Spot Safety Project Evaluation

Order # 41000003832

Spot Safety Project # 05-01-213

Spot Safety Project Evaluation of the Traffic Signal Installation at the Intersection of SR 1571 (Gorman St) and the I-40/I-440 Westbound Ramps
Wake 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

Brad Robinson, PE

2/17/2010
Date

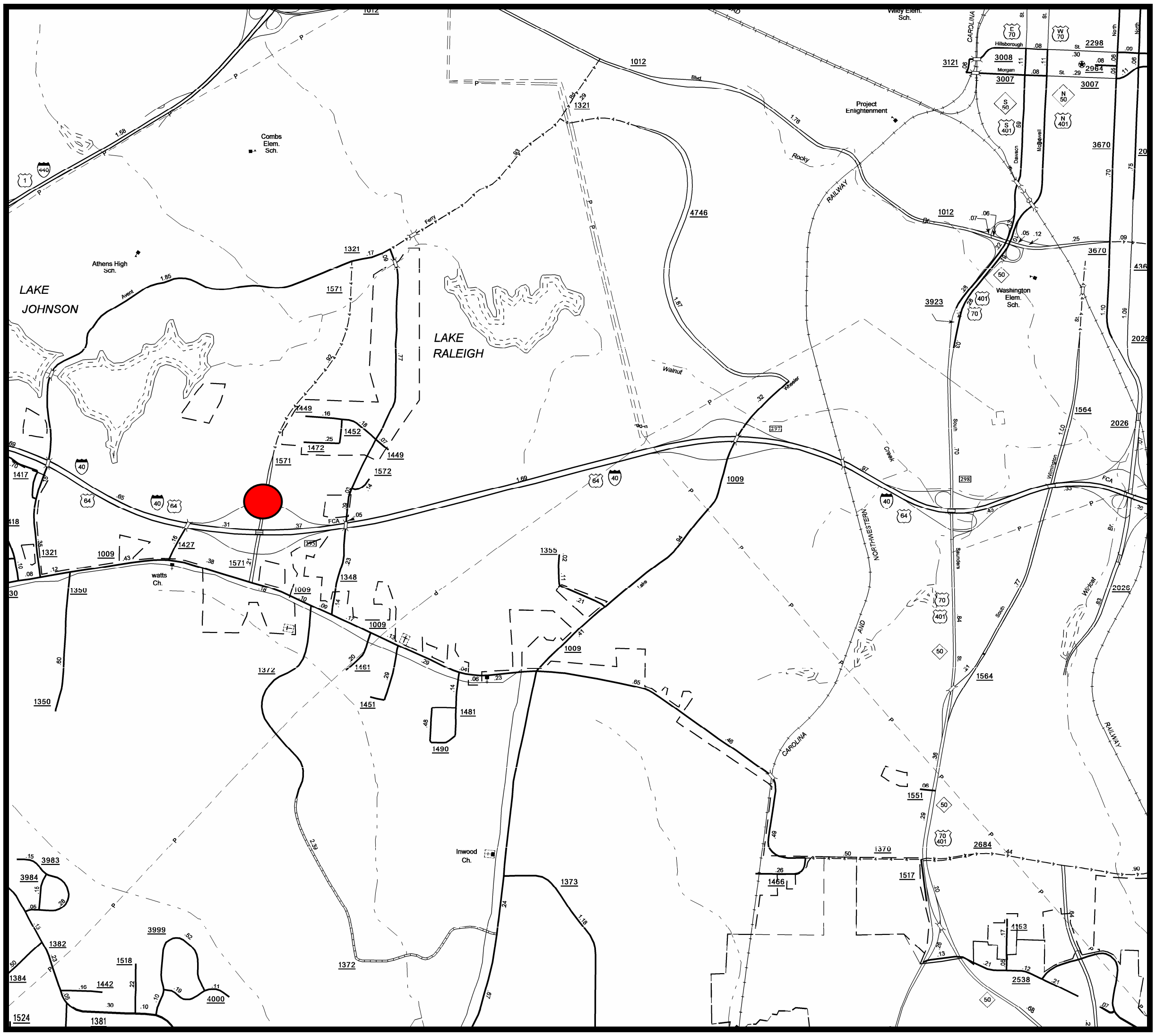
Traffic Safety Project Engineer

Spot Safety Project Evaluation Documentation

Subject Location

Evaluation of Spot Safety Project Number 05-01-213 – The Intersection of SR 1571 (Gorman St) and the I-40/I-440 westbound ramps.

