

# **Hazard Elimination Project Evaluation**

Project Log # 200705269

Hazard Elimination Projects W-4442

**Evaluation of Shoulder Guardrail Installation on SR 1004 from NC 63 to the Haywood County Line,  
Buncombe County**

Documents Prepared By:

Safety Evaluation Group  
Traffic Safety Systems Management Section  
Transportation Mobility and Safety Division  
North Carolina Department of Transportation

**Principal Investigator**

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Traffic Safety Project Engineer

\_\_\_\_\_  
10-29-08  
Date

# ***Hazard Elimination Project Evaluation Documentation***

## **Subject Location**

Evaluation of Hazard Elimination Project W-4442 – Installation of shoulder guardrail on SR 1004 from NC 63 to the Haywood County Line in Buncombe County

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

The safety countermeasure chosen for the subject location was the installation of shoulder guardrail. SR 1004 is a two-lane highway with speed limits varying from 35 miles per hour to 55 miles per hour along the 8.8 mile study area. According to the project file, the roadway shoulders are narrow and drop-offs in excess of 10 feet exist.

The initial crash analysis for this location was completed from January 1, 1999 through December 31, 2001 with a total of 84 reported crashes. The most prevalent crash pattern at the location was ran off road crashes, which made up 33 percent of the total crashes. The guardrail was installed to reduce the severity of the pattern of ran off road crashes. The project was let in late July of 2003 and was closed out in March of 2004 at an estimated cost of \$390,000.

## **Naïve Before and After Analysis**

After reviewing the hazard elimination project file folder along with all the crashes at the subject locations, the crash data omitted from this analysis to consider for an adequate construction period was from August 1, 2003 through March 31, 2004. The before period consisted of reported crashes from March 1, 1999 through July 31, 2003 (4 Years, 5 Months) and the after period consisted of reported crashes from April 1, 2004 through August 31, 2008 (4 Years, 5 Months). The ending date for this analysis was determined by the available before period crash data.

The treatment data consisted of all crashes on the 8.80 mile strip of SR 1004 from NC 63 to the Haywood County Line with a 0 foot y-line. Please see the attached *Location Map* for further detail.

The following table depicts the Naïve Before and After Analysis for the Total Crashes and Target Crashes at the treatment location. Please note that Ran Off Road crash types were the target crashes for the applied countermeasure. Ran Off Road crash types considered are as follows: Ran Off Road – Left, Ran Off Road – Right, Ran Off Road – Straight, Fixed Object, Head-on, Sideswipe – Same Direction, Sideswipe – Opposite Direction, and Overturn / Rollover.

Treatment Information	Before	After	Percent Reduction (-)/ Percent Increase (+)
<i>Total Crashes</i>			
Total Crashes	129	122	-5.4%
<i>Total Crashes - Injuries</i>			
Fatal Injury Crashes	3	1	-66.7%
Severe Injury Crashes	8	3	-62.5%
KAB Injury Crashes	37	28	-24.3%
Injury Crashes	70	63	-10.0%
Severity Index	9.26	6.5	-29.8%
<i>Total Crashes - Contributing Factors</i>			
Night Crashes	39	41	5.1%
Wet Crashes	22	15	-31.8%
<i>Total Crashes - Crash Types</i>			
Animal	4	3	-25.0%
Frontal Impact	49	30	-38.8%
Other	3	6	100.0%
Lane Departure	54	58	7.4%
Rear End	17	24	41.2%
Pedestrian / Pedalcyclist	2	1	-50.0%
<i>Volume</i>			
Volume	2500	2900	16.0%

Target Crash Information	Before	After	Percent Reduction (-)/ Percent Increase (+)
<i>Target Crashes</i>			
Target Crashes	54	58	7.4%
<i>Total Crashes - Injuries</i>			
Fatal Injury Crashes	3	1	-66.7%
Severe Injury Crashes	4	2	-50.0%
KAB Injury Crashes	18	17	-5.6%
Injury Crashes	29	35	20.7%
Severity Index	10.04	7.82	-22.1%
<i>Target Crashes - Contributing Factors</i>			
Night Crashes	27	28	3.7%
Wet Crashes	9	8	-11.1%
<i>Target Crashes - Crash Types</i>			
Fixed Object	25	37	48.0%
Head On	1	2	100.0%
Overtum / Rollover	9	11	22.2%
Ran Off Road - Left	2	0	-100.0%
Ran Off Road - Right	5	0	-100.0%
Ran Off Road - Straight	0	0	--
Sideswipe, Opposite Direction	9	8	-11.1%
Sideswipe, Same Direction	3	0	-100.0%

