

Spot Safety Project Evaluation

Work Order #41000003709

Spot Safety Project # 04-02-271

Spot Safety Project Evaluation of the Traffic Signal Installation and Left Turn Lane Construction at the Intersection of NC 210 and SR 1330 (Raleigh Rd) 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



Brad Robinson, PE

2/17/2010

Date

Traffic Safety Project Engineer

The original statement of problem was that a high school had recently opened on SR 1330 approximately 0.5 miles north of NC 210.

The initial crash analysis was conducted from June 1, 1999 to May 31, 2002 with a total of 6 reported crashes, 5 of which were considered correctable by the chosen countermeasures. The final completion date for the improvements at the subject intersection was on January 9, 2004 with a total cost of \$150,000.00.

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 December 1, 2003 to February 29, 2004. The before period consisted of reported crashes from February 1, 2000 through November 30, 2003 (3 years and 10 months) and the after period consisted of reported crashes from March 1, 2004 through December 31, 2007 (3 years and 10 months). The beginning date for this analysis was limited by flasher that was installed in January 2000.

The treatment data consisted of all reported crashes within 150 feet of the subject intersection. The following data table depicts the Naive Before and After Analysis for the treatment location. Please note that there were two Target Crash Types for the applied countermeasure. The first are Frontal Impact Crashes. These crash types are considered as follows: Left Turn, same roadway; Left Turn, different roadway; Right Turn, same roadway; Right Turn, different roadway; Head On and Angle. The second type of Target Crashes were Rear-End Crashes approaching the intersection. The target crashes are clearly identified in the before and after period collision diagrams.

<u>Treatment Information</u>	Before	After	Percent Reduction (-) Percent Increase (+)
Total Crashes	7	16	128.6
Total Severity Index	5.23	8.98	71.7
Frontal Impact Crashes	4	10	150.0
Frontal Impact Severity Index	6.55	12.28	87.5
Rear-End Target Crashes	2	3	50.0
Rear-End Severity Index	1	3.47	247.0
Volume	6,800	7,400	8.8
<u>Target Crash Severity Summary</u>			
Fatal Crashes	0	0	N/A
Class A Crashes	0	1	N/A
Class B Crashes	3	1	-66.7
Class C Crashes	0	5	N/A
PDO Crashes	3	6	100.0

The naive before and after analysis at the treatment location resulted in a 129 percent increase in Total Crashes, a 150 percent increase in Frontal Impact Crashes, a 50 percent increase in Target Crashes, and a 9 percent increase in Average Daily Traffic (ADT). The before period ADT year was 2001 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 129 percent increase in Total Crashes, a 150 percent increase in Frontal Impact Crashes, and a 50 percent increase in Rear-End Target Crashes. The Total Severity Index increased by 72 percent, the Frontal Impact Severity Index increased by 88 percent, and the Rear-End Severity Index increased by 247 percent. The summary results above demonstrate that both Total Crashes and Target Crashes appear to have increased at the subject location from the before to the after period.

The calculated benefit to cost ratio for this project is -7.35 considering total crashes. The benefit to cost ratio considering only target crashes is also -7.26. 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.

Both type of Target Crashes increased from the before to the after period. Two small patterns of Frontal Impact Crashes developed in the after period. There were five Left Turn-Same Roadway Crashes on SR 1330, three involving northbound vehicles turning left and two involving southbound vehicles turning left. There were three Left Turn-Different Roadway Crashes between northbound SR 1330 vehicles turning left and eastbound NC 210 vehicles.

Just for your information, a collision diagram was made including the entire after period (March 1, 2004 through December 31, 2007) plus the additional crash data we have at the time this analysis was conducted (through November 30, 2009). A table is provided below comparing this period to the before period data in a per-year format. The before period is still 3 years, 10 months and the after period is 5 years, 9 months.

