Hazard Elimination Project Evaluation

Project Log # 200608059

Hazard Elimination Projects W-4400

Evaluation of Shoulder Guardrail Installation on NC 81 (Swannanoa River Rd)
From SR 3214 (Biltmore Ave) to US 70
Buncombe County

Documents Prepared By:

Safety Evaluation Group
Traffic Safety Systems Management Section
Traffic Engineering and Safety Systems Branch
North Carolina Department of Transportation

Principal Investigator

_____ 7/25/2008
Brad Robinson Date

Traffic Safety Project Engineer

Hazard Elimination Project Evaluation Documentation

Subject Location

Evaluation of Hazard Elimination Project W-4400 – Installation of shoulder guardrail on NC 81 (Swannanoa River Rd) from SR 3214 (Biltmore Ave) to US 70 in Buncombe County.

Project Information and Background from the Project File Folder

The safety countermeasure chosen for the subject location was the installation of approximately 12,255 linear feet of shoulder guardrail and replacing 2,280 linear feet of existing nonstandard guardrail.

NC 81 (Swannanoa River Rd) is a two lane highway with 11 to 12 foot lanes and an average shoulder width of 4 feet. The Swannanoa River runs adjacent to NC 81 along much of the roadway.

The initial crash analysis for this location was completed from August 1, 1996 through July 31, 1999 with a total of 163 reported crashes, including 16 Ran Off Road Crashes. The Ran Off Road Crashes included two Fatal Crashes and 12 other Injury Crashes. The guardrail was installed to reduce the severity of the pattern of Ran Off Road Crashes. The Benefit-Cost ratio was calculated to be 77.05. The project was completed on August 31, 2001 with a total cost of $235,000.00

Naïve Before and After Analysis

After reviewing the hazard elimination 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 was from May 1, 2001 through October 31, 2001. The before period consisted of reported crashes from August 1, 1995 through April 30, 2001 (5 Years, 9 Months) and the after period consisted of reported crashes from November 1, 2001 through July 31, 2007 (5 Years, 9 Months). The ending date for this analysis was determined by the available after period crash data.

The treatment data consisted of all crashes on NC 81 from 150’ east of Bryson St (MP 0.5) to 150’ east of Azalea (MP 3.69) 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 (+)**
Total Crashes	193	170	-11.9
Total Severity Index	7.25	4.98	-31.3
Total Target Crashes	85	43	-49.4
Target Severity Index	8.42	6.55	-22.2
Volume	10,300	12,300	19.4

Target Crash Information	**Before**	**After**	**Percent Reduction (-)/ Percent Increase (+)**
Target Crashes - Injuries			
Fatal Injury Crashes	2	1	-50.0
Non-Fatal Injury Crashes	37	22	-40.5
Total Injury Crashes	39	23	-41.0
Target Crashes - Contributing Factors			
Night Crashes	52	17	-67.3
Wet Crashes	25	6	-76.0
Target Crashes - Crash Types			
Ran Off Road	70	20	-71.4
Fixed Object	8	8	0.0
Sideswipe-Total	3	9	200.0
Head On	2	5	150.0
Overturn / Rollover	2	1	-50.0
Target Crashes – Crash Severity Summary			
Fatal Crashes	2	1	-50.0
Class A Crashes	3	0	-100.0
Class B Crashes	15	8	-46.7
Class C Crashes	19	14	-26.3
Property Damage Only Crashes	46	20	-56.5

The naïve before and after analysis at the treatment location resulted in a 12 percent decrease in Total Crashes, a 49 percent decrease in Target Crashes, and a 19 percent increase in Average Daily Traffic (ADT). Further investigation shows there was a 31 percent decrease in the Severity Index for both Total Crashes and a 22 percent decrease in the Severity Index for Target Crashes. The before period ADT year was 2000 and the after period ADT year was 2005.

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 12 percent decrease in Total Crashes and a 49 percent decrease in Target Crashes. Further investigation shows that the Total Severity Index decreased by 31 percent and the Target Severity Index decreased by 22 percent using naïve methodologies. The summary results above demonstrate that the treatment location appears to have had a decrease in both Total and Target Crashes as well as experiencing decreases in both Severity Indexes.

The calculated benefit to cost ratio for this project is 15.55 considering total crashes. The benefit to cost ratio considering only target crashes is 11.23. 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 Ran Off Road Crashes and a decrease in the severity of Ran Off Road crashes. The increase in Ran Off Road Crashes is expected due to the placement of a fixed object (guardrail) near the travel way. The decrease in the severity of Ran Off Road Crashes 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 in that the severity of Ran Off Crashes decreased by 22% although the number of Ran Off Road crashes unexpectedly decreased by almost 50 percent.