The signal number for this location is 05-1729.



Project Information and Background from the Project File Folder

The spot safety project improvement countermeasure chosen for the subject location was the installation of a traffic signal.

SR 1571 (Gorman St) is a four-lane divided facility in the vicinity of the intersection. Northbound SR 1571 has two through lanes and a left turn lane at the subject intersection. Southbound SR 1571 has two through lanes a right turn lane. The speed limit is 45 mph. The westbound I-40 ramp has a through-left and a yielding right turn lane.

The original statement of problem was that vehicles on the I-40/I-440 westbound off ramp could not safely enter or cross SR 1571 due to insufficient gaps in traffic.

The initial crash analysis was conducted from July 1, 1997 to June 30, 2000 with a total of 14 reported crashes, 2 of which was considered correctable by the chosen countermeasure. The final completion date for the improvements at the subject intersection was on February 4, 2004 with a total cost of $40,000.00.

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 January 1, 2004 to March 31, 2004. The before period consisted of reported crashes from June 1, 1998 through December 31, 2003 (5 years and 7 months) and the after period consisted of reported crashes from April 1, 2004 through October 31, 2009 (5 years and 7 months). The ending date for this analysis was limited by the available crash data at the time the analysis was conducted.

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 Frontal Impact crash types were the Target Crashes for the applied countermeasure. 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 target crashes are clearly identified in the before and after period collision diagrams.

Treatment Information			
	Before	**After**	**Percent Reduction (-) Percent Increase (+)**
Total Crashes	29	69	137.9
Total Severity Index	6.17	6.63	7.5
Target Crashes	12	41	241.7
Target Crash Severity Index	11.02	8.31	-24.6
Volume*	118,000	130,500	10.6
Target Crash Severity Summary			
Fatal Crashes	0	0	N/A
Class A Crashes	1	2	100.0
Class B Crashes	1	7	600.0
Class C Crashes	5	13	160.0
PDO Crashes	5	19	280.0

*Ramp Volumes not available, so volumes were calculated by using SR 1571 volumes and I-40 volumes and the assumption was made that ramp volumes would increase proportionally to I-40 volumes

The naive before and after analysis at the treatment location resulted in a 138 percent increase in Total Crashes, a 241 percent increase in Target Crashes, and a 11 percent increase in Average Daily Traffic (ADT). The before period ADT year was 2001 and the after period ADT year was 2007.

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 138 percent increase in Total Crashes and a 242 percent increase in Target Crashes. The Total Severity Index increased by 8 percent and the Target Severity Index decreased by 24 percent. The summary results above demonstrate that both Total Crashes and Target Crashes appear to have decreased at the treatment location from the before to the after period.

The calculated benefit to cost ratio for this project is -23.04 considering total crashes. The benefit to cost ratio considering only target crashes is also -19.56. 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.

Most of the increase in Total Crashes and Target Crashes can be attributed to a pattern of Left Turn-Same Roadway crashes involving left turning vehicles from SR 1571 onto the westbound I-40 ramp. In the before period there were three crashes of this type and in the after period there were 29, an increase of 867 percent.

When the signal was installed it was operating with a protected/permitted left turn phasing for vehicles turning onto the ramp. A signal plan was found dated August 2007 that appears to have removed the permitted phase from the left turn maneuver. Because a field investigation was not conducted, it is not known if or when this was placed into affect. There have only been two Left Turn-Same Roadway Crashes involving this turning movement in the time period from September 2007 to October 31, 2009. In one of the crashes the southbound SR 1571 vehicle ran the signal and in the second one the fault was undetermined.

Rear-End Crashes on SR 1571 increased by 300 percent, from 3 in the before period to 12 in the after period. An increase in rear-end crashes is expected when a signal is installed.

