Project Evaluation

Project Log # 200801065
Order #41000002501
Spot Safety Projects # 08-04-222 & 08-04-221

Project Evaluation (and Final Monitoring Update) of the Installation of Shoulder Rumble Strips Along SR 1529 (Cox Mill Rd) And the Installation of Approach and Trailing Guardrail on Bridge #32 on SR 1529 Lee 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

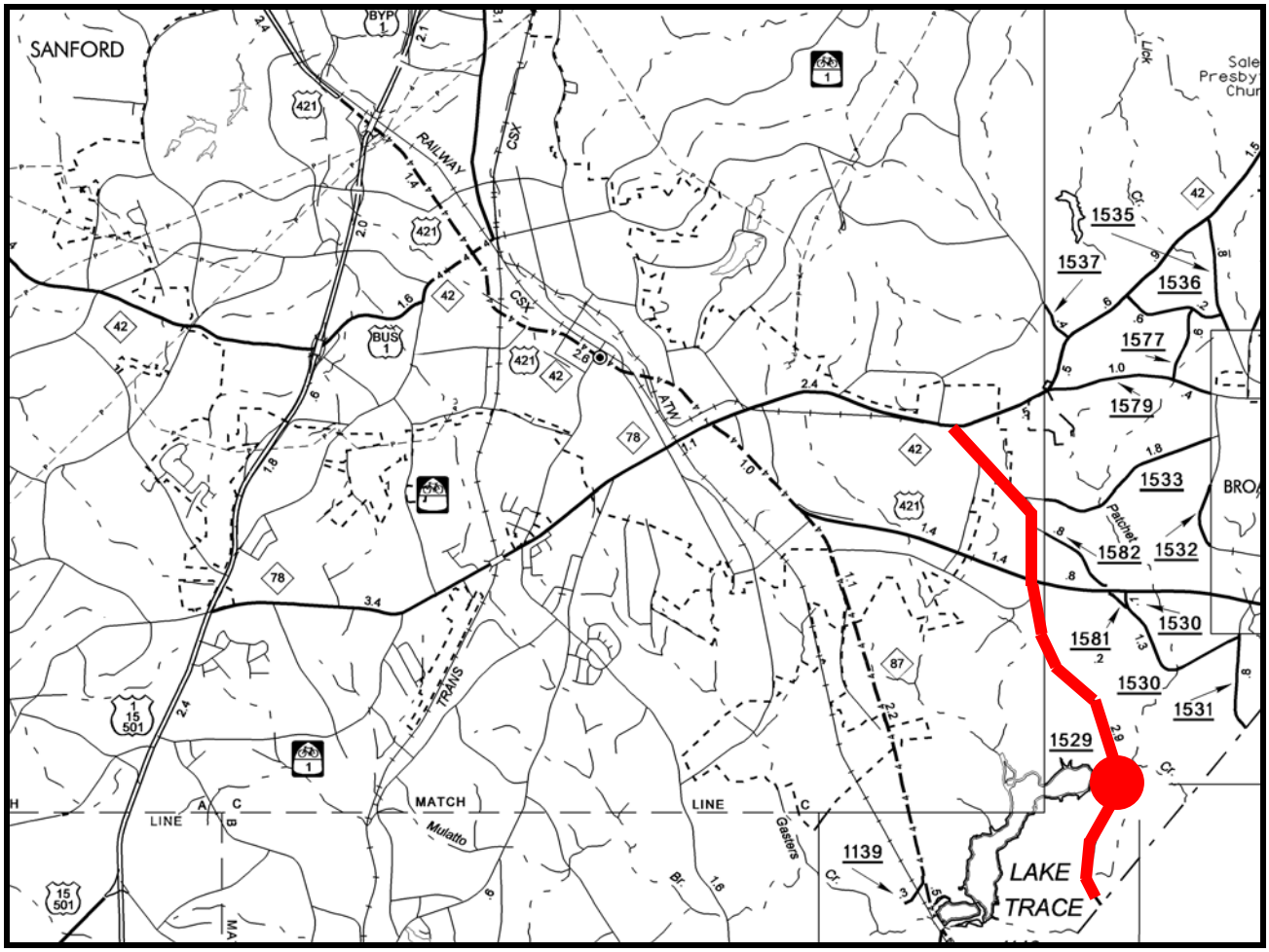
11/05/2009
Date

Traffic Safety Project Engineer

Project Evaluation Documentation

Subject Location

The subject location is SR 1529 (Cox Mill Rd) from NC 42 to the Harnett County Line in Lee County. Bridge #32 is located on SR 1529 approximately 1.1 miles north of the county line.



