

Spot Safety Project Evaluation

Order # 41000006533

Spot Safety Project # 04-04-205

Spot Safety Project Evaluation of a Radar Sign Installation Entrance Ramp from NC 42 Eastbound to I-40 Westbound Johnston County

Documents Prepared By:

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

Principal Investigator



Chad J. Neilson

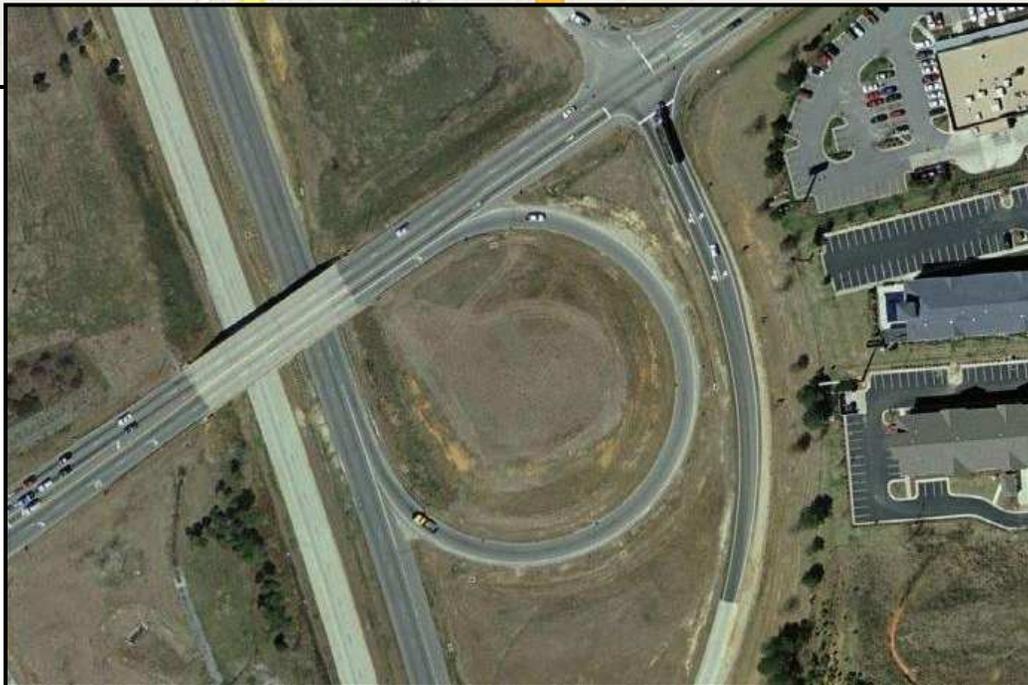
6-29-2010
Date

Traffic Safety Project Engineer

Spot Safety Project Evaluation Documentation

Subject Location

Evaluation of Spot Safety Project Number 04-04-205 located on the entrance ramp from NC 42 Eastbound to I-40 Westbound in Johnston County, near the Town of Clayton.



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 radar sign on the entrance ramp from NC 42 Eastbound to I-40 Westbound. NC 42 is a four-lane facility at the study area with a speed limit of 35 mph for both approaches. I-40 is a median divided four-lane facility with a posted speed limit of 70 mph. The ramp from NC 42 Eastbound to I-40 Westbound has a posted speed limit of 25 mph.

The original statement of problem was the concern for crashes due to a single radius curve used as the loop instead of a motorist expected 3-centered curve. Many motorists drive too fast for the conditions and run off the outside of the curve into I-40 Westbound traffic. The intended purpose of the radar sign is to notify motorist that they maybe driving too fast for the roadway conditions.

The initial crash analysis was completed from May 1, 2000 to April 30, 2003 with thirty-seven (37) reported crashes, twenty-six (26) of which were deemed correctable including one fatality crash. The final completion date for the improvement at the subject intersection was on September 1, 2005 with a total cost of \$18,000.00.

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 the month of August 2005. The before period consisted of reported crashes from April 1, 2001 through July 31, 2006 (4 years and 4 months); and the after period consisted of reported crashes from September 1, 2005 through December 31, 2009 (4 years and 4 months). It was brought to attention from a NCDOT engineer that the sign was malfunctioning in February 2010. Therefore, the study limits were determined to include crashes up to December 31, 2009.

