

Spot Safety Project Evaluation

Order # 41000011928

Spot Safety Project # 04-05-201

Spot Safety Project Evaluation of the Traffic Signal Installation NC 210 at I-40 Westbound Ramp Terminal 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



Jason B. Schronce

7-5-2011

Date

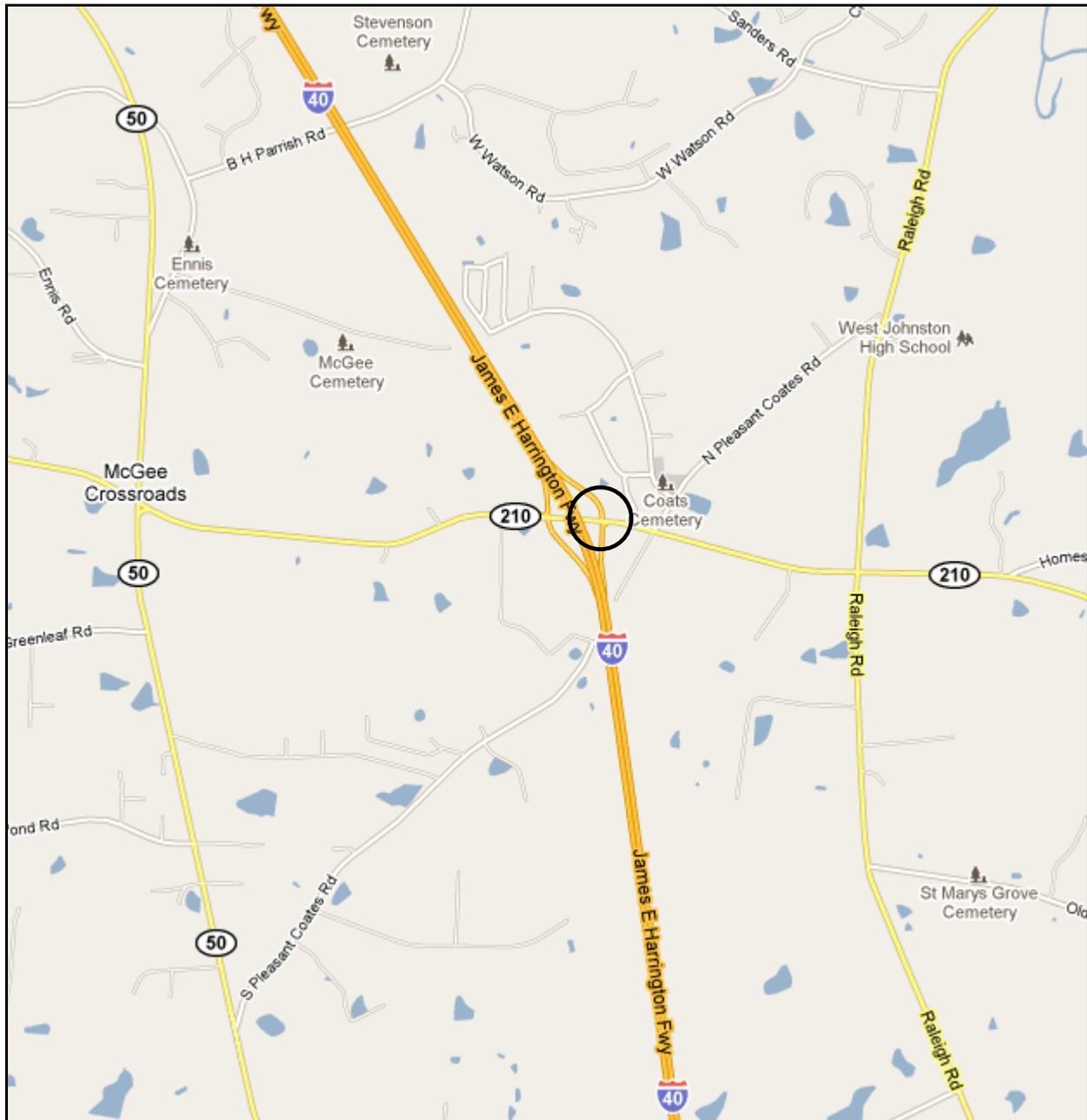
Traffic Safety Project Engineer

Spot Safety Project Evaluation Documentation

Subject Location

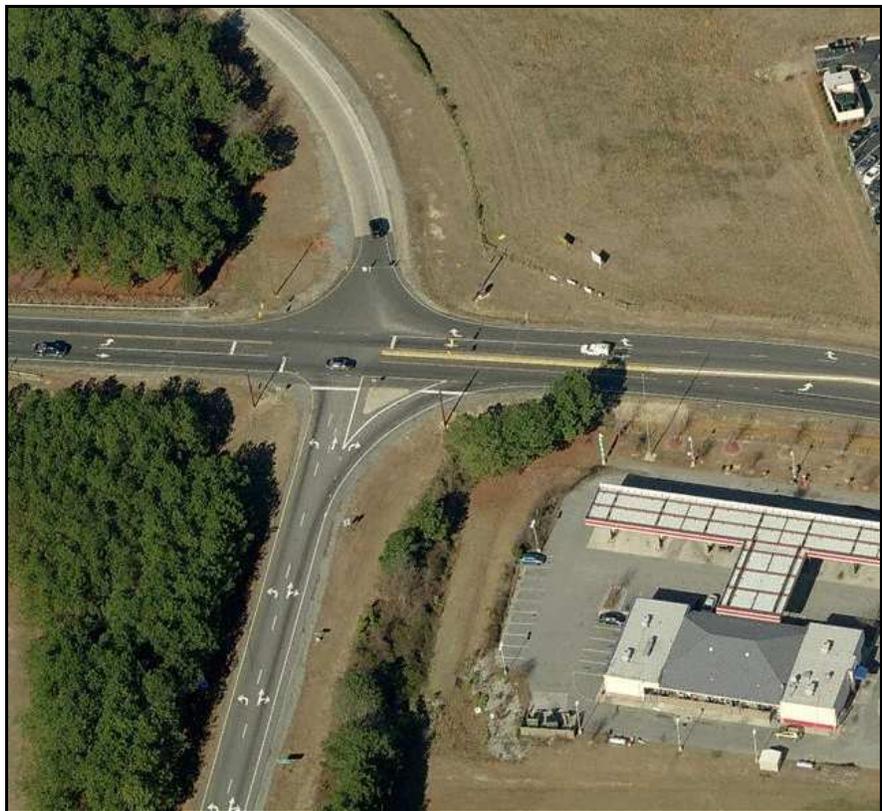
Evaluation of Spot Safety Project Number 04-05-201 located at the Intersection of NC 210 and the I-40 Westbound Ramp Terminal (Exit 319) in Johnston County, near McGee Crossroads.

The Sig ID is 04-1089 for this newly installed traffic signal.





Before Traffic Signal



After Traffic Signal Installation

Project Information and Background from the Project File Folder

The spot safety project improvement countermeasure chosen for the subject location was the installation of an intersection traffic signal at the I-40 Westbound Ramp Terminal. At the same time but with different funding, the ramp was widened for an independent left turn lane and westbound NC 210 gained a right turn lane onto the entrance ramp. NC 210 is a two-lane roadway with a left turn lane onto the entrance ramp and a speed limit of 45 mph. In the before period, the I-40 Westbound Ramp (Exit 319) was a single lane approach that widened for a right turn slip lane and operated under stop sign control.

The original statement of problem identified this area as experiencing phenomenal growth and needing additional measures to control motorists and assign right-of-way. The concern centered on mobility issues but the intersection met signal warrants 1B, 2, and 3B.

The initial crash analysis was completed from October 1, 1999 to September 30, 2004 with eleven (11) reported crashes, six (6) of which were deemed correctable frontal impact collisions. The final completion date for the improvement at the subject intersection was on November 15, 2007 with a total cost of \$82,000.

