

# Spot Safety Project Evaluation

Project Log # 200812180

Spot Safety Project # 10-00-211

**Spot Safety Project Evaluation of the Traffic Signal Installation  
At the Intersection of SR 2472 (Mallard Creek Church Rd) and the  
I-85 Southbound Ramp Terminal (Exit 46)  
City of Charlotte, Mecklenburg 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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Jason B. Schronce

3-11-2009

Date

Traffic Safety Project Engineer

# ***Spot Safety Project Evaluation Documentation***

## **Subject Location**

Evaluation of Spot Safety Project Number 10-00-211 located at the Intersection of SR 2472 (Mallard Creek Church Road) and the I-85 Southbound Ramp Terminal (Exit 46) within the City of Charlotte in Mecklenburg County.

The Signal ID is 10-1789 for the subject location.

## **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 actuated traffic signal. SR 2472 is a four lane concrete median divided facility at the subject intersection that also provides a westbound left turn lane for ramp access and an eastbound right turn slip lane that operates under a yield condition. The posted speed limit for Mallard Creek Church Road is 45 mph. The southbound off-ramp from I-85 has a shared thru-left turn lane and a right turn slip that is controlled by double posted yield signs. In February 2008, the westbound SR 2472 left turn lane was updated and is currently operating under a flashing yellow permissive signal phase.

The original statement of problem was that congestion related issues had developed from ramp traffic entering a high volume roadway. The intended purpose of the proposed countermeasure was to alleviate congestion and reduce angle collisions. The intersection met warrants 2, 9 and 11.

The initial crash analysis was completed from December 1, 1996 to December 1, 1999 with nine (9) reported crashes, three (3) of which were deemed correctable. The final completion date for the improvement at the subject intersection was on January 31, 2003 with a total cost of \$44,500.00.

## **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 December 1, 2002 to January 31, 2003. The before period consisted of reported crashes from December 1, 1997 through November 30, 2002 (5 years); and the after period consisted of reported crashes from February 1, 2003 through January 31, 2008 (5 years). The ending date for this analysis was determined by the installation of the flashing yellow left turn signal phasing.

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; and Angle.

<b><u>Treatment Information</u></b>	<b>Before</b>	<b>After</b>	<b>Percent Reduction (-) Percent Increase (+)</b>
Total crashes	54	124	129.6 %
Total Severity Index	3.74	3.70	- 1.1 %
Target Crashes – Frontal Impact	9	33	266.7 %
Target Crash Severity Index	3.47	6.88	98.3 %
Volume	26,600	34,200	28.6 %
<b><u>Injury Crash Summary</u></b>			
Fatal injury Crashes	0	0	N/A
Class A injury Crashes	0	1	100.0 %
Class B injury Crashes	1	5	400.0 %
Class C Injury Crashes	19	30	57.9 %
Total Injury Crashes	20	36	80.0 %

The naive before and after analysis at the treatment location resulted in a 130 percent increase in Total Crashes, a 267 percent increase in Target Crashes, and a 1 percent decrease in the Total Severity Index. 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 130 percent increase in Total Crashes and an 267 percent increase in Target Crashes. 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.

Referencing the *Collision Diagrams*, two distinctive crash patterns are evident at the intersection in the after period. Frontal impact target crashes increased from nine (9) to thirty-three (33) in the after period with thirty (30) of these collisions resulting from the permissive left turn phase of SR 2472 onto the I-85 On-ramp. The Exit 46 off-ramp also experienced an increase in rear-end collisions at the right turn slip access onto SR 2472 which is controlled by dual posted yield signs. This pattern increased by 96 percent from the before to the after period.

As mentioned in the *Project Background* section, the Flashing Yellow Left Turn Arrow was installed at this location with a completion date of February 25, 2008. The following table indicates how the intersection has functioned since the flashing yellow arrow installation by showing the treatment site progression broken down by crashes per year. The Flashing Yellow Arrow analysis was conducted from March 1, 2008 to October 31, 2008 (7 months). The ending date was determined by the available crash data at the time of analysis.