The treatment data consisted of all crashes including vehicles that had exited the study ramp. *Please see attached location map, aerial map, and photos for further details.*

The following data table depicts the Naive Before and After Analysis for the treatment location. Please note that rear-end crashes, sideswipe crashes, ran-off road crashes and rollover crashes were the target crashes for the applied countermeasure.

<u>Treatment Information</u>	Before	After	Percent Reduction (-) Percent Increase (+)
Total Crashes	36	23	- 36.11 %
Total Severity Index	8.96	6.23	- 30.47 %
Target Crashes	34	20	- 41.18 %
Target Crash Severity Index	9.43	7.01	- 25.66 %
Volume	53,000	59,700	12.64 %

<u>Injury Crash Summary</u>	Before	After	Percent Reduction (-) Percent Increase (+)
Fatal Injury Crashes	1	0	- 100.00 %
Class A Injury Crashes	2	1	- 50.00 %
Class B Injury Crashes	4	2	- 50.00 %
Class C Injury Crashes	4	4	- 100.00 %
Total Injury Crashes	11	7	- 36.36 %

The naive before and after analysis at the treatment location resulted in a thirty-six (36) percent decrease in Total Crashes, an forty-one (41) percent decrease in Target Crashes, and a thirty (30) percent decrease in the Total Severity Index. The before period ADT year was 2003 and the after period ADT year was 2007.

Results and Discussion

Referencing the *Collision Diagrams*, the before period diagram shows three crash patterns. One crash pattern was a side-swipe, same direction crash from vehicles entering I-40 from the NC 42 ramp, which accounted for twelve (12) target crashes, including one fatality. The next crash pattern to note is the ran-off roadway crashes which occurred from vehicles entering I-40 too fast, losing control and over correcting. This over compensation caused the vehicle to run off the road into a guardrail on either side of I-40 Westbound. The ran-off road crash pattern accounted for thirteen (13) target crashes. Also, during the before period, there were three (3) rollover target crashes, which occurred from excessive speeds on the ramp. After the radar sign installation, the side-swipe, same direction crashes were reduced to ten (10) target crashes and the ran-off roadway crashes were reduced to three (3) target crashes. The rollover crash pattern was eliminated in the after period.

The calculated benefit to cost ratio for this project is **87.52 considering total crashes**. The benefit to cost ratio **considering only target crashes is 87.80**. 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.

Please see the attached *Treatment Site Photos*. 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.

TREATMENT SITE PHOTOS



1st Notification of Study Ramp on NC 42



2nd Notification of Study Ramp on NC 42



3rd Notification of Study Ramp on NC 42



Radar Sign on Entrance Ramp



Looking on I-40 at the Start of Merger Lane from NC 42 Ramp



Looking on I-40 WB from Merger Lane (NC 42 overpass in view)

BENEFIT-COST ANALYSIS WORKSHEET - TOTAL CRASHES

LOCATION: NC 42 EB Ramp to I 40 WB		BY: C Neilson						
COUNTY: Johnston		DATE: 6/14/2010						
FILE NO.: SS 04-04-205								
DETAILED COST:	TYPE IMPROVEMENT -	Radar Sign (Speed)						
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$18,000	10	0.149	\$2,683			
	Right-of-Way	\$0	0	0.000	\$0			
	TOTALS	\$18,000	10	0.149	\$2,683			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$500			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$350			
	TOTAL ANNUAL COST=				\$3,533			
	TOTAL COST OF PROJECT=				\$18,000			
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	4.33	3	0.69	8	1.85	25	5.77	\$498,268
AFTER	4.33	1	0.23	6	1.39	16	3.70	\$189,099
						Annual Benefits from Crash Cost Savings		\$309,169
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST						=	\$305,636	
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST						=	87.52	
TOTAL COST OF PROJECT		-	\$18,000	COMPREHENSIVE B/C RATIO		-	87.52	

