

# Hazard Elimination Project Evaluation

Order # 41000004716

Hazard Elimination Project W-4817

**Evaluation of the Rumble Strip Installation on I-85 in Alamance and Orange Counties**

Documents Prepared By:

Safety Evaluation Group  
Traffic Safety Systems Management Section  
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**Principal Investigator**



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Carrie L. Simpson, PE

6/3/2010

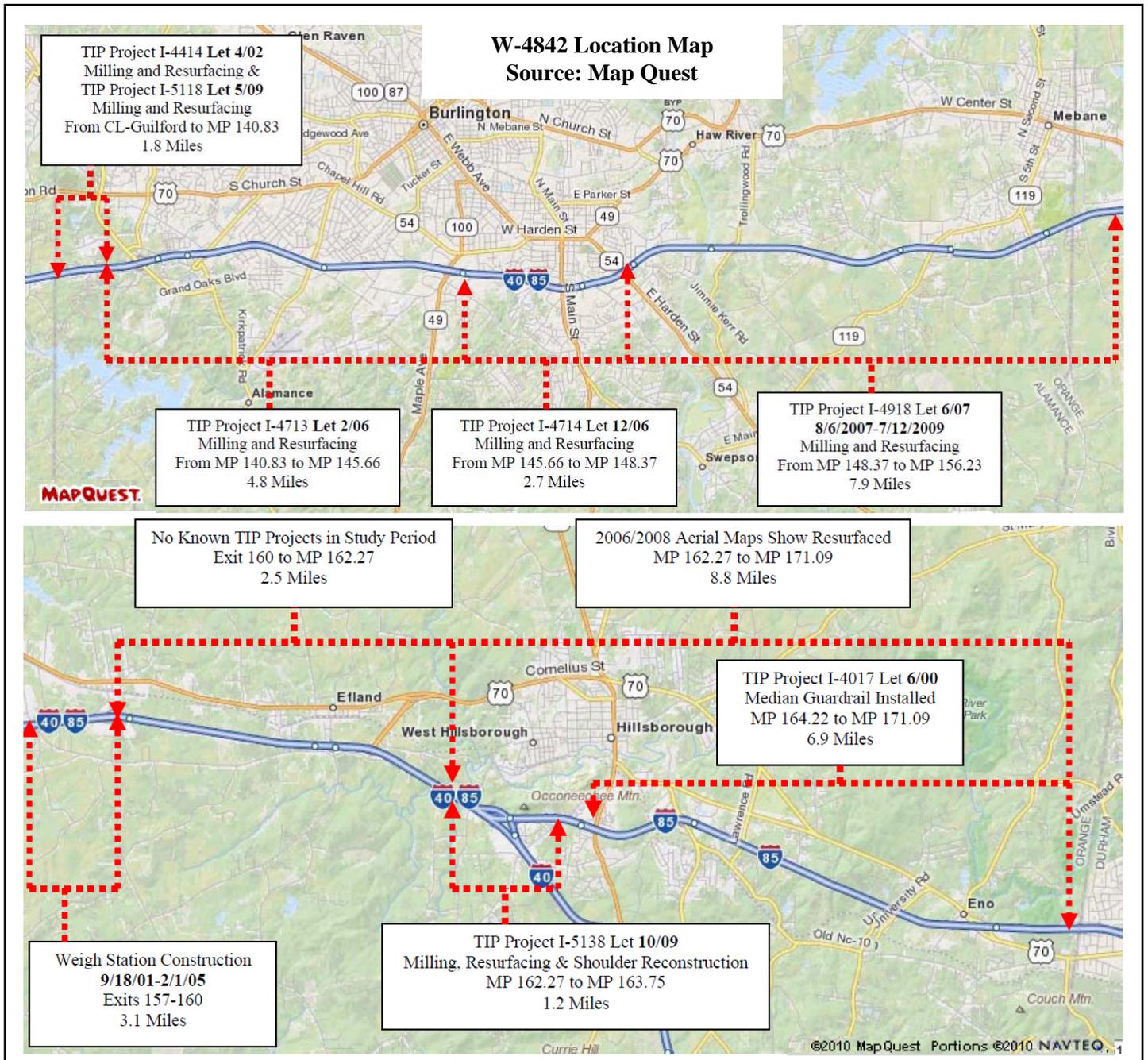
Date

Traffic Safety Project Engineer

# Hazard Elimination Project Evaluation Documentation

## Subject Location

W-4817 was installed on I-85 in Alamance and Orange Counties. Multiple resurfacing projects were completed on this section of roadway after the completion of W-4817. Weigh stations were also constructed west of Hillsboro that involved lane closures for both directions of I-85 from Late 2001 to Early 2005. In addition, double-faced median guardrail was installed on I-85 east of SR 1009 to the Durham County Line, with construction beginning July 31, 2000. Due to the number and duration of additional projects, they are noted in the Location Map below for your reference but are not accounted for in this evaluation.



## Project Information and Background from the Project File Folder

The hazard elimination project improvement chosen was the installation of shoulder rumble strips. The countermeasure was applied to both the eastbound and westbound travel lanes for 32 miles of I-85. The portion of I-85 that runs with I-40 is an 8-lane divided controlled access highway with 12 foot lanes, variable 10-12 foot outside shoulders, and variable 6-10 foot median shoulders. Median barrier is provided. The portion of I-85 east of the I-40 split in Orange County is a 4-lane divided controlled access highway. For this section, median guardrail was installed under TIP Project I-4017 during the before period. The posted speed limit is 65 mph. The intended purpose of the improvement was to alleviate the frequency of run-off-road (drift-off) crashes. The initial crash analysis was completed from August 1, 2000 to July 31, 2003 with 1,961 total reported crashes, 892 of which were deemed correctable Ran Off Road crashes. The improvement was completed on June 30, 2005 with a total cost of \$200,000. The projected B/C Ratio was 212.29.

