Spot Safety Project Evaluation

Order # 41000005676

Spot Safety Project # 09-02-204

Spot Safety Project Evaluation of the Signal Installation
SR 4325 (MLK Jr. Drive) at Reynolds Park Road
Winston-Salem, Forsyth 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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Traffic Safety Project Engineer

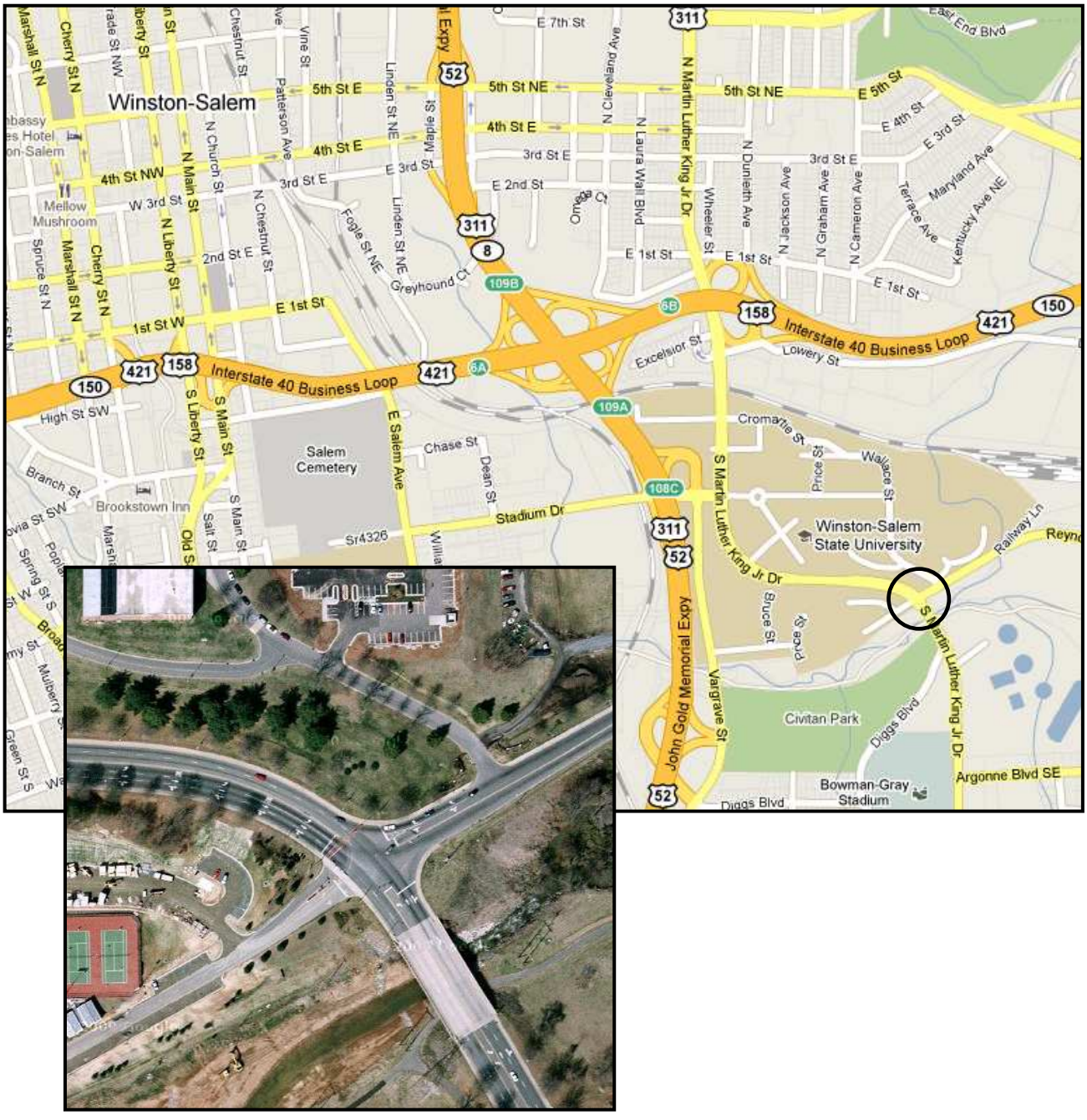
4-20-2010
Date

Spot Safety Project Evaluation Documentation

Subject Location

Evaluation of Spot Safety Project Number 09-02-204 located at the Intersection of SR 4325 (Martin Luther King Jr. Drive) at Reynolds Park Road in Forsyth County, in City of Winston-Salem by Winston-Salem State University.

The Sig ID is 09-1283 for this newly installed traffic signal.



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 with interconnection to the Winston-Salem signal system. SR 4325 (Martin Luther King Jr. Drive) is a four lane divided roadway with a left turn lane on the north approach and a five lane section on the south approach with a speed limit of 35 mph. Reynolds Park Road is a two-lane roadway with a marked right turn lane at the intersection and a 45 mph posted speed limit. The fourth leg of the intersection is composed of a driveway to Winston-Salem State University's Anderson Center and is also a two lane roadway. The location is a crossroads type intersection which is located at the bottom of a vertical curve and was controlled by stop signs on the Reynolds Park Road and Anderson Center Driveway approaches during the before period.

The original statement of problem was the existence of angle collisions resulting from motorists entering a high volume roadway from a lower volume side street. This location was also experiencing congestion and delay issues, especially during school operation of the University. The intended purpose of the new signal was to alleviate crashes and improve intersection functionality.

The initial crash analysis was completed from May 1, 1999 to May 1, 2002 with nineteen (19) reported crashes, six (6) of which were deemed correctable including one A-injury crash. The final completion date for the improvement at the subject intersection based from the actual crash reports was during the 3rd Quarter of 2002 with a total cost of $45,000.

