



Project Summary Report O-4048-S

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Project O-4048: Before and After Evaluation
of Safety Treatments on Rural Highways

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Summary of Treatments for Crashes on Rural Two-Lane Highways in Texas

The majority of the highway system in Texas, as well as in the United States, consists of two- and three-lane rural roads. Specifically, the state of Texas maintains nearly 80,000 centerline-miles of paved roadways serving about 400 million vehicle miles per day. Due to the low volume and relatively low crash frequency on many rural roads, it is often not cost-effective to upgrade the roads. However, vehicles traveling on these roadways generally have high speeds and, thus, tend to have relatively more severe injuries when vehicle crashes do occur.

To address these concerns, the Texas Department of Transportation (TxDOT) sponsored Project O-4048 with the following objectives:

- Identify common types of crashes on rural, low-volume roadways (average daily traffic less than 2000).

- Identify potential low-cost safety improvements for rural Texas roadways.
- Investigate the effectiveness of selected safety improvements.

What We Did...

In order to fulfill these objectives, Project O-4048 was composed of three phases, each phase containing a number of tasks to accomplish the project objectives. Those phases, along with a summary of the efforts within the phase, follow.

Phase I — Identify Characteristics of Crashes and Known Benefits of Countermeasures

The research team investigated the characteristics of low-volume, rural two-lane highway crashes using the Texas Department of Public Safety crash and TxDOT roadway inventory databases. The team also gathered information on safety practices by conducting a mail-out survey and interviews with TxDOT district and

division representatives. A comprehensive literature search was included as part of the Phase I activities.

Phase II — State-of-the-Practice on Treatments for Crashes on Rural Two-Lane Highways

In Phase II, the research team developed and refined a reference tool. The tool was designed so that designers, area engineers, maintenance foremen, and others can obtain information on crash characteristics and countermeasures for rural roads in Texas. The tool emphasizes low-cost countermeasures for low-volume roads and includes information on rural crashes and how to conduct a crash study in Texas.

Phase III — Before-and-After Evaluations of Safety Treatments for Rural Highways

Activities within Phase III included developing and refining the methodology for conducting before-and-after studies, completing the before-and-after evaluations for the



individual sites, and analyzing the effectiveness of treatments in reducing crashes. Figure 1 shows an example of one of the before-and-after study sites.

What We Found...

Crash Characteristics

The types of crashes that are occurring in rural areas in Texas as compared to urban areas in Texas differ. Most of the crashes in rural areas occur away from intersections and driveways (60 percent). While only 40 percent of rural crashes occur at or near intersections or driveways, most urban crashes occur at or are related to either intersections or driveways (57 percent). Striking a fixed object is more common in rural areas (25 percent) than in urban areas (14 percent).

The distribution for injury severity shows some differences between rural and urban crashes. The percentage of fatal crashes is higher in rural areas (3 percent to 1 percent) as well as the percentage of incapacitating crashes (10 percent to 5 percent). The percentage of non-injury crashes is slightly higher in rural areas (37 percent compared to 31 percent). Urban areas have a higher proportion of possible injury crashes (46 percent) than rural areas (28 percent). Most of the crashes in both urban and rural environments occurred during daylight (69 and 63 percent, respectively). A higher percent of the rural crashes, however, occurred during dark (no lights) condition — 27 percent in rural areas and 6 percent in urban areas.



Figure 1. Example of a Study Site.

The findings from a comparison of the crashes at the state and district levels identified key directions that a TxDOT district may want to pursue when considering various types of low-cost improvements:

- treatments that either decrease the number of vehicles leaving the roadway, especially on tight horizontal curves, or that better communicate the nature of the curve;
- improvements to reduce the number of nighttime crashes;
- treatments that reduce crashes at driveways; and
- improvements to minimize severity of crashes if a vehicle leaves the road.

Crash Treatments

TxDOT sponsored the development of a document titled *Treatments for Crashes on Rural Two-Lane Highways in Texas* (Report 4048-2) to provide transportation practitioners with information

on crash characteristics for rural roads in Texas. It starts with information on rural crashes and how to conduct a crash study in Texas. The document presents discussion on low-cost safety treatments used on highways and at intersections along with their known effectiveness. Table 1 lists the treatments discussed in the document. Experiences with selected treatments in Texas, including whether the treatment would be considered elsewhere, are also included in the report.

