

# **Hazard Elimination Project Evaluation**

Order # 41000018548

Hazard Elimination Project W-4815

**Evaluation of the Rumble Strip Installation on US 1  
From 0.8 Mile South of US 1 Business, Northward to I-85  
Vance 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

6/21/2012

Date

Traffic Safety Project Engineer

# *Hazard Elimination Project Evaluation Documentation*

## **Subject Location**

US 1 from 0.8 miles south of US 1 Business, northward to I-85, a distance of approximately 8 miles. Two TIP projects were completed on this section of roadway during the analysis period for this evaluation. They are noted in the location map for your reference but are not accounted for in this evaluation.



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

The hazard elimination project improvement chosen for the subject location was the installation of rumble strips along both the inside and outside shoulders of US 1.

US 1 is a four-lane divided facility with a grass median and a speed limit of 55 mph in the subject area. Both the inside and outside shoulders have widths of four feet. The intended purpose of the improvement was to alleviate the frequency of run-off-road crashes.

The initial crash analysis was completed from July 31, 2000 to June 30, 2003 with 27 ran off road crashes. The improvement was completed on April 1, 2006 with a total cost of \$90,000. The projected B/C Ratio was 36.46.

### 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 February 1, 2006 through April 30, 2006. The before period consisted of reported crashes from May 1, 2000 through January 31, 2006 (5.76 years); and the after period consisted of reported crashes from May 1, 2006 through January 31, 2012 (5.76 years). 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 2003 and the after period ADT year was 2009.

The treatment data consisted of all mainline crashes on US 1 from 0.8 miles south of US 1 Business to I-85. The analysis was completed with a 0' y-line.

The following data tables depict the Naïve Before and After Analysis for the treatment location. Please note that lane departure crashes were the target crashes for the applied countermeasure. The lane departure crash types are considered as follows: Fixed Object, Head-On, Jackknife Overturn/Rollover, Parked Motor Vehicle, Ran-Off Roadway (Right, Left, and Straight), and Sideswipe (Same and Opposite Direction).

<b><u>Treatment Information</u></b>	<b>Before</b>	<b>After</b>	<b>Percent Reduction (-)/ Percent Increase (+)</b>
Total Crashes – Both Directions	105	95	-9.5
Total Severity Index	3.91	5.11	30.7
Lane Departure Crashes – Both Directions	69	46	-33.3
Lane Departure Severity Index	4.78	5.70	19.2
Volume (2003, 2009)	9,900	9,000	-9.1
Total Crash Rate (100 Million Vehicle Miles)	60.93	61.06	0.2

<b><u>US 1 Target Crashes Both Directions</u></b>	<b>Before</b>	<b>After</b>	<b>Percent Reduction (-)/ Percent Increase (+)</b>
<b>Injury Crashes</b>			
Fatal Injury Crashes	1	0	-100.0
Class-A Injury Crashes	0	1	N/A
Class-B Injury Crashes	7	6	-14.3
Class-C Injury Crashes	18	13	-27.8
Property Damage Only Crashes	43	26	-39.5

<b>Contributing Factors</b>			
Night Crashes	35	19	-45.7
Wet Road Crashes	4	5	25.0
Alcohol Related	3	4	33.3
<b>Lane Departure Crash Types</b>			
Fixed Object	45	32	-28.9
Jackknife	0	1	N/A
Overtum / Rollover	7	4	-42.9
Ran Off Road	10	3	-70.0
Sideswipe, Same Direction	7	6	-14.3

<b><u>US 1 Northbound Only</u></b>	<b>Before</b>	<b>After</b>	<b>Percent Reduction (-)/ Percent Increase (+)</b>
NB Total Crashes	52	54	3.8
NB Total Severity Index	3.56	3.91	9.8
NB Lane Departure Crashes	32	29	-9.4
NB Lane Departure Severity Index	4.01	6.17	53.9

<b><u>US 1 Southbound Only</u></b>	<b>Before</b>	<b>After</b>	<b>Percent Reduction (-)/ Percent Increase (+)</b>
SB Total Crashes	53	41	-22.6
SB Total Severity Index	4.25	6.68	57.2
SB Lane Departure Crashes	37	17	-54.1
SB Lane Departure Severity Index	5.45	4.92	-9.7

