

# **Spot Safety Project Evaluation**

Project Log # 200812060

Spot Safety Project # 14-01-207

## **Spot Safety Project Evaluation of the Traffic Signal Installation on US 276 at the US 23/74 Westbound Ramps Haywood 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

7/14/09

Date

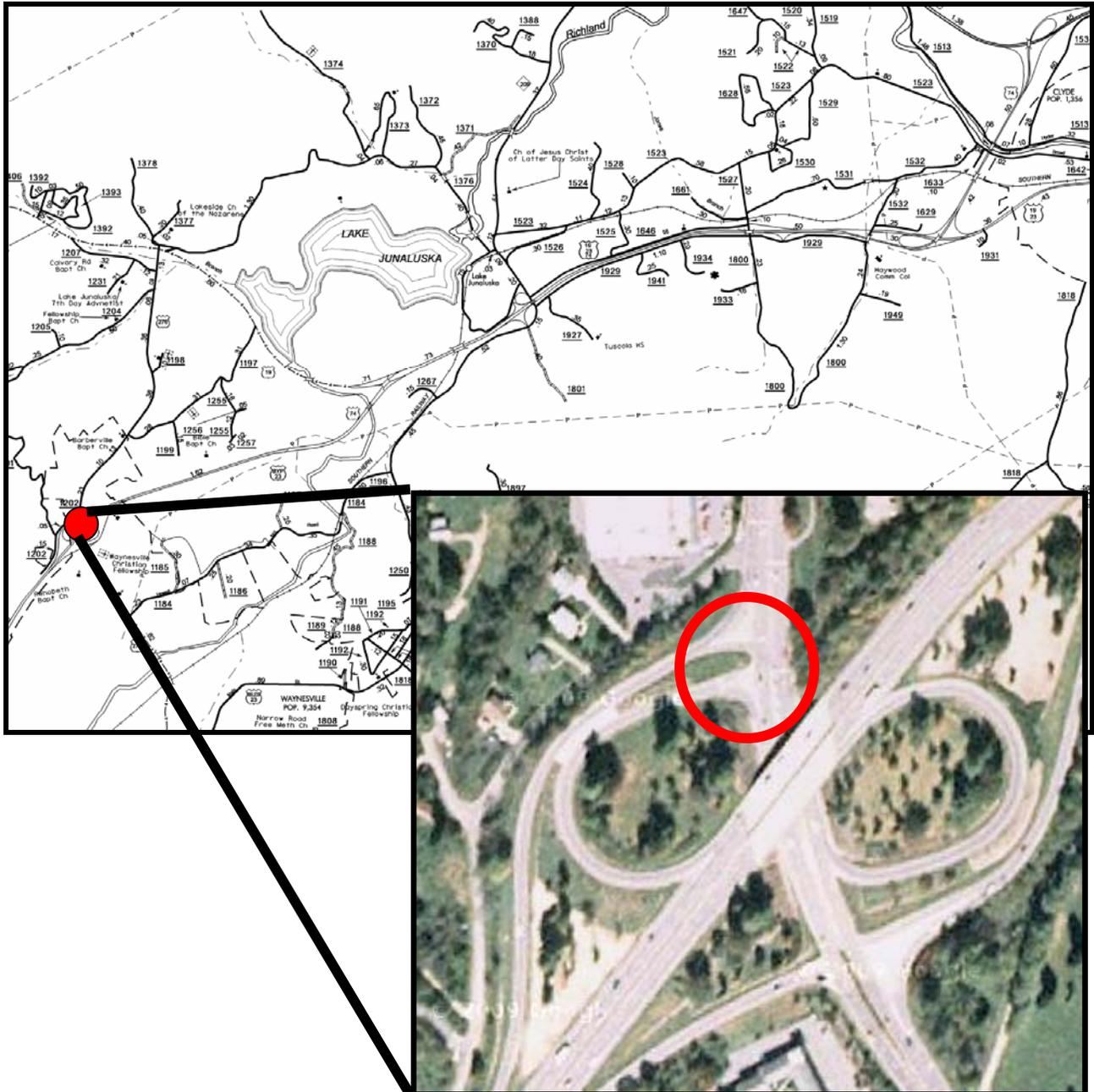
Traffic Safety Project Engineer

# Spot Safety Project Evaluation Documentation

## Subject Location

Evaluation of Spot Safety Project Number 14-01-207 – The Intersection of US 276 and the US 23/74 westbound ramps in Haywood County.

The signal number for this location is 14-0974.