	Before	Before Per Year	After	After Per Year	Annual Percent Reduction (-) Percent Increase (+)
Total Crashes	7	1.83	23	4	118.6
Total Severity Index	5.23		10.81		106.7
Frontal Impact Crashes	4	1.04	18	3.13	201
FI Severity Index	6.55		12.71		94
Rear-End Target Crashes	2	0.52	4	0.69	32.7
Rear-End Severity Index	1		2.85		185

When looking at this data on a per-year basis, it appears that after including this additional time period, the crash patterns remained relatively consistent with what was analyzed in the original after period. The Total Crash increase was slightly less (119% vs. 129%), the Frontal Impact Crash

increase was more (201% vs. 150%) and the Rear-End Crash increase was slightly less (33% vs. 50%). Please see additional Collision Diagram included at the end of this report.

Please see the attached *Treatment Site Photos*. Photos were obtained from Google Street-view. 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: NC 210 at SR 1330
 COUNTY: Johnston
 FILE NO.: SS 04-02-271

BY: bdr
 DATE: 2/8/2010

DETAILED COST: TYPE IMPROVEMENT - Signal and Left Turn Lanes

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$0	0	0.000	\$0
	\$150,000	10	0.149	\$22,354
Right-of-Way	\$0	0	0.000	\$0
TOTALS	\$150,000	10	0.149	\$22,354

ESTIMATED INCREASE IN ANNUAL MAINT. COST = \$2,000
 ESTIMATED INCREASE IN ANNUAL UTILITY COST = \$900
 TOTAL ANNUAL COST= \$25,254
 TOTAL COST OF PROJECT= \$150,000

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	3.83	0	0.00	4	1.04	3	0.78	\$24,178
AFTER	3.83	1	0.26	7	1.83	8	2.09	\$209,817

Annual Benefits from Crash Cost Savings (\$185,640)

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = (\$210,894)

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = -7.35

TOTAL COST OF PROJECT - \$150,000 COMPREHENSIVE B/C RATIO - -7.35

BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: NC 210 at SR 1330
 COUNTY: Johnston
 FILE NO.: SS 04-02-271 Target Crashes Only

BY: bdr
 DATE: 2/8/2010

DETAILED COST: TYPE IMPROVEMENT - Signal and Left Turn Lanes

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
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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	3.83	0	0.00	3	0.78	3	0.78	\$18,956
AFTER	3.83	1	0.26	6	1.57	6	1.57	\$202,402

Annual Benefits from Crash Cost Savings (\$183,446)

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = (\$208,701)

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = -7.26

TOTAL COST OF PROJECT - \$150,000 COMPREHENSIVE B/C RATIO - -7.26

Treatment Site Photos from Google Street-View



Looking West on NC 210



Looking East on NC 210



Looking North on SR 1330 (Raleigh Rd)