## Location Photographs





### **Naive Before and After Analysis**

After reviewing the 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 from January 1, 2005 through June 30, 2005. The before period consisted of reported crashes from July 1, 2000 through December 31, 2004 (4.5 years); and the after period consisted of reported crashes from July 1, 2005 through December 31, 2009 (4.5 years). The ending date for this analysis was determined by the date of available crash data at the time of analysis. The before period ADT year was 2002 and the after period ADT year was 2007.

The treatment data consisted of all mainline crashes on I-85 in Alamance and Orange Counties. The analysis was completed with a 0' y-line. Target crashes are lane departure crash types.

For the purposes of this evaluation, we assumed that there were no rumble strips present in the before period and continuous rumble strips present for the duration of the after period. Due to the number and duration of other TIP projects completed in the before and after periods, we were unable to account for construction periods associated with these.

<b><u>Treatment Information</u></b>	<b>Before</b>	<b>After</b>	<b>Percent Reduction (-)/ Percent Increase (+)</b>
Total Crashes – Both Directions	2733	2761	1.0%
Total Severity Index	4.57	3.59	-21.4%
<b>Lane Departure Crashes – Both Directions</b>			
Lane Departure Crashes – Both Directions	2055	2054	0.0%
Lane Departure Severity Index	4.66	3.48	-25.3%
<b>Volume</b>			
Volume	76500	82500	7.8%

The following tables divide the crash data by direction of travel. Crashes where the direction of travel was coded as either North or East are included in the Northbound Treatment Information, and crashes where the direction of travel was coded as either South or West are included in the Southbound Treatment Information.