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: SR 1571 at I-40 WB Ramps
COUNTY: Wake
FILE NO.: SS 05-01-213

BY: bdr
DATE: 2/12/2010

DETAILED COST: TYPE IMPROVEMENT - Sigal

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	$0	0	0.000	$0
	$40,000	10	0.149	$5,961
Right-of-Way	$0	0	0.000	$0
TOTALS	$40,000	10	0.149	$5,961

ESTIMATED INCREASE IN ANNUAL MAINT. COST = $2,000
ESTIMATED INCREASE IN ANNUAL UTILITY COST = $900

TOTAL ANNUAL COST= $8,861
TOTAL COST OF PROJECT= $40,000

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	5.59	1	0.18	10	1.79	18	3.22	$162,004
AFTER	5.59	2	0.36	32	5.72	35	6.26	$366,190

Annual Benefits from Crash Cost Savings ($204,186)

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = ($213,047)

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = -23.04

TOTAL COST OF PROJECT - $40,000 COMPREHENSIVE B/C RATIO - -23.04

BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: SR 1571 at I-40 WB Ramps BY: bdr
COUNTY: Wake DATE: 2/12/2010
FILE NO.: SS 05-01-213 Target Crashes Only

DETAILED COST: TYPE IMPROVEMENT - Sigal

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	$0	0	0.000	$0
	$40,000	10	0.149	$5,961
Right-of-Way	$0	0	0.000	$0
TOTALS	$40,000	10	0.149	$5,961

ESTIMATED INCREASE IN ANNUAL MAINT. COST = $2,000
ESTIMATED INCREASE IN ANNUAL UTILITY COST = $900

TOTAL ANNUAL COST= $8,861
TOTAL COST OF PROJECT= $40,000

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	5.59	1	0.18	6	1.07	5	0.89	$137,925
AFTER	5.59	2	0.36	20	3.58	19	3.40	$311,234

Annual Benefits from Crash Cost Savings ($173,309)

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = ($182,171)