Crash Analysis

A total of 50 sites were identified for inclusion in a before-and-after evaluation of the effectiveness of countermeasures on rural highways. The countermeasures were installed between 1995 and 2000. The results from the evaluation should be considered preliminary since the after data for many of the sites are less than 36 months and time constraints limited the ability to identify suitable reference sites.



Table 1. Treatments Discussed in *Treatments for Crashes on Rural Two-Lane Highways in Texas*.

Roadway Segments	Intersections
<ul style="list-style-type: none"> • Rumble strips • Passing improvements • Two-way left-turn lanes • Lane or shoulder widening • Pavement edge drop-off improvements • Pavement markings • Mowing • Skid resistance improvements • Side slope flattening • Recovery distance improvements • Tree mitigation • Culvert modifications • Advance warning for horizontal curves • Delineation • Barrier reflectors • Animal countermeasures 	<ul style="list-style-type: none"> • Advance warning for intersections • Approach rumble strips • Left-turn lanes • Shoulder bypass lanes • Intersection flashing beacons • Signalization • High-intensity strobe lights • Backplates on traffic signals • Illumination • Sight obstruction reduction

Table 2. Distribution of Preventable Crashes by Severity.

	Before	After ¹	% Reduction
Injury	142	98	31
Non-injury	67	79	-17
All Crashes	209	177	15
¹ Number of after crashes is based on an assumed 36-month period.			

The overall reduction in crashes at the 50 study sites was 15 percent, based on an average crash rate for all sites of 0.12 crashes per month per site in the before period and 0.10 crashes per month per site in the after period. Summing the preventable crashes yields 209 preventable crashes in the before period and 177 preventable crashes over an assumed 36-month after period. There was a noticeable reduction in the crash rate (15 percent) with an actual reduction in the number of preventable crashes estimated to be 32 crashes (0.64 crashes per site) over an assumed three-year after period.

To further emphasize the treatments' effects on safety, a similar before-and-after comparison can be made with injury crashes, as shown in [Table 2](#). A total of 142 injury crashes occurred in the before period, while 98 injury crashes occurred in the after period (after adjusting to a 36-month period). The crash data from all 50 study sites show a remarkable 31 percent reduction in injury crashes following installation of their respective treatments, resulting in a decrease of 44 injury crashes over an assumed 36-month after period. The substantial drop in preventable injury crashes (31 percent)

exceeds the aforementioned 15 percent decrease in all preventable crashes.

Another example of the benefit of the treatments can be shown in the percent of crashes with injuries. In the before period, 70 percent of the preventable crashes at the 50 sites involved some type of injury (142 injury crashes/209 total crashes). In the after period only 56 percent of preventable crashes involved injuries (98 injury crashes/177 total crashes). So in addition to decreasing the total number of crashes, the treatments at the 50 sites also decreased the percent of crashes with injuries.

The Researchers Recommend...

The document *Treatments for Crashes on Rural Two-Lane Highways in Texas* serves as the main implementation product from this project. It provides transportation practitioners with information on crash characteristics for rural roads in Texas. It also presents discussion of low-cost safety treatments used on highways and at intersections along with their known effectiveness.

There are a wide variety of available countermeasures, many of them at low costs, which can be and have been implemented to address safety issues. Implementing these countermeasures for crashes on rural roads provides benefits to the motoring public both in reducing the number of preventable crashes and in reducing the severity of the crashes that do occur.



For More Details...

Reference Tool:

Report 4048-2, *Treatments for Crashes on Rural Two-Lane Highways in Texas*

Related Reports:

Report 4048-1, *Characteristics of and Potential Treatments for Crashes on Low-Volume, Rural Two-Lane Highways in Texas*

Report 4048-3, *Additional Characteristics of Crashes on Rural Two-Lane Highways*

Report 0-4048-4, *Handbook Details Crash Treatments for Rural Highways*

Report 0-4048-5, *Preliminary Evaluations of Safety Treatments on Rural Highways in Texas*

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