Additionally, this new signal was interconnected to the existing signal at the eastbound ramp terminal and the planned signal at NC 210 and SR 1382 (Pleasant Coates Road) to the east. The planned signal was installed under Spot Safety Project #04-99-245; which also extended the concrete median barrier (as seen in the aerial photos) to the east from the westbound ramp intersection to limit access to multiple PVAs in the vicinity. By design, this additional median countermeasure created the I-40 Westbound Ramp Terminal intersection as a U-Turn Location for vehicles that were prevented from turning left out of Crape Myrtle Drive.

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 were the months of August through November 2007. The before period consisted of reported crashes from May 1, 2004 through July 31, 2007 (3 years and 3 months); and the after period consisted of reported crashes from December 1, 2007 through February 28, 2011 (3 years and 3 months). The ending date for this analysis was determined by the date of available crash data at the time of analysis.

The treatment data consisted of all crashes within 150 feet of the subject intersection. *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 Frontal Impact Crashes were the target crashes for the applied countermeasure. The Frontal Impact Crash types considered are as follows: Left turn, same roadway; Left turn, different roadways; Right turn, same roadway; Right turn, different roadways; Head on; U-Turn; and Angle.

<u>Treatment Information</u>	Before	After	Percent Reduction (-) Percent Increase (+)
Total Crashes	8	22	175.0 %
Total Severity Index	2.85	2.68	- 6.0 %
Target Crashes – Frontal Impact	3	15	400.0 %
Target Crash Severity Index	3.47	3.47	0.0 %
Target Crashes without U-Turns	3	8	166.7 %
Volume (2005, 2009)	13,000	10,400	- 20.0 %

<u>Injury Crash Summary</u>	Before	After	Percent Reduction (-) Percent Increase (+)
Fatal injury Crashes	0	0	N/A
Class A injury Crashes	0	0	N/A
Class B injury Crashes	1	3	200.0 %
Class C Injury Crashes	1	2	100.0 %
Total Injury Crashes	2	5	150.0 %

The naive before and after analysis at the treatment location resulted in a 175 percent increase in Total Crashes, a 400 percent increase in Target Crashes, but a 6 percent decrease in the Total Severity Index. The before period ADT year was 2005 and the after period ADT year was 2009.

Results and Discussion

Referencing the *Collision Diagrams*, this intersection experienced significant crash increase from the before to the after period. Concerning frontal impact crashes, the before period showed one vehicle improperly exiting the ramp left while this pattern increased to three (3) red-light run crashes in the after period. Also, left turn same roadway collisions on NC 210 increased from one (1) to four (4) with the protected-permissive signal phase. Each period additionally indicated one (1) right turn-different roadway collision from a vehicle turning right off the ramp.

The after period indicates a new pattern of seven (7) U-Turn related collisions from vehicles travelling westbound on NC 210. This has resulted from Spot Safety Project # 04-99-245 as previously mentioned in this report. Also, the exit ramp from Interstate 40 experienced an increase of rear-end crashes at the right-turn slip point from two (2) in the before period to four (4) in the after period.

The calculated benefit to cost ratio for this project is **(-2.15) considering total crashes**. The benefit to cost ratio **considering only target crashes is (-2.30)**. 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 *Site Photos*. Photos are provided from our field visit on May 25, 2011 for the three approaches to the treatment intersection. 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.