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 were the months of July through September 2002 (3rd Quarter of 2002). The before period consisted of reported crashes from February 1, 1995 through June 30, 2002 (7 years and 5 months); and the after period consisted of reported crashes from October 1, 2002 through February 28, 2010 (7 years and 5 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; and Angle.

Treatment Information	Before	After	Percent Reduction (-) Percent Increase (+)
Total Crashes	71	97	36.6 %
Total Severity Index	4.54	4.81	5.9 %
Target Crashes – Frontal Impact	15	19	26.7 %
Target Crash (Frontal) Severity Index	6.92	5.28	- 23.7 %
Volume (1998, 2006)	19,800	23,100	16.7 %

Injury Crash Summary	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	7	6	- 14.3 %
Class C Injury Crashes	27	44	63.0 %
Total Injury Crashes	34	50	47.1 %

The naive before and after analysis at the treatment location resulted in a 37 percent increase in Total Crashes, a 27 percent increase in Target Crashes, and a 6 percent increase in the Total Severity Index. The before period ADT year was 1998 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 37 percent increase in Total Crashes and a 27 percent increase in Target Crashes. The summary results above demonstrate that both Total and Target Crashes appear to have increased at the treatment location from the before to the after period.

Referencing the *Collision Diagrams*, the before period was experiencing a pattern of eleven (11) crashes from motorists improperly accessing the intersection attempting to enter or cross SR 4325 from Reynolds Park Road. Only one (1) vehicle actually ran the stop sign. There was also a small pattern of three (3) left-turn same roadway crashes on Martin Luther King Jr. Drive. After the signal installation, frontal impact crashes increased by 27 percent mainly from left-turn same roadway crashes on SR 4325. Collisions from the permissive left turn signal phase on SR 4325 increased from three (3) in the before period to fourteen (14) in the after period.

The calculated benefit to cost ratio for this project is **(-4.49) considering total crashes**. The benefit to cost ratio **considering only the frontal impact target crashes is (-0.02)**. 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.

