

Hazard Elimination Project Evaluation

Project Log # 200902134

Hazard Elimination Project W-4439

Evaluation of the Friction Course Overlay & Shoulder Rumble Strips On I-85 from US 321 to NC 7 in Gaston County

Documents Prepared By:

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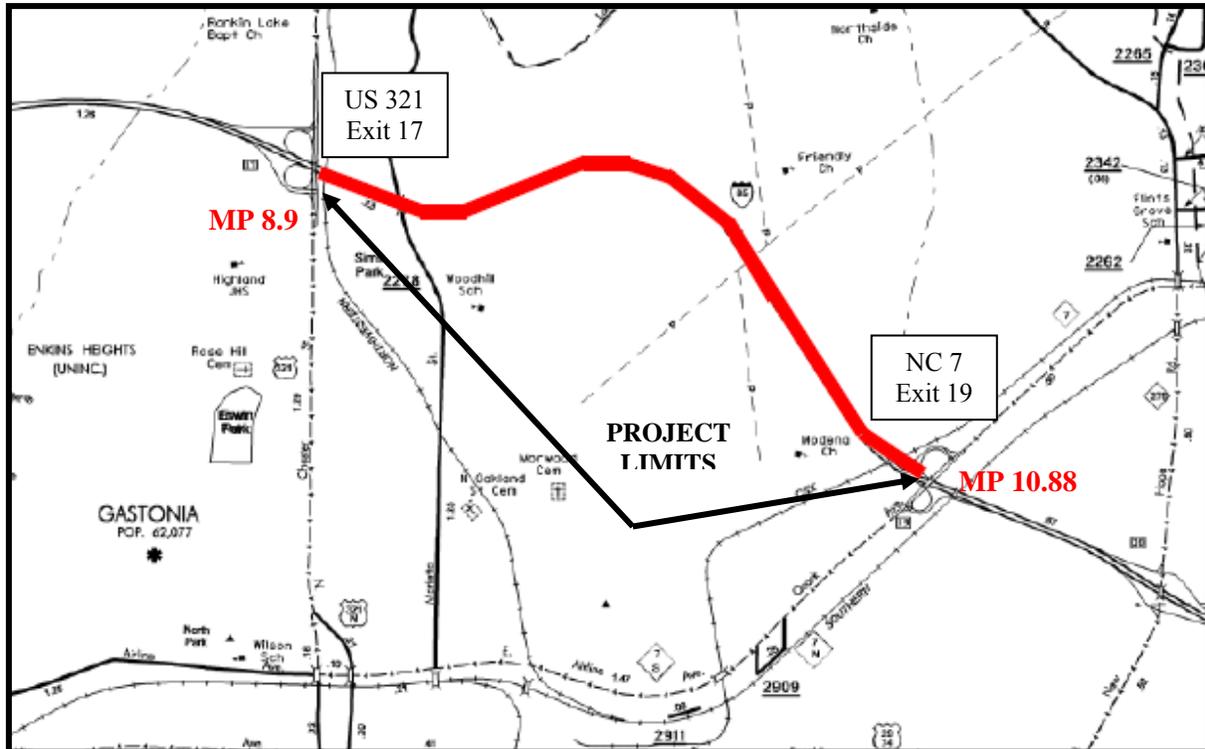
4-20-09
Date

Traffic Safety Project Engineer

Hazard Elimination Project Evaluation Documentation

Subject Location

Evaluation of Hazard Elimination Project W-4439 – On I-85 from US 321 to NC 7 in Gaston Co.



Project Information and Background from the Project File Folder

The safety countermeasures chosen for the subject location included overlaying I-85 northbound and southbound with a friction course and adding shoulder rumble strips. I-85 is a six lane divided roadway with a concrete median wall in the treatment section. The speed limit was 55 mph in the before period and 60 mph in the after period. The treatment section is located in a reverse curve.

In addition to the Hazard Elimination project improvements, drainage upgrades were made on this portion of I-85 in 2002 (completed 2/27/02) under Spot Safety Project #12-01-224. The project included some milling, resurfacing, and the installation of additional drainage boxes. The Spot Safety Project was evaluated in August 2007 as Project Log # 200611051.