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = -19.56

TOTAL COST OF PROJECT - $40,000 COMPREHENSIVE B/C RATIO - -19.56

Treatment Site Photos from Google Street-View

Looking west from ramp

Looking west from ramp

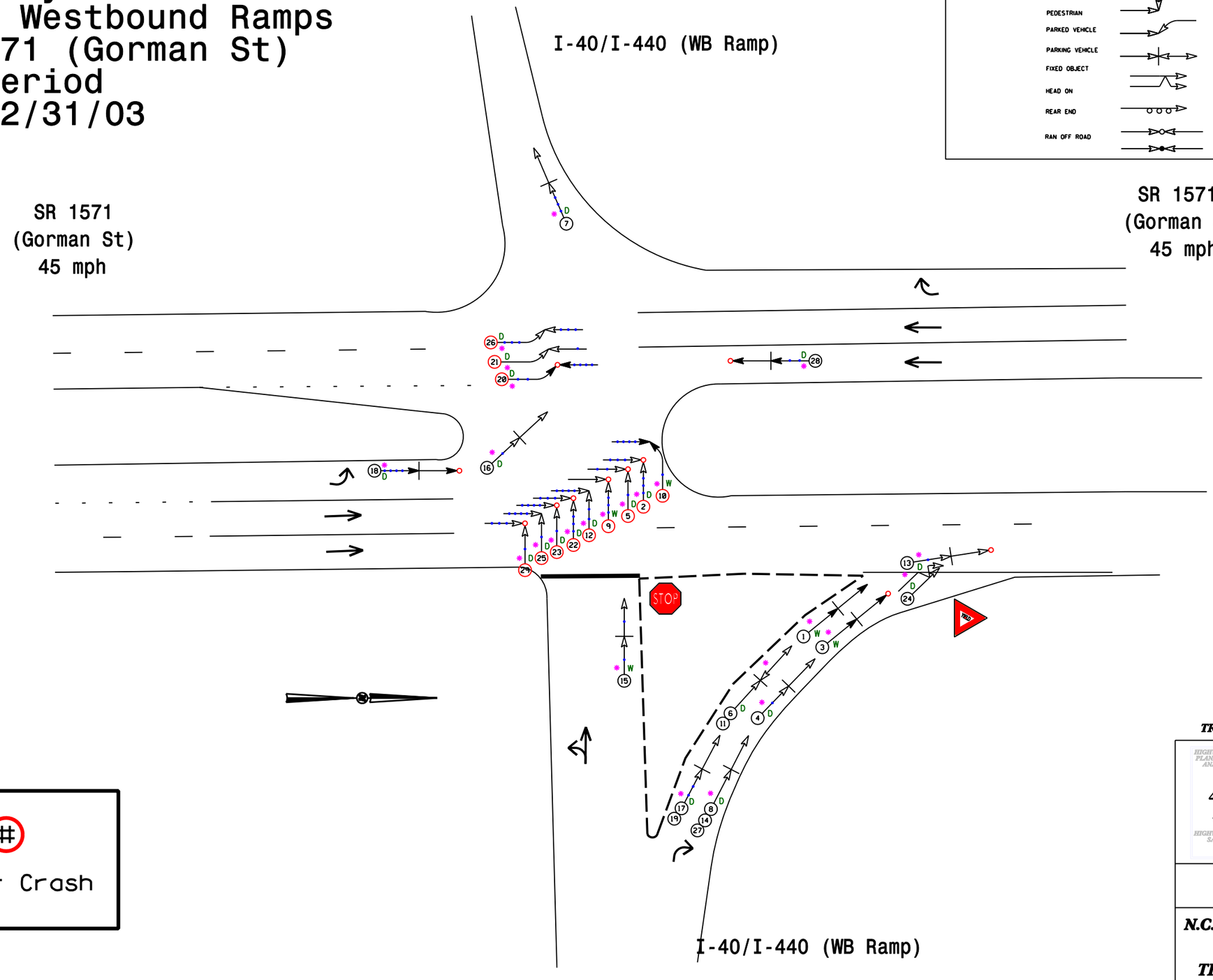
Looking North on SR 1571 (Gorman St)

Looking South on SR 1571 (Gorman St)

Wake County
I-40/440 Westbound Ramps
at SR 1571 (Gorman St)
BEFORE Period
6/1/98-12/31/03