The intersection also experienced two other distinct crash patterns during the evaluation period that are highlighted and discussed below:

1 – Rear-End Crashes in the Reynolds Park Rd Right Turn Lane

2 – Rear-End Crashes on the Southbound SR 4325 Approach

Westbound Reynolds Park Rd	**Before**	**After**	**Percent Reduction (-) Percent Increase (+)**
Right Turn Lane Rear-End Crashes	24	17	- 29.2 %
Right Turn Rear-End Severity Index	4.39	4.92	12.1 %

The before period showed a pattern of twenty-four (24) rear-end collisions in the right turn lane on Reynolds Park Road. All of the collisions in the before period were at speeds of under 20 mph and resulted from vehicles pulling forward after believing the vehicle in front had cleared. After the signal installation, this pattern reduced slightly to seventeen (17) collisions; thirteen (13) of which occurred under 20 mph.

North Leg of SR 4325 Martin Luther King Jr. Drive	**Before**	**After**	**Percent Reduction (-) Percent Increase (+)**
Southbound Rear-End Crashes	4	29	500+ %
SB Rear-End Severity Index	2.85	5.34	87.4 %
Total Crashes on North Leg of SR 4325	20	44	120.0 %
Wet Crashes on North Leg MLK Jr. Drive	9	16	77.8 %
SR 4325 North Leg Ingress Wet Crashes	3	15	400.0 %
SR 4325 North Leg Egress Wet Crashes	6	1	- 83.3 %

The highest increase in crashes at the intersection during the analysis period was observed on the north leg of the intersection. Southbound Rear-End crashes on SR 4325 (MLK Jr. Drive) approaching the intersection increased from four (4) to twenty-nine (29) collisions with a severity index increase of 87 percent. Total crashes on this leg of the intersection increased by 120 percent from twenty (20) to forty-four (44) crashes.

From examining the Collision Diagrams on this approach to the intersection, we felt there might exist a wet-roadway crash issue. Forty-five (45) percent of the north leg crashes during the before period and thirty-six (36) percent during the after period were wet roadway related. These crashes include rear-ends, sideswipes, vehicles running-off the roadway, and motorists crossing the concrete median and striking on-coming traffic. From the table above, notice the increase by 400 percent in wet roadway crashes on the ingress (approaching the intersection) through the evaluation.

To further validate the wet roadway crash issue with the SR 4325 north leg, a comparison was conducted between wet roadway crashes on the north leg to the total intersection. The before period experienced nine (9) wet crashes on the north approach and twelve (12) at the intersection; which means this leg carried 75 percent of the wet collisions. Again, the after period indicated a 76 percent grouping of wet crashes with the north leg concentrating sixteen (16) of the twenty-one (21) intersection wet roadway crashes.

Please see the attached *Treatment Site Photos*. Photos are provided from Google Street View for all four 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.

TREATMENT SITE PHOTOS

Traveling South on SR 4325 (MLK Jr. Drive) approaching signal

Traveling South on SR 4325 (MLK Jr. Drive)

Traveling North on SR 4325 (Martin Luther King Jr. Drive)

Looking West onto the Anderson Center Driveway approach
Winston-Salem State University Campus

Traveling West on Reynolds Park Drive approaching signal

Traveling West on Reynolds Park Drive

BENEFIT-COST ANALYSIS WORKSHEET - Total Crashes

LOCATION: MLK at Reynolds Park
COUNTY: Forsyth
FILE NO.: SS 09-02-204
BY: JBS
DATE: 4/19/2010
NOTES: Total Crashes

DETAILED COST: TYPE IMPROVEMENT - New Traffic Signal

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	$45,000	10	0.149	$6,706
	$0	0	0.000	$0
Right-of-Way	$0	0	0.000	$0
TOTALS	$45,000	10	0.149	$6,706