Project Information and Background

The safety improvements chosen for the subject location was to install rumble strips along both sides of the roadway (SS #08-04-222) and to install approach and trailing guardrail at bridge #32 (SS #08-04-221). The subject location is a two-lane roadway with 1.5-2 foot paved shoulders. The speed limit is 55 mph.

The original statement of problem for spot safety project #08-04-222 was that there was a large run off road crash pattern on SR 1529. The rumble strips were installed in an attempt to reduce this pattern. The initial crash analysis for this project was completed from April 1, 2001 to March 31, 2004 with a total of 55 reported crashes, 14 of which were considered correctable by the chosen countermeasure. We were originally asked to monitor this section and have provided bi-annual updates since the rumble strips were installed.

A second spot safety project (#08-04-221) was developed at the same time to address a specific problem location on SR 1529. A ran off road crash pattern existed at bridge #32 on SR 1529, with vehicles either striking the bridge or going down the embankment. Approach and trailing guardrail was installed at the bridge in an attempt to reduce the severity of ran off road crashes. The initial crash analysis for this project was completed from March 1, 1994 to February 29, 2004 with a total of 12 reported crashes, eight of which were considered correctable by the chosen countermeasure.

The final completion date for the rumble strips installation was in August, 2006 with a total cost of $107,000.00. The final completion date for the guardrail installation was on June 30, 2006 with a total cost of $26,000.00.

Naïve Before and After Analysis

After reviewing the spot safety project file folders along with all the crashes at the subject locations, the crash data omitted from this analysis to consider for an adequate construction period was from June 1, 2006 to August 31, 2006. The before period consisted of reported crashes from June 1, 2003 to May 31, 2006 (3 years); and the after period consisted of reported crashes from September 1, 2006 to August 31, 2009 (3 years). The ending date for this analysis was determined by the available crash data at the time of analysis.

The treatment data for the rumble strip evaluation consisted of all crashes on SR 1519. The treatment data for the guardrail evaluation consisted of all crashes on SR 1529 within 150' of the bridge. The following table depicts the Naïve Before and After Analysis for the Total Crashes and Target Crashes at the treatment location. Please note that Ran Off Road crash types were the target crashes for both of the applied countermeasures. Ran Off Road crash types considered are as follows: Ran Off Road – Left, Ran Off Road – Right, Ran Off Road – Straight, Fixed Object, Head-on, Sideswipe – Same Direction, Sideswipe – Opposite Direction, and Overturn / Rollover.

Treatment Information For Strip (Rumble Strip Evaluation)	**Before**	**After**	**Percent Reduction (-)/ Percent Increase (+)**
Total Crashes	45	28	-37.8
Total Severity Index	6.84	6.35	-7.2
Target Crashes	16	7	-56.3
Target Severity Index	8.98	16.06	78.8
Volume	2,200	3,000	36.4

Target Crash Information for Strip	**Before**	**After**	**Percent Reduction (-)/ Percent Increase (+)**
Fatal Crashes	0	0	N/A
Class A Crashes	1	1	0.0
Class B Crashes	2	0	-100.0
Class C Crashes	5	4	-20.0
PDO Crashes	8	2	-75.0

The naïve before and after analysis along SR 1529 resulted in a 38 percent decrease in total crashes, a 56 percent decrease in Target Crashes, and a 36 percent increase in Average Daily Traffic (ADT). The before period ADT year was 2004 and the after period ADT year was 2007.

Treatment Information at Bridge #32 (Guardrail Evaluation)	**Before**	**After**	**Percent Reduction (-)/ Percent Increase (+)**
Total Crashes	4	1	-75.0
Total Severity Index	4.7	8.4	78.7
Target Crashes	4	1	-75.0
Target Severity Index	4.7	8.4	78.7

Target Crash Information at Bridge	**Before**	**After**	**Percent Reduction (-)/ Percent Increase (+)**
Fatal Crashes	0	0	N/A
Class A Crashes	0	0	N/A
Class B Crashes	1	0	-100.0
Class C Crashes	1	1	0.0
PDO Crashes	2	0	-100.0

The naïve before and after analysis at Bridge #32 resulted in a 75 percent decrease in both Total and Target Crashes and a 79 percent increase in the Severity index.

