

# **Hazard Elimination Project Evaluation**

Project Log # 200608062/200608077

Hazard Elimination Projects W-4406/4408

**Evaluation of Shoulder Guardrail Installations, Left & Right Turn Lane Installations,  
Lengthening of Acceleration & Deceleration Lanes at Interchange Locations, and  
Drainage Structure Upgrades on US 1 from SR 2080 (Broad St) to SR 2080 (May St)  
In Southern Pines, Moore County**

Documents Prepared By:

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

**Principal Investigator**



---

Carrie L. Simpson, PE

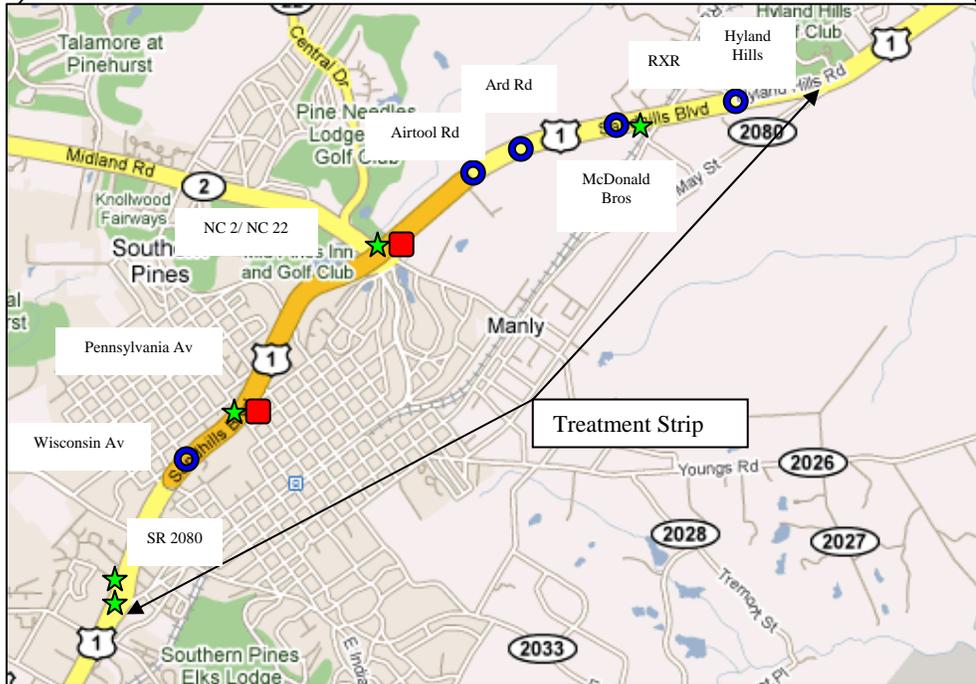
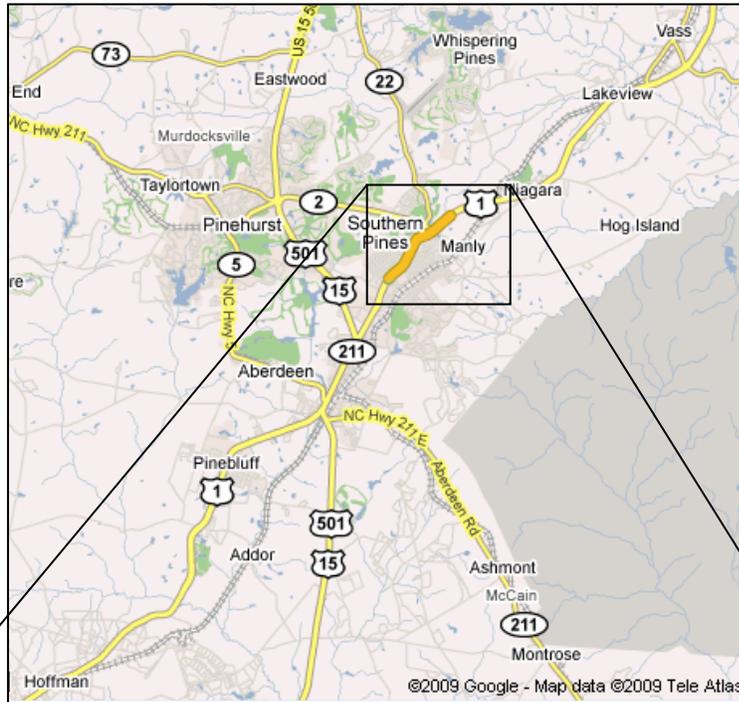
3-3-09  
Date