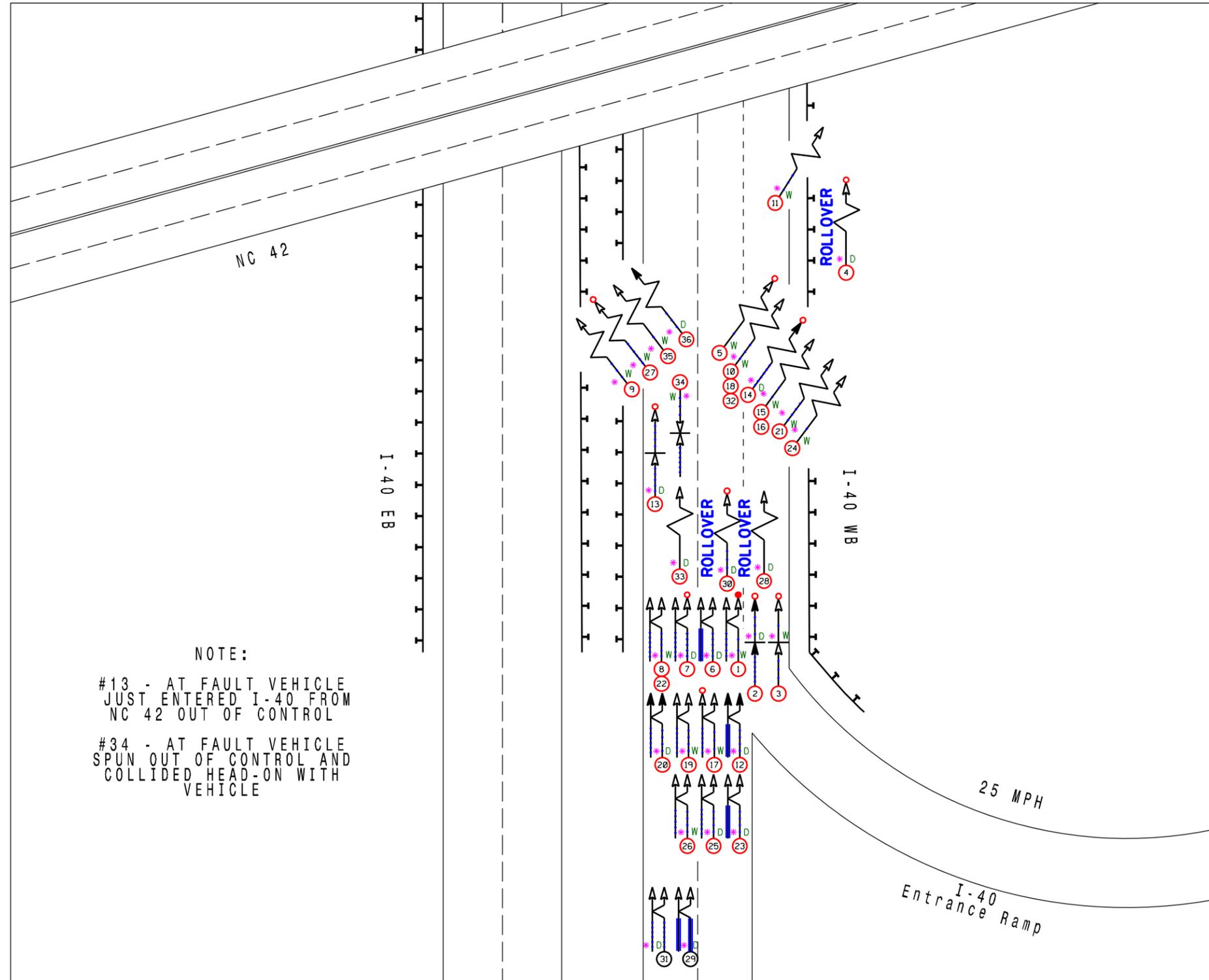
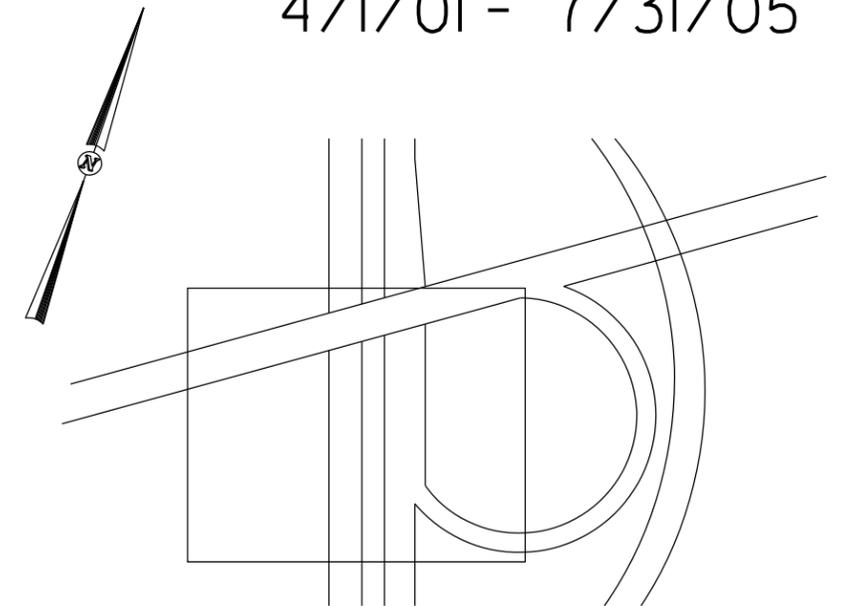
BENEFIT-COST ANALYSIS WORKSHEET - TARGET CRASHES