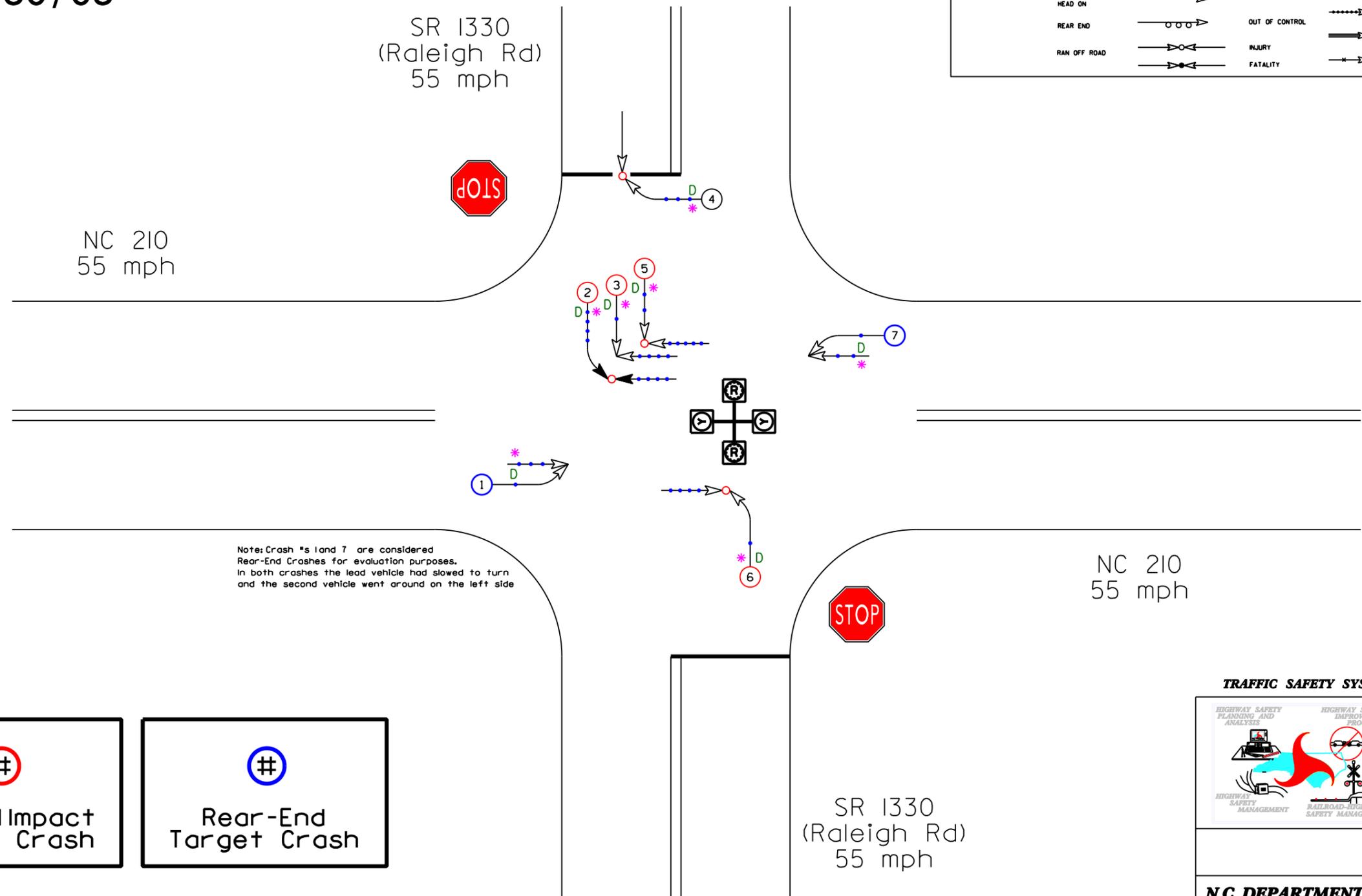


Looking South on SR 1330 (Raleigh Rd)

Johnston County
 NC 210 at SR 1330 (Raleigh Rd)
 BEFORE Period
 2/1/00-11/30/03

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		



NC 210
55 mph

SR 1330
(Raleigh Rd)
55 mph

Note: Crash #s 1 and 7 are considered Rear-End Crashes for evaluation purposes. In both crashes the lead vehicle had slowed to turn and the second vehicle went around on the left side