<b><u>Northbound Treatment Information</u></b>	<b>Before</b>	<b>After</b>	<b>Percent Reduction (-)/ Percent Increase (+)</b>
Total Crashes	1351	1411	4.4%
Total Severity Index	4.77	3.45	-27.7%
<b>Lane Departure Crashes</b>			
Lane Departure Crashes	1028	1045	1.7%

<b><u>Northbound Crash Details</u></b>	<b>Before</b>	<b>After</b>	<b>Percent Reduction (-)/ Percent Increase (+)</b>
<b>Segment Crashes – Injuries</b>			
Fatal Injury Crashes	11	4	-63.6%
Non-Fatal Injury Crashes	419	361	-13.8%
Property Damage Only Crashes	921	1046	13.6%
<b>Crashes - Contributing Factors</b>			
Night Crashes	450	492	9.3%
Wet Road Crashes	446	566	26.9%
Alcohol Related	55	54	-1.8%
<b>Lane Departure Crash Types</b>			
Angle	42	34	-19.0%
Fixed Object	542	502	-7.4%
Head On	6	4	-33.3%
Jackknife	6	5	-16.7%
Movable Object	65	101	55.4%
Overturn / Rollover	27	22	-18.5%
Parked Motor Vehicle	30	14	-53.3%
Ran Off Road (Right & Left)	58	58	0.0%
Sideswipe, Same Direction	251	298	18.7%
Sideswipe, Opposite Direction	1	7	600.0%

<b>Southbound Treatment Information</b>	<b>Before</b>	<b>After</b>	<b>Percent Reduction (-)/ Percent Increase (+)</b>
Total Crashes	1382	1350	-2.3%
Total Severity Index	4.38	3.74	-14.6%
Lane Departure Crashes	1027	1009	-1.8%

<b>Southbound Crash Details</b>	<b>Before</b>	<b>After</b>	<b>Percent Reduction (-)/ Percent Increase (+)</b>
<b>Segment Crashes – Injuries</b>			
Fatal Injury Crashes	12	4	-66.7%
Non-Fatal Injury Crashes	406	375	-7.6%
Property Damage Only Crashes	964	971	0.7%
<b>Crashes - Contributing Factors</b>			
Night Crashes	447	479	7.2%
Wet Road Crashes	455	477	4.8%
Alcohol Related	46	36	-21.7%
<b>Lane Departure Crash Types</b>			
Angle	41	35	-14.6%
Fixed Object	537	475	-11.5%
Head On	5	8	60.0%
Jackknife	3	5	66.7%
Movable Object	67	106	58.2%
Overturn / Rollover	29	24	-17.2%
Parked Motor Vehicle	32	15	-53.1%
Ran Off Road (Right & Left)	45	56	24.4%
Sideswipe, Same Direction	265	282	6.4%
Sideswipe, Opposite Direction	3	3	0.0%

## Results and Discussion

Using naïve before and after analysis, the number of Total and Target Crashes remained about the same on the section of I-85 installed with rumble strips under project W-4817, while the severity of Total and Target Crashes decreased. The naïve before and after analysis for the project resulted in an overall 1 percent increase in Total Crashes and a 21 percent decrease in the Total Severity Index. There was no change in Target Crashes and a 25 percent decrease in the Target Severity Index. In the Northbound direction, the occurrence of Lane Departure Crashes increased by 2 percent. In the Southbound direction, the occurrence of Lane Departure Crashes decreased by 2 percent.

The calculated benefit to cost ratio for W-4817 is **134.2** considering Total Crashes. The benefit to cost ratio considering only Target Crashes is **125.4**. 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 costs when applicable.

In the after period, the percentage of crashes occurring under wet road conditions was about 40 percent and the percentage of crashes occurring at night was about 35 percent of all crashes. See the figures below for the breakdown of wet and dark crashes by direction in the after period. In the northbound direction, there was an increase in wet road crashes of about 27 percent from the before to the after period.

