

Spot Safety Project Evaluation

Order # 41000014754

Spot Safety Project 08-06-209

**Evaluation of the Rumble Strip Installation on
US 421 from NC 49 to the Guilford County Line
Randolph County**

Documents Prepared By:

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

Principal Investigator



Brad Robinson, PE

10/4/2011

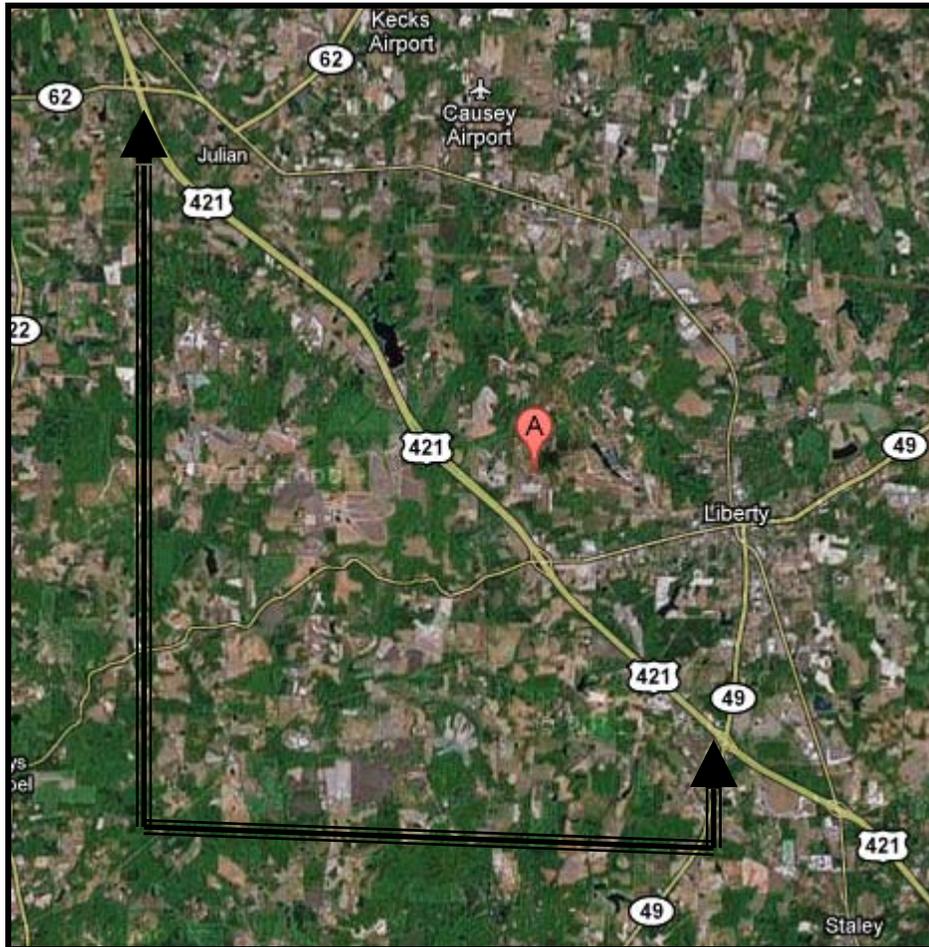
Date

Traffic Safety Project Engineer

Spot Safety Project Evaluation Documentation

Subject Location

Evaluation of Spot Safety Project Number 08-06-209 – US 421 from NC 49 to the Guilford County Line (approximately 8.5 miles) in Randolph County.



Project Information and Background from the Project File Folder

The safety countermeasure chosen for the subject location was to install milled rumble strips on both the median and the outside shoulders.

US 421 is a four-lane divided highway with a 55 mph speed limit. There had been several run-off-road crashes along this strip of US 421.

The project was completed on December 6, 2007 with a total cost of \$115,000.00.