## Results and Discussion

The naïve before and after analysis involving the comparison of treatment actual before data versus treatment actual after data resulted in a 5 percent decrease in Total Crashes and a 7 percent increase in Target Crashes. Further investigation shows that the Severity Index of Total Crashes and Target Crashes appear to have decreased 30 and 22 percent respectively using naïve methodologies. The summary results above demonstrate that the treatment location appears to have had a slight increase in Target Crashes and a significant decrease in the Severity Index from the before to the after period. The Average Daily Traffic (ADT) at this site has increased by 16 percent. The before period ADT year was 2001 and the after period ADT year was 2006.

The calculated benefit to cost ratio for this project is 9.74 considering total crashes. The benefit to cost ratio considering only target crashes is 3.32. 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 constructions costs as well as the increase in annual maintenance and utility costs.

It should be noted that there was no specific information in the project file as to exactly where each run of guardrail was placed in this project. Therefore specific crash information for each run of guardrail could not be analyzed. The site visit confirmed where guardrail exists along the segment today, but there was no way to determine where guardrail existed before the project.

Typically, one would expect guardrail installation projects to result in an increased number of Lane Departure Crashes and a decrease in the severity of Lane Departure crashes. The increase in Lane Departure Crashes is expected due to the placement of a fixed object (guardrail) near the travel way. The decrease in the severity of Lane Departure is expected due to the guardrail being more forgiving than the object it is protecting. The results from this project seem to be in concurrence with the above-mentioned expectations. It may be beneficial to explore the possibility of placing countermeasures such as centerline or shoulder rumble strips to prevent drivers from leaving the roadway. This may help to decrease further the substantial number of Lane Departure Crashes.

Please see the attached Treatment Site Photos for additional visual information. As the Safety Evaluation Group completes additional reviews for this type of countermeasure, we will be able to provide more objective and definite information regarding actual crash reduction factors.

**BENEFIT-COST ANALYSIS WORKSHEET**

LOCATION: SR 1004 from NC 63 to the Haywood County      BY: Brian Murphy  
 COUNTY: Buncombe      DATE: 10/29/2008  
 FILE NO.: W-4442 TOTAL CRASHES

DETAILED COST:      TYPE IMPROVEMENT -      **Shoulder Guardrail**

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$0	0	0.000	\$0
Right-of-Way	\$390,000	10	0.149	\$58,122
	\$0	0	0.000	\$0
<b>TOTALS</b>	<b>\$390,000</b>	<b>10</b>	<b>0.149</b>	<b>\$58,122</b>

ESTIMATED INCREASE IN ANNUAL MAINT. COST =	\$4,343
ESTIMATED INCREASE IN ANNUAL UTILITY COST =	\$0
TOTAL ANNUAL COST=	\$62,465
TOTAL COST OF PROJECT=	\$390,000

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	4.42	8	1.81	62	14.03	59	13.35	\$1,280,520
AFTER	4.42	3	0.68	60	13.57	59	13.35	\$672,376

Annual Benefits from Crash Cost Savings      \$608,145

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST      =      \$545,680

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST      =      9.74

TOTAL COST OF PROJECT      -      \$390,000      COMPREHENSIVE B/C RATIO      -      9.74

**BENEFIT-COST ANALYSIS WORKSHEET**

LOCATION: SR 1004 from NC 63 to the Haywood County      BY: Brian Murphy  
 COUNTY: Buncombe      DATE: 10/29/2008  
 FILE NO.: W-4442 TARGET CRASHES

DETAILED COST:      TYPE IMPROVEMENT -      **Shoulder Guardrail**

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$0	0	0.000	\$0
Right-of-Way	\$390,000	10	0.149	\$58,122
	\$0	0	0.000	\$0
<b>TOTALS</b>	<b>\$390,000</b>	<b>10</b>	<b>0.149</b>	<b>\$58,122</b>

ESTIMATED INCREASE IN ANNUAL MAINT. COST =	\$4,343
ESTIMATED INCREASE IN ANNUAL UTILITY COST =	\$0
TOTAL ANNUAL COST=	\$62,465
TOTAL COST OF PROJECT=	\$390,000

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	4.42	4	0.90	25	5.66	25	5.66	\$610,294
AFTER	4.42	2	0.45	33	7.47	23	5.20	\$403,009

