

# Spot Safety Project Evaluation

Order # 41000001102

Spot Safety Project # 11-03-205

## Spot Safety Project Evaluation of the Signal Phase Change US 221 / NC 194 at US 221 Business / NC 194 / NC 163 Ashe 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

9-28-2009

Date

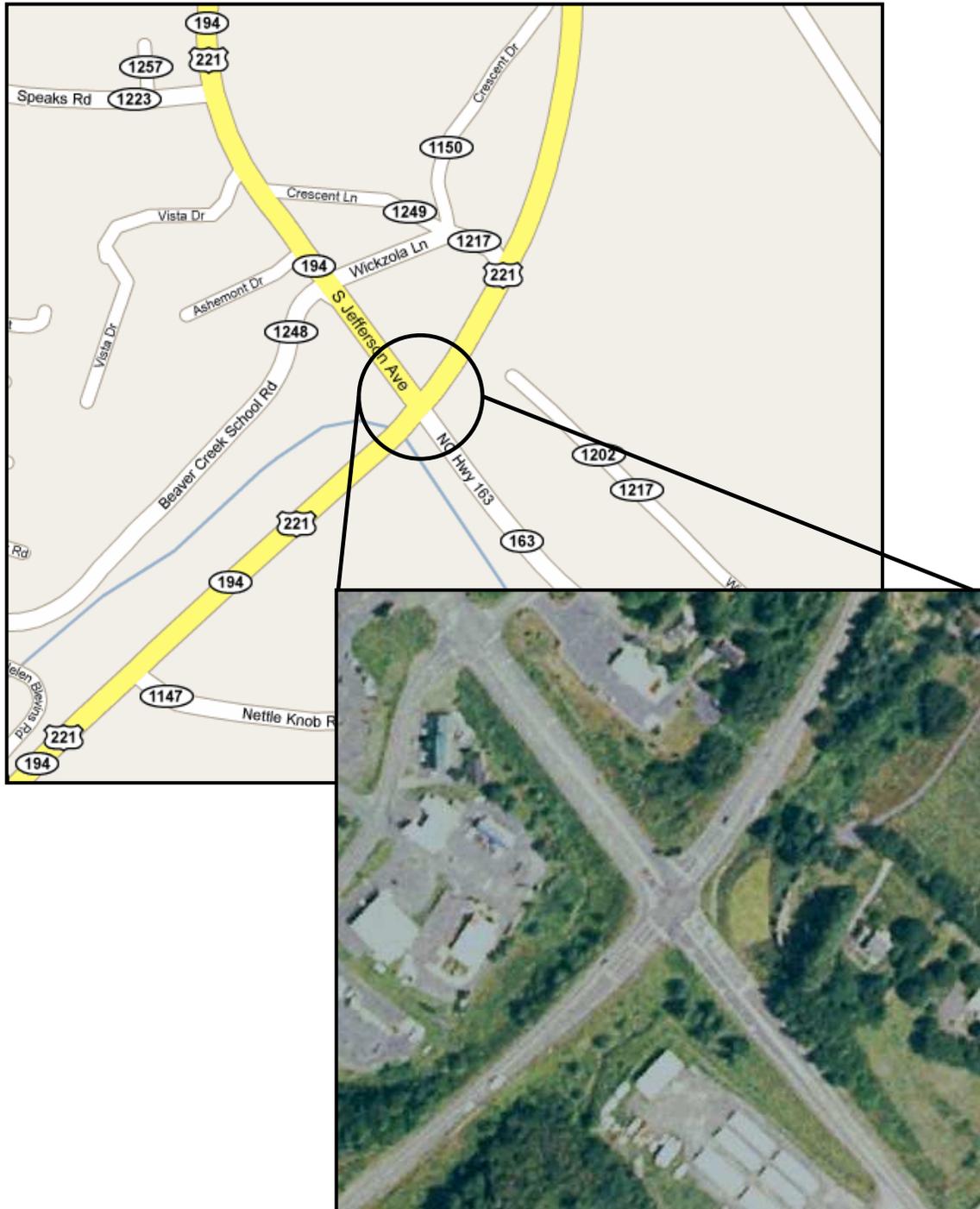
Traffic Safety Project Engineer

# Spot Safety Project Evaluation Documentation

## Subject Location

Evaluation of Spot Safety Project Number 11-03-205 located at the Intersection of US 221 (Robert G. Barr Expressway) / NC 194 at US 221 Business (Jefferson Ave) / NC 194 / NC 163 in Ashe County, City of West Jefferson.