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 November 1, 2007 through December 31, 2007. The before period consisted of reported crashes from May 1, 2004 through October 31, 2007 (3 years and 6 months) and the after period consisted of reported crashes from January 1, 2008 through June 30, 2011 (3 years and 6 months). 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 2006 and the after period ADT year was 2009.

The treatment data consisted of all mainline crashes on US 421 from just north of NC 49 to the Guilford County Line. The analysis was completed with a 0' y-line. Crashes that occurred in intersections were not counted in the analysis. Target crashes are lane departure crash types. Lane Departure crash types are considered as follows: Ran Off Road – Left, Ran Off Road – Right, Fixed Object, Head-on, Jackknife, Parked Motor Vehicle, Sideswipe – Same Direction, Sideswipe – Opposite Direction, and Overturn / Rollover.

<u>Treatment Information (8.5 Miles)</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes – Both Directions	87	76	-12.6
Total Severity Index	2.45	5.06	106.5
Lane Departure Crashes – Both Directions	59	36	-39.0
Lane Departure Severity Index	2.76	7.06	155.8
Volume	12,500	12,000	-4.0

The following tables divide the crash data by direction of travel

<u>Northbound Treatment Information</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes	41	32	-22.0
Total Severity Index	2.44	2.16	-11.5
Lane Departure Crashes	31	12	-61.3

<u>Northbound Target Crash Details</u>			
Segment Crashes – Injuries			
Fatal Injury Crashes	0	0	N/A
Non-Fatal Injury Crashes	8	5	-37.5
Property Damage Only Crashes	23	7	-69.6
Crashes - Contributing Factors			
Night Crashes	11	4	-63.6
Wet Road Crashes	15	7	-53.3
Alcohol Related	2	0	-100.0
Lane Departure Crash Types			
Fixed Object	20	9	-55.0
Head On	0	0	N/A
Jackknife	1	0	-100.0
Overturn / Rollover	4	0	-100.0
Ran Off Road (Right & Left)	0	0	N/A
Sideswipe, Same Direction	6	3	-50.0
Sideswipe, Opposite Direction	0	0	N/A

<u>Southbound Treatment Information</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes	46	44	-4.3
Total Severity Index	2.45	7.18	193.1
Lane Departure Crashes	28	24	-14.3

<u>Southbound Target Crash Details</u>			
Segment Crashes – Injuries			
Fatal Injury Crashes	0	2	N/A
Non-Fatal Injury Crashes	6	4	-33.3
Property Damage Only Crashes	22	18	-18.2
Crashes - Contributing Factors			
Night Crashes	5	10	100.0
Wet Road Crashes	6	9	50.0
Alcohol Related	0	3	N/A
Lane Departure Crash Types			
Fixed Object	21	20	-4.8
Head On	0	0	N/A
Jackknife	0	0	N/A
Overturn / Rollover	2	0	-100.0
Ran Off Road (Right & Left)	1	1	0.0
Sideswipe, Same Direction	4	2	-50.0
Sideswipe, Opposite Direction	0	1	N/A

Results and Discussion

Total Crashes decreased by 13 percent and Lane Departure Crashes decreased by 39 percent from the before to the after period. Northbound Target Crashes decreased by 61 percent and Southbound Target Crashes decreased by 14 percent.

The Target Crash Severity Index increased by 156 percent from the before to the after period. There were two fatal Target Crashes in the after period, both involving southbound vehicles. One of the crashes involved a vehicle traveling at an estimated 100 miles per hour losing control and running off the road to the left and striking several trees. The second fatal crash involved a vehicle running off the road to the left, overcorrecting, and then running off the road to the right and hitting several trees.

The calculated benefit to cost ratio is **-28.93** considering Total Crashes. The benefit to cost ratio considering only Target Crashes is **-17.90**. 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.

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 treatment.