SITE PHOTOS



Travelling East on NC 210 approaching signal



Travelling West on NC 210 approaching signal



Travelling on I-40 Ramp (Exit 319) approaching signal

BENEFIT-COST ANALYSIS WORKSHEET - Total Crashes

LOCATION: NC 210 at I-40 Westbound Ramps		BY: JBS						
COUNTY: Johnston		DATE: 6/1/2011						
FILE NO.: SS 04-05-201								
DETAILED COST:	TYPE IMPROVEMENT -	New Traffic Signal						
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$82,000	10	0.149	\$12,220			
	Right-of-Way	\$0	0	0.000	\$0			
		\$0	0	0.000	\$0			
	TOTALS	\$82,000	10	0.149	\$12,220			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$2,200			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$900			
	TOTAL ANNUAL COST=				\$15,320			
	TOTAL COST OF PROJECT=				\$82,000			
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	3.25	0	0.00	2	0.62	6	1.85	\$20,246
AFTER	3.25	0	0.00	5	1.54	17	5.23	\$53,262
						Annual Benefits from Crash Cost Savings		(\$33,015)
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST						=		(\$48,336)
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST						=		-2.15
TOTAL COST OF PROJECT		-	\$82,000	COMPREHENSIVE B/C RATIO		-		-2.15

BENEFIT-COST ANALYSIS WORKSHEET - Target Crashes

LOCATION: NC 210 at I-40 Westbound Ramps		BY: JBS						
COUNTY: Johnston		DATE: 6/1/2011						
FILE NO.: SS 04-05-201		Target Frontal Impact Crashes						
DETAILED COST:	TYPE IMPROVEMENT -	New Traffic Signal						
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$82,000	10	0.149	\$12,220			
	Right-of-Way	\$0	0	0.000	\$0			
		\$0	0	0.000	\$0			
	TOTALS	\$82,000	10	0.149	\$12,220			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$2,200			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$900			
	TOTAL ANNUAL COST=				\$15,320			
	TOTAL COST OF PROJECT=				\$82,000			
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	3.25	0	0.00	1	0.31	2	0.62	\$8,800
AFTER	3.25	0	0.00	5	1.54	10	3.08	\$44,000
						Annual Benefits from Crash Cost Savings		(\$35,200)
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST						=		(\$50,520)
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST						=		-2.30
TOTAL COST OF PROJECT		-	\$82,000	COMPREHENSIVE B/C RATIO		-		-2.30



I-40 Entrance Ramp
Westbound Only
Exit 319

NC 210
45 MPH

ADT (Year)
12,000 (2005)

Concrete Median

ADT (Year)
11,000 (2005)

I-40 Exit Ramp
Westbound Only
Exit 319

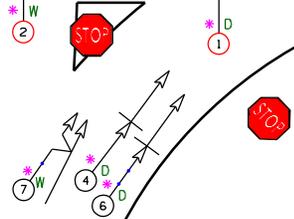
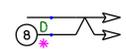
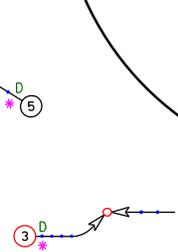
ADT (Year)
3,000 (2005)

LEGEND

	MOVING VEHICLE		ANGLE		9 MPH OR LESS		PEDESTRIAN
	PEDESTRIAN		TURNING		10 MPH TO 19		TRAIN
	PARKEED VEHICLE		BACKING		20 MPH TO 29		DRIVER AT FAULT
	PARKEED VEHICLE		SIDE-SWIPE		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		SPEED UNKNOWN
	RAN OFF ROAD				70 AND UP		ONLY

