

# Spot Safety Project Evaluation

Order # 41000001395

Spot Safety Project # 14-03-207

## Spot Safety Project Evaluation of the Rumble Strip Installation I-40: Milepost Range 20.13 to 36.84 Haywood County

Documents Prepared By:

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8-17-2010

Date

# Spot Safety Project Evaluation Documentation

## Subject Location

Evaluation of Spot Safety Project Number 14-03-207 located along Interstate 40 in Haywood County from 0.5 mile west of US 276 (MP 20.13) to the Buncombe County Line (MP 36.84).



## **Project Information and Background from the Project File Folder**

The spot safety project improvement countermeasure chosen for the subject I-40 interstate segment was the installation of rumble strips on both the median and outside shoulders. The countermeasure was applied to both the eastbound and westbound travel lanes. Interstate 40 along this strip is mostly a four-lane cross-section with twelve (12) foot lanes, ten (10) foot outside shoulders, and four (4) foot median shoulders. The posted speed limit is 65 mph and the segment is 16.71 miles in length.

The original statement of problem was the increased occurrence of ran-off roadway type accidents resulting in fatal and severe injury collisions. The intended purpose of these improvements was to alleviate the frequency of roadway departure accidents by alerting the motorist of their actions.

The initial crash analysis was completed from January 1, 2000 to December 31, 2002 with 342 total reported crashes, 143 of which were deemed correctable including three fatal collisions. The final completion date for the improvement at the subject intersection was on January 13, 2004 with a total cost of \$174,000.

The Safety Evaluation Group also discovered that two additional projects had occurred along this interstate segment around our analysis. Guardrail was installed on this strip under Project I-4015 and was completed on May 8, 2001. Also, in the first quarter of 2009 the interstate from Exit 27 (US 19/74) to the Buncombe County Line was resurfaced with a rehab project. Rumble strips were not reinstalled along this portion of the segment until approximately 6 months later.

## **Naive Before and After Analysis**

After reviewing the spot safety project file folder along with all the crashes at the subject location, the crash data omitted from this analysis to consider for an adequate construction period were the months of December 2003 through January 2004. The before period consisted of reported crashes from June 1, 2001 through November 30, 2003 (2 years and 6 months); and the after period consisted of reported crashes from February 1, 2004 through December 31, 2008 (4 years and 11 months). This analysis was limited by the guardrail installation in the before period and the rehab resurfacing project in the after period.

The treatment data consisted of all crashes along this roadway segment and the analysis was completed with a zero (0) foot y-line. This means that ramp collisions were not included. *Please see attached location map and photos for further details.*

The following data table depicts the Naive Before and After Analysis for the treatment strip. Please note that a particular target crash type was not selected; however the charts highlight lane departure and wet roadway crash types. Lane Departure Crash Types are listed as followed: Angle, Fixed Object, Head-on, Jackknife, Moveable Object, Overturn/Rollover, Parked Motor Vehicle, Ran-Off Roadway (Right and Left), Right Turn-Same Roadway, and Sideswipe-Same Roadway.

<b>Treatment Information</b>	<b>Before 2.50 Yrs</b>	<b>After 4.92 Yrs</b>	<b>Percent Reduction (-)/ Percent Increase (+)</b>
Total Crashes – Combined Directions	330	565	N/A
<b>Total Crashes per Year</b>	<b>132.00</b>	<b>114.84</b>	<b>- 13.0 %</b>
Total Severity Index	5.47	4.42	- 19.2 %
<b>Lane Departure Crashes - Combined</b>			
Lane Departure Crashes - Combined	219	418	N/A
<b>Lane Departure Crashes per Year</b>	<b>87.60</b>	<b>84.96</b>	<b>- 3.0 %</b>
<b>Wet Road Crashes – Combined</b>			
Wet Road Crashes – Combined	112	204	N/A
<b>Wet Road Crashes per Year</b>	<b>44.80</b>	<b>41.46</b>	<b>- 7.5 %</b>
<b>Volume (2001, 2006)</b>			
Volume (2001, 2006)	34,300	39,700	15.7 %

The naive before and after analysis at the treatment location resulted in an overall 13 percent decrease in Total Crashes per Year and a 19 percent decrease in the Total Severity Index. The before period ADT year was 2001 and the after period ADT year was 2006. The following charts divide the data by direction of travel.

<b>Eastbound Treatment Info</b>	<b>Before 2.50 Yrs</b>	<b>After 4.92 Yrs</b>	<b>Percent Reduction (-)/ Percent Increase (+)</b>
Total Crashes	174	274	N/A
<b>Total Crashes per Year</b>	<b>69.60</b>	<b>55.69</b>	<b>- 20.0 %</b>
Total Severity Index	5.47	3.48	- 36.4 %
<b>Lane Departure Crashes</b>			
Lane Departure Crashes	112	189	N/A
<b>Lane Departure Crashes per Year</b>	<b>44.80</b>	<b>38.41</b>	<b>- 14.3 %</b>