BENEFIT-COST ANALYSIS WORKSHEET - TOTAL

LOCATION: US 421 from NC 49 to Guilford County Line		BY: bdr						
COUNTY: Randolph		DATE: 8/19/2011						
FILE NO.: SS 08-06-209								
DETAILED COST:	TYPE IMPROVEMENT - rumblestrips							
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$0	0	0.000	\$0			
		\$115,000	10	0.149	\$17,138			
	Right-of-Way	\$0	0	0.000	\$0			
	TOTALS	\$115,000	10	0.149	\$17,138			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$0			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0			
	TOTAL ANNUAL COST=				\$17,138			
	TOTAL COST OF PROJECT=				\$115,000			
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	3.50	0	0.00	17	4.86	70	20.00	\$183,143
AFTER	3.50	3	0.86	11	3.14	62	17.71	\$679,029
							Annual Benefits from Crash Cost Savings	(\$495,886)
	NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST							(\$513,024)
	BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST							-28.93
	TOTAL COST OF PROJECT	-	\$115,000		COMPREHENSIVE B/C RATIO	-		-28.93

BENEFIT-COST ANALYSIS WORKSHEET - TARGET

LOCATION: US 421 from NC 49 to Guilford County Line		BY: bdr						
COUNTY: Randolph		DATE: 8/19/2011						
FILE NO.: SS 08-06-209								
DETAILED COST:	TYPE IMPROVEMENT - rumblestrips							
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$0	0	0.000	\$0			
		\$115,000	10	0.149	\$17,138			
	Right-of-Way	\$0	0	0.000	\$0			
	TOTALS	\$115,000	10	0.149	\$17,138			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$0			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0			
	TOTAL ANNUAL COST=				\$17,138			
	TOTAL COST OF PROJECT=				\$115,000			
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	3.50	0	0.00	14	4.00	45	12.86	\$135,286
AFTER	3.50	2	0.57	9	2.57	25	7.14	\$442,143
							Annual Benefits from Crash Cost Savings	(\$306,857)
	NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST							(\$323,996)
	BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST							-17.90
	TOTAL COST OF PROJECT	-	\$115,000		COMPREHENSIVE B/C RATIO	-		-17.90

Treatment Site Photos Taken September 14, 2011



Traveling northwest on US 421



Traveling northwest on US 421

SS 08-06-209
Randolph County
US 421 From NC 49 to
Guilford County line
BEFORE Period
5/1/2004-10/31/2007

Total Crashes
Crash Severity Diagram

Study Range
Randolph County MP: 2.1-9.98
Total Length = 7.9 Miles
Crashes Right of US 421 are Northbound Crashes
Crashes Left of US 421 are Southbound Crashes