Traffic Safety Project Engineer

# Hazard Elimination Project Evaluation Documentation

## Subject Location

Evaluation of Hazard Elimination Projects W-4406 & W-4408 –  
On US 1 from SR 2080 (Broad St) to SR 2080 (May St), Bypass of Southern Pines in Moore Co.



Location Map (See Next Page for Treatment Descriptions)

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

Multiple safety countermeasures were chosen for the subject location under W-4406 & W-4408. They are labeled on the Location Map and include the following:

- **Construct Left and/or Right Turn Lanes on US 1 at the Following Five Locations:**
  - Northbound Left Turn Lane & Right Turn Lane at the entrance to Hyland Hills Country Club & Sandhills Assembly of God,
  - Northbound Right Turn Lane & Southbound Left Turn Lane at the entrance to McDonald Brothers Equipment Rental,
  - Southbound Left Turn Lane at SR 2089 (Ard Rd),
  - Northbound Right Turn Lane at Airtool Rd, and
  - Northbound & Southbound Right Turn Lane at Wisconsin Ave.
  
- **Extend Acceleration and Deceleration Lanes on US 1 at the Following Two Locations:**
  - At the NC 2/NC 22/Midland Rd Interchange & SR 1848 (Pennsylvania Ave) Interchange, Extend the Northbound and Southbound Acceleration Lanes at the On-Ramps and Extend the Northbound and Southbound Deceleration Lanes at the Off-Ramps.
  
- ★ **Install Steel Beam Guardrail at the Following Five Locations:**
  - On the US 1 Bridge over CSX Railroad and SR 1857 (Valley View Rd), add Guardrail Approaching and Departing the Bridge Northbound and Southbound along the Median and Outside Shoulders,
  - On the US 1 Bridge over NC 2/NC 22/Midland Rd, add Guardrail Approaching and Departing the Bridge Northbound and Southbound along the Median and Outside Shoulders,
  - On US 1 underneath the SR 1848 (Pennsylvania Ave) Bridge, add Guardrail in the Median and on the Outside Shoulders Northbound and Southbound,
  - On the US 1 Bridge over Old US 1 (SR 2080-Broad St), add Guardrail Approaching and Departing the Bridge on Northbound US 1, and
  - On Old US 1 (SR 2080-Broad St) Underneath US 1, add Guardrail along Both Sides of Broad St Southbound.

### **Convert All Drainage Structures with Concrete Covers to Drainage Structures with 2 Grate Inlets Level with the Existing Ditch Grades as Follows:**

- On US 1 from SR 2080 (South Interchange) to SR 2080 (North Intersection) in the Median and on the Left and Right Shoulders of the Northbound and Southbound Lanes.

US 1 (Southern Pines Bypass) is a four lane divided roadway with interchanges at SR 1309 (Morganton Rd), SR 1848 (Pennsylvania Ave) and NC 2/NC 22/Midland Rd. Two way ramp conditions exist at the interchanges with Morganton Rd and Midland Rd. There is one at-grade intersection (May St), four median crossovers, and one access point for southbound motorists and northbound motorists at Wisconsin Ave along this route. A grade separation exists at SR 1857 (Valley View Rd) and the CSX Railroad. A “fly-over” exists at the south end of the Bypass with Old US 1 (SR 2080-Broad St). The current speed limit is 55 mph. According to the project file, substandard designs and the lack of safety devices led to high frequencies of severe crashes.

