Wyoming Technology Transfer Center
WY T² LTAP
Local Technical Assistance Program

T² Roads on the Range

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Rural roads are a critical link in the nation's transportation system, providing access from urban areas to the heartland. These roads also provide farm-to-market transportation and are the primary routes of travel and commerce for the approximately 60 million people living in rural America. But rural roads in the nation's heartland are carrying growing levels of traffic and commerce, often lack many desirable safety features and experience serious traffic accidents at a rate far higher than all other roads and highways [1]. Nationally, about 60 percent of traffic fatalities are rural, the majority of which occur on two-lane roads. The overall number of U.S. traffic fatalities has remained steady at more than 42,000 annually. According to a National Highway Traffic Safety Administration (NHTSA) study in 2002, health costs each year due to motor vehicle crashes have been estimated at $230 billion, or 2.3 percent of the U.S. gross domestic product [2]. Rural America has a significant highway safety problem. Close to 80 percent of the nation's roadway miles are in rural areas; over 58 percent of the total fatalities occur in rural areas and the fatality rate for rural areas (per 100 million vehicles miles of travel) is more than twice that of urban areas. Crashes in rural areas are more likely to result in fatalities due to a combination of factors including extreme terrain, faster speeds, more alcohol involvement, and the longer time intervals from the advent of a crash to medical treatment due to delays in locating crash victims and the distance to medical treatment centers.

The U.S. Department of Transportation's highway safety goals are to achieve a 50 percent reduction in truck crash-related fatalities by 2010, and a 20 percent reduction in crash-related fatalities and serious injuries by 2008. Among the priority safety areas for the Department of Transportation are reducing single-vehicle run-off-road fatal crashes, two-thirds of which occur in rural areas. Many of these fatal crashes take place on two-lane rural roads and involve vehicles striking fixed objects, or going down an embankment or into a ditch. Speeding is another factor in many run-off-the road rural crashes [3]. The Highway Safety Improvement Program (HSIP) was elevated to a core program as a result of the passage of SAFETEA-LU. It includes a new set-aside provision known as the High Risk Rural Roads (HRRR) Program. This program is a component of the HSIP and is a $90 million per year program set-aside after HSIP funds have been apportioned to the states. The purpose of this program is to achieve a significant reduction in traffic fatalities and incapacitating injuries on rural major or minor collectors, and/or rural local roads [4].

THE WRRSP

In this study, the Wyoming LTAP Center developed a Wyoming Rural Road Safety Program (WRRSP) with funding from WYDOT and FHWA and in cooperation with Wyoming counties. The primary objective of this program was to help counties in identifying high risk rural locations and then develop a strategy to obtain funding for the top-ranked sections to reduce crashes and fatalities on rural roads statewide.

As part of this study, a Local Road Safety Advisory Group (LRSAG) was established. This group included representatives from: WYDOT, Wyoming LTAP, Wyoming Association of County Engineers and Road Supervisors (WACERS), Wyoming Association of Municipalities (WAM), and FHWA. Three Wyoming counties were included in the pilot phase of this study. The program involved the collection of data for the three counties: Carbon, Laramie, and Johnson counties. These counties were selected to cover the variations in traffic patterns, crashes, and populations among Wyoming counties.

A five-step procedure was developed by the LTAP center and approved by the LRSAG. These five steps are:

1. Crash data analysis
2. Level I field evaluation
3. Combined ranking to identify potential high risk locations based on steps 1 and 2
4. Level II field evaluation to identify countermeasures
5. Benefit/cost analysis

The five-step procedure is shown graphically in Figure 1. This program utilizes the combination of historical crash records and field safety evaluations in identifying high risk locations. A benefit/cost analysis can then be applied to determine the most cost effective countermeasures at the high risk locations.

PROGRAM DESCRIPTION

As described above, the five steps included in the WRRSP will insure selecting high risk locations based on both field conditions and historical crashes. This section describes these five steps in detail and shows how these steps were applied in Laramie County, one of the counties included in the pilot study.

Step1: Crash data analysis

The Wyoming Department of Transportation (WYDOT) has crash data on all rural county roadways in Wyoming over a ten-year period. The crash data obtained from WYDOT contains information regarding the road sections where crashes occurred i.e. road number, severity of crashes, road surface conditions, road alignment details, weather conditions, first harmful event (FHE), etc.

The LRSAG provided direction to the LTAP Center to place every crash into the actual single-mile strip for a road on which it occurred, i.e. Road 10, mile 2.01-3.00. So every PDO, injury, and fatal crash should be recorded per each single-mile strip of roadway in an Excel spreadsheet. The data can be then sorted from largest to smallest based on total number of crashes. The top 30 single-mile strips are then identified for the follow-up analysis. The analysis can be conducted on the EPDO or fatal crashes but the LRSAG and the LTAP Center agreed that fatal crashes were too limited in number and this would not result in a meaningful analysis. In addition, the EPDO analysis would put too much emphasis on fatal and injury-related crashes which might skew the analysis. Ranking sections based on the actual number of crashes on specific one-mile segments was identified as the procedure to follow in this study. The final ranking of sections in a county should look similar to Table 1 which was prepared for Laramie County.