After Period Light and Road Conditions Summaries

*Northbound I-85 in Alamance and Orange Counties:*

**Light and Road Conditions Summary**

Condition	Dry	Wet	Other	Total
Day	485	356	30	871
Dark	262	189	41	492
Other	22	21	5	48
Total	769	566	76	1411

*Southbound I-85 in Alamance and Orange Counties:*

**Light and Road Conditions Summary**

Condition	Dry	Wet	Other	Total
Day	500	304	38	842
Dark	271	161	47	479
Other	13	12	4	29
Total	784	477	89	1350

As shown in the Location Map at the beginning of the document, there were at least eight TIP projects completed on this section of roadway that may influence the number of crashes in our before and after periods. Although we did not account for construction periods associated with other TIP projects in our evaluation, we were able to determine what percent of crashes were related to work zones to determine what effect the other active work zones may have had on our data. In the before period, crashes coded as occurring in or near a work zone accounted for 7 percent (181) of Total Crashes and 4 percent (79) of Target Crashes. In the after period, crashes coded as occurring in or near a work zone accounted for 2 percent (42) of Total Crashes and 1 percent (24) of Target Crashes. The higher percentage of before period work zone crashes were mostly concentrated in Alamance County between the Guilford County Line and 3 miles east of the Guilford County Line, likely associated with TIP I-4414 let in April 2002. The impact of the completed resurfacing and guardrail improvements on crashes is not known.

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.

**BENEFIT-COST ANALYSIS WORKSHEET**

LOCATION: I-85 CountyWide  
 COUNTY: Alamance and Orange  
 FILE NO.: W-4817  
 TOTAL CRASHES

BY: CLS  
 DATE: 4/26/2010

DETAILED COST: TYPE IMPROVEMENT - Rumblestrips

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$200,000	10	0.149	\$29,806
		0	0.000	\$0
		0	0.000	\$0
<b>TOTALS</b>	<b>\$200,000</b>	<b>10</b>	<b>0.149</b>	<b>\$29,806</b>

ESTIMATED INCREASE IN ANNUAL MAINT. COST = \$0  
 ESTIMATED INCREASE IN ANNUAL UTILITY COST = \$0  
 TOTAL ANNUAL COST= \$29,806  
 TOTAL COST OF PROJECT= \$200,000

COMPREHENSIVE COST REDUCTION:

TIME PERIOD	YEARS	ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES						ANNUAL COSTS
		K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	PDO CRASHES	PDO CRASHES PER YR	
BEFORE	4.50	51	11.33	797	177.11	1885	418.89	\$12,441,556
AFTER	4.50	24	5.33	720	160.00	2017	448.22	\$8,442,533

Annual Benefits from Crash Cost Savings \$3,999,022

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = \$3,969,216  
 BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 134.17

TOTAL COST OF PROJECT - \$200,000 COMPREHENSIVE B/C RATIO - 134.17

**BENEFIT-COST ANALYSIS WORKSHEET**

LOCATION: I-85 CountyWide  
 COUNTY: Alamance and Orange  
 FILE NO.: W-4817  
 TARGET CRASHES

BY: CLS  
 DATE: 4/26/2010

DETAILED COST: TYPE IMPROVEMENT - Rumblestrips

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$200,000	10	0.149	\$29,806
		0	0.000	\$0
		0	0.000	\$0
<b>TOTALS</b>	<b>\$200,000</b>	<b>10</b>	<b>0.149</b>	<b>\$29,806</b>

ESTIMATED INCREASE IN ANNUAL MAINT. COST = \$0  
 ESTIMATED INCREASE IN ANNUAL UTILITY COST = \$0  
 TOTAL ANNUAL COST= \$29,806  
 TOTAL COST OF PROJECT= \$200,000

COMPREHENSIVE COST REDUCTION:

TIME PERIOD	YEARS	ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES						ANNUAL COSTS
		K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	PDO CRASHES	PDO CRASHES PER YR	
BEFORE	4.50	40	8.89	608	135.11	1407	312.67	\$9,615,422
AFTER	4.50	15	3.33	534	118.67	1505	334.44	\$5,878,000

Annual Benefits from Crash Cost Savings \$3,737,422

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = \$3,707,616  
 BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 125.39

TOTAL COST OF PROJECT - \$200,000 COMPREHENSIVE B/C RATIO - 125.39