<b>Eastbound Crash Details</b>	<b>Before 2.50 Yrs</b>	<b>After 4.92 Yrs</b>	<b>Percent Reduction (-)/ Percent Increase (+)</b>
<b>Segment Crashes - Injuries</b>			
Fatal Injury Crashes	2	0	N/A
<b>Fatal Injury Crashes per Year</b>	<b>0.80</b>	<b>0.00</b>	<b>- 100.0 %</b>
Non-Fatal Injury Crashes	57	92	N/A
<b>Non-Fatal Injury Crashes per Year</b>	<b>22.80</b>	<b>18.70</b>	<b>- 18.0 %</b>
Property Damage Only Crashes	115	182	N/A
<b>PDO Crashes per Yr</b>	<b>46.00</b>	<b>37.00</b>	<b>- 19.7 %</b>
<b>Crashes - Contributing Factors</b>			
Night Crashes	44	69	N/A
<b>Night Crashes per Year</b>	<b>17.60</b>	<b>14.02</b>	<b>- 20.3 %</b>
Wet Road Crashes	66	89	N/A
<b>Wet Road Crashes per Year</b>	<b>26.40</b>	<b>18.09</b>	<b>- 31.5 %</b>
Alcohol Related Crashes	4	6	N/A
<b>Alcohol Crashes per Year</b>	<b>1.60</b>	<b>1.22</b>	<b>- 23.8 %</b>

<i>Westbound Treatment Info</i>	Before 2.50 Yrs	After 4.92 Yrs	Percent Reduction (-)/ Percent Increase (+)
Total Crashes	156	291	N/A
<b>Total Crashes per Year</b>	<b>62.40</b>	<b>59.15</b>	<b>- 5.2 %</b>
Total Severity Index	5.46	5.35	- 2.0 %
Lane Departure Crashes	107	229	N/A
<b>Lane Departure Crashes per Year</b>	<b>42.80</b>	<b>46.54</b>	<b>8.7 %</b>

<i>Westbound Crash Details</i>	Before 2.50 Yrs	After 4.92 Yrs	Percent Reduction (-)/ Percent Increase (+)
<b>Segment Crashes - Injuries</b>			
Fatal Injury Crashes	2	2	N/A
<b>Fatal Injury Crashes per Year</b>	<b>0.80</b>	<b>0.41</b>	<b>- 48.8%</b>
Non-Fatal Injury Crashes	55	95	N/A
<b>Non-Fatal Injury Crashes per Year</b>	<b>22.0</b>	<b>19.31</b>	<b>- 12.2 %</b>
Property Damage Only Crashes	99	194	N/A
<b>PDO Crashes per Year</b>	<b>39.6</b>	<b>39.4</b>	<b>- 0.5 %</b>
<b>Crashes - Contributing Factors</b>			
Night Crashes	40	71	N/A
<b>Night Crashes per Year</b>	<b>16.00</b>	<b>14.43</b>	<b>- 9.8 %</b>
Wet Road Crashes	46	115	N/A
<b>Wet Road Crashes per Year</b>	<b>18.40</b>	<b>23.37</b>	<b>27.0 %</b>
Alcohol Related Crashes	5	7	N/A
<b>Alcohol Crashes per Year</b>	<b>2.00</b>	<b>1.42</b>	<b>- 29.0 %</b>

## Results and Discussion

Referencing the *charts above*, with the installation of the rumble strips this interstate segment experienced crashes per year improvements in total crashes, wet crashes, and lane departure crashes. However, the overall reduction of lane departure crashes per year by three (3) percent is better represented by direction of travel. Lane departure crashes per year reduced by fourteen (14) percent in the eastbound direction while it experienced a nine (9) percent increase for westbound motorists. Wet Roadway crashes per year also saw a thirty-one (31) percent decrease for eastbound vehicles but a twenty-seven (27) percent increase for westbound motorists. The westbound direction did however experience a five (5) percent overall crash reduction and a fifty (50) percent decrease in fatal injury collisions.

The calculated benefit to cost ratio for this project is **43.62 considering total crashes**. 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.

Please see the attached *Treatment Site Photo*. A photo is provided from Google Street View showing the rumble strip installation and the standard roadway geometrics. As the Safety Evaluation Group completes additional spot 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 intersection.

## TREATMENT SITE PHOTO



Typical I-40 Roadway Cross-Section on this segment.  
Rumble Strips installed on both sides of roadway.  
Concrete Barrier separating directional lanes of travel.

**BENEFIT-COST ANALYSIS WORKSHEET - Total Crashes**

LOCATION: I-40	BY: JBS
COUNTY: Haywood	DATE: 11/10/2009
FILE NO.: SS 14-03-207	NOTES: Total Crashes

DETAILED COST:            TYPE IMPROVEMENT -            Rumble Strips

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$174,000	10	0.149	\$25,931
	\$0	0	0.000	\$0
Right-of-Way	\$0	0	0.000	\$0
<b>TOTALS</b>	<b>\$174,000</b>	<b>10</b>	<b>0.149</b>	<b>\$25,931</b>

ESTIMATED INCREASE IN ANNUAL MAINT. COST =	\$0
ESTIMATED INCREASE IN ANNUAL UTILITY COST =	\$0
<b>TOTAL ANNUAL COST=</b>	<b>\$25,931</b>
<b>TOTAL COST OF PROJECT=</b>	<b>\$174,000</b>

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	2.50	9	3.60	107	42.80	214	85.60	\$2,904,240
AFTER	4.92	8	1.63	181	36.79	376	76.42	\$1,773,252

Annual Benefits from Crash Cost Savings    \$1,130,988

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST	=	\$1,105,057
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST	=	43.62

TOTAL COST OF PROJECT	-	\$174,000	COMPREHENSIVE B/C RATIO	-	43.62
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