## **Results and Discussion**

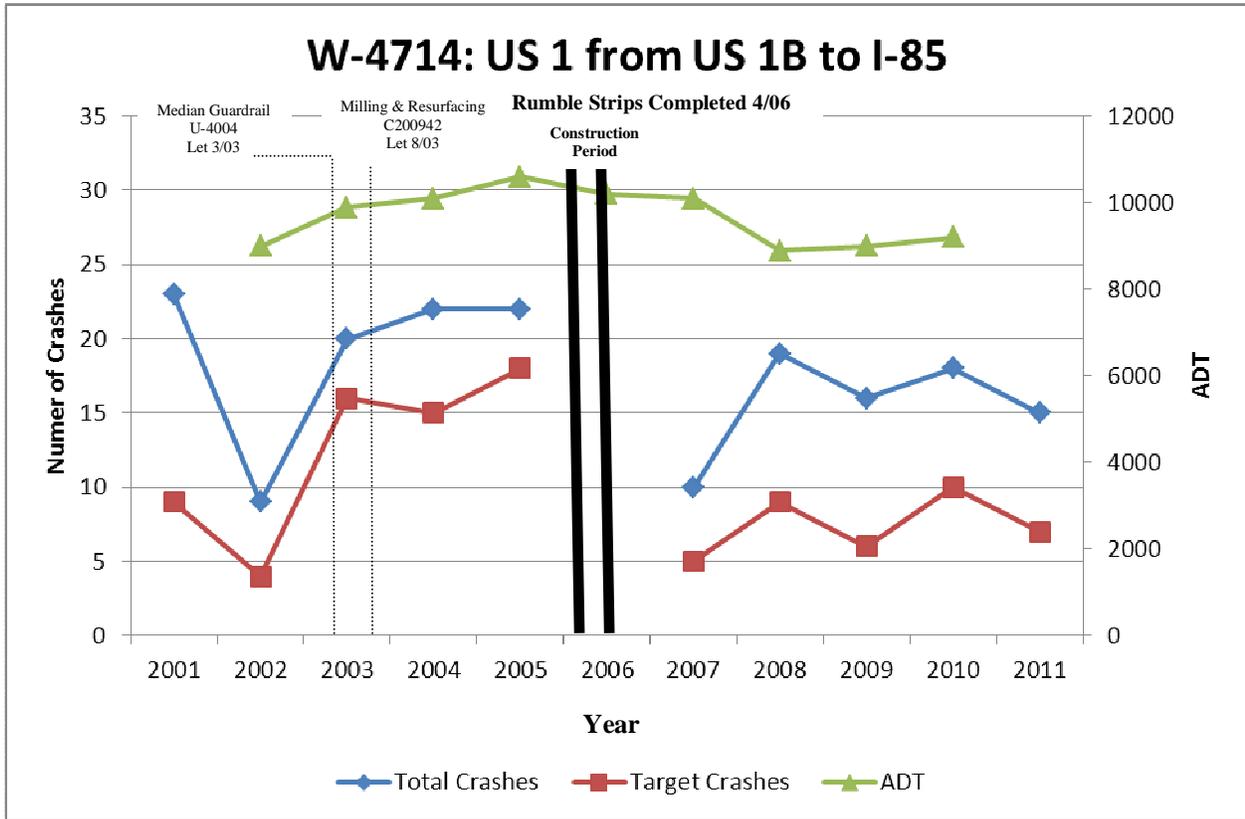
Using naïve before and after analysis, Total Crashes have decreased by 10 percent and Target Crashes have decreased by 33 percent in the subject area. Looking at the crashes by direction, the northbound lanes experienced a 9 percent decrease in Target Crashes and the southbound lanes experienced a 54 percent decrease in Target Crashes.

The rumble strip installation appears to have been effective at reducing lane departure crash types at the subject location. In addition to the decreases in overall Target Crashes, those that occurred at night decreased by 46 percent.

The calculated benefit to cost ratio for the project is **-13.81** considering Total Crashes. The benefit to cost ratio considering only Target Crashes is **2.50**. 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 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.