<u>Site Treatment Progression</u>	<b>Before Signal (5.0 yrs)</b>	<b>After Signal (5.0 yrs)</b>	<b>Flashing Yellow Arrow (0.58 yr)</b>
Total crashes	<b>54</b>	<b>124</b>	<b>18</b>
Total Severity Index	3.74	3.70	3.06
Total Crashes Per Year	<b>10.8</b>	<b>24.8</b>	<b>31.0</b>
Target Crashes – Frontal Impact	<b>9</b>	<b>33</b>	<b>6</b>
Target Crash Severity Index	3.47	6.88	4.70
Target Crashes Per Year	<b>1.8</b>	<b>6.6</b>	<b>10.3</b>
SB Yield Ramp Rear-End Crashes	29	57	5
Yield Ramp Rear-End Crashes Per Year	5.8	11.4	8.6

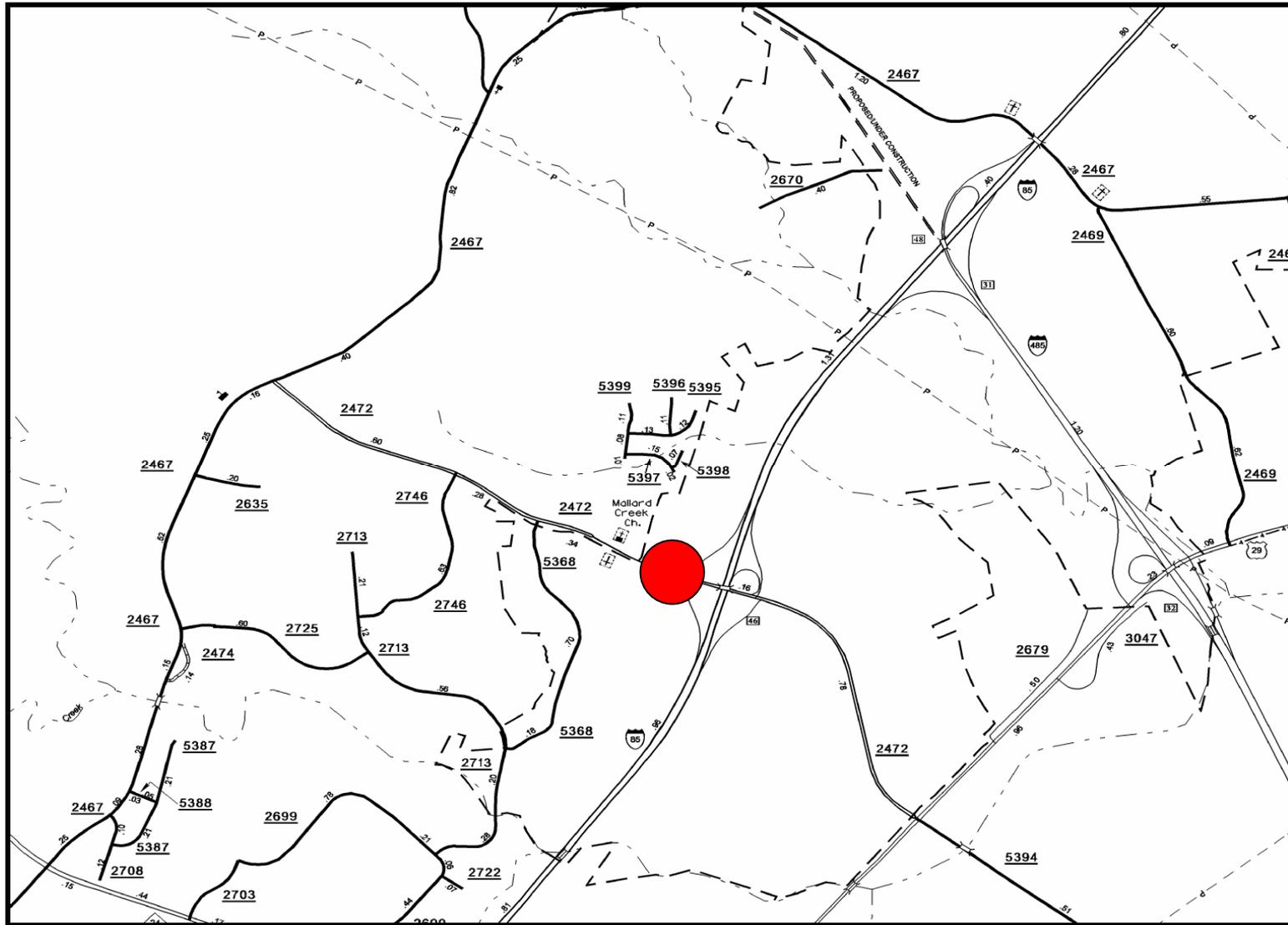
As displayed in the Site Treatment Progression table, total crashes per year and target crashes per year appear to steadily rise through the full analysis period. These figures indicate that crash frequency doubled with the signal installation and appear to be increasing at a steady level with the addition of the flashing yellow arrow control.