Legend

Target Crashes severity

- ★ K
- ★ A
- ★ B
- ★ C
- ★ O

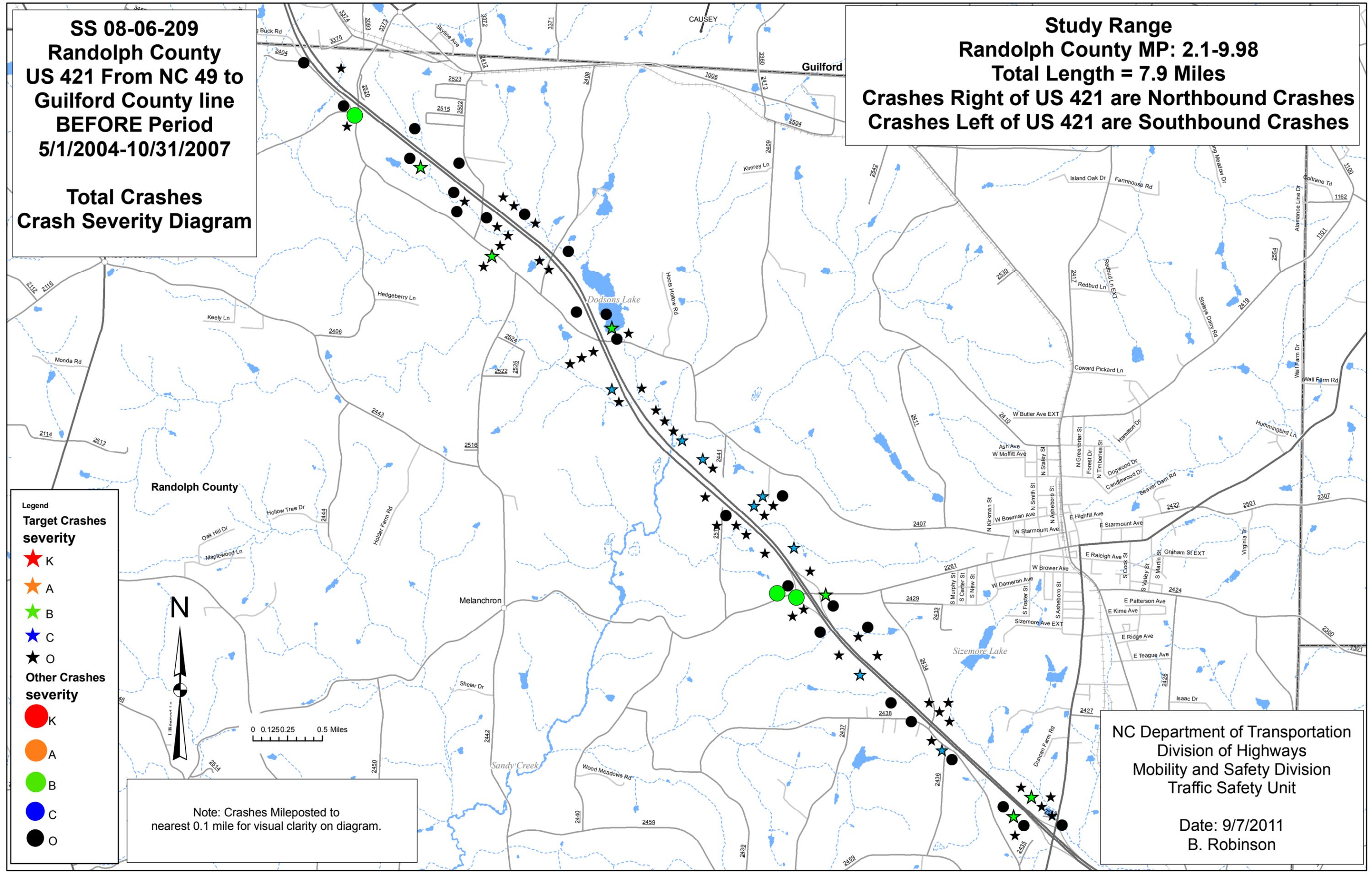
Other Crashes severity

- K
- A
- B
- C
- O



0 0.1250.25 0.5 Miles

Note: Crashes Mileposted to nearest 0.1 mile for visual clarity on diagram.



NC Department of Transportation
 Division of Highways
 Mobility and Safety Division
 Traffic Safety Unit

Date: 9/7/2011
 B. Robinson

SS 08-06-209
Randolph County
US 421 From NC 49 to
Guilford County line
AFTER Period
1/1/2008-6/30/2011

Total Crashes
Crash Severity Diagram

Study Range
Randolph County MP: 2.1-9.98
Total Length = 7.9 Miles
Crashes Right of US 421 are Northbound Crashes
Crashes Left of US 421 are Southbound Crashes

- Legend**
- Target Crashes severity**
- ★ K
 - ★ A
 - ★ B
 - ★ C
 - ★ O
- Other Crashes severity**
- K
 - A
 - B
 - C
 - O



0 0.1250.25 0.5 Miles

Note: Crashes Mileposted to nearest 0.1 mile for visual clarity on diagram.

After Period Countermeasure
Rumble Strips

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 Division of Highways
 Mobility and Safety Division
 Traffic Safety Unit

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