## Project Information and Background from the Project File Folder

The spot safety project improvement countermeasure chosen for the subject location was the installation of a traffic signal.

US 276 is a divided four lane roadway with a speed limit of 35 mph. Both the westbound off-ramp and westbound on-ramp to US 23/74 intersect US 276 from the west. The on/off ramps are divided by a grass median. Phillips Rd intersects US 276 less than 100 feet north of the ramps and was signalized along with the ramps.

The original statement of problem was that increased vehicular usage of the intersection was leading to congestion and delay.

The initial crash analysis was conducted from May 1, 1998 to April 30, 2001 with a total of one reported crash. This crash was considered correctable by the chosen countermeasure. The final completion date for the improvements at the subject intersection was on February 5, 2003 with a total cost of \$75,000.00.

### Naive Before and After Analysis

After reviewing the spot safety 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, 2003 to March 31, 2003. The before period consisted of reported crashes from February 1, 1997 through December 31, 2002 (5 years and 11 months) and the after period consisted of reported crashes from April 1, 2003 through February 28, 2009 (5 years and 11 months). The ending date for this analysis was limited by the available crash data at the time the analysis was conducted.

The treatment data consisted of all reported crashes within 150 feet of the ramps and Phillips Rd. The following data table depicts the Naive Before and After Analysis for the treatment location. Please note that Frontal Impact crash types were the Target Crashes for the applied countermeasure. These crash types considered are as follows: Left Turn, same roadway; Left Turn, different roadway; Right Turn, same roadway; Right Turn, different roadway; Head On and Angle. The target crashes are clearly identified in the before and after period collision diagrams.

<b>Treatment Information</b>	<b>Before</b>	<b>After</b>	<b>Percent Reduction (-) Percent Increase (+)</b>
Total Crashes	8	19	137.5
Total Severity Index	2.85	9.27	225.3
Target Crashes	1	13	1200.0
Target Crash Severity Index	1	11.38	1038.0
Volume	56,000	55,000	-1.8

<b>Crash Severity Summary</b>			
Fatal Crashes	0	0	N/A
Class A Crashes	0	1	N/A
Class B Crashes	0	3	N/A
Class C Crashes	2	8	300.0
PDO Crashes	6	7	16.7

The naive before and after analysis at the treatment location resulted in a 138 percent increase in Total Crashes, a 1,200 percent increase in Target Crashes, and a 2 percent decrease in Average Daily Traffic (ADT). The before period ADT year was 2000 and the after period ADT year was 2006.

## **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 138 percent increase in Total Crashes and a 1,200 percent increase in Target Crashes. The Total Severity Index increased by 225 percent and the Target Crash Severity Index increased by 1,038 percent. The summary results above demonstrate that both Total Crashes and Target Crashes appear to have significantly increased at the treatment location from the before to the after period.

The calculated benefit to cost ratio for this project is -9.77 considering total crashes. The benefit to cost ratio considering only target crashes is also -9.63. 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.

In the before period there was only a single Target Crash. This crash involved a vehicle turning left onto US 276 from the off-ramp and failing to yield for a southbound vehicle. In the after period there were four crashes of this type, all involving the southbound vehicle running the red signal.

A pattern of nine Left Turn-Same Roadway Crashes emerged in the after period. This movement has protected/permitted signal phasing. In six of the crashes the left turning vehicle was faulted for failure to yield. In two of the crashes the southbound vehicle was faulted for running the red light. The fault was undetermined in the final crash of this pattern.

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 intersection.

**BENEFIT-COST ANALYSIS WORKSHEET**

LOCATION: US 276 at US 23/74 WB ramps  
 COUNTY: Haywood  
 FILE NO.: SS 14-01-207

BY: BDR  
 DATE: 7/13/2009

DETAILED COST: TYPE IMPROVEMENT - Signal

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$0	0	0.000	\$0
	\$75,000	10	0.149	\$11,177
Right-of-Way	\$0	0	0.000	\$0
<b>TOTALS</b>	<b>\$75,000</b>	<b>10</b>	<b>0.149</b>	<b>\$11,177</b>

ESTIMATED INCREASE IN ANNUAL MAINT. COST = \$2,000  
 ESTIMATED INCREASE IN ANNUAL UTILITY COST = \$900  
 TOTAL ANNUAL COST= \$14,077  
 TOTAL COST OF PROJECT= \$75,000

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	5.92	0	0.00	2	0.34	6	1.01	\$11,014
AFTER	5.92	1	0.17	11	1.86	7	1.18	\$148,547

