

# Hazard Elimination Project Evaluation

Project Log # 200608070

Hazard Elimination Project W-4003

**Evaluation of the Intersection Realignment and Traffic Signal Installation at the Intersection of NC 42 / NC 58 (Ward Blvd) and SR 1356 (Raleigh Rd) in Wilson, Wilson County**

Documents Prepared By:

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

**Principal Investigator**



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Carrie L. Simpson, PE

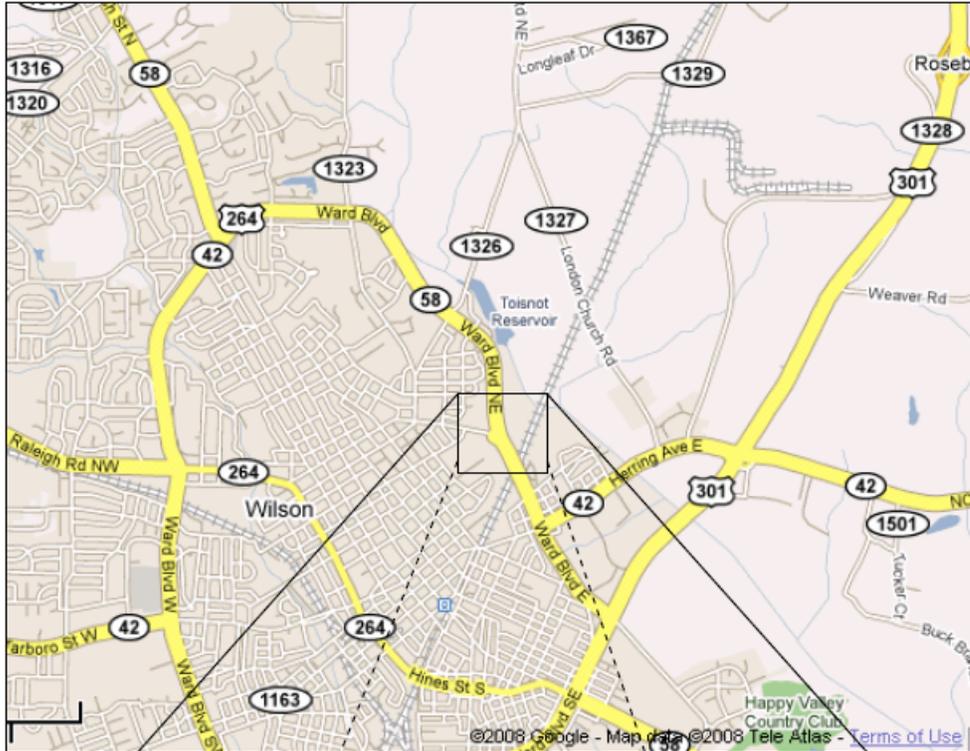
2/2/2009  
Date

Traffic Safety Project Engineer

# Hazard Elimination Project Evaluation Documentation

## SUBJECT LOCATION

Intersection of NC 42 / NC 58 (Ward Blvd) at SR 1356 (Raleigh Rd) in Wilson.  
See Location Map below.