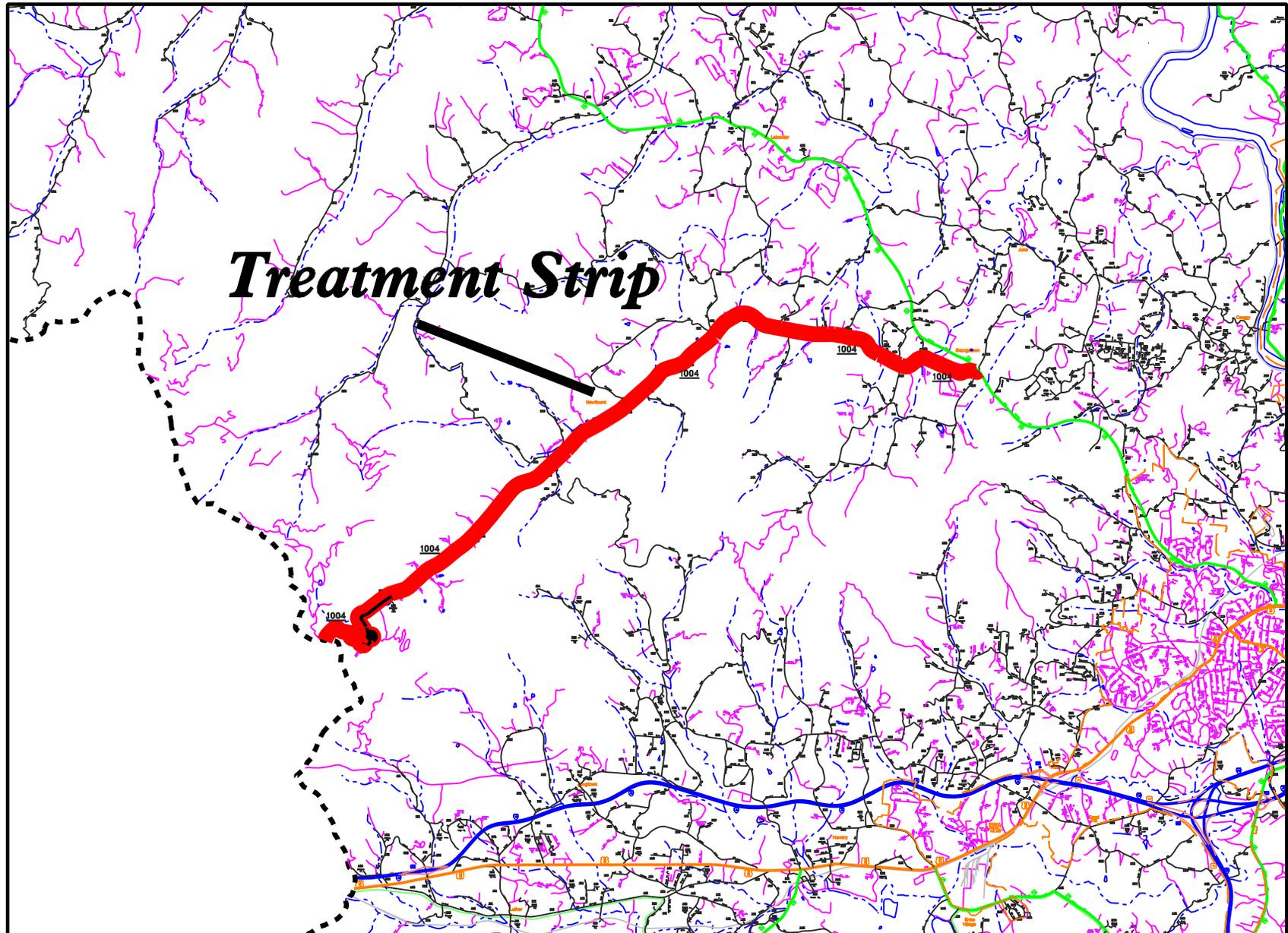
Annual Benefits from Crash Cost Savings      \$207,285

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST      =      \$144,821

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST      =      3.32

TOTAL COST OF PROJECT      -      \$390,000      COMPREHENSIVE B/C RATIO      -      3.32

# *Location Map, Buncombe County Evaluation of W-442*



*Treatment Strip: SR 1004 (Newfound) From NC 63 to the Haywood County Line*

*Treatment Site Photos (Taken on March 18, 2008)*



Traveling East on SR 1004



Traveling East on SR 1004

*Treatment Site Photos (Taken on March 18, 2008)*



Traveling East on SR 1004



Traveling East on SR 1004