

Spot Safety Project Evaluation

Project Log # 200611045

Spot Safety Project # 14-02-201

**Evaluation of the Replacement of an Existing Curve/Grade Warning Sign
And the Installation of Flashers on the New Sign on US 23/441 Near the Jackson County Line
Macon County**

Documents Prepared By:

Safety Evaluation Group
Traffic Safety Systems Management Section
Traffic Engineering and Safety Systems Branch
North Carolina Department of Transportation

Principal Investigator

Brad Robinson, EI

8/02/2007
Date

Traffic Safety Project Engineer

Spot Safety Project Evaluation Documentation

Subject Location

Evaluation of Spot Safety Project Number 14-02-201 – US 23/441 near the Jackson County Line in Macon County.

Project Information and Background from the Project File Folder

The spot safety project improvement countermeasure chosen for the subject location was the replacement of an existing curve/grade warning sign with a new sign and the installation of flashers. US 23/441 is a five-lane facility at the subject location with a horizontal grade of 8%. The speed limit for this section is 55 mph, with a 35 mph advisory for the curves.

The initial statement of problem was the existing sign only warned motorists of one particular curve and did not address the other curves in the section that should be traversed at lower speeds.

The initial crash analysis for this strip was completed from June 1, 1998 to May 31, 2001. There were 33 crashes during this time period, with 26 of these considered correctable.

The final completion date for the improvements at the subject location was on October 21, 2002 with a total cost of \$10,000.

Naive Before and After Analysis

After reviewing the 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 September 1, 2002 through November 30, 2002. The before period consisted of reported crashes from November 1, 1998 through August 31, 2002 (3 Years, 10 Months) and the after period consisted of reported crashes from December 1, 2002 through September 30, 2006 (3 Years, 10 Months). The ending date for this analysis was determined by the time available crash data at the time the analysis was conducted.

The treatment data consisted of all crashes on a strip of US 23 from MP 19.84 to MP 21.66 in Macon County. A 0 feet Y-line was used in the analysis and only mainline crashes were included. Please see attached *Location Map* for further detail.

The following data table depicts the Naive Before and After Analysis for the treatment location. Please note that crashes involving vehicles losing control and leaving their lane of travel are the Target Crashes for the applied countermeasure. Target Crashes include the following crash types: Ran Off Road - Right, Ran Off Road - Left, Ran Off Road - Straight, Overturn/Rollover, Fixed Object, Head On, Sideswipe - Same Direction, Sideswipe - Opposite Direction, and Parked Motor Vehicle.

<u>Treatment Information</u>			
	Before Period	After Period	Percent Reduction (-)/ Percent Increase (+)
Total Crashes	43	57	32.6
Total Severity Index	24.56	17.93	-27.0
Target Crashes	34*	53**	55.9
Target Severity Index	28.14	18.93	-32.7
Volume	13,000	13,000	0.0
<u>Target Crash Severity Summary</u>			
Fatal Crashes	0	1	N/A
Class A Crashes	11	9	-18.2
Class B Crashes	6	14	133.3
Class C Crashes	6	12	100.0
PDO Crashes	11	17	54.5

*Target Crashes in the before period includes 2 coded as “angle”, 1 coded as “jackknife”, and 1 coded as “other non-collision”

Does not include 2 coded as “fixed object” and 1 coded as “ran off road – right” due to not being true target crashes

**Target Crashes in the after period include 1 coded as “other non-collision”, 1 coded as “movable object”, and 1 coded as “angle”

The naive before and after analysis at the treatment location resulted in a 33 percent increase in Total Crashes, a 56 percent increase in Target Crashes, and no change in Average Daily Traffic (ADT). The before period ADT year was 2000 and the after period ADT year was 2004.

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 33 percent increase in Total Crashes, a 56 percent decrease in Target Crashes, and no change in ADT. The Total Severity Index decreased by 27 percent and the Target Severity Index decreased by 33 percent. The summary results above demonstrate that the treatment location appears to have had an increase in both Total Crashes and Target Crashes from the before to the after period.

It appears that the increase in Total Crashes at the subject location is entirely related to the increase in Target Crashes. Ninety-two percent of the Total Crashes in the after period were Target Crashes. Referencing the *Collision Diagrams*, it appears that all the crash patterns in the before period became even worse in the after period. Notably, the Target Crashes involving the first curve on the segment (immediately after the flashers) has increased from 1 to 9 from the before to the after period.

After further analysis, it was noted that motorcycle crashes made up a significant portion of Target Crashes on this segment. In the before period motorcycles were involved in 26 percent of the

Target Crashes (9 out of 34) and in the after period motorcycles were involved in 32 percent of the Target Crashes (17 of out 53).