Location Map

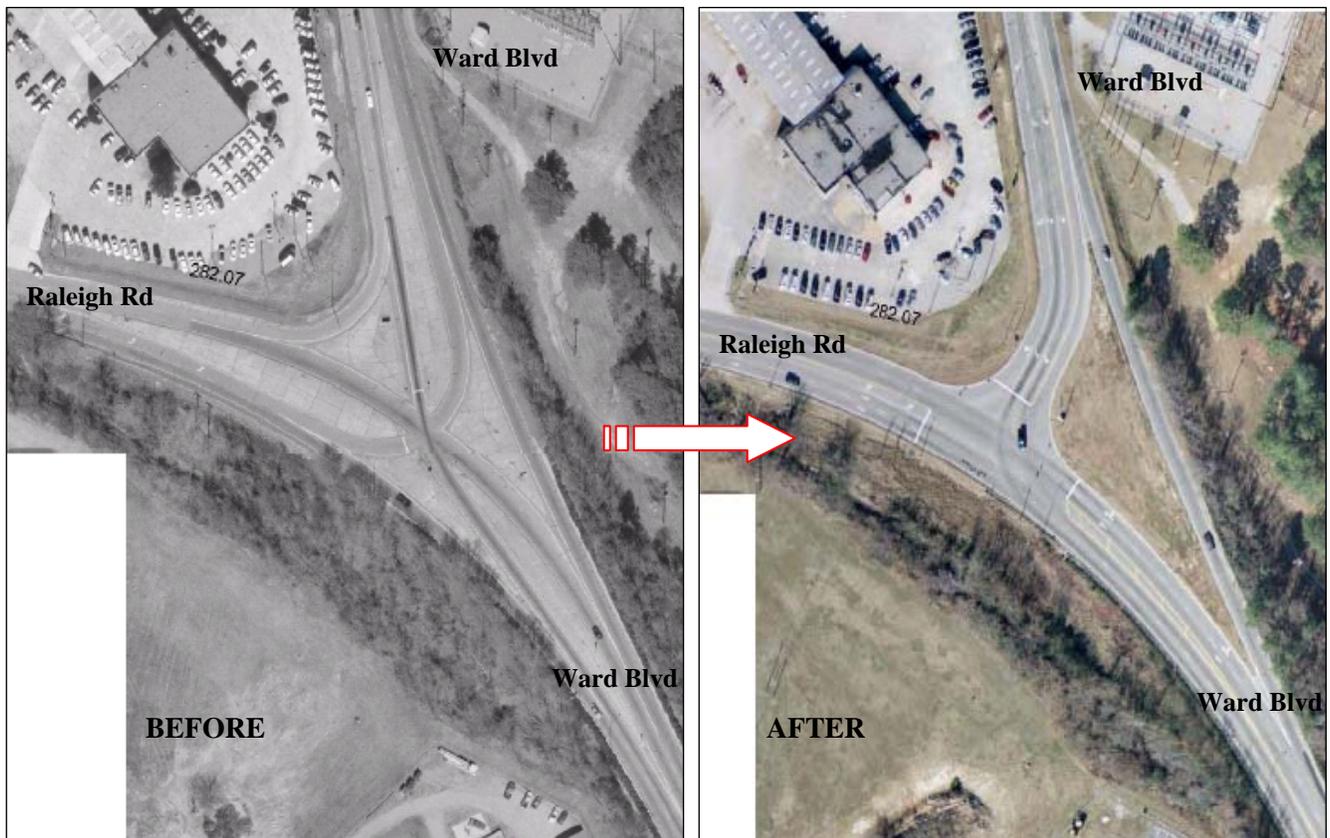
## PROJECT INFORMATION

The safety countermeasures chosen for the subject location were to redesign the intersection of NC 42 / NC 58 (Ward Blvd) and SR 1356 (Raleigh Rd) to provide:

- Two eastbound through lanes on Ward Blvd,
- Two lanes from Ward Blvd westbound to Raleigh Rd,
- One left turn lane from Raleigh Rd to westbound Ward Blvd,
- Two right turn lanes from Raleigh Rd to eastbound Ward Blvd. and
- Retain the free-flow right turn movement on westbound Ward Blvd.

Also, the project included the installation of a three phase fully actuated traffic signal (**signal inventory no. 04-0661**).

NC 42 / NC 58 (Ward Blvd) and SR 1356 (Raleigh Rd) are both 52' curb and gutter sections with a 45 mph posted speed limit. Prior to realignment, traffic on westbound Ward Blvd was allowed to free-flow with one lane on Ward Blvd and one lane onto Raleigh Rd. Eastbound traffic on Ward Blvd was required to stop for westbound traffic on Raleigh Rd. Eastbound Ward Blvd onto Raleigh Rd was a free-flow right turn. Right turning eastbound traffic on Raleigh Rd was allowed to free-flow onto Ward Blvd. The left turn on Raleigh Rd was controlled by a stop sign.