The following chart depicts the crash trends along this segment of US 1. The number of Total and Target Crashes per year are plotted in the before and after periods, along with the ADT. The dates of known projects that may have influenced crashes are noted.



**BENEFIT-COST ANALYSIS WORKSHEET - TOTAL**

LOCATION: US 1 From US 1B to I-85		BY: bdr							
COUNTY: Vance		DATE: 5/2/2012							
FILE NO.: W-4815									
DETAILED COST:	TYPE IMPROVEMENT - Rumble Strips								
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST				
	Construction	\$0	0	0.000	\$0				
		\$90,000	10	0.149	\$13,413				
	Right-of-Way	\$0	0	0.000	\$0				
	TOTALS	\$90,000	10	0.149	\$13,413				
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$0				
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0				
	TOTAL ANNUAL COST=				\$13,413				
	TOTAL COST OF PROJECT=				\$90,000				
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	5.76	1	0.17	31	5.38	73	12.67	\$271,510	
AFTER	5.76	3	0.52	22	3.82	70	12.15	\$456,771	
							Annual Benefits from Crash Cost Savings	(\$185,260)	
	NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST				=	(\$198,673)			
	BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST				=	-13.81			
	TOTAL COST OF PROJECT	-	\$90,000	COMPREHENSIVE B/C RATIO	-	-13.81			

**BENEFIT-COST ANALYSIS WORKSHEET - TARGET**

LOCATION: US 1 From US 1B to I-85		BY: bdr							
COUNTY: Vance		DATE: 5/2/2012							
FILE NO.: W-4815									
DETAILED COST:	TYPE IMPROVEMENT - Rumble Strips								
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST				
	Construction	\$0	0	0.000	\$0				
		\$90,000	10	0.149	\$13,413				
	Right-of-Way	\$0	0	0.000	\$0				
	TOTALS	\$90,000	10	0.149	\$13,413				
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$0				
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0				
	TOTAL ANNUAL COST=				\$13,413				
	TOTAL COST OF PROJECT=				\$90,000				
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	5.76	1	0.17	25	4.34	43	7.47	\$228,281	
AFTER	5.76	1	0.17	19	3.30	26	4.51	\$194,757	
							Annual Benefits from Crash Cost Savings	\$33,524	
	NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST				=	\$20,112			
	BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST				=	2.50			
	TOTAL COST OF PROJECT	-	\$90,000	COMPREHENSIVE B/C RATIO	-	2.50			