The Sig ID is 11-0341 for this existing traffic signal.



## Project Information and Background from the Project File Folder

The spot safety project improvement countermeasure chosen for the subject location was the addition of a northbound US 221 protected-permissive left turn signal phase. Also, pavement markings were revised and the US 221 left turn lanes were shifted three (3) feet to provide better sight distance for left turning motorists. US 221 is a two lane roadway that widens at the intersection to provide both right and left turn lanes. US 221 Business (Jefferson Avenue) / NC 194 / NC 163 is a four-lane roadway that also provides dedicated right and left turn lanes at the intersection. The speed limits are 55 mph and 45 mph respectfully. This is a major crossroads intersection accessing the city of West Jefferson and has been operating under signal control since November of 1983.

The original statement of problem was the existing crash pattern of left turning collisions resulting from US 221 vehicles turning against the opposing high volume and high speed approach. The turn phase was permissive only in the before period. The intended purpose of the countermeasure was to alleviate crashes.

The initial crash analysis was completed from January 1, 2000 to December 31, 2002 with fourteen (14) reported crashes, eight (8) of which were deemed correctable. The final completion date for the improvement at the subject intersection was on April 21, 2004 with a total cost of \$69,000.

### 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 months of March through April 2004. The before period consisted of reported crashes from January 1, 1999 through February 29, 2004 (5 years and 2 months); and the after period consisted of reported crashes from May 1, 2004 through June 30, 2009 (5 years and 2 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 and aerial map for further details.*

The following data table depicts the Naive Before and After Analysis for the treatment location. Please note that Northbound US 221 Left Turn-Same Roadway Crashes were the target crashes for the applied countermeasure.

<u>Treatment Information</u>	<b>Before</b>	<b>After</b>	<b>Percent Reduction (-) Percent Increase (+)</b>
Total crashes	36	34	- 5.6 %
Total Severity Index	6.19	3.18	- 48.6 %
Target Crashes	14	12	- 14.3 %
Target Crash Severity Index	11.17	4.70	- 57.9 %
Volume	17,600	24,200	37.5 %

<u>Injury Crash Summary</u>	Before	After	Percent Reduction (-) Percent Increase (+)
Fatal injury Crashes	0	0	N/A
Class A injury Crashes	1	0	- 100.0 %
Class B injury Crashes	4	4	0.0 %
Class C Injury Crashes	11	6	- 45.5 %
<b>Total Injury Crashes</b>	<b>16</b>	<b>10</b>	<b>- 37.5 %</b>

The naive before and after analysis at the treatment location resulted in a 6 percent decrease in Total Crashes, a 14 percent decrease in Target Crashes, and a 49 percent decrease in the Total Severity Index. 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 6 percent decrease in Total Crashes and an 14 percent decrease in Target Crashes. The summary results above demonstrate that both Total Crashes and Target Crashes appear to have decreased slightly at the treatment location from the before to the after period.

Referencing the *Collision Diagrams*, the before period left turn target crash pattern at the intersection consisted of fourteen (14) collisions, including one A-injury crash. After the northbound US 221 left turn protected-permissive signal phase was installed and the turn lanes shifted, this pattern still remained consistent with twelve (12) collisions. However, due to there being no severe injury collisions (K or A) in the after period, this countermeasure obtained a fairly high benefit-cost ratio.

From the collision diagrams, the Safety Evaluation Group also observed a slight decrease in intersection red-light run collisions from nine (9) in the before period to seven (7) in the analysis after period. Rear-end collisions did increase slightly from seven (7) to ten (10) through the analysis period. One aspect to note is that the intersection ADT did increase by 37.5% during this time period; however the Safety Evaluation Group does not know the exact distribution of this volume increase and was unable to analyze the target crash pattern accounting for the traffic volume adjustment.