LOCATION: NC 42 EB Ramp to I 40 WB		BY: C Neilson						
COUNTY: Johnston		DATE: 6/14/2010						
FILE NO.: SS 04-04-205								
DETAILED COST:	TYPE IMPROVEMENT -	Radar Sign (Speed)						
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$18,000	10	0.149	\$2,683			
	Right-of-Way	\$0	0	0.000	\$0			
	TOTALS	\$18,000	10	0.149	\$2,683			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$500			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$350			
	TOTAL ANNUAL COST=				\$3,533			
	TOTAL COST OF PROJECT=				\$18,000			
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	4.33	3	0.69	8	1.85	23	5.31	\$496,282
AFTER	4.33	1	0.23	6	1.39	13	3.00	\$186,120
						Annual Benefits from Crash Cost Savings		\$310,162
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST						=	\$306,629	
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST						=	87.80	
TOTAL COST OF PROJECT		-	\$18,000	COMPREHENSIVE B/C RATIO		-	87.80	

LEGEND

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

SS# 04-04-205
 Order# 41000006533
 Johnston County
 BEFORE Period
 4/1/01 - 7/31/05



NOTE:
 #13 - AT FAULT VEHICLE JUST ENTERED I-40 FROM NC 42 OUT OF CONTROL
 #34 - AT FAULT VEHICLE SPUN OUT OF CONTROL AND COLLIDED HEAD-ON WITH VEHICLE

Target Crashes

N.C. DEPARTMENT of TRANSPORTATION
 DIVISION of HIGHWAYS
 TRANSPORTATION MOBILITY and SAFETY DIVISION

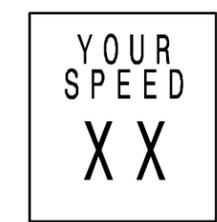
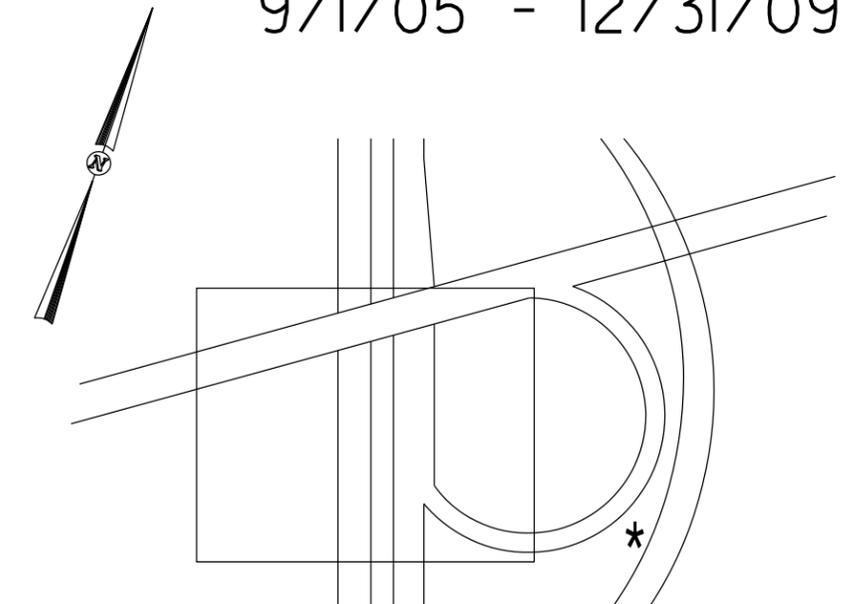
TRAFFIC SAFETY UNIT

Date: 6-14-2010 Prepared By: C Neilson

LEGEND

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

SS# 04-04-205
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 Johnston County
 AFTER Period
 9/1/05 - 12/31/09