**Before and After Aerial Photographs**

The initial crash analysis for this location was completed from November 1, 1994 through October 31, 1997. Four crash patterns were identified. Of the 98 Total Crashes, there were 33 Angle Crashes (34%), 32 Rear End Crashes (33%), 11 Left Turn Crashes (11%), and 22 “Random” Crashes (22%).

According to the Project Report, crashes were occurring because of congestion and insufficient gaps for turning traffic. Angle Crashes occurred when eastbound motorists on Ward Blvd accepted a gap that was too short to continue traveling on Ward Blvd. The traffic signal installation was intended to reduce this crash pattern. Rear End Crashes occurred due to “false starts” from those attempting to enter the traffic stream and then having to stop suddenly, or due to vehicles that did enter the traffic stream safely but did not accelerate quickly enough. The realignment and traffic signal were intended to reduce this crash pattern. Left Turn Crashes resulted from motorists trying to turn left but choosing an insufficient gap in oncoming traffic to turn. Random Crashes occurred for a variety of reasons. The realignment and traffic signal were intended to reduce these crashes by acting as a calming device to motorists.

The final completion date for the improvement at the subject intersection was on September 1, 2002 with a total cost of \$467,500.

#### **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 January 1, 2002 through October 31, 2002. The before period consisted of reported crashes from January 1, 1996 through December 31, 2001 (6 years) and the after period consisted of reported crashes from November 1, 2002 through October 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 within 500 feet of the intersection of NC 42 / NC 58 (Ward Blvd) and SR 1356 (Raleigh Rd). The extended y-line was used to include the entire length affected by the intersection realignment.

The following tables depict the Naïve Before and After Analysis for the Total Crashes and Target Crashes at the treatment location. Please note that the Target Crashes for the applied countermeasure include three crash types:

- Target Crash 1. Angle Crashes Involving Eastbound Vehicles on Ward Blvd
- Target Crash 2. Left-Turn Crashes Involving Vehicles from Raleigh Rd, and
- Target Crash 3. Rear End Crashes Approaching Intersection.

Target Crashes 1, 2, and 3 are denoted on the Collision Diagrams by Red, Blue, and Green, respectively.

<b>Table 1a.</b>			
<b>Total Treatment Information</b>	<b>Before</b>	<b>After</b>	<b>Percent Reduction (-)/ Percent Increase (+)</b>
Total Crashes	78	59	-24.4%
Total Severity Index	4.61	2.63	-43.0%
Target Angle Crashes	40	2	-95.0%
Target Angle Severity Index	6.36	8.40	32.1%
Target Left-Turn Crashes	15	9	-40.0%
Target Left-Turn Severity Index	2.48	5.11	106.0%
Target Rear End Crashes	4	5	25.0%
Target Rear End Severity Index	1.00	2.48	148.0%
Volume	17,700	17,700	0.0%

<b>Table 1b.</b>			
<b>Total Crash Information</b>	<b>Before</b>	<b>After</b>	<b>Percent Reduction (-)/ Percent Increase (+)</b>
Fatal Injury Crashes	0	0	N/A
Non-Fatal Injury Crashes	38	13	-65.8%
Total Injury Crashes	38	13	-65.8%
Night Crashes	17	16	-5.9%
Wet Crashes	19	28	47.4%

The naïve before and after analysis for the treatment location resulted in a 24 percent decrease in Total Crashes, a 95 percent decrease in Target Angle Crashes, a 40 percent decrease in Target Left-Turn Crashes, a 25 percent increase in Target Rear End Crashes, and no change in Average Daily Traffic (ADT). The before period ADT year was 1998 and the after period ADT year was 2005.

## RESULTS AND DISCUSSION

Using naïve before and after analysis methodologies, it appears the intersection realignment and traffic signal installation has been effective at reducing both Total and Target Frontal Impact Crashes at this location. The number of Total Crashes decreased by 24 percent, while the number of Target Angle Crashes and Target Left-Turn Crashes decreased by 95 percent and 40 percent, respectively. The Total Severity Index also decreased by 43 percent, which may be attributed to the decrease in Target Frontal Impact Crashes.