The calculated benefit to cost ratio for this project is **10.47 considering total crashes**. The benefit to cost ratio **considering only target crashes is 9.96**. 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.

Photos were not available from the internet at the time of analysis for this location. 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 - Total Crashes**

LOCATION: US 221 at US 221 Business		BY: JBS							
COUNTY: Ashe		DATE: 9/22/2009							
FILE NO.: SS 11-03-205		NOTES: Total Crashes							
DETAILED COST:	TYPE IMPROVEMENT - Signal Phase Change - NB US 221 Protected-Permissive								
ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST					
Construction	\$69,000	10	0.149	\$10,283					
Right-of-Way	\$0	0	0.000	\$0					
TOTALS	\$69,000	10	0.149	\$10,283					
ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$200					
ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$150					
TOTAL ANNUAL COST=				\$10,633					
TOTAL COST OF PROJECT=				\$69,000					
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	5.16	1	0.19	15	2.91	20	3.88	\$164,341	
AFTER	5.16	0	0.00	10	1.94	24	4.65	\$53,023	
Annual Benefits from Crash Cost Savings								\$111,318	
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST					=	\$100,685			
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST					=	10.47			
TOTAL COST OF PROJECT		-	\$69,000	COMPREHENSIVE B/C RATIO		-	10.47		

**BENEFIT-COST ANALYSIS WORKSHEET - Target Crashes**

LOCATION: US 221 at US 221 Business		BY: JBS							
COUNTY: Ashe		DATE: 9/22/2009							
FILE NO.: SS 11-03-205		NOTES: Target Crashes - NB Left Turn-Same Roadway							
DETAILED COST:	TYPE IMPROVEMENT - Signal Phase Change - NB US 221 Protected-Permissive								
ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST					
Construction	\$69,000	10	0.149	\$10,283					
Right-of-Way	\$0	0	0.000	\$0					
TOTALS	\$69,000	10	0.149	\$10,283					
ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$200					
ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$150					
TOTAL ANNUAL COST=				\$10,633					
TOTAL COST OF PROJECT=				\$69,000					
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	5.16	1	0.19	9	1.74	4	0.78	\$131,318	
AFTER	5.16	0	0.00	6	1.16	6	1.16	\$25,465	
Annual Benefits from Crash Cost Savings								\$105,853	
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST					=	\$95,220			
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST					=	9.96			
TOTAL COST OF PROJECT		-	\$69,000	COMPREHENSIVE B/C RATIO		-	9.96		



US 221  
55 MPH

US 221 Business  
NC 194  
Jefferson Ave  
45 MPH

NC 163  
55 MPH

US 221 / NC 194  
55 MPH

**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# 11-03-205  
Ashe County  
City - W. Jefferson  
BEFORE Period  
1/1/99 - 2/29/04