The calculated benefit to cost ratio for this project is **(-20.15) considering total crashes**. The benefit to cost ratio **considering only target crashes is (-15.89)**. 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. A negative benefit-cost ratio indicates an increase in either crash frequency or severity through the analysis.

Please see the attached *Treatment Site Photos*. Photos are provided for all approaches to the treatment intersection, although the signal configuration shown is different from the configuration that was analyzed for this study, as explained in the *Project Background* section with the installation of the flashing yellow arrow.

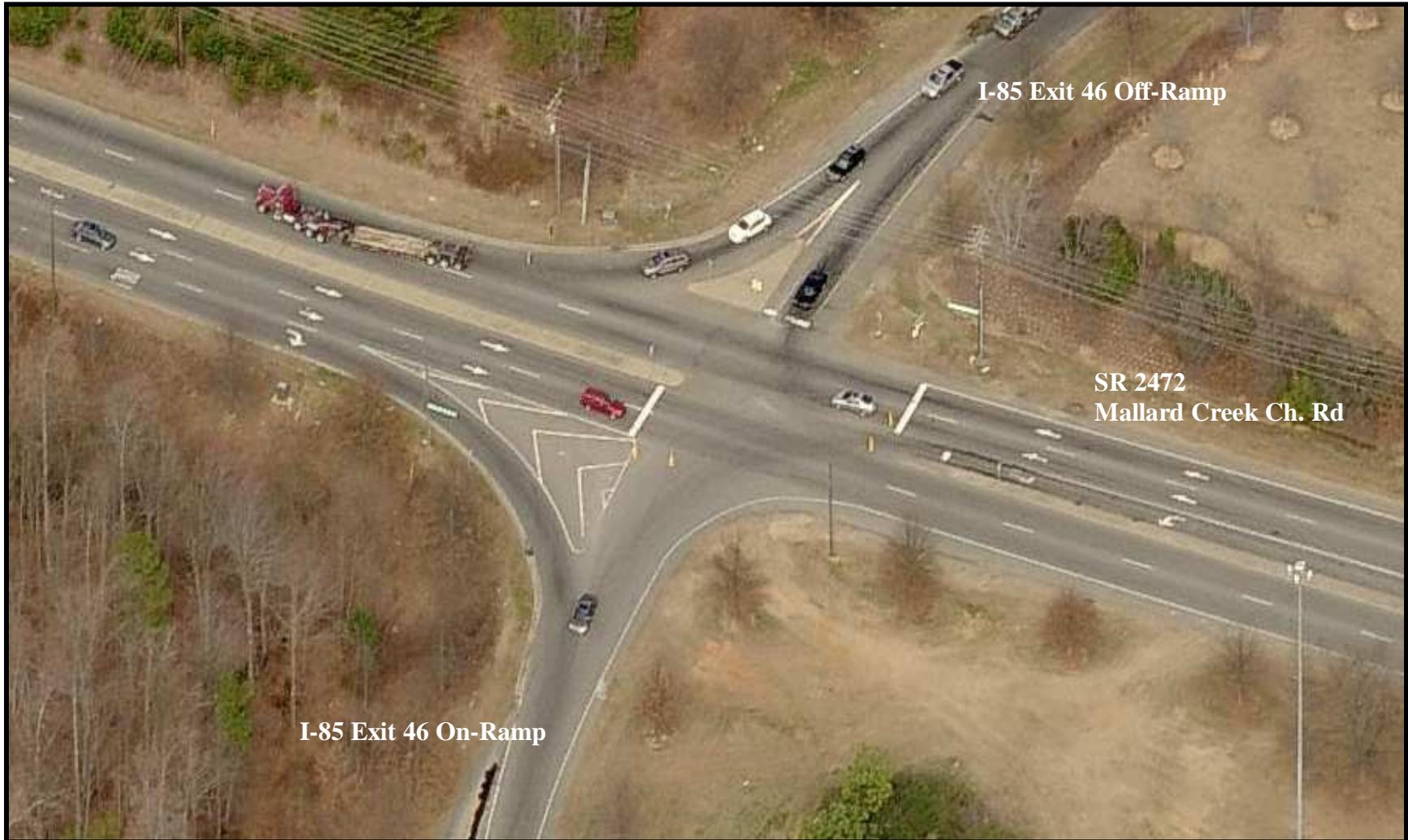
As the Safety Evaluation Group completes additional spot safety reviews for this type of countermeasure, we will be able to provide objective and definite information regarding actual crash reduction factors for this type of intersection.