It does not appear that the replacement of the warning sign and the installation of flashers helped to reduce speeds along the segment. Target Crashes increased 56 percent along the segment. Further analysis of the Target Crashes reveals that the average estimate of original traveling speeds for vehicles involved in Target Crashes increased 6 percent (from 51.5 mph to 54.7 mph). Please note that there was not a speed study conducted for this segment. The estimated speeds were taken from the crash reports.

The section of US 23/441 appears to have a large portion of crashes that are related to excessive speeds. Forty-eight percent of before period Total Crashes and 65 percent of after period Total Crashes were coded as either "Exceeded Authorized Speed Limit" or "Exceeded Safe Speed For Conditions" on the DMV-349 Reports under contributing circumstances. For comparison purposes a segment of US 23/441 immediately downstream from the treatment section (MP 16.59 to 19.83) was also analyzed. Only 27 percent of before period crashes and 33 percent of after period crashes were coded as either "Exceeded Authorized Speed Limit" or "Exceeded Safe Speed For Conditions" under contributing circumstances. The assumption made by this comparison is that the same drivers drove these two segments and the same reporting officers investigated the crashes.

The calculated benefit to cost ratio for this project is 99.6 considering total crashes. The benefit to cost ratio considering only target crashes is 30.2. 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 the analysis. The costs of the project include the actual construction costs as well as the increase in annual maintenance and utility costs.

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 road.

BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: US 23/411 near the Jackson County Line
 COUNTY: Macon
 FILE NO.: SS 14-02-201

BY: Brad Robinson
 DATE: 7/31/2007

DETAILED COST: TYPE IMPROVEMENT - Sign Replacement and installation of Flashers

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$10,000	10	0.149	\$1,490
	\$0	0	0.000	\$0
Right-of-Way	\$0	0	0.000	\$0
TOTALS	\$10,000	10	0.149	\$1,490

ESTIMATED INCREASE IN ANNUAL MAINT. COST = \$100
 ESTIMATED INCREASE IN ANNUAL UTILITY COST = \$350
 TOTAL ANNUAL COST= \$1,940
 TOTAL COST OF PROJECT= \$10,000

COMPREHENSIVE COST REDUCTION:

ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES

TIME PERIOD	YEARS	ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES				PDO		ANNUAL COSTS
		K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	CRASHES	CRASHES PER YR	
BEFORE	3.83	12	3.13	14	3.66	17	4.44	\$1,649,687
AFTER	3.83	10	2.61	28	7.31	19	4.96	\$1,456,423

Annual Benefits from Crash Cost Savings \$193,264

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = \$191,323

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 99.61

TOTAL COST OF PROJECT - \$10,000 COMPREHENSIVE B/C RATIO - 99.61

BENEFIT-COST ANALYSIS WORKSHEET TARGET CRASHES

LOCATION: **US 23/411 near the Jackson County Line** BY: **Brad Robinson**
 COUNTY: **Macon** DATE: **7/31/2007**
 FILE NO.: **SS 14-02-201**

DETAILED COST: TYPE IMPROVEMENT - **Sign Replacement and installation of Flashers**

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$10,000	10	0.149	\$1,490
	\$0	0	0.000	\$0
Right-of-Way	\$0	0	0.000	\$0
TOTALS	\$10,000	10	0.149	\$1,490

ESTIMATED INCREASE IN ANNUAL MAINT. COST = **\$100**
 ESTIMATED INCREASE IN ANNUAL UTILITY COST = **\$350**
 TOTAL ANNUAL COST= **\$1,940**
 TOTAL COST OF PROJECT= **\$10,000**

COMPREHENSIVE COST REDUCTION:

ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES

TIME PERIOD	YEARS	ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES				PDO		ANNUAL COSTS
		K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	CRASHES	CRASHES PER YR	
BEFORE	3.83	11	2.87	12	3.13	11	2.87	\$1,503,629
AFTER	3.83	10	2.61	26	6.79	17	4.44	\$1,444,987