The initial crash analysis for this location was completed from June 1, 1995 through May 31, 1999 (4 years) with a total of 124 reported crashes. There were 37 Rear-End Crashes (30%), 42 Ran Off Road Crashes (34%), 12 Angle Crashes (10%), 12 Left Turn Crashes (10%), 5 Sideswipe Crashes (4%), and 16 Miscellaneous Crashes (13%). The projected Benefit Cost Ratio for the ramp improvements and guardrail installations was 12.44:1. The projected Benefit Cost Ratio for the turn lanes and drainage structure upgrades was 20.32:1.

The projects were let in June 2001 and completed in June 2002 at an estimated combined cost of \$1.319 M.

### **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, 2001 through July 31, 2002. The before period consisted of reported crashes from August 1, 1995 through July 31, 2001 (6 Years) and the after period consisted of reported crashes from August 1, 2002 through July 31, 2008 (6 Years). The ending date for this analysis was determined by the available crash data at the time the crash analysis was completed.

The treatment data consisted of all crashes on the 5-mile strip of US 1 from 750' South of SR 2080 (Broad St) to 150' South of SR 2080 (May Rd). The crash analysis also included ramp crashes where the acceleration/deceleration lanes were extended, and crashes at the SR 2080 bridge guardrail location. Please see the *Location Map* for further detail.

The following tables depict the Naïve Before and After Analysis for the Total Crashes and Target Crashes at the treatment location. Please note that there are multiple Target Crash categories coinciding with the multiple countermeasures applied under these projects. Target Crashes include the following crash types:

**Target Crash 1. Ran Off Road Crashes on US 1 - Entire Strip**

*Countermeasure = Drainage Structure Upgrades*

**Target Crash 1A. Ran Off Road Crashes on US 1 at the Six Treatment Bridges (500' Y-line) and on SR 2080/Broad St (150' Y-line)**

*Countermeasure = Guardrail Installations*

**Target Crash 2. Left Turn, Same Roadway Crashes on US 1 at the Five Treatment Median Crossovers (150' Y-Line)**

*Countermeasure = Turn Lane Installations*

**Target Crash 3. Rear End Crashes on US 1 at the Five Treatment Median Crossovers (150' Y-Line) and at the Eight Treatment On/Off Ramp Merge Points**

*Countermeasures = Turn Lane Installations & Ramp Improvements*

**Target Crash 4. Sideswipe Crashes on US 1 at the Five Treatment Median Crossovers (150' Y-Line) and at the Eight Treatment On/Off Ramp Merge Points**

*Countermeasures = Turn Lane Installations & Ramp Improvements*

<b><u>Crash Analysis</u></b>	<b>Before</b>	<b>After</b>	<b>Percent Reduction (-)/ Percent Increase (+)</b>
Total Crashes	197	224	13.7%
Target Crashes	93	65	-30.1%
Target 1. Ran Off Road Crashes	60	52	-13.3%
Target 1A. Ran Off Road Crashes	15	12	-20.0%
Target 2. Left Turn, Same Roadway Crashes	2	2	0.0%
Target 3. Rear End Crashes	27	8	-70.4%
Target 4. Sideswipe Crashes	4	3	-25.0%

<b><u>Total Crash Information</u></b>	<b>Before</b>	<b>After</b>	<b>Percent Reduction (-)/ Percent Increase (+)</b>
<i>Total Crashes</i>			
Total Crashes	197	224	13.7%
<i>Total Crashes - Injuries</i>			
Fatal Injury Crashes	2	4	100.0%
KAB Injury Crashes	37	28	-24.3%
Injury Crashes	87	89	2.3%
Severity Index	7.74	6.08	-21.4%
<i>Total Crashes - Contributing Factors</i>			
Night Crashes	46	50	8.7%
Wet Crashes	43	50	16.3%
<i>Volume</i>			
Volume	15,400	18,200	18.2%

<b><u>Target Crash Information</u></b>	<b>Before</b>	<b>After</b>	<b>Percent Reduction (-)/ Percent Increase (+)</b>
<i>Target Crashes</i>			
Target Crashes	93	65	-30.1%
<i>Target Crashes - Injuries</i>			
Fatal Injury Crashes	2	2	0.0%
KAB Injury Crashes	19	11	-42.1%
Injury Crashes	48	32	-33.3%
Severity Index	9.23	7.80	-15.5%
<i>Target Crashes - Contributing Factors</i>			
Night Crashes	24	14	-41.7%
Wet Crashes	19	20	5.3%