**Location Map**  
**City of Charlotte, Mecklenburg County**  
**Evaluation of Spot Safety Project # 10-00-211**



**Treatment Location: SR 2472 (Mallard Creek Church Rd) at I-85 SB Ramp Terminal (Exit 46)**

**SS# 10-00-211 Aerial Map  
Mecklenburg County**



**TREATMENT SITE PHOTOS TAKEN 1/15/2009**



Traveling East on SR 2472 (Mallard Creek Church Road)



Traveling East on SR 2472



Traveling West on SR 2472 (Mallard Creek Church Road)



Traveling West on SR 2472 – notice Yellow Flash Signal Head



Traveling South on I-85 Off-Ramp (Exit 46)



Traveling South on I-85 Off-Ramp (Exit 46) – Double Posted Yield Signs

**BENEFIT-COST ANALYSIS WORKSHEET**

LOCATION: SR 2472 at I-85 SB Ramps  
 COUNTY: Mecklenburg  
 FILE NO.: SS 10-00-211

BY: JBS  
 DATE: 3/10/2009  
 NOTES: Total Crashes

DETAILED COST: TYPE IMPROVEMENT - New Signal

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$44,500	10	0.149	\$6,632
	\$0	0	0.000	\$0
Right-of-Way	\$0	0	0.000	\$0
<b>TOTALS</b>	<b>\$44,500</b>	<b>10</b>	<b>0.149</b>	<b>\$6,632</b>

ESTIMATED INCREASE IN ANNUAL MAINT. COST = \$2,200  
 ESTIMATED INCREASE IN ANNUAL UTILITY COST = \$900  
 TOTAL ANNUAL COST= \$9,732  
 TOTAL COST OF PROJECT= \$44,500

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	5.00	0	0.00	20	4.00	34	6.80	\$98,520
AFTER	5.00	1	0.20	35	7.00	88	17.60	\$294,640

Annual Benefits from Crash Cost Savings (\$196,120)

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = (\$205,852)

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = -20.15

TOTAL COST OF PROJECT - \$44,500 COMPREHENSIVE B/C RATIO - -20.15

**BENEFIT-COST ANALYSIS WORKSHEET**

LOCATION: SR 2472 at I-85 SB Ramps  
 COUNTY: Mecklenburg  
 FILE NO.: SS 10-00-211

BY: JBS  
 DATE: 3/9/2009  
 NOTES: Target Crashes - Frontal Impact

DETAILED COST: TYPE IMPROVEMENT - New Signal

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$44,500	10	0.149	\$6,632
	\$0	0	0.000	\$0
Right-of-Way	\$0	0	0.000	\$0
<b>TOTALS</b>	<b>\$44,500</b>	<b>10</b>	<b>0.149</b>	<b>\$6,632</b>

ESTIMATED INCREASE IN ANNUAL MAINT. COST = \$2,200  
 ESTIMATED INCREASE IN ANNUAL UTILITY COST = \$900  
 TOTAL ANNUAL COST= \$9,732  
 TOTAL COST OF PROJECT= \$44,500

COMPREHENSIVE COST REDUCTION:

ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES

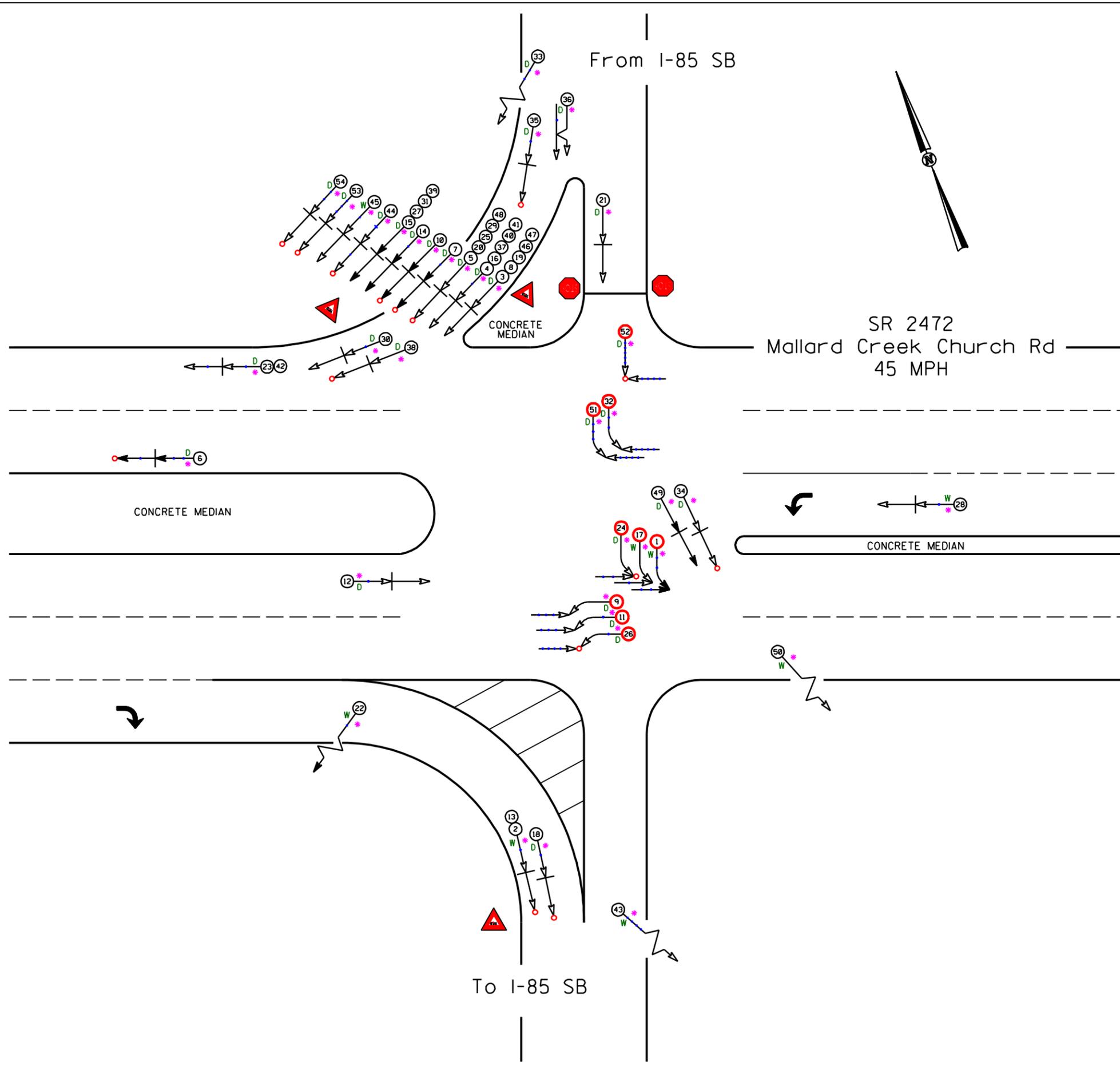
TIME PERIOD	YEARS	K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	PDO CRASHES	PDO CRASHES PER YR	ANNUAL COSTS
BEFORE	5.00	0	0.00	3	0.60	6	1.20	\$15,480
AFTER	5.00	1	0.20	16	3.20	16	3.20	\$170,080

Annual Benefits from Crash Cost Savings (\$154,600)

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = (\$164,332)