The initial statement of problem was that vehicles were hydroplaning and skidding during rain storms. Due to the alignment of I-85 in this section, water would sheet across the roadway in the reverse curve during moderate to heavy rainstorms. Drivers would lose control of their vehicles on the sheeting water. The friction course was intended to eliminate the polished surface and cut down on the spray from trucks for improved visibility and sheeting effects. The drainage improvements handled under Spot Safety Project #12-01-224 were intended to eliminate the standing water.

The initial crash analysis for this strip was completed from April 1, 1997 to March 31, 2000 with a total of 191 reported crashes. According to the initial crash analysis, there were 143 Ran-Off-Road crashes (75%), 46 Rear End crashes (24%), and 2 Head On crashes (1%).

The final completion date for the Hazard Elimination project improvements at the subject location was on August 15, 2003 at a total cost of \$1,210,000.

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 (including construction of the Spot Safety and Hazard Elimination Projects) was from January 1, 2002 through December 31, 2003. The before period consisted of reported crashes from January 1, 1997 through December 31, 2001 (5 Years) and the after period consisted of reported crashes from January 1, 2004 through December 31, 2008 (5 Years). The ending date for this analysis was determined by the available crash data at the time the analysis was conducted.

The treatment data consisted of all crashes on the two-mile strip of I-85 from US 321 (Exit 17) to NC 7 (Exit 19). A 0-foot Y-line was used in the analysis and only mainline crashes were included. The before period ADT year was 1999 and the after period ADT year was 2006. The following data table depicts the Naive Before and After Analysis for the treatment location.

Target crashes include all crashes occurring under Wet conditions (including Wet, Water, Ice, Snow, and Slush Road Conditions). Lane Departure Crashes (including Ran-off Roadway, Overturn/Rollover, Fixed Object, Parked Motor Vehicle, Head On, and Sideswipe Crashes) and Rear End Crashes were also examined.

Crash Analysis Summary	Before Period	After Period	Percent Reduction (-)/ Percent Increase (+)
Total Crashes	369	291	-21.1
Severity Index	5.64	4.53	-19.7
Wet Crashes (% of Total)	230 (62%)	120 (41%)	-47.8
Severity Index	5.52	5.67	2.7
Lane Departure Crashes	277	196	-29.2
Lane Departure Crashes-Wet (% of L.D.)	185 (67%)	98 (50%)	-47.0
Rear End Crashes	77	82	6.5
Rear End Crashes-Wet (% of Rear Ends)	41 (53%)	22 (27%)	-46.3
Volume	74,000	96,000	29.7

Wet Crash Injury Summary	Before Period	After Period	Percent Reduction (-)/ Percent Increase (+)
Fatal Injury Crashes	1	3	200.0
Class A Injury Crashes	5	0	-100.0
Class B Injury Crashes	10	7	-30.0
Class C Injury Crashes	69	38	-44.9
Total Injury Crashes	85	48	-43.5

Results and Discussion

The naive before and after analysis involving the comparison of treatment actual before data versus treatment actual after data resulted in a 21 percent decrease in Total Crashes, a 48 percent decrease in Target Crashes, and a 30 percent increase in ADT. The Total Severity Index decreased by 20 percent and the Target Severity Index increased by 3 percent. The summary results above demonstrate that the treatment location appears to have had a decrease in both the number of Total Crashes and Target Crashes from the before to the after period.

The calculated benefit to cost ratio for this project is **6.66** considering total crashes. The benefit to cost ratio considering only target crashes is **4.67**. 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.

Wet Crashes by Year

It appears that the improvements were effective in reducing Wet Road Crashes along this section of I-85. Below is a breakdown of Total and Wet Crashes by year for the before and after period. The number of Wet Crashes per year shows a decreasing trend in the after period, although the yearly precipitation and the number of days with measurable precipitation have remained somewhat steady (with the exception of 2007).

Year	Total Crashes	Wet Crashes	% of Total Crashes	Days with Measurable Precipitation	% of Total Days	Total Yearly Precipitation (in)
1997	92	65	70.7	n/a	n/a	n/a
1998	82	54	65.9	n/a	n/a	n/a
1999	59	41	69.5	115	32.3	31.6
2000	62	31	50.0	n/a	n/a	n/a
2001	74	39	52.7	93	26.1	29.8
2004	103	49	47.6	128	36.0	45.1
2005	64	21	32.8	130	36.5	38.9
2006	46	17	37.0	130	36.5	41.3
2007	50	16	32.0	82	23.0	29.6
2008	28	17	60.7	132	37.1	38.7

The meteorological data was collected from Weather Underground (www.wunderground.com) for nearby Gastonia Municipal Airport. Measurable precipitation indicates at least 0.01 inches of rain or other forms of precipitation. Note that rainfall data was not available for years 1997, 1998, or 2000; therefore, all before period precipitation data is based only on 1999 and 2001 data.