ESTIMATED INCREASE IN ANNUAL MAINT. COST = $2,200
ESTIMATED INCREASE IN ANNUAL UTILITY COST = $900

TOTAL ANNUAL COST= $9,806
TOTAL COST OF PROJECT= $45,000

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	7.42	0	0.00	34	4.58	37	4.99	$101,927
AFTER	7.42	0	0.00	50	6.74	47	6.33	$145,997

Annual Benefits from Crash Cost Savings ($44,070)

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = ($53,876)

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = -4.49

TOTAL COST OF PROJECT - $45,000 COMPREHENSIVE B/C RATIO - -4.49

BENEFIT-COST ANALYSIS WORKSHEET - Target Crashes

LOCATION: MLK at Reynolds Park
COUNTY: Forsyth
FILE NO.: SS 09-02-204
BY: JBS
DATE: 4/20/2010
NOTES: Target Crashes - Frontal Impact

DETAILED COST: TYPE IMPROVEMENT - New Traffic Signal

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	$45,000	10	0.149	$6,706
	$0	0	0.000	$0
Right-of-Way	$0	0	0.000	$0
TOTALS	$45,000	10	0.149	$6,706

ESTIMATED INCREASE IN ANNUAL MAINT. COST = $2,200
ESTIMATED INCREASE IN ANNUAL UTILITY COST = $900

TOTAL ANNUAL COST= $9,806
TOTAL COST OF PROJECT= $45,000

COMPREHENSIVE COST REDUCTION:

ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES

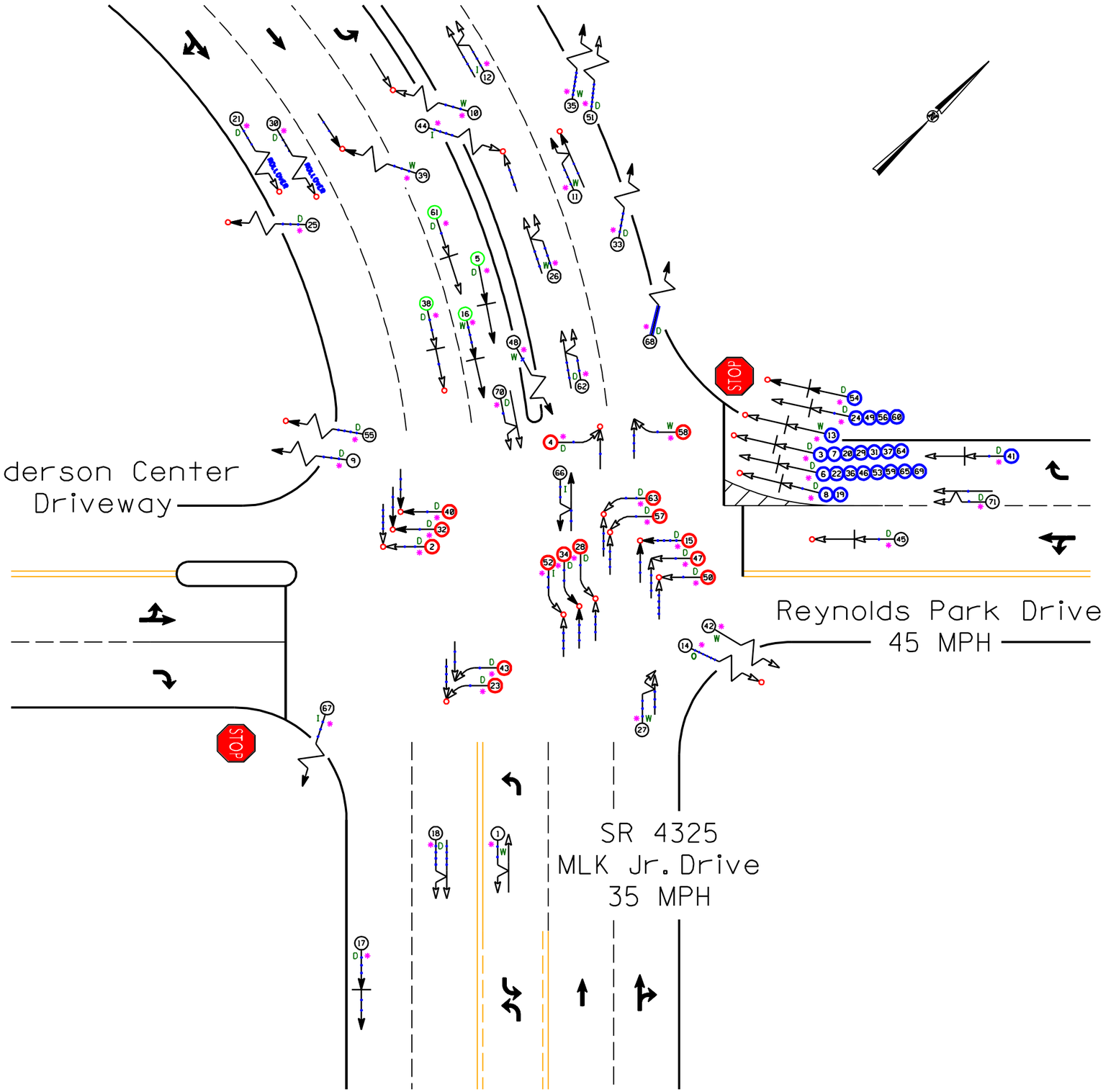
TIME PERIOD	YEARS	K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	PDO CRASHES	PDO CRASHES PER YR	ANNUAL COSTS
BEFORE	7.42	0	0.00	12	1.62	3	0.40	$30,687
AFTER	7.42	0	0.00	11	1.48	8	1.08	$30,889