Results and Discussion

The naïve before and after analysis involving the comparison of treatment actual before data versus treatment actual after data for spot safety project #08-04-222 (rumble strips) resulted in a 38 percent decrease in Total Crashes and an 56 percent decrease in Target Crashes. The naïve before and after analysis for spot safety project #08-04-221 (guardrail) resulted in a 75 percent decrease in both Total Crashes and Target Crashes. The summary results above demonstrate that both of the Treatment Locations appears to have had a decrease in Total and Target Crashes from the before to after period.

For Spot Safety Project #08-04-222 the calculated benefit to cost ratio is 16.23 considering total crashes. The benefit to cost ratio considering only target crashes is 1.78. For Spot Safety Project #08-04-221 the calculated benefit to cost ratio for this project is 2.36 for both total and target crashes since all crashes at the bridge were target crashes. 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.

There was a fatal crash in the before period that was not a Target Crash. It was an angle crash that occurred at the intersection of US 421 and SR 1529.

It appears that the rumble strip installation was effective at reducing Run Off Road crashes at the subject location. In the before period the largest concentration of crashes appeared to be on the northbound lane at bridge #32. Four vehicles ran off the road at this location. Two ran off the road before the guardrail and went down the embankment. The other two hit the guardrail. In the after period there was only one crash at this location. It involved a vehicle losing control just prior to the

bridge, hitting the bridge rail and traveling over it into the creek. The driver said he was trying to avoid a deer.

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

BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: SR 1529 BY: BDR
COUNTY: Lee DATE: 10/26/2009
FILE NO.: SS 08-04-222

DETAILED COST: TYPE IMPROVEMENT - Shoulder Rumble Strips

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	$0	0	0.000	$0
	$107,000	10	0.149	$15,946
Right-of-Way	$0	0	0.000	$0
TOTALS	$107,000	10	0.149	$15,946

ESTIMATED INCREASE IN ANNUAL MAINT. COST = $0
ESTIMATED INCREASE IN ANNUAL UTILITY COST = $0

TOTAL ANNUAL COST= $15,946
TOTAL COST OF PROJECT= $107,000

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	3.00	2	0.67	15	5.00	28	9.33	$559,200
AFTER	3.00	1	0.33	10	3.33	17	5.67	$300,467

Annual Benefits from Crash Cost Savings $258,733

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = $242,787

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 16.23

TOTAL COST OF PROJECT - $107,000 COMPREHENSIVE B/C RATIO - 16.23

BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: SR 1529 BY: BDR
COUNTY: Lee DATE: 10/26/2009
FILE NO.: SS 08-04-222 Target Crashes Only

DETAILED COST: TYPE IMPROVEMENT - Shoulder Rumble Strips

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	$0	0	0.000	$0
	$107,000	10	0.149	$15,946
Right-of-Way	$0	0	0.000	$0
TOTALS	$107,000	10	0.149	$15,946

ESTIMATED INCREASE IN ANNUAL MAINT. COST = $0
ESTIMATED INCREASE IN ANNUAL UTILITY COST = $0

TOTAL ANNUAL COST= $15,946
TOTAL COST OF PROJECT= $107,000

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	3.00	1	0.33	7	2.33	8	2.67	$267,867
AFTER	3.00	1	0.33	4	1.33	2	0.67	$239,467

Annual Benefits from Crash Cost Savings $28,400

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = $12,454

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 1.78

TOTAL COST OF PROJECT - $107,000 COMPREHENSIVE B/C RATIO - 1.78

BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: SR 1529 at bridge #32 BY: BDR
COUNTY: Lee DATE: 10/26/2009
FILE NO.: SS 08-04-221 (Total Crashes and Target Crashes only are the same)

DETAILED COST: TYPE IMPROVEMENT - Shoulder Rumble Strips

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	$0	0	0.000	$0
	$26,000	10	0.149	$3,875
Right-of-Way	$0	0	0.000	$0
TOTALS	$26,000	10	0.149	$3,875

ESTIMATED INCREASE IN ANNUAL MAINT. COST = $133
ESTIMATED INCREASE IN ANNUAL UTILITY COST = $0

TOTAL ANNUAL COST= $4,008
TOTAL COST OF PROJECT= $26,000

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	3.00	0	0.00	2	0.67	2	0.67	$16,133
AFTER	3.00	0	0.00	1	0.33	0	0.00	$6,667
							Annual Benefits from Crash Cost Savings	$9,467