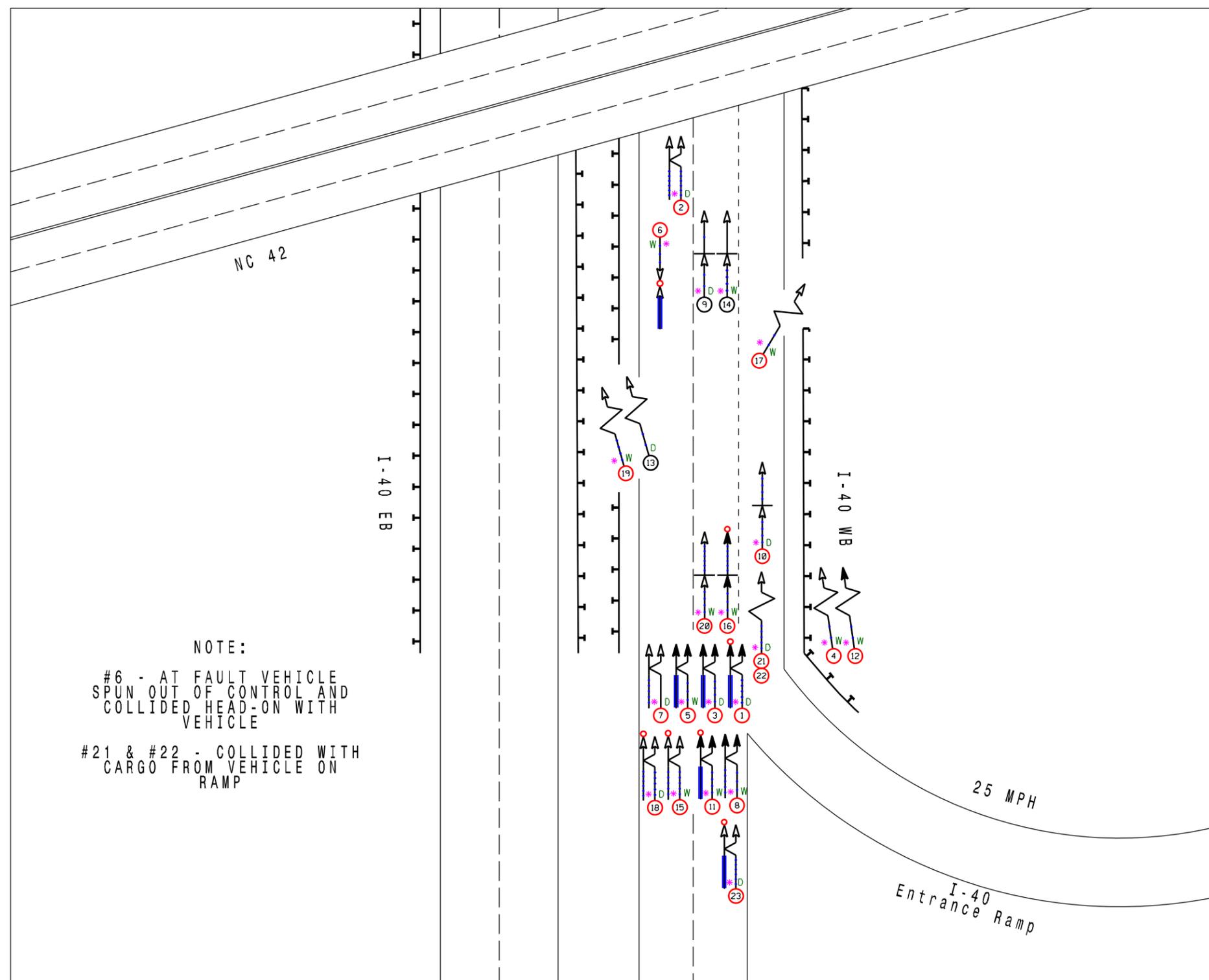


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 DIVISION of HIGHWAYS
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TRAFFIC SAFETY UNIT

Date: 6-14-2010

Prepared By: C Neilson



NOTE:
 #6 - AT FAULT VEHICLE SPUN OUT OF CONTROL AND COLLIDED HEAD-ON WITH VEHICLE
 #21 & #22 - COLLIDED WITH CARGO FROM VEHICLE ON RAMP

NC 42

I-40 EB

I-40 WB

I-40 Entrance Ramp

25 MPH