Crashes coded as Fixed Object Crashes seemed to undergo a large increase (327%), while crashes coded as Ran Off Road appeared to undergo a large decrease (67%) from the before to the after period. Although the guardrail installation helped contribute to these numbers, it should be noted that Fixed Object Crashes were re-defined for law enforcement officers in the year 2000. For example, a vehicle running off the roadway and hitting a tree or ditch might have been coded as a Ran Off Road Crash before 2000, while a similar crash in the after period might have been coded as a Fixed Object Crash after 2000.

It should also be noted that there was no crash type for "Sideswipe-Opposite Direction" on crash reports before the year 2000. For this reason, Sideswipe-Opposite Direction and Sideswipe-Same Direction Crashes were combined into the "Sideswipe-Total" category for a more appropriate before and after comparison.

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: NC 81 from SR 3214 to US 70 BY: Brad Robinson
COUNTY: Buncombe DATE: 4/18/2008
FILE NO.: W-4400

DETAILED COST: TYPE IMPROVEMENT - Shoulder Guardrail

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	$0	0	0.000	$0
	$235,000	10	0.149	$35,022
Right-of-Way	$0	0	0.000	$0
TOTALS	$235,000	10	0.149	$35,022

ESTIMATED INCREASE IN ANNUAL MAINT. COST = $2,991
ESTIMATED INCREASE IN ANNUAL UTILITY COST = $0

TOTAL ANNUAL COST= $38,013
TOTAL COST OF PROJECT= $235,000

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	5.75	8	1.39	81	14.09	104	18.09	$1,079,200
AFTER	5.75	2	0.35	71	12.35	97	16.87	$488,122

Annual Benefits from Crash Cost Savings $591,078

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = $553,065

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 15.55

TOTAL COST OF PROJECT - $235,000 COMPREHENSIVE B/C RATIO - 15.55

BENEFIT-COST ANALYSIS WORKSHEET

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COUNTY: Buncombe DATE: 4/18/2008
FILE NO.: W-4400 Taget Crashes

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BEFORE	5.75	5	0.87	34	5.91	46	8.00	$606,017
AFTER	5.75	1	0.17	22	3.83	20	3.48	$179,130

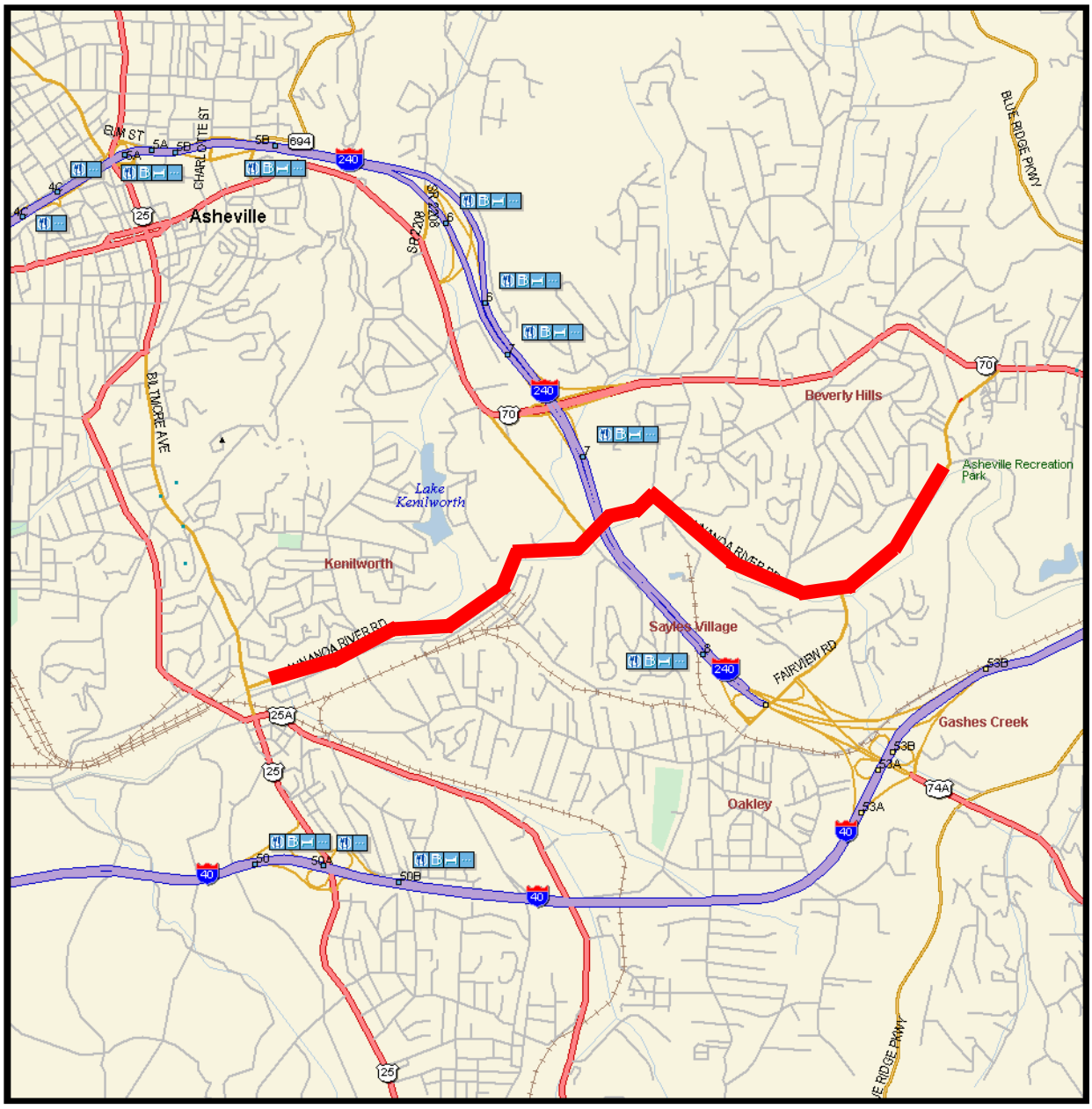
Annual Benefits from Crash Cost Savings $426,887