Although the number of Target Angle and Left-Turn Crashes decreased, the Severity Indexes associated with these crash types increased by 32 percent and 106 percent, respectively. The intersection also experienced increases in several crash types, including a 25 percent increase in Target Rear End Crashes (from four to five crashes) with a 148 percent increase in Severity Index for Target Rear End Crashes.

An area of particular concern is the 47 percent increase in Wet Crashes and the associated pattern of Sideswipe and Ran-Off-Road Crashes that developed in the After Period. In the After Period, there were 16 Sideswipe, Same Direction Crashes and 16 Ran-Off Road / Fixed Object Crashes involving vehicles turning left from eastbound Ward Blvd, 75 percent of which occurred under Wet conditions.

The pattern of Left Turn-Same Roadway Crashes involving left turning vehicles from Raleigh Rd is a pattern that has decreased but still remains in the After Period. There were nine Left Turn-Same Roadway Crashes in the after period. Raleigh Rd currently has a Permitted Left-Turn Signal.

Please see the *Collision Diagrams* and *Location Photos* for more information.

The calculated benefit to cost ratio for this project is **1.49** considering Total Crashes. The benefit to cost ratio considering only Target Crashes is **1.76**. 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 and utility costs.

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.

W-4003 Location Photos (Taken December 30, 2008)



W-4003 Location Photos (Taken December 30, 2008)



W-4003 Location Photos (Taken December 30, 2008)



**BENEFIT-COST ANALYSIS WORKSHEET**

LOCATION: **Ward at Raleigh - TOTAL CRASHES**  
 COUNTY: **Wilson**  
 FILE NO.: **W-4003**

BY: **CLS**  
 DATE: **1/6/2009**

DETAILED COST:           TYPE IMPROVEMENT -           **Intersection Realignment and Signal Installation**

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
<b>Construction</b>	<b>\$418,000</b>	<b>20</b>	<b>0.102</b>	<b>\$42,574</b>
	<b>\$49,500</b>	<b>10</b>	<b>0.149</b>	<b>\$7,377</b>
<b>Right-of-Way</b>	<b>\$0</b>	<b>0</b>	<b>0.000</b>	<b>\$0</b>
<b>TOTALS</b>	<b>\$467,500</b>	<b>18</b>	<b>0.107</b>	<b>\$49,951</b>

ESTIMATED INCREASE IN ANNUAL MAINT. COST =           **\$2,200**  
 ESTIMATED INCREASE IN ANNUAL UTILITY COST =           **\$900**  
 TOTAL ANNUAL COST=           **\$53,051**  
 TOTAL COST OF PROJECT=           **\$467,500**

COMPREHENSIVE COST REDUCTION:

ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES

TIME PERIOD	YEARS	ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES				PDO		ANNUAL COSTS
		K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	CRASHES	CRASHES PER YR	
<b>BEFORE</b>	<b>6.00</b>	<b>0</b>	<b>0.00</b>	<b>38</b>	<b>6.33</b>	<b>40</b>	<b>6.67</b>	<b>\$154,667</b>
<b>AFTER</b>	<b>6.00</b>	<b>0</b>	<b>0.00</b>	<b>13</b>	<b>2.17</b>	<b>46</b>	<b>7.67</b>	<b>\$75,533</b>

Annual Benefits from Crash Cost Savings           **\$79,133**

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST           =           **\$26,082**  
 BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST           =           **1.49**

TOTAL COST OF PROJECT           -           **\$467,500**           COMPREHENSIVE B/C RATIO           -           **1.49**