Annual Benefits from Crash Cost Savings (\$137,534)

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = (\$151,611)

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = -9.77

TOTAL COST OF PROJECT - \$75,000 COMPREHENSIVE B/C RATIO - -9.77

**BENEFIT-COST ANALYSIS WORKSHEET**

LOCATION: US 276 at US 23/74 WB ramps  
 COUNTY: Haywood  
 FILE NO.: SS 14-01-207 Target Crashes Only

BY: BDR  
 DATE: 7/13/2009

DETAILED COST: TYPE IMPROVEMENT - Signal

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$0	0	0.000	\$0
	\$75,000	10	0.149	\$11,177
Right-of-Way	\$0	0	0.000	\$0
<b>TOTALS</b>	<b>\$75,000</b>	<b>10</b>	<b>0.149</b>	<b>\$11,177</b>

ESTIMATED INCREASE IN ANNUAL MAINT. COST = \$2,000  
 ESTIMATED INCREASE IN ANNUAL UTILITY COST = \$900  
 TOTAL ANNUAL COST= \$14,077  
 TOTAL COST OF PROJECT= \$75,000

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	5.92	0	0.00	0	0.00	1	0.17	\$709
AFTER	5.92	1	0.17	8	1.35	4	0.68	\$136,284

Annual Benefits from Crash Cost Savings (\$135,574)

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = (\$149,652)