Crash Frequency by Daily Precipitation

The meteorological data was also used to determine the approximate amount of daily precipitation in the study area for the years data was available. Based on this data, the calculated average daily rainfall increased by 26 percent from 0.084" in the before period to 0.106" in the after period.

The daily precipitation totals were classified into the four groups shown below:

Precipitation Level	Amount
None	0" or Trace
Slight	0.01 to 0.10"
Moderate	0.11 to 0.50"
Heavy	> 0.50"

The daily precipitation data was correlated with crash frequency and the results are summarized below. The 39 "heavy" and 73 "moderate" precipitation days during the before period averaged 0.97 and 0.44 crashes per day, respectively. In comparison the 127 "heavy" and 171 "moderate" precipitation days during the after period averaged only 0.54 and 0.27 crashes per day, respectively. This represents a 44 and 39 percent decrease in crashes on "heavy" and "moderate" rainfall days, respectively. The daily crash frequencies increased during days with "slight" precipitation and remained the same during days with no precipitation.

Crashes by Precipitation Level	Average Daily Crashes		Percent Reduction (-)/ Percent Increase (+)
	Before Period	After Period	
None	0.10	0.10	0.0
Slight	0.08	0.18	125.0
Moderate	0.44	0.27	-38.6
Heavy	0.97	0.54	-44.3

Wet Days with High Crash Frequency

In the after period, there were eight days with precipitation where at least three crashes occurred in that single day. Six of these high crash days were in 2004. Below is a summary of the weather conditions on these days. Note that in the events column, F is fog, R is rain, and T is thunderstorm.

Date	Total Crashes	Precipitation (in)	Events	Max Temp (F)	Min Temp (F)
1/27/2004	3	0.02		33	27
6/13/2004	3	0.52	R	73	64
6/14/2004	4	2.07*	F-R-T	81	70
6/23/2004	6	2.27*	F-R-T	86	69
9/17/2004	3	1.33	F-R-T	77	68
11/23/2004	3	0.25	F-R	64	60
6/9/2005	3	1.37	F-R-T	88	70
8/26/2008	3	4.45*	R-T	75	71

* 6/23/04 & 6/14/04 – Second & Third Highest Precipitation in 2004.

* 8/26/08 – Highest Precipitation in 2008.

Fatalities

Injury crashes of all types decreased for wet road crashes except for fatal crashes. There were three fatal crashes in the after period, all of which involved a lane departure under wet conditions. The fatal crash on February 6, 2004 involved a vehicle traveling northbound at a high rate of speed and running off the road, striking a sign post near NC 7. The fatal crash on June 9, 2005 appears to have occurred due to a medical condition, where a motorist blacked out, ran off the roadway, and

hit an occupied parked vehicle near MM 18. The fatal crash on November 14, 2008 involved a vehicle merging onto I-85 N from US 321, losing control, and sideswiping a truck.

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 road.

BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: I-85 Gastonia - TARGET Crashes
 COUNTY: Gaston
 FILE NO.: W-4439

BY: CLS
 DATE: 3/9/2009

DETAILED COST: TYPE IMPROVEMENT - Overlay & Rumblestrips

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction Overlay/Rumble	\$1,210,000	20	0.102	\$123,241
Right-of-Way	\$0	0	0.000	\$0
TOTALS	\$1,210,000	20	0.102	\$123,241

ESTIMATED INCREASE IN ANNUAL MAINT. COST = \$0
 ESTIMATED INCREASE IN ANNUAL UTILITY COST = \$0
 TOTAL ANNUAL COST= \$123,241
 TOTAL COST OF PROJECT= \$1,210,000

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	5.00	6	1.20	79	15.80	145	29.00	\$1,193,800
AFTER	5.00	3	0.60	45	9.00	72	14.40	\$618,480

Annual Benefits from Crash Cost Savings \$575,320

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = \$452,079
 BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 4.67

TOTAL COST OF PROJECT - \$1,210,000 COMPREHENSIVE B/C RATIO - 4.67