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = -15.89

TOTAL COST OF PROJECT - \$44,500 COMPREHENSIVE B/C RATIO - -15.89



**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		70 AND UP		SPEED UNKNOWN		

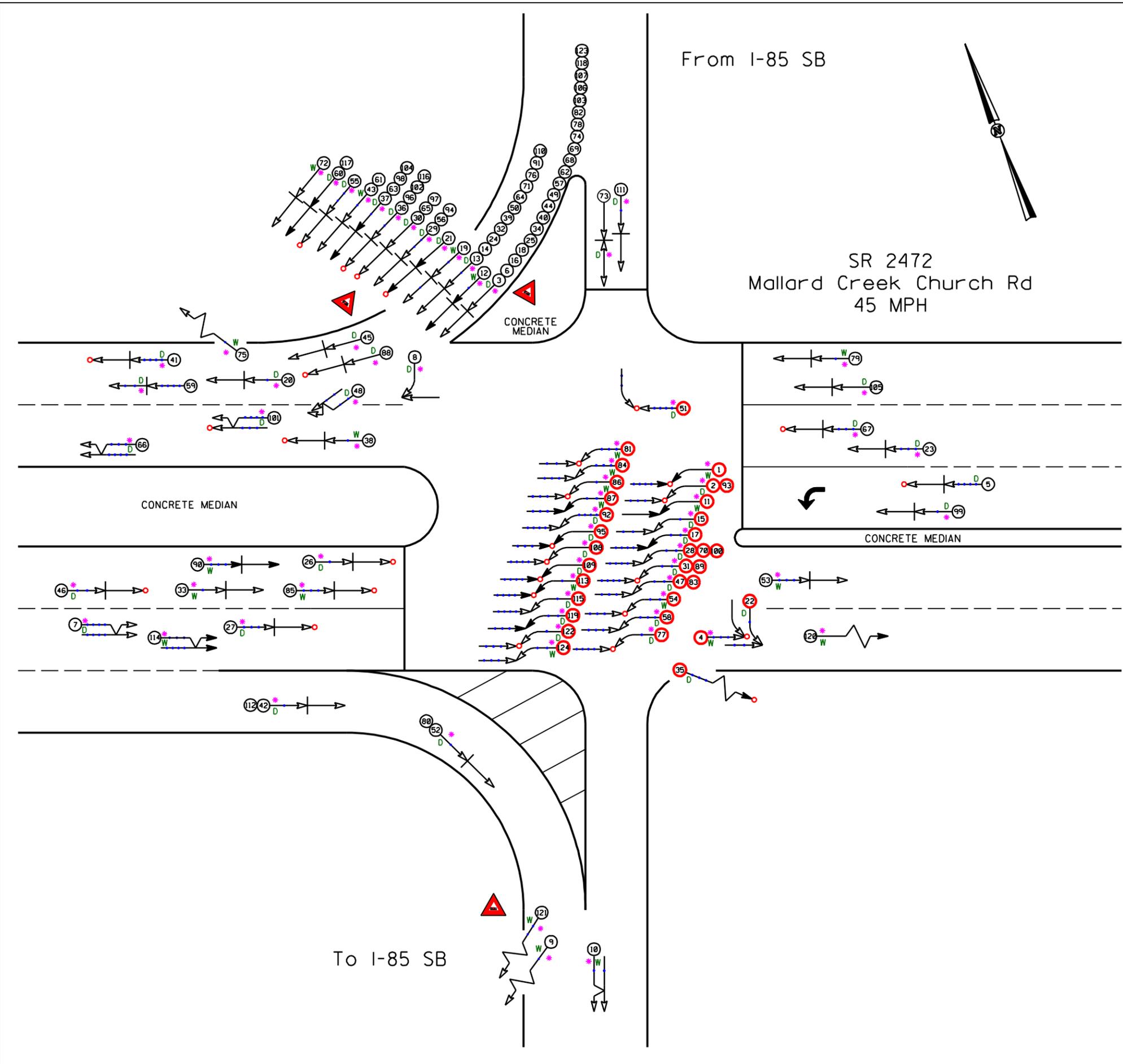
SS# 10-00-211  
 Mecklenburg County  
 City of Charlotte  
 BEFORE Period  
 12/1/97 - 11/30/02

Target Crashes

**TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT**

	<b>COLLISION DIAGRAM</b>	
	DIVISION: 10	AREA:
	STUDY PERIOD: 12/1/1997 - 11/30/2002	
	DISTANCE: Y-LINE = 150FT	
ANALYSIS PREPARED BY: JBS		
ANALYSIS CHECKED BY: BR		
DIAGRAM PREPARED BY: JBS		
DIAGRAM REVIEWED BY: ST		
SCALE: NOT TO SCALE		
DATE: 2-26-2009		
LOG NUMBER: SS* 10-00-211 BEFORE		

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



### 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		70 AND UP		SPEED UNKNOWN		

SS# 10-00-211  
 Mecklenburg County  
 City of Charlotte  
 AFTER Period  
 2/1/03 - 1/31/08



New Signalized  
 Intersection

Target Crashes

**TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT**

	COLLISION DIAGRAM	
	DIVISION: 10	AREA:
	STUDY PERIOD: 2/1/2003 - 1/31/2008	
	DISTANCE: Y-LINE = 150FT	
ANALYSIS PREPARED BY: JBS		
ANALYSIS CHECKED BY: BR		
DIAGRAM PREPARED BY: JBS		
DIAGRAM REVIEWED BY: ST		
SCALE: NOT TO SCALE		
DATE: 3-9-2009		
LOG NUMBER: SS* 10-00-211AFTR		

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