Annual Benefits from Crash Cost Savings **\$58,642**

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = **\$56,702**

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = **30.22**

TOTAL COST OF PROJECT - **\$10,000** COMPREHENSIVE B/C RATIO - **30.22**

Treatment Site Photos Taken July 17, 2007



Driving Southwest



Driving Southwest



Driving Southwest



Driving Southwest



Driving Southwest



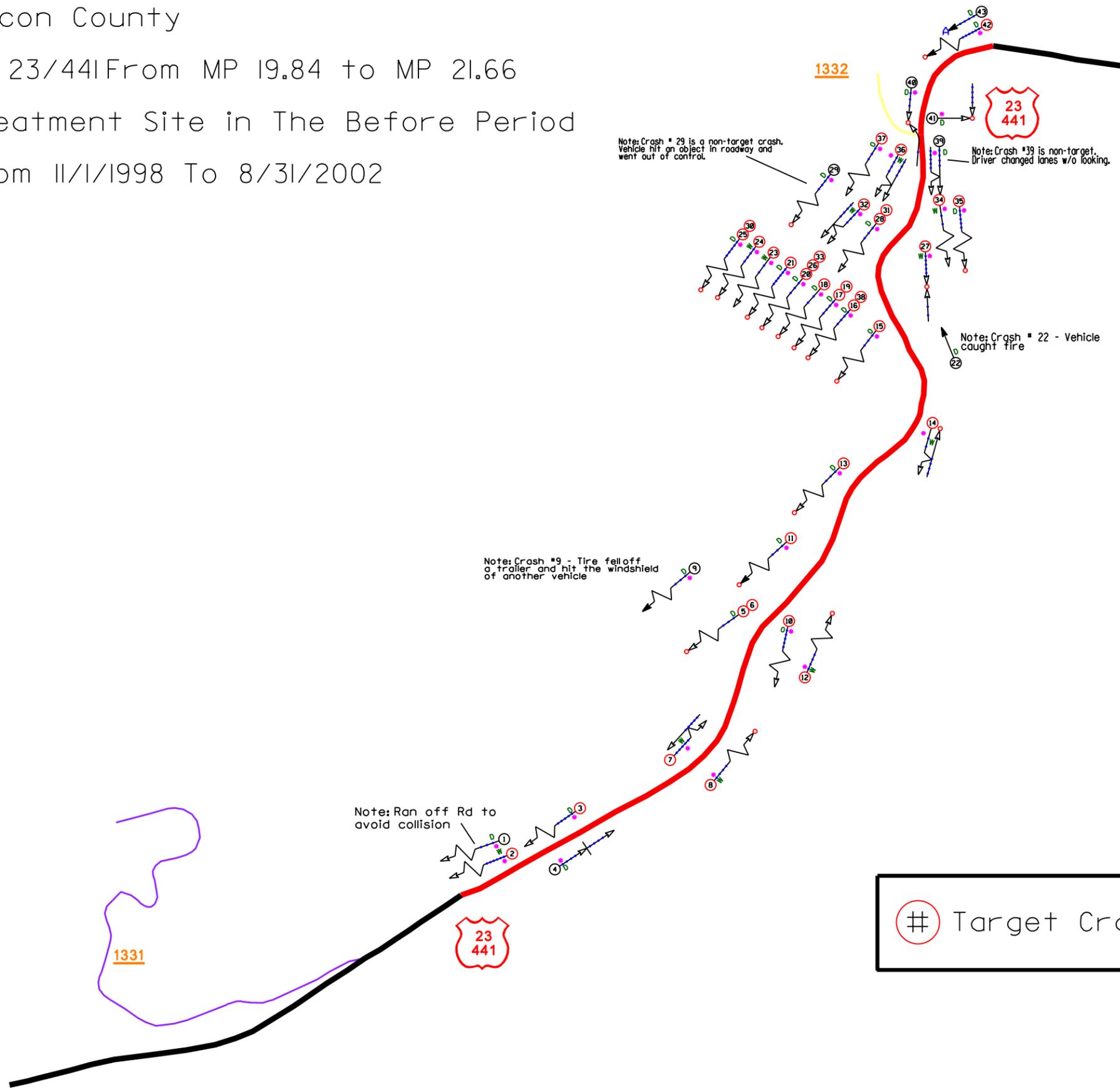
Driving Southwest

Macon County

US 23/441 From MP 19.84 to MP 21.66

Treatment Site in The Before Period

From 11/1/1998 To 8/31/2002



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		ONLY
	RAN OFF ROAD		SPEED UNKNOWN		70 AND UP		



Target Crashes

TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

	COLLISION DIAGRAM	
	DIVISION: 14	AREA:
	STUDY PERIOD: 11/1/1997-8/31/2002	
	DISTANCE: Y-LINE : OF 1	
	ANALYSIS PREPARED BY: B. Robinson	
ANALYSIS CHECKED BY:		
DIAGRAM PREPARED BY: B. Robinson		
DIAGRAM REVIEWED BY:		
SCALE:	NOT TO SCALE	
DATE:	July 2007	
LOG NUMBER:	2006R045	