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = $5,459

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 2.36

TOTAL COST OF PROJECT - $26,000 COMPREHENSIVE B/C RATIO - 2.36

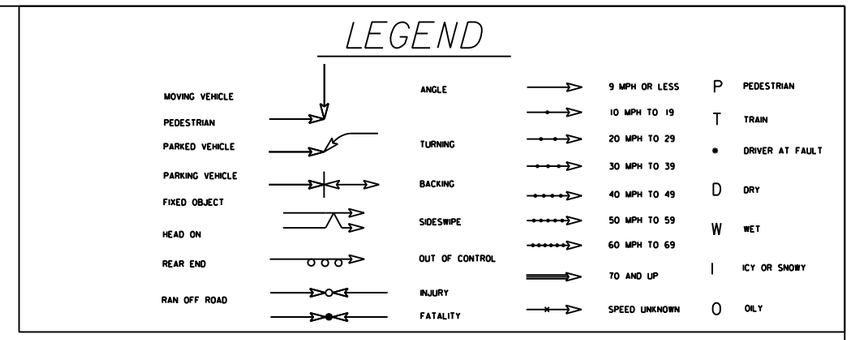
Site Photos from Google Street-View

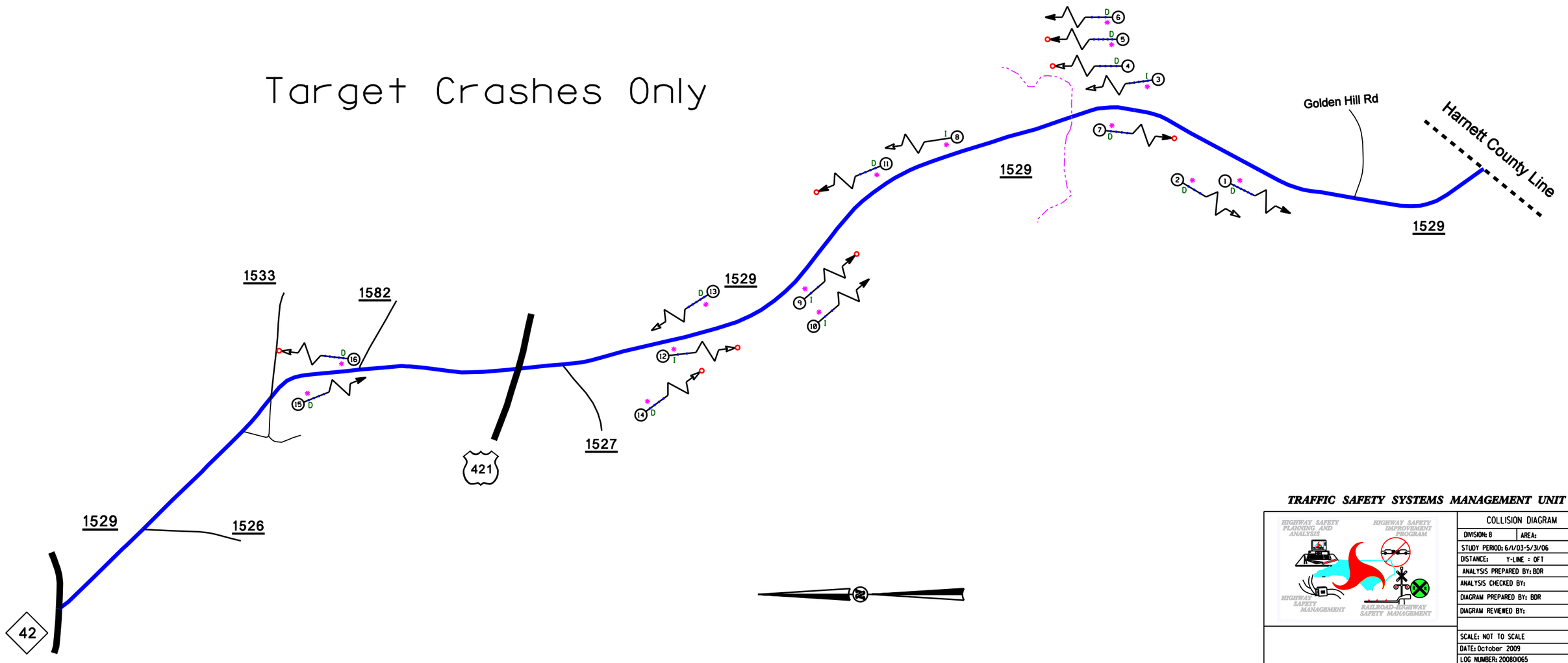
Looking North on SR 1529 approaching bridge over creek (approximate milepost 1.1)

Looking South on SR 1529 (approximate milepost 2.0)

Lee County
SR 1529 (Cox Mill Rd) from
NC 42 to Harnett County Line
BEFORE Period
6/1/2003-5/31/2006

