JBS						
COUNTY: Henderson / Polk		DATE: 6/12/2012						
FILE NO.: W-4845								
DETAILED COST:	TYPE IMPROVEMENT -	Rumble Strips						
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$209,000	10	0.149	\$31,147			
		\$0	0	0.000	\$0			
	Right-of-Way	\$0	0	0.000	\$0			
	TOTALS	\$209,000	10	0.149	\$31,147			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$0			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0			
	TOTAL ANNUAL COST=				\$31,147			
	TOTAL COST OF PROJECT=				\$209,000			
COMPREHENSIVE COST REDUCTION:								
ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES								
TIME PERIOD	YEARS	K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	PDO CRASHES	PDO CRASHES PER YR	ANNUAL COSTS
BEFORE	4.33	27	6.24	315	72.75	760	175.52	\$6,138,106
AFTER	4.33	31	7.16	270	62.36	821	189.61	\$6,572,818
							Annual Benefits from Crash Cost Savings	(\$434,711)
	NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST							(\$465,858)
	BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST							-13.96
	TOTAL COST OF PROJECT	-	\$209,000		COMPREHENSIVE B/C RATIO	-		-13.96

BENEFIT-COST ANALYSIS WORKSHEET - LD Crashes All Segments

LOCATION: I-26 / US-25		BY: JBS						
COUNTY: Henderson / Polk		DATE: 6/12/2012						
FILE NO.: W-4845		Lane Departure Target Crashes						
DETAILED COST:	TYPE IMPROVEMENT -	Rumble Strips						
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$209,000	10	0.149	\$31,147			
		\$0	0	0.000	\$0			
	Right-of-Way	\$0	0	0.000	\$0			
	TOTALS	\$209,000	10	0.149	\$31,147			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$0			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0			
	TOTAL ANNUAL COST=				\$31,147			
	TOTAL COST OF PROJECT=				\$209,000			
COMPREHENSIVE COST REDUCTION:								
ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES								
TIME PERIOD	YEARS	K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	PDO CRASHES	PDO CRASHES PER YR	ANNUAL COSTS
BEFORE	4.33	17	3.93	226	52.19	498	115.01	\$4,011,871
AFTER	4.33	22	5.08	167	38.57	466	107.62	\$4,435,058
							Annual Benefits from Crash Cost Savings	(\$423,187)
	NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST							(\$454,334)
	BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST							-13.59
	TOTAL COST OF PROJECT	-	\$209,000		COMPREHENSIVE B/C RATIO	-		-13.59