NC 210
55 mph

SR 1330
(Raleigh Rd)
55 mph

Frontal Impact
Target Crash

Rear-End
Target Crash

TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

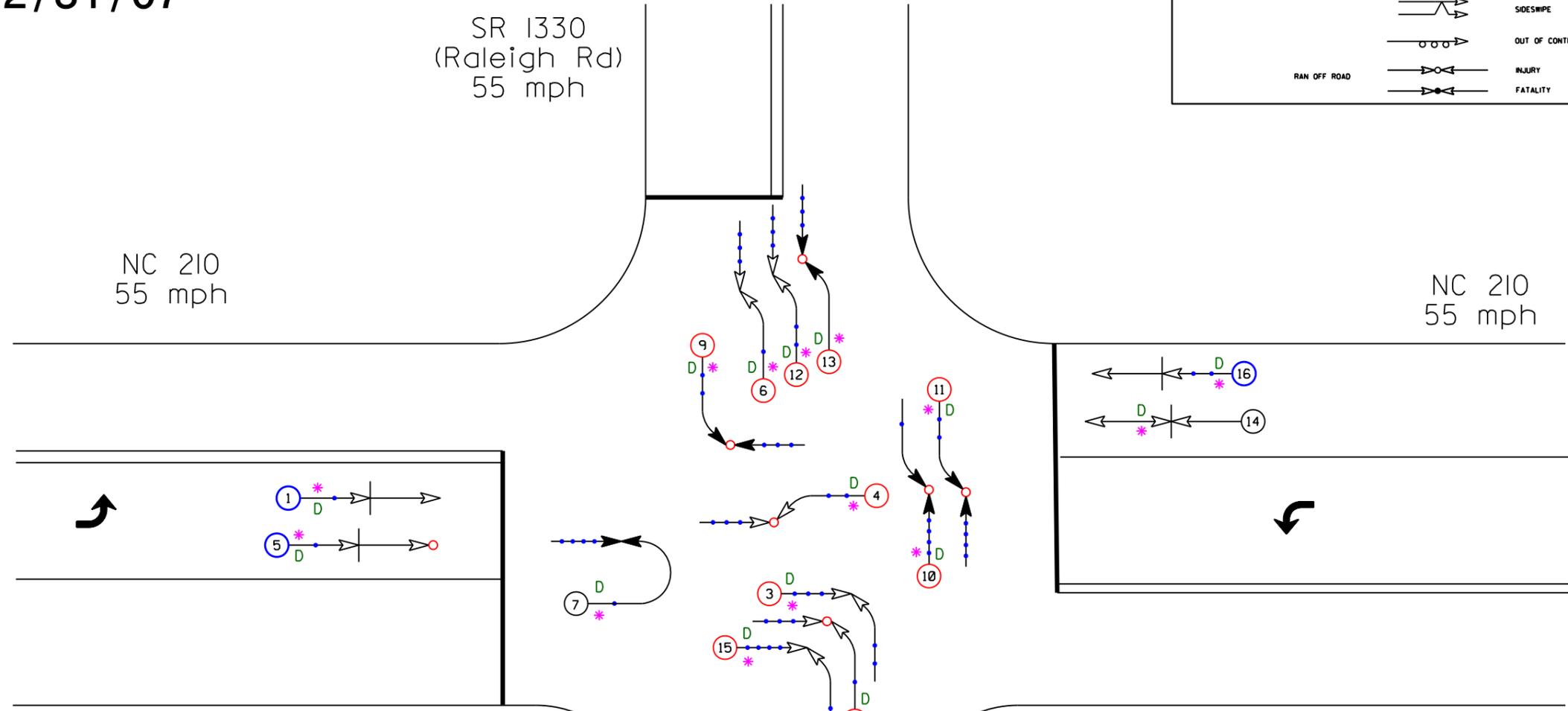
	COLLISION DIAGRAM	
	DIVISION: 4	AREA:
	STUDY PERIOD: 2/1/00-11/30/03	
	DISTANCE: Y-LINE + 150 FT	
	ANALYSIS PREPARED BY: BDR	
ANALYSIS CHECKED BY:		
DIAGRAM PREPARED BY: BDR		
DIAGRAM REVIEWED BY:		
SCALE: NOT TO SCALE		
DATE: December 2009		
LOG NUMBER: 4000003709		