The naïve before and after analysis for the treatment location resulted in a 14 percent increase in Total Crashes, a 30 percent decrease in Target Crashes, and an 18 percent increase in Average Daily Traffic (ADT). The before period ADT year was 1998 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 14 percent increase in Total Crashes and a 30 percent decrease in Target Crashes. Further investigation shows that the Severity Index of Total Crashes and Target Crashes appear to have decreased 21 and 16 percent respectively using naïve methodologies. The summary results above demonstrate that the treatment location appears to have had an increase in Total Crashes, but a decrease in Target Crashes and a decrease in the Severity Index from the before to the after period. The Average Daily Traffic (ADT) at this site has also increased by 18 percent.

Target Ran-Off-Road, Left Turn-Same Roadway, Rear End, and Sideswipe Crashes all experienced decreases or remained the same in the after period. Target Rear End Crashes at the crossovers and ramp merge points experienced the most substantial decrease in the after period, with a reduction of 70 percent (from 27 to 8 crashes). Target KAB Injury Crashes decreased by 42 percent (from 19 to 11 crashes). Also, Target Nighttime Crashes decreased by 42 percent (from 24 to 14 crashes).

The calculated benefit to cost ratio for this project is **1.96** considering Total Crashes. The benefit to cost ratio considering only Target Crashes is **2.56**. 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.

Please see the attached *Aerial Photographs* for placement of each of the turn lanes, acceleration/ deceleration lanes, and guardrail. Below is a photo of one of the drainage structures located in the median of US 1.



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: **US 1 Southern Pines - TOTAL Crashes**  
 COUNTY: **Moore**  
 FILE NO.: **W-4406/4408**

BY: **CLS**  
 DATE: **2/27/2009**

DETAILED COST: TYPE IMPROVEMENT - **Turn Lanes, Ramp Extensions, Guardrail, Drainage Structure Upgrades**

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
<b>Construction</b>				
Ramp Improv	\$421,600	20	0.102	\$42,941
Guardrail	\$273,700	15	0.117	\$31,976
Turning Lns	\$391,000	20	0.102	\$39,824
Box Convert	\$60,000	20	0.102	\$6,111
PE	\$172,700	20	0.102	\$17,590
<b>Right-of-Way</b>	\$0	0	0.000	\$0

TOTALS \$1,319,000 19 0.105 \$138,442

ESTIMATED INCREASE IN ANNUAL MAINT. COST = \$4,700  
 ESTIMATED INCREASE IN ANNUAL UTILITY COST = \$0  
 TOTAL ANNUAL COST= \$143,142  
 TOTAL COST OF PROJECT= \$1,319,000

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
<b>BEFORE</b>	6.00	10	1.67	77	12.83	110	18.33	\$1,383,667
<b>AFTER</b>	6.00	7	1.17	82	13.67	135	22.50	\$1,102,833