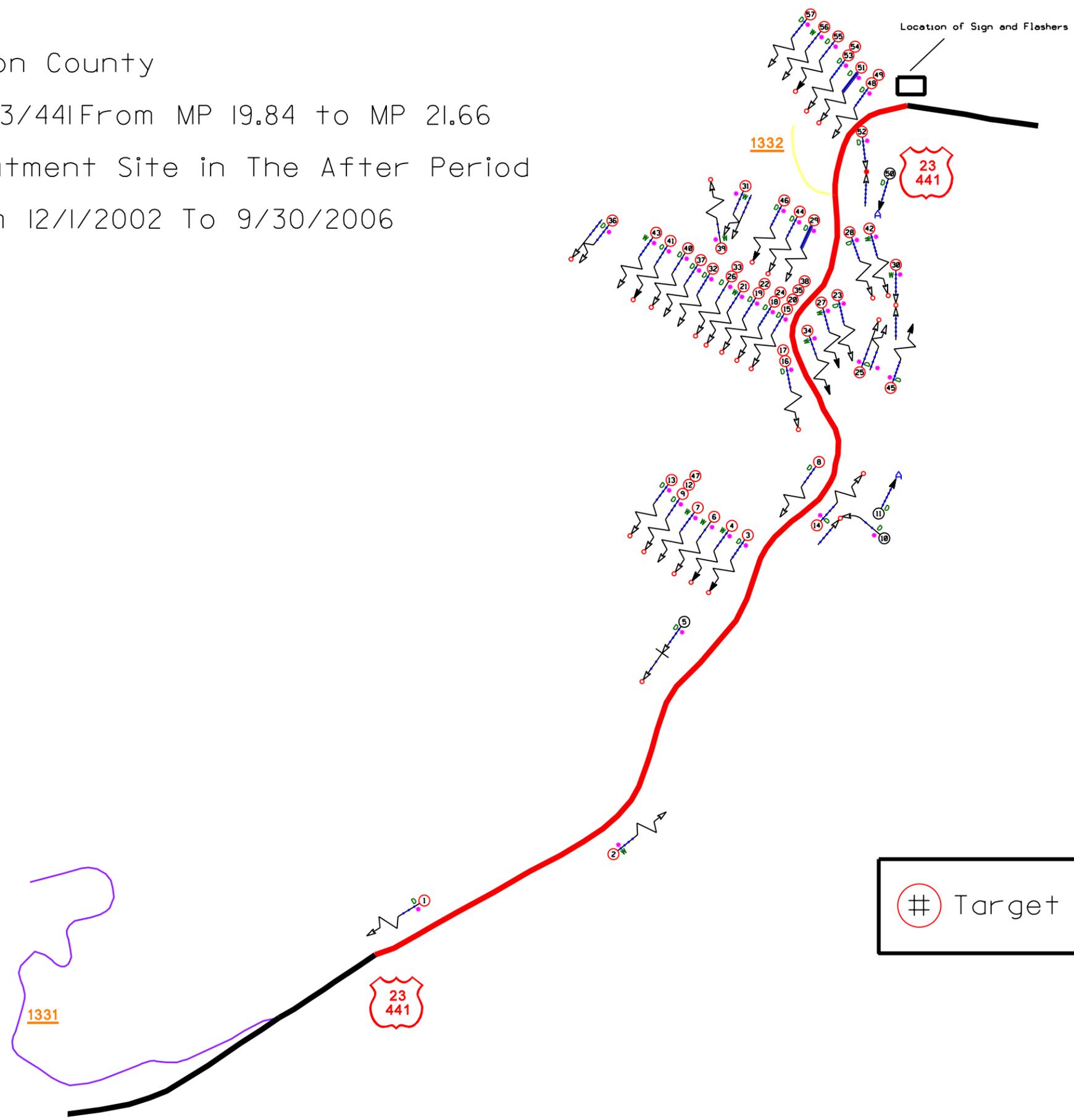
N.C. DEPARTMENT of TRANSPORTATION
DIVISION of HIGHWAYS
TRAFFIC ENGINEERING AND SAFETY
SYSTEMS BRANCH

Macon County

US 23/441 From MP 19.84 to MP 21.66

Treatment Site in The After Period

From 12/1/2002 To 9/30/2006



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				TO AND UP		
					SPEED UNKNOWN		



Target Crashes

TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

	COLLISION DIAGRAM	
	DIVISION: 14	AREA:
STUDY PERIOD: 12/1/2002-9/30/2006		DISTANCE: Y-LINE = OFT
ANALYSIS PREPARED BY: B. Robinson		ANALYSIS CHECKED BY:
DIAGRAM PREPARED BY: B. Robinson		DIAGRAM REVIEWED BY:
SCALE:	NOT TO SCALE	
DATE: July 2007		
LOG NUMBER: 2006H045		

N.C. DEPARTMENT of TRANSPORTATION
DIVISION of HIGHWAYS
TRAFFIC ENGINEERING AND SAFETY
SYSTEMS BRANCH