Target Crashes Only





TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

COLLISION DIAGRAM	
DIVISION: 8	AREA:
STUDY PERIOD: 6/1/03-5/31/06	
DISTANCE: Y-LINE = 0FT	
ANALYSIS PREPARED BY: BDR	
ANALYSIS CHECKED BY:	
DIAGRAM PREPARED BY: BDR	
DIAGRAM REVIEWED BY:	
SCALE: NOT TO SCALE	
DATE: October 2009	
LOG NUMBER: 20080065	

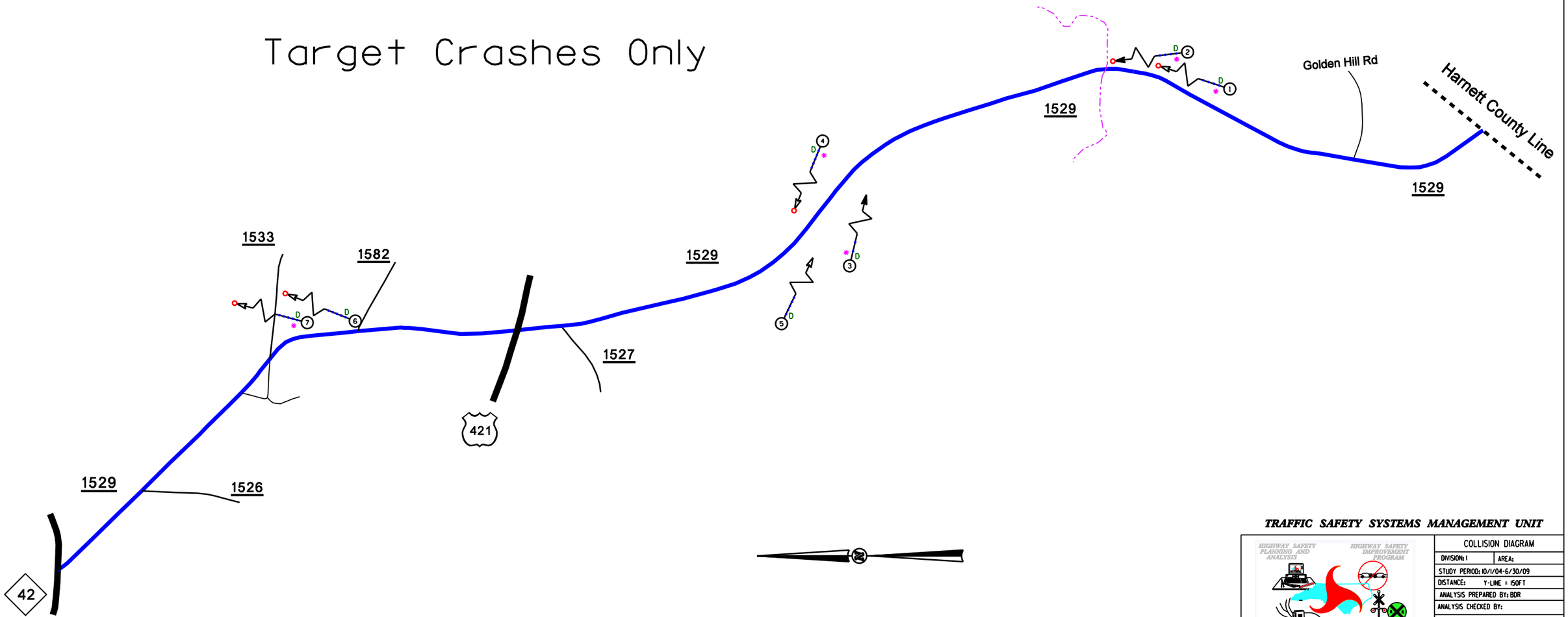
N.C. DEPARTMENT of TRANSPORTATION
DIVISION of HIGHWAYS
TRANSPORTATION MOBILITY AND SAFETY DIVISION

Lee County
SR 1529 (Cox Mill Rd) from NC 42 to Harnett County Line
AFTER Period
9/1/2006-8/31/2009

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		

Target Crashes Only



TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

COLLISION DIAGRAM	
DIVISION: 1	AREA:
STUDY PERIOD: 10/1/04-6/30/09	
DISTANCE: Y-LINE = 150FT	
ANALYSIS PREPARED BY: BDR	
ANALYSIS CHECKED BY:	
DIAGRAM PREPARED BY: BDR	
DIAGRAM REVIEWED BY:	
SCALE: NOT TO SCALE	
DATE: August 2009	
LOG NUMBER: 200908069	

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