Annual Benefits from Crash Cost Savings \$280,833

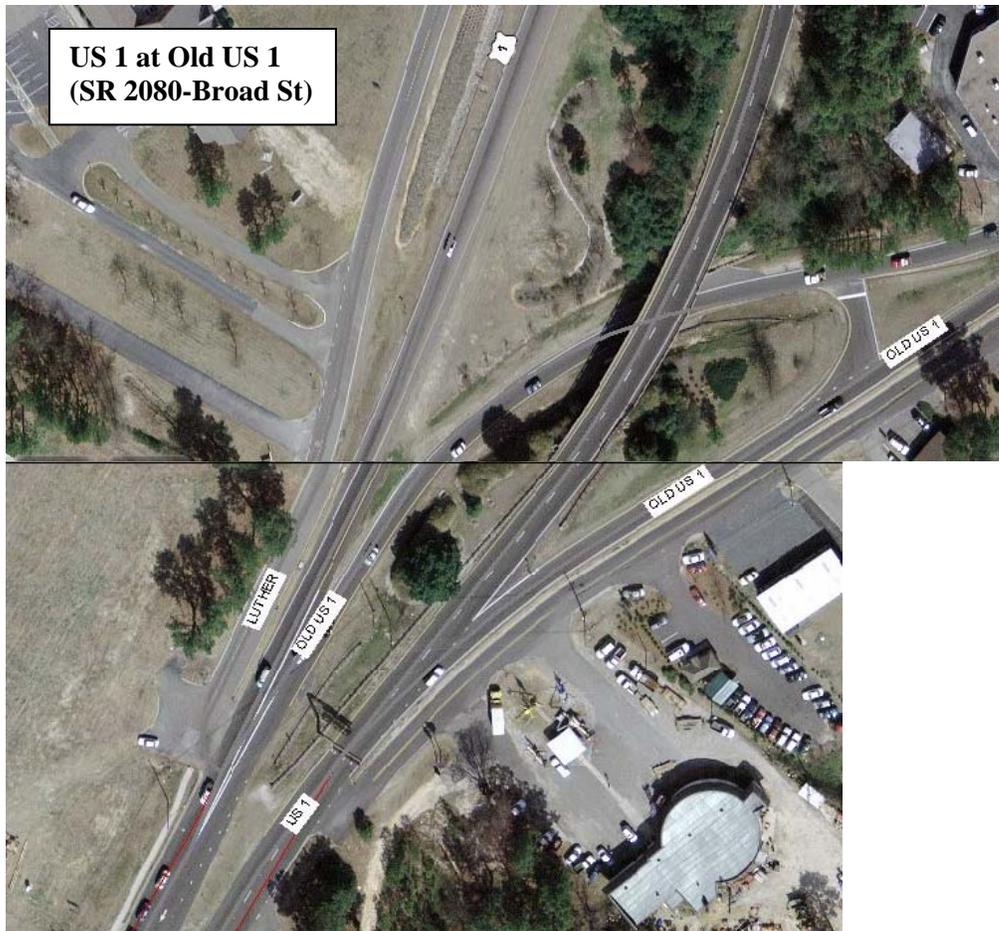
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = \$137,691

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 1.96

TOTAL COST OF PROJECT - \$1,319,000 COMPREHENSIVE B/C RATIO - 1.96



**AERIAL PHOTOGRAPHS**



On the US 1 Bridge Over Old US 1 (SR 2080-Broad St), Added Guardrail Approaching and Departing the Bridge Northbound US 1. And, On Old US 1 (SR 2080-Broad St) Underneath US 1, Added Guardrail Along Both Sides of Broad Street Southbound.



Added Northbound and Southbound Right Turn Lanes at Wisconsin Ave

**US 1 at the SR 1848 (Pennsylvania Ave) Interchange:** On US 1 Underneath the SR 1848 (Pennsylvania Ave) Bridge, Added Guardrail in the Median and on the Outside Shoulders Northbound and Southbound. Extended the Northbound and Southbound Acceleration Lanes at the On-Ramps and Extend the Northbound and Southbound Deceleration Lanes at the Off-Ramps.



**US 1 at the NC 2/ NC 22/ Midland Road Interchange:** On the US 1 Bridge Over NC 2/ NC 22/ Midland Rd, Added Guardrail Approaching and Departing the Bridge Northbound and Southbound Along the Median and Outside Shoulders. Extended the Northbound and Southbound Acceleration Lanes at the On-Ramps and Extend the Northbound and Southbound Deceleration Lanes at the Off-Ramps.





Added Northbound Right Turn Lane at Airtool Rd



Added Southbound Left Turn Lane at SR 2089 (Ard Rd)



Added Northbound Right Turn Lane and Southbound Left Turn Lane at the Entrance to McDonald Brothers Equipment Rental



Added Northbound Left and Right Turn Lanes at the entrance to Hyland Hills Country Club/ Sandhills Assembly of God

**US 1 Bridge Over CSX Railroad and SR 1857 (Valley View Rd): Added Guardrail Approaching and Departing the Bridge Northbound and Southbound Along the Median and Outside Shoulders**