NC 42 / NC 58 (Ward Blvd) at SR 1356 (Raleigh Rd) in Wilson, Wilson County

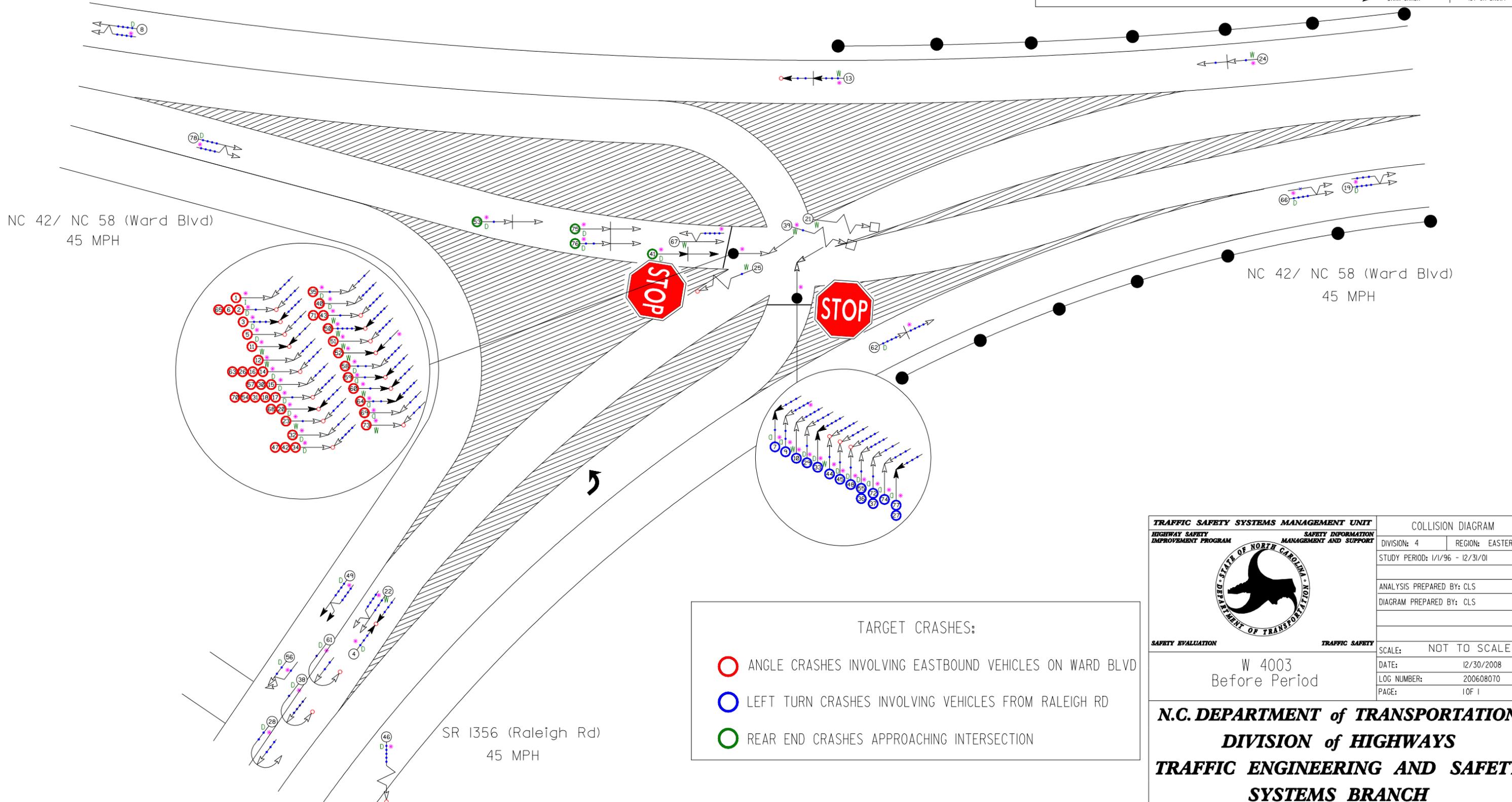
January 1, 1996 - December 31, 2001

(6 YRS)