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = -9.63

TOTAL COST OF PROJECT - \$75,000 COMPREHENSIVE B/C RATIO - -9.63



Looking North on US 276 toward US 23/74 WB Ramps



Looking North on US 276 at US 23/74 WB Ramps



Looking North on US 276 approaching Phillips Rd



Looking South on US 276 at Phillips Rd



Looking South on US 276 at Phillips Rd Looking toward US 23/74 Ramps



Looking at US 23/74 WB Ramps

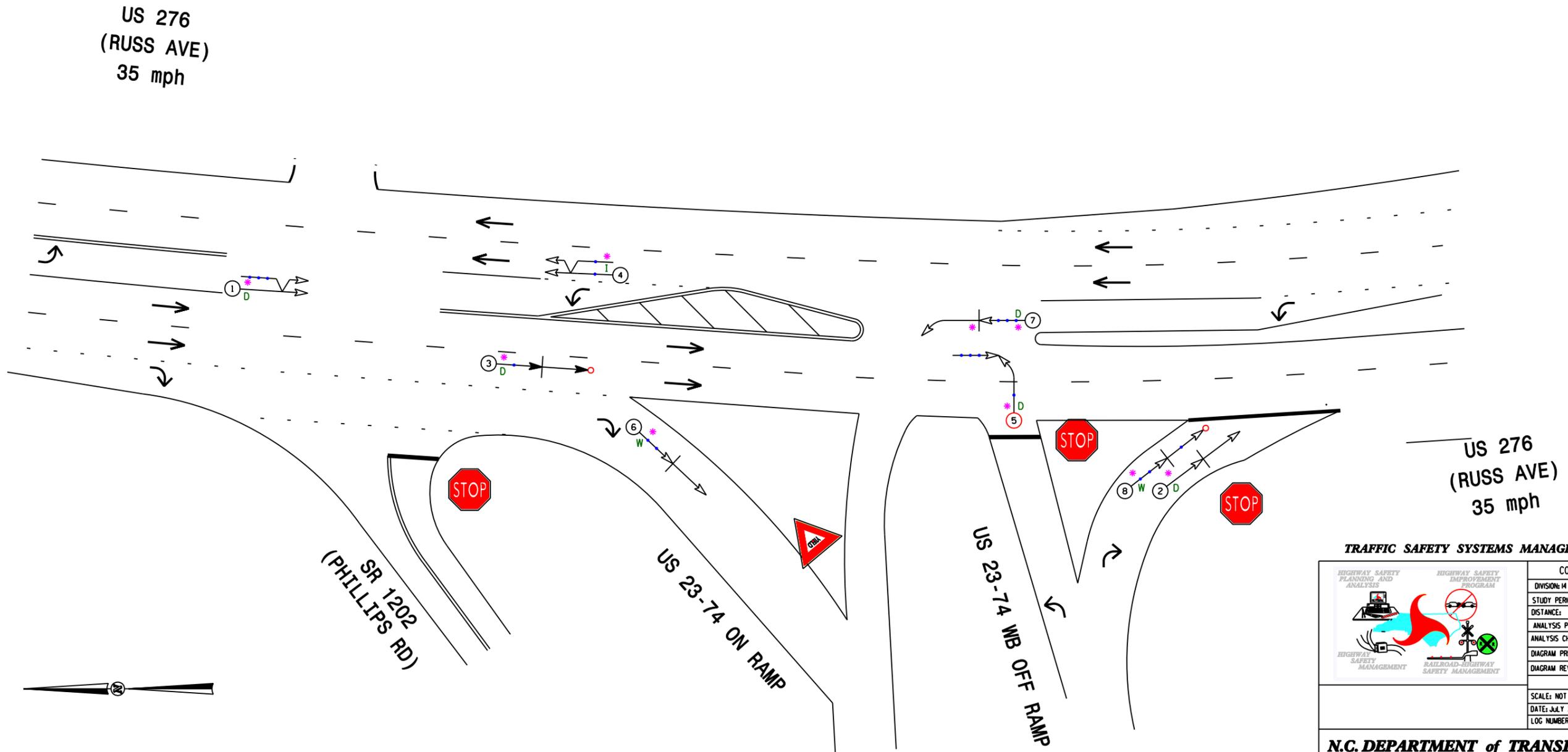


On US 23/74 WB Off Ramps, looking toward US 276

Haywood County  
 US 276 at US 23/74 Westbound  
 Ramps (Exit 102)  
 BEFORE Period  
 2/1/1997-12/31/2002

**LEGEND**

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

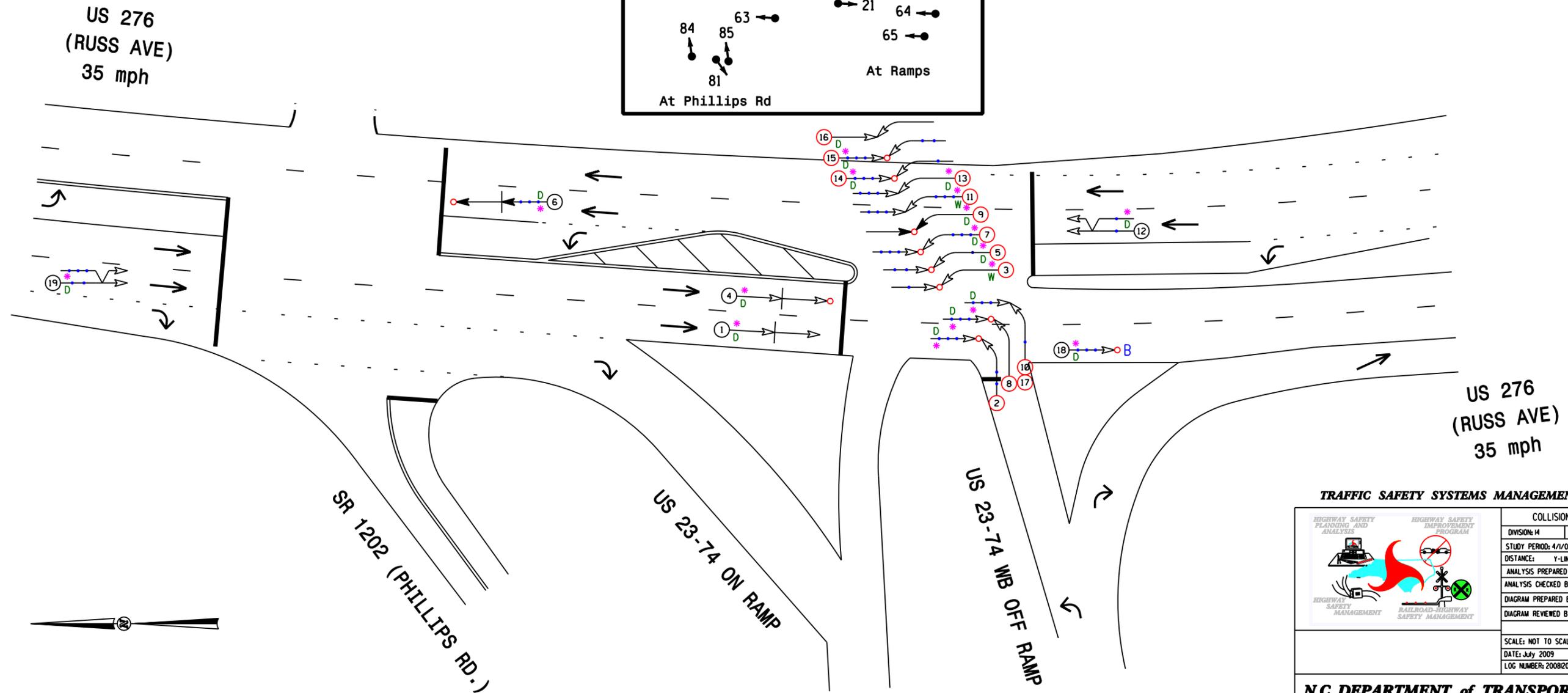
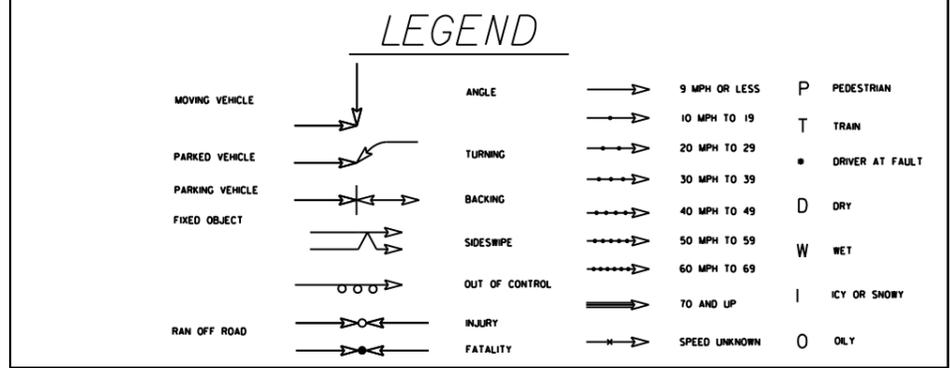
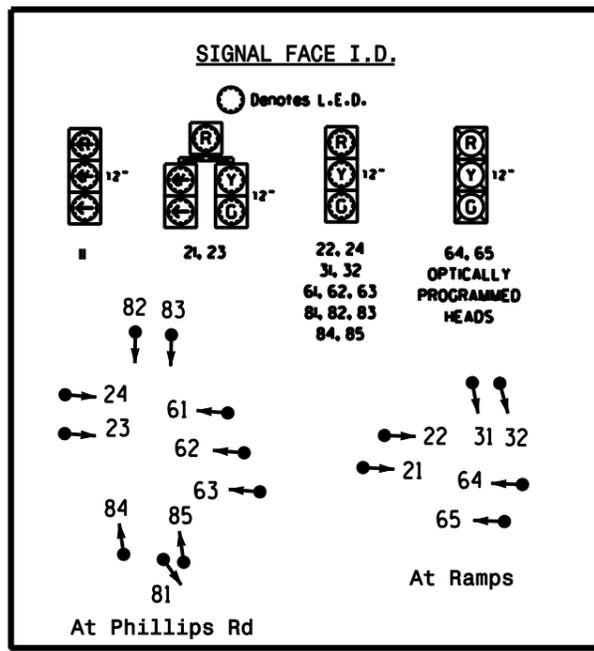


**TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT**

	COLLISION DIAGRAM	
	DIVISION: M	AREA:
STUDY PERIOD: 2/1/97-12/31/02		
DISTANCE: Y-LINE = 150 FT		
ANALYSIS PREPARED BY: BDR		
ANALYSIS CHECKED BY:		
DIAGRAM PREPARED BY: BDR		
DIAGRAM REVIEWED BY:		
SCALE: NOT TO SCALE		
DATE: JULY 2009		
LOG NUMBER: 20082060		

**N.C. DEPARTMENT of TRANSPORTATION**  
 DIVISION of HIGHWAYS  
 TRANSPORTATION MOBILITY AND  
 SAFETY DIVISION

Haywood County  
 US 276 at US 23/74 Westbound  
 Ramps (Exit 102)  
 AFTER Period  
 4/1/2003-2/28/2009



**TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT**

COLLISION DIAGRAM	
DIVISION: M	AREA:
STUDY PERIOD: 4/1/03-2/28/09	
DISTANCE: Y-LINE = 150FT	
ANALYSIS PREPARED BY: BDR	
ANALYSIS CHECKED BY:	
DIAGRAM PREPARED BY: BDR	
DIAGRAM REVIEWED BY:	
SCALE: NOT TO SCALE	
DATE: July 2009	
LOG NUMBER: 20082060	

**N.C. DEPARTMENT of TRANSPORTATION**  
 DIVISION of HIGHWAYS  
 TRANSPORTATION MOBILITY AND SAFETY DIVISION