SS# 04-05-201
Order# 41000011928
Johnston County
BEFORE Period
5/1/04 - 7/31/07

ROLLOVER



Frontal Impact
Target Crashes

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

TRAFFIC SAFETY UNIT

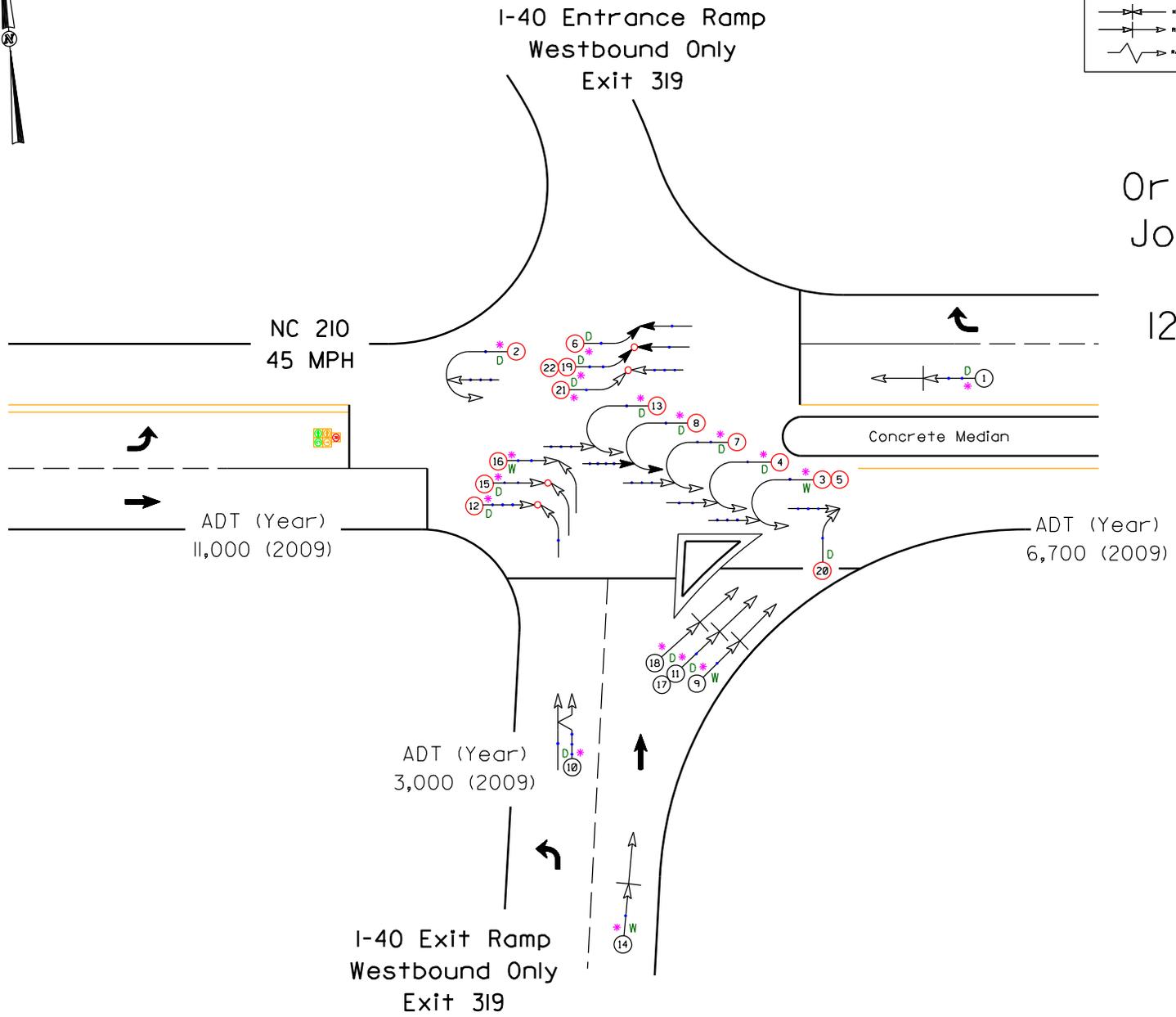
Date: 6-1-2011 Prepared By: J. Schronce



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
	FIXED OBJECT		SIDE-SWIPE		30 MPH TO 39		DOT
	HEAD-ON		OUT OF CONTROL		40 MPH TO 49		WET
	REAR-END		INJURY		50 MPH TO 59		ICY OR SNOWY
	RAN OFF ROAD		FATALITY		60 MPH TO 69		70 AND UP
					SPEED UNKNOWN		ONLY

SS# 04-05-201
 Order# 41000011928
 Johnston County
 AFTER Period
 12/1/07 - 2/28/11



New Signalized
 Intersection
 Sig ID 04-1089



Frontal Impact
Target Crashes

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

TRAFFIC SAFETY UNIT

Date: 6-1-2011

Prepared By: J. Schronce