Before Period - Total Crashes

**LEGEND**

	MOVING VEHICLE		ANGLE		9 MPH OR LESS		P PEDESTRIAN
	PEDESTRIAN		TURNING		10 MPH TO 19		B BICYCLE
	PARKED VEHICLE		BACKING		20 MPH TO 29		T TRAIN
	PARKING VEHICLE		SIDESWIPE		30 MPH TO 39		A ANIMAL
	FIXED OBJECT		OUT OF CONTROL		40 MPH TO 49		VEHICLE FIRE
	HEAD ON		INJURY		50 MPH TO 59		* DRIVER AT FAULT
	REAR END		FATALITY		60 MPH TO 69		D DRY
	RAN OFF ROAD		DAYLIGHT CRASH		70 AND UP		W WET
			DARK CRASH		SPEED UNKNOWN		I ICY OR SNOWY



**TARGET CRASHES:**

- ANGLE CRASHES INVOLVING EASTBOUND VEHICLES ON WARD BLVD
- LEFT TURN CRASHES INVOLVING VEHICLES FROM RALEIGH RD
- REAR END CRASHES APPROACHING INTERSECTION

<b>TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT</b>		COLLISION DIAGRAM	
<b>HIGHWAY SAFETY IMPROVEMENT PROGRAM</b>		DIVISION: 4	REGION: EASTERN
		STUDY PERIOD: 1/1/96 - 12/31/01	
<b>SAFETY EVALUATION</b>		ANALYSIS PREPARED BY: CLS	
<b>TRAFFIC SAFETY</b>		DIAGRAM PREPARED BY: CLS	
W 4003 Before Period		SCALE: NOT TO SCALE	
		DATE: 12/30/2008	
		LOG NUMBER: 200608070	
		PAGE: 1 OF 1	
<b>N.C. DEPARTMENT of TRANSPORTATION</b>			
<b>DIVISION of HIGHWAYS</b>			
<b>TRAFFIC ENGINEERING AND SAFETY</b>			
<b>SYSTEMS BRANCH</b>			