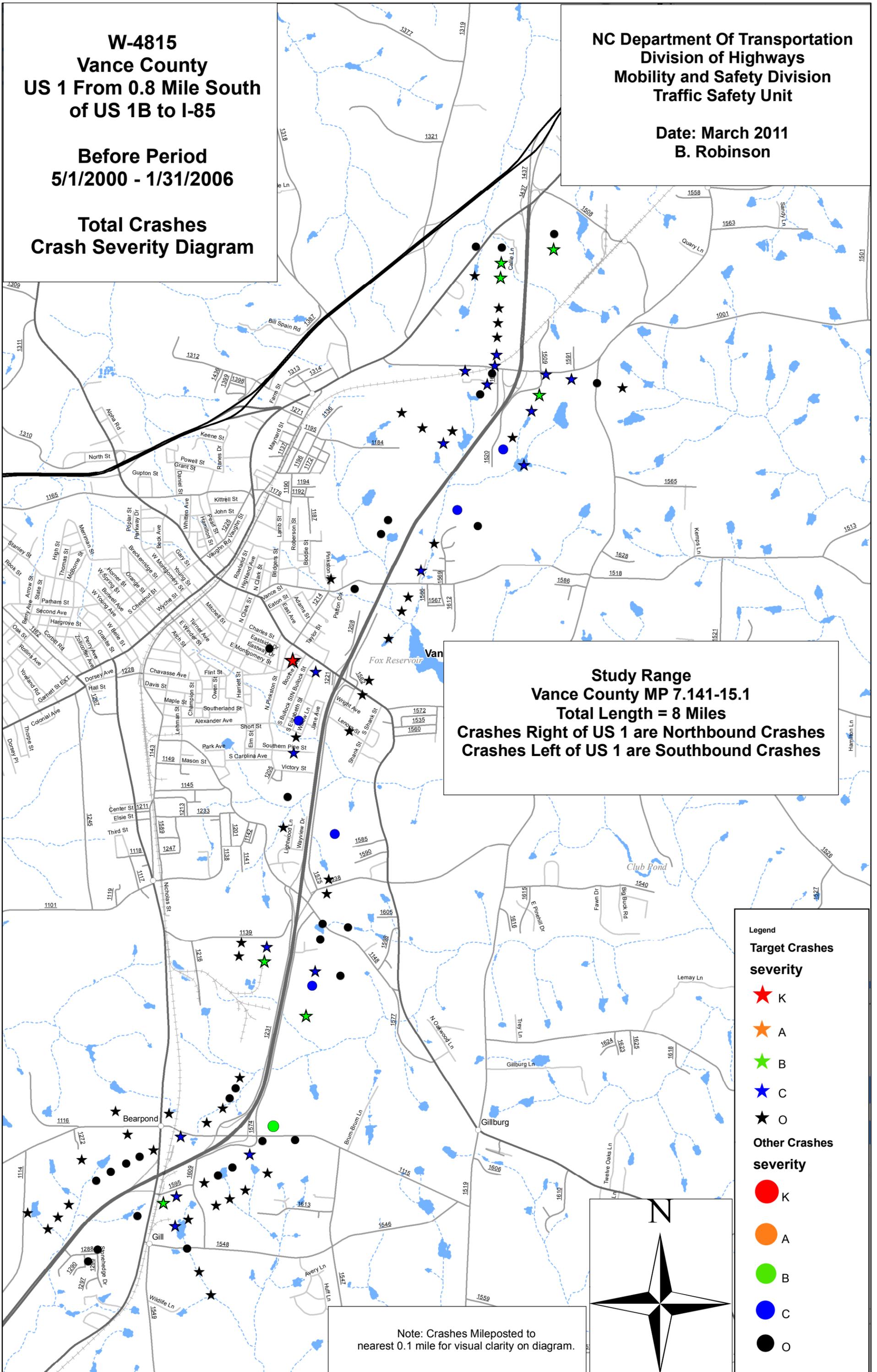
**W-4815  
Vance County  
US 1 From 0.8 Mile South  
of US 1B to I-85**

**Before Period  
5/1/2000 - 1/31/2006**

**Total Crashes  
Crash Severity Diagram**

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

**Date: March 2011  
B. Robinson**



**Study Range  
Vance County MP 7.141-15.1  
Total Length = 8 Miles  
Crashes Right of US 1 are Northbound Crashes  
Crashes Left of US 1 are Southbound Crashes**

**Legend**

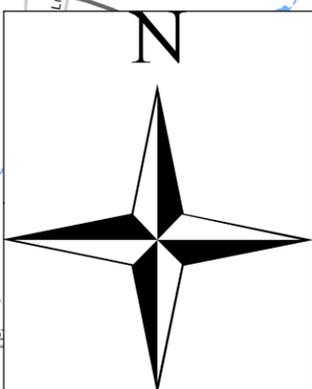
**Target Crashes severity**

- ★ K
- ★ A
- ★ B
- ★ C
- ★ O

**Other Crashes severity**

- K
- A
- B
- C
- O

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



**W-4815  
Vance County  
US 1 From 0.8 Mile South  
of US 1B to I-85**

**After Period  
5/1/2006-1/31/2012**

**Total Crashes  
Crash Severity Diagram**

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

**Date: March 2011  
B. Robinson**

**After Period Countermeasure  
Rumble Strips**

**Study Range  
Vance County MP 7.141-15.1  
Total Length = 8 Miles  
Crashes Right of US 1 are Northbound Crashes  
Crashes Left of US 1 are Southbound Crashes**

**Legend**

**Target Crashes  
severity**

- ★ K
- ★ A
- ★ B
- ★ C
- ★ O

**Other Crashes  
severity**

- K
- A
- B
- C
- O



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