LEGEND

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



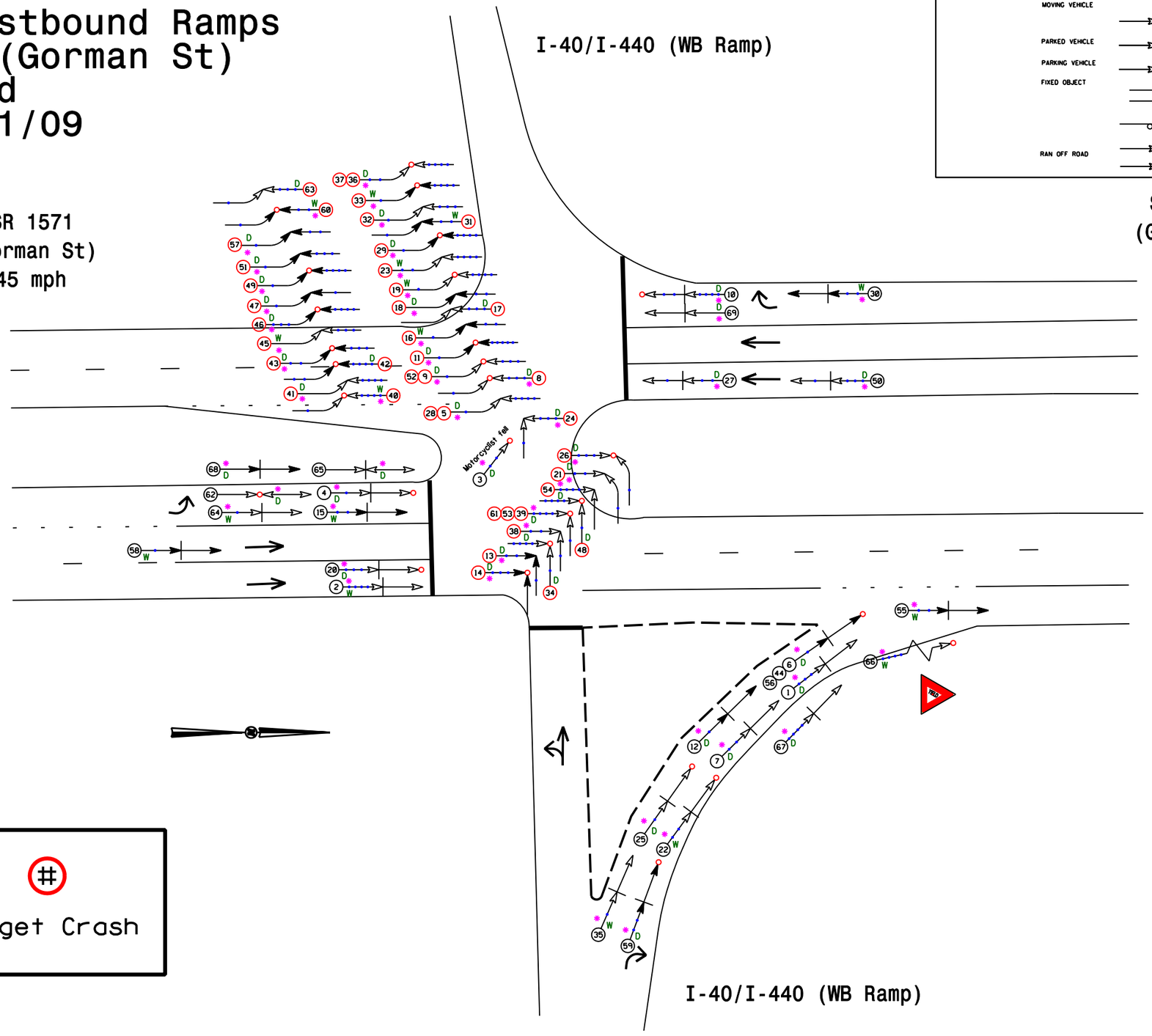
Target Crash

TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

COLLISION DIAGRAM	
DIVISION: 5	AREA:
STUDY PERIOD: 6/1/98-12/31/03	
DISTANCE: Y-LINE = 150FT	
ANALYSIS PREPARED BY: BDR	
ANALYSIS CHECKED BY:	
DIAGRAM PREPARED BY: BDR	
DIAGRAM REVIEWED BY:	
SCALE: NOT TO SCALE	
DATE: February 2010	
LOG NUMBER: 41000003832	

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

Wake County
I-40/440 Westbound Ramps
at SR 1571 (Gorman St)
AFTER Period
4/1/04-10/31/09



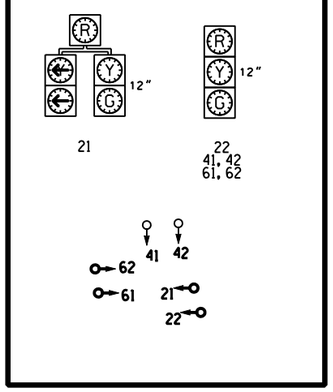
LEGEND

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
	OUT OF CONTROL	40 MPH TO 49	W	WET
RAN OFF ROAD	INJURY	50 MPH TO 59	I	ICY OR SNOWY
	FATALITY	60 MPH TO 69	O	OILY
		70 AND UP		
		SPEED UNKNOWN		

Target Crash

SIGNAL FACE I.D.

Denotes L.E.D.



TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

COLLISION DIAGRAM	
DIVISION: 5	AREA:
STUDY PERIOD: 3/1/04-10/31/09	
DISTANCE: Y-LINE = 150FT	
ANALYSIS PREPARED BY: BDR	
ANALYSIS CHECKED BY:	
DIAGRAM PREPARED BY: BDR	
DIAGRAM REVIEWED BY:	
SCALE: NOT TO SCALE	
DATE: January 2010	
LOG NUMBER: 41000003797	

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