NC 42 / NC 58 (Ward Blvd) at SR 1356 (Raleigh Rd) in Wilson, Wilson County

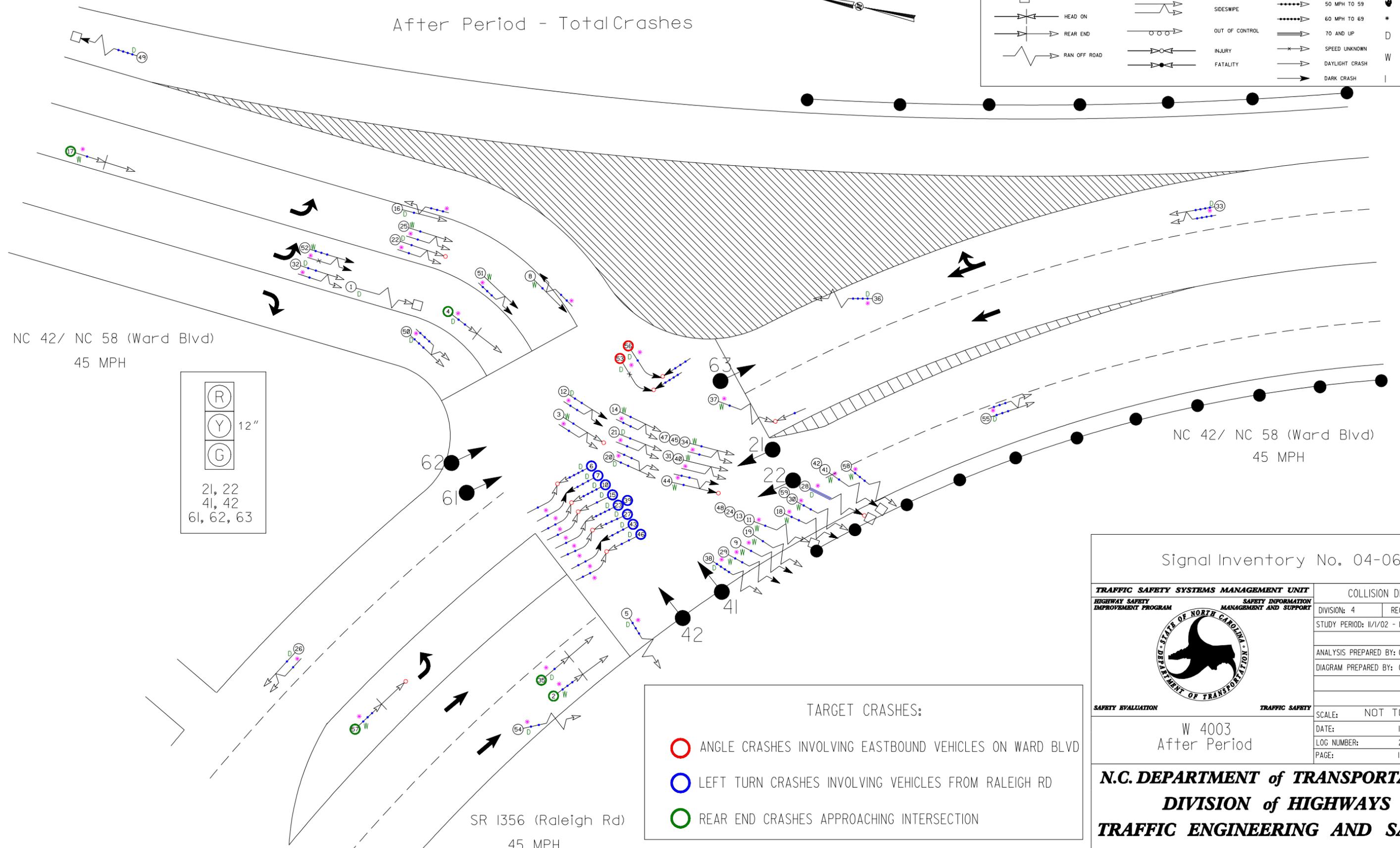
November 1, 2002 - October 31, 2008

(6 YRS)

After Period - TotalCrashes

### LEGEND

	MOVING VEHICLE		ANGLE		9 MPH OR LESS		PEDESTRIAN
	PEDESTRIAN		TURNING		10 MPH TO 19		BICYCLE
	PARKED VEHICLE		BACKING		20 MPH TO 29		TRAIN
	PARKING VEHICLE		SIDESWIPE		30 MPH TO 39		ANIMAL
	FIXED OBJECT		OUT OF CONTROL		40 MPH TO 49		VEHICLE FIRE
	HEAD ON		INJURY		50 MPH TO 59		DRIVER AT FAULT
	REAR END		FATALITY		60 MPH TO 69		DRY
	RAN OFF ROAD		DAYLIGHT CRASH		TO AND UP		WET
			DARK CRASH		SPEED UNKNOWN		ICY OR SNOWY



NC 42/ NC 58 (Ward Blvd)  
45 MPH

R	12"
Y	
G	

21, 22  
41, 42  
61, 62, 63

NC 42/ NC 58 (Ward Blvd)  
45 MPH

SR 1356 (Raleigh Rd)  
45 MPH

TARGET CRASHES:

- ANGLE CRASHES INVOLVING EASTBOUND VEHICLES ON WARD BLVD
- LEFT TURN CRASHES INVOLVING VEHICLES FROM RALEIGH RD
- REAR END CRASHES APPROACHING INTERSECTION

Signal Inventory No. 04-0661

<b>TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT</b>		COLLISION DIAGRAM	
<b>HIGHWAY SAFETY IMPROVEMENT PROGRAM</b>	<b>SAFETY INFORMATION MANAGEMENT AND SUPPORT</b>	DIVISION: 4	REGION: EASTERN
		STUDY PERIOD: 11/1/02 - 10/31/08	
		ANALYSIS PREPARED BY: CLS	
		DIAGRAM PREPARED BY: CLS	
<b>SAFETY EVALUATION</b>		<b>TRAFFIC SAFETY</b>	
W 4003 After Period		SCALE: NOT TO SCALE	
		DATE: 12/30/2008	
		LOG NUMBER: 200608070	
		PAGE: 1 OF 1	

**N.C. DEPARTMENT of TRANSPORTATION**  
**DIVISION of HIGHWAYS**  
**TRAFFIC ENGINEERING AND SAFETY**  
**SYSTEMS BRANCH**