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

Johnston County
 NC 210 at SR 1330 (Raleigh Rd)
 AFTER Period
 3/1/04-12/31/07

LEGEND

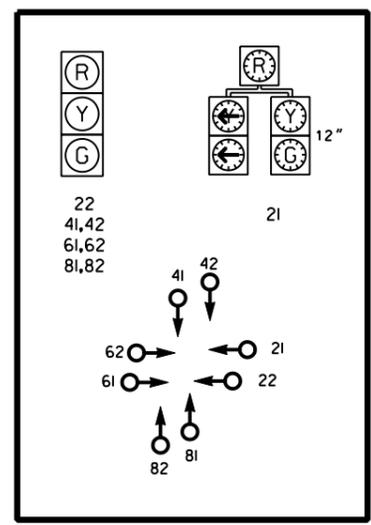
MOVING VEHICLE	ANGLE	9 MPH OR LESS	P PEDESTRIAN
PARKED VEHICLE	TURNING	10 MPH TO 19	T TRAIN
PARKING VEHICLE	BACKING	20 MPH TO 29	* DRIVER AT FAULT
FIXED OBJECT	SIDESWIPE	30 MPH TO 39	D DRY
RAN OFF ROAD	OUT OF CONTROL	40 MPH TO 49	W WET
	INJURY	50 MPH TO 59	I ICY OR SNOWY
	FATALITY	60 MPH TO 69	O OILY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



#
 Frontal Impact
 Target Crash

#
 Rear-End
 Target Crash

SR 1330
 (Raleigh Rd)
 55 mph



TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

	COLLISION DIAGRAM	
	DIVISION: 4	AREA:
	STUDY PERIOD: 3/1/04-12/31/07	
	DISTANCE: Y-LINE = 150 FT	
	ANALYSIS PREPARED BY: BDR	
ANALYSIS CHECKED BY:		
DIAGRAM PREPARED BY: BDR		
DIAGRAM REVIEWED BY:		
SCALE: NOT TO SCALE		
DATE: December 2009		
LOG NUMBER: 4000003709		

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

Johnston County NC 210 at SR 1330 (Raleigh Rd) AFTER PERIOD PLUS ADDITIONAL TIME 3/1/04-11/30/09

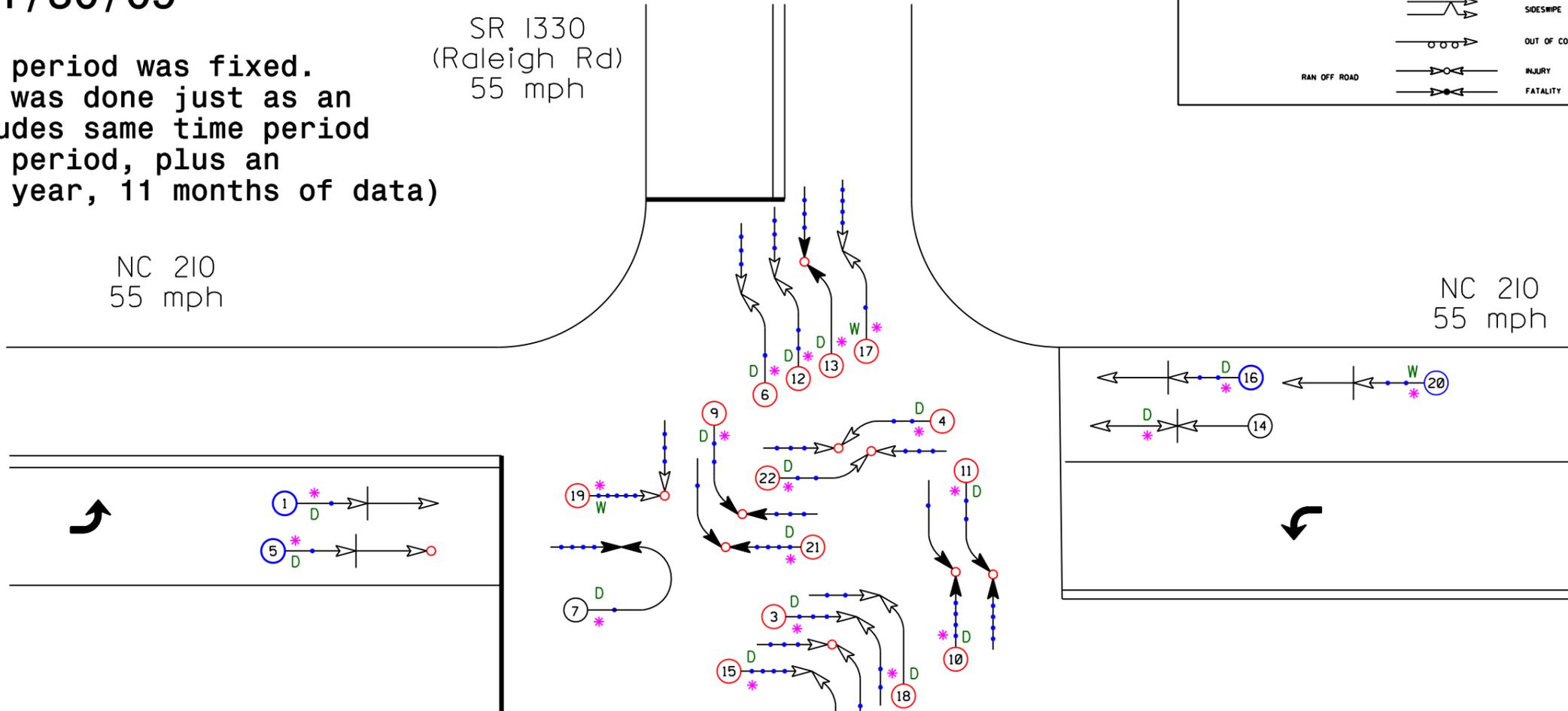
(Before time period was fixed.
This Diagram was done just as an
fyi and includes same time period
as the After period, plus an
additional 1 year, 11 months of data)