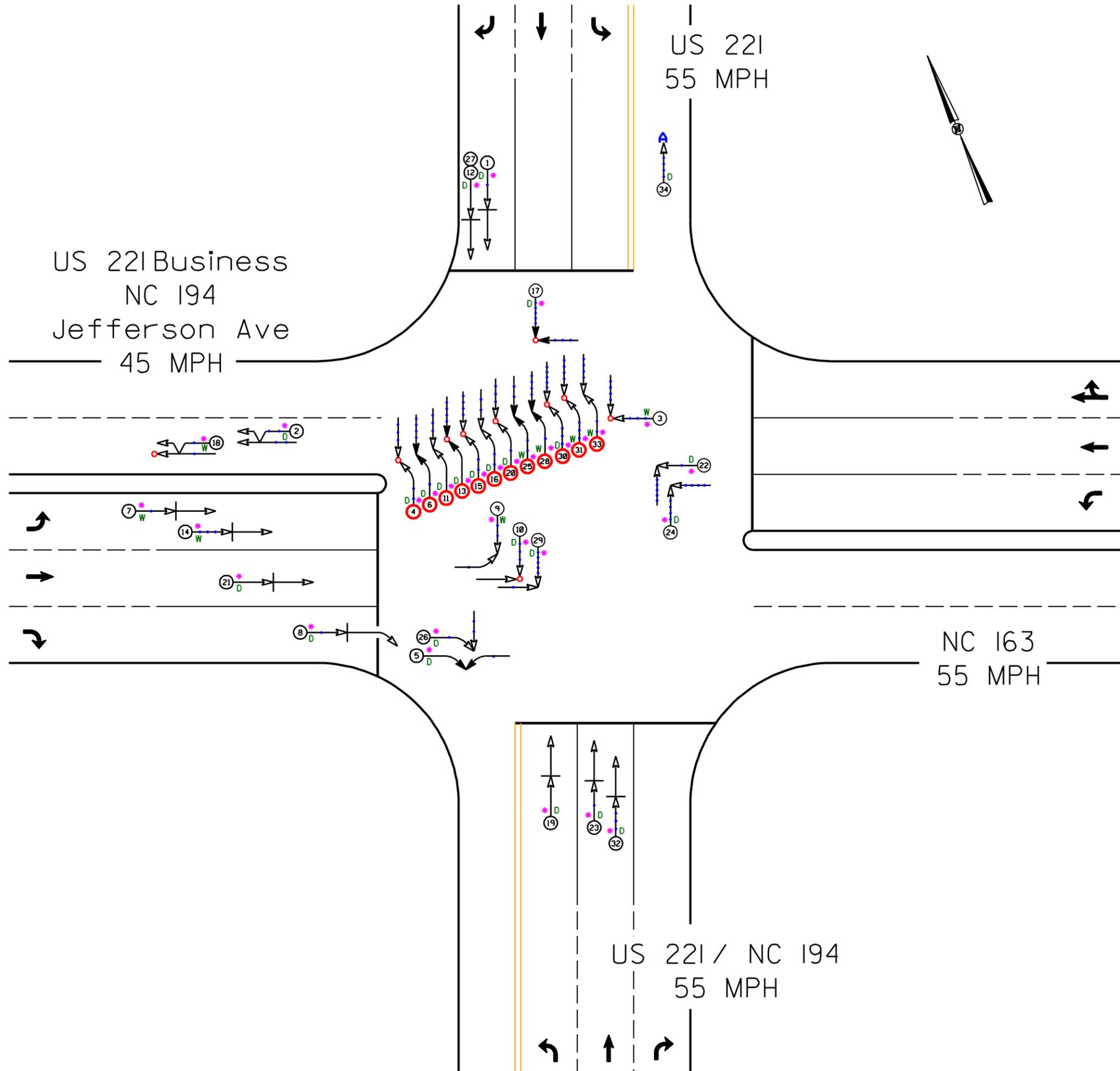
Existing  
 Traffic Signal  
 Sig ID 11-0341

NB Left Turn  
Target Crashes

**TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT**

	<b>COLLISION DIAGRAM</b>	
	DIVISION: II	AREA: I
	STUDY PERIOD: 1/1/1999 - 2/29/2004	
	DISTANCE: Y-LINE = 150 FT	
ANALYSIS PREPARED BY: JBS		
ANALYSIS CHECKED BY: BR		
DIAGRAM PREPARED BY: JBS		
DIAGRAM REVIEWED BY: ST		
SCALE: NOT TO SCALE		
DATE: 9-16-2009		
LOG NUMBER: SS* 11-03-205 BEFORE		

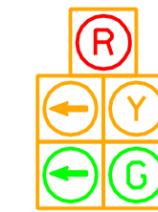
**N.C. DEPARTMENT of TRANSPORTATION**  
**DIVISION of HIGHWAYS**  
**TRANSPORTATION MOBILITY and**  
**SAFETY DIVISION**



**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# II-03-205  
 Ashe County  
 City - W. Jefferson  
 AFTER Period  
 5/1/04 - 6/30/09



Upgraded  
 Traffic Signal  
 Sig ID II-0341  
 Add NB 221 Prot-Perm Phase

NB Left Turn  
 Target Crashes

**TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT**

	<b>COLLISION DIAGRAM</b>	
	DIVISION: II	AREA: I
STUDY PERIOD: 5/1/2004 - 6/30/2009		
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: 9-21-2009		
LOG NUMBER: SS* II-03-205 AFTER		

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