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = $388,874

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 11.23

TOTAL COST OF PROJECT - $235,000 COMPREHENSIVE B/C RATIO - 11.23

Location Map
Buncombe County
Evaluation of W-4400



Treatment Location: NC 81 (Swannanoa River Rd) From Bryson Rd to Azalea Rd

Treatment Site Photos Taken March 17, 2008

Traveling East on NC 81

Traveling East on NC 81

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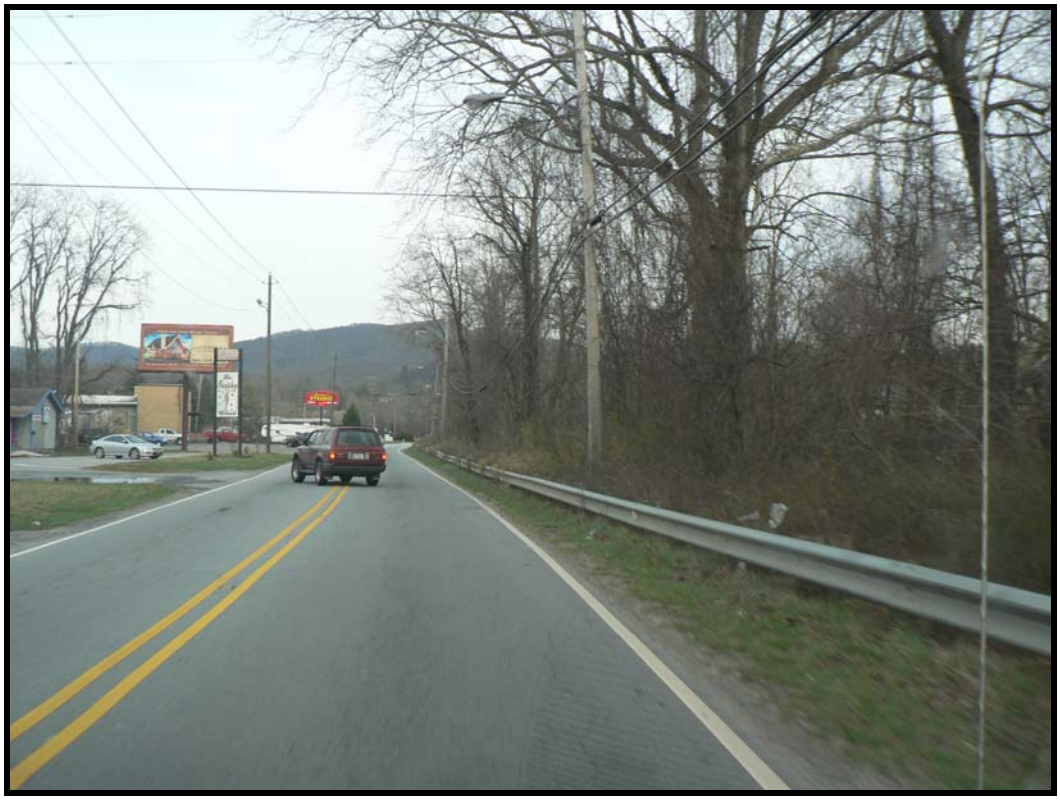
Traveling East on NC 81

Traveling East on NC 81



Traveling East on NC 81