SR 1330
(Raleigh Rd)
55 mph

NC 210
55 mph

NC 210
55 mph

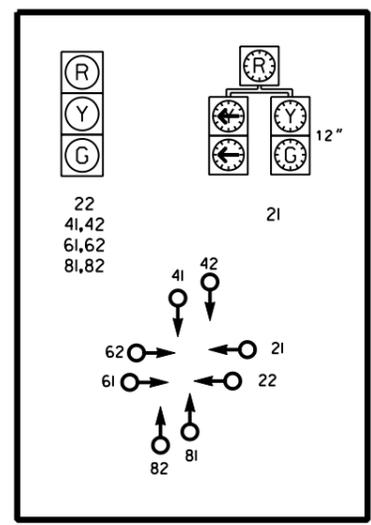
LEGEND					
MOVING VEHICLE	ANGLE	→	9 MPH OR LESS	P	PEDESTRIAN
PARKED VEHICLE	TURNING	↘	10 MPH TO 19	T	TRAIN
PARKING VEHICLE	BACKING	↔	20 MPH TO 29	*	DRIVER AT FAULT
FIXED OBJECT	SIDESWIPE	↔	30 MPH TO 39	D	DRY
RAN OFF ROAD	OUT OF CONTROL	↔	40 MPH TO 49	W	WET
	INJURY	↔	50 MPH TO 59	I	ICY OR SNOWY
	FATALITY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



#
Frontal Impact
Target Crash

#
Rear-End
Target Crash

SR 1330
(Raleigh Rd)
55 mph



TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

COLLISION DIAGRAM	
DIVISION: 4	AREA:
STUDY PERIOD: 3/1/04-12/31/07	
DISTANCE: Y-LINE = 150 FT	
ANALYSIS PREPARED BY: BDR	
ANALYSIS CHECKED BY:	
DIAGRAM PREPARED BY: BDR	
DIAGRAM REVIEWED BY:	
SCALE: NOT TO SCALE	
DATE: December 2009	
LOG NUMBER: 4000003709	

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