Annual Benefits from Crash Cost Savings ($202)

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = ($10,008)

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = -0.02

TOTAL COST OF PROJECT - $45,000 COMPREHENSIVE B/C RATIO - -0.02



LEGEND

MOVING VEHICLE
PEDESTRIAN
PARKED VEHICLE
PARKING VEHICLE
FIXED OBJECT
HEAD ON
REAR END
RAN OFF ROAD

ANGLE
TURNING
BACKING
SIDESWIPE
OUT OF CONTROL
INJURY
FATALITY

9 MPH OR LESS
10 MPH TO 19
20 MPH TO 29
30 MPH TO 39
40 MPH TO 49
50 MPH TO 59
60 MPH TO 69
70 AND UP
SPEED UNKNOWN

P PEDESTRIAN
T TRAIN
* DRIVER AT FAULT
D DRY
W WET
I ICY OR SNOWY
O OILY

SS# 09-02-204
Forsyth County
Winston-Salem
WSSU Campus
BEFORE Period
2/1/95 - 6/30/02

Frontal Impact Target Crashes

SB MLK Rear-Ends

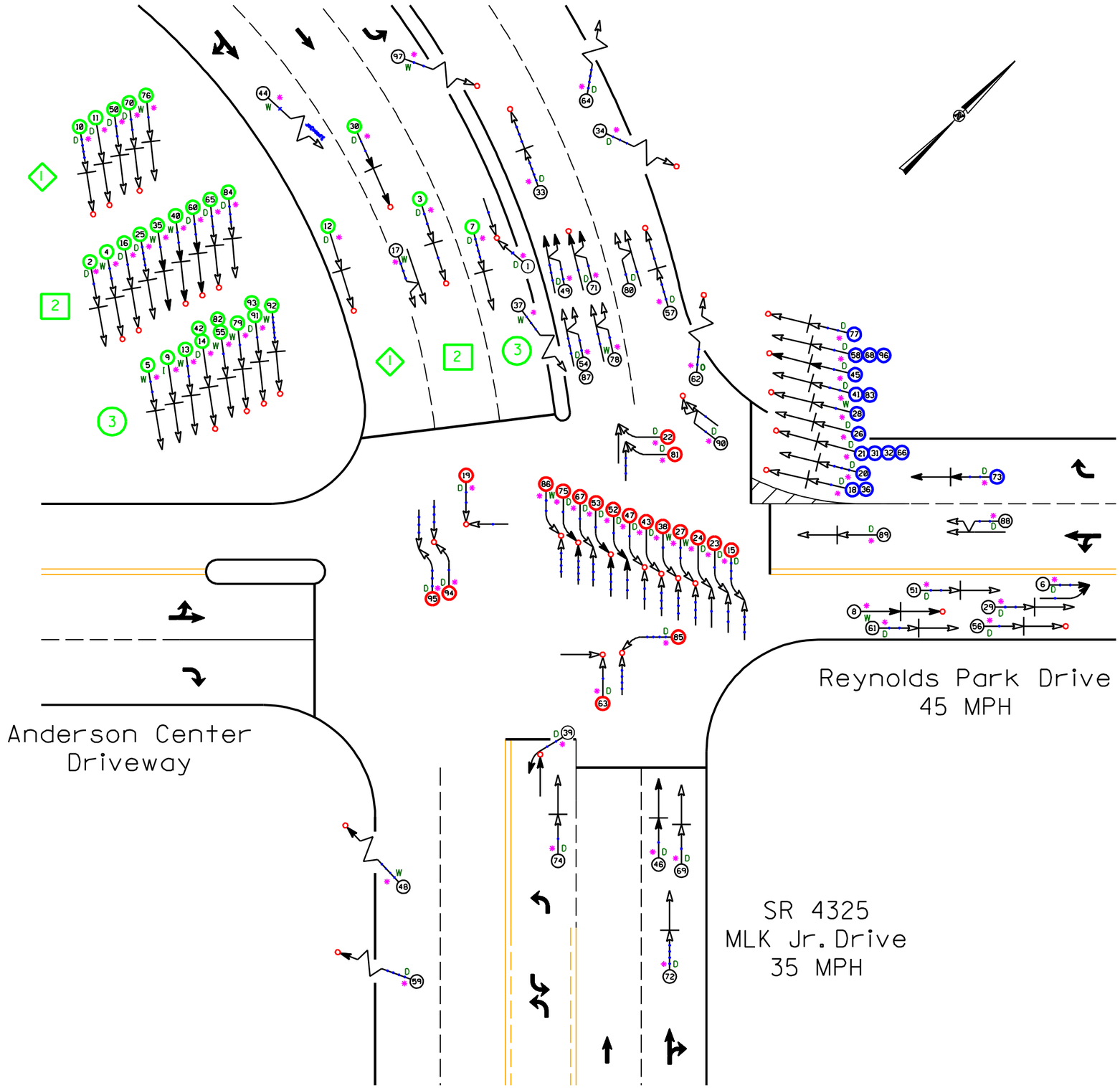
WB Reynolds Right Turn Rear-Ends

TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

HIGHWAY SAFETY PLANNING AND ANALYSIS
HIGHWAY SAFETY IMPROVEMENT PROGRAM
HIGHWAY SAFETY MANAGEMENT
RAILROAD-HIGHWAY SAFETY MANAGEMENT

COLLISION DIAGRAM	
DIVISION: 9	AREA:
STUDY PERIOD: 2/1/1995 - 6/30/2002	
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: 4-15-2010	
LOG NUMBER: SS# 09-02-204 BEFORE	

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



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SS# 09-02-204
Forsyth County
Winston-Salem
WSSU Campus
AFTER Period
10/1/02 - 2/28/10

R Y G
New Signalized
Intersection
Sig ID 09-1283

Frontal Impact
Target Crashes

SB MLK
Rear-Ends

WB Reynolds Right
Turn Rear-Ends

TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

HIGHWAY SAFETY PLANNING AND ANALYSIS
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DIAGRAM PREPARED BY: JBS	
DIAGRAM REVIEWED BY: ST	
SCALE: NOT TO SCALE	
DATE: 4-16-2010	
LOG NUMBER: SS# 09-02-204 BEFORE	

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