After the high risk one-mile segments are identified in a county, 10 to 15 roads that have high ranking segments should be selected for inclusion

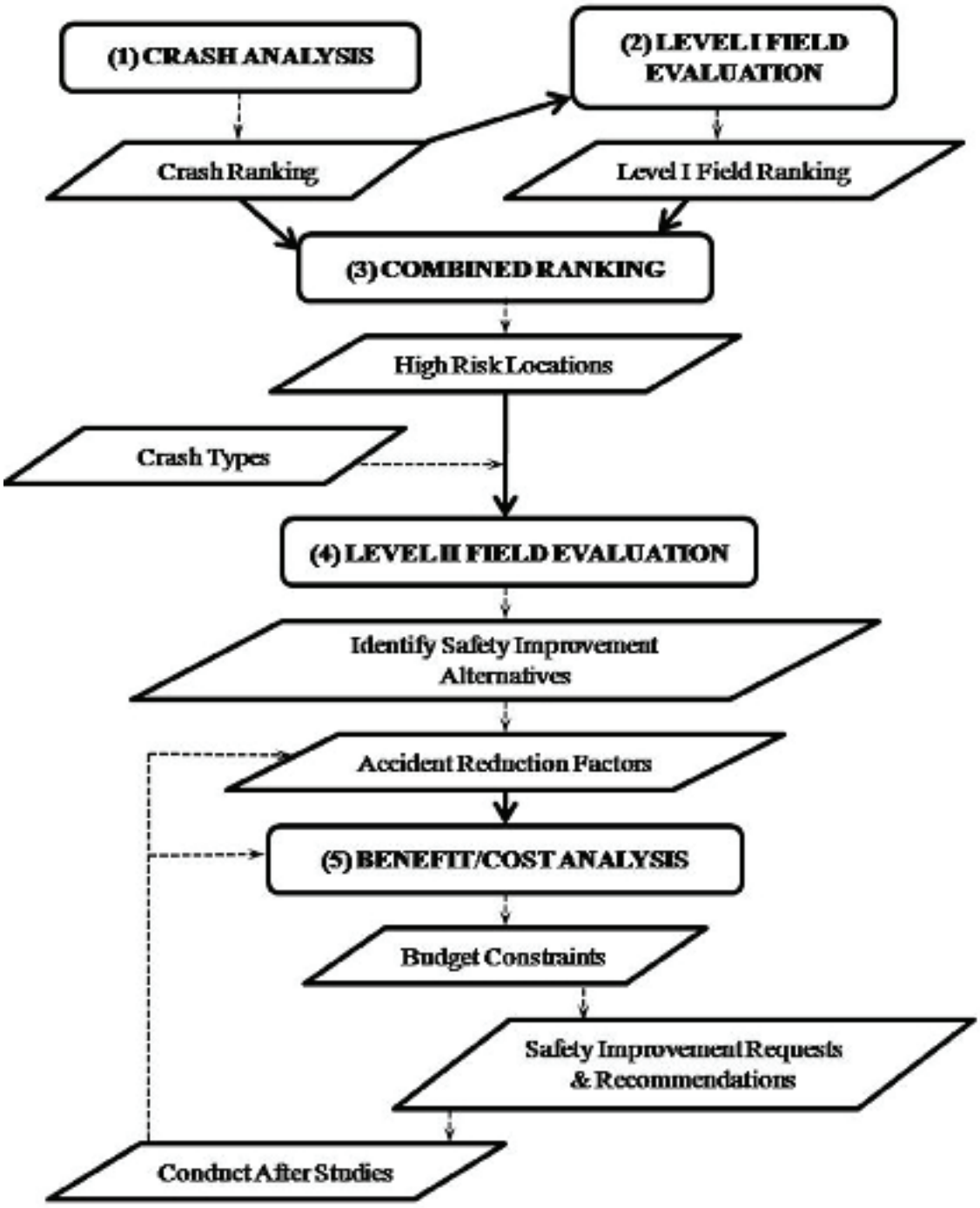

Figure 1. The five step process to identify high risk rural roads.

Table 1. Results from crash analysis in Laramie County.

ROAD NO.	MILE POST	TOTAL CRASHES	PDOS	INJURIES	FATALS
210-1	5.01-6.00	9	4	5	0
215-3	2.01-3.00	9	3	6	0
109-1	1.01-2.00	9	1	7	1
124-2	1.01-2.00	8	5	3	0
215-3	0.00-1.00	8	3	5	0
162-2	9.01-10.00	7	2	5	0
215-3	1.01-2.00	7	4	3	0
210-1	4.01-5.00	6	2	4	0
212-7	3.01-4.00	6	1	5	0
203-1	17.01-18.00	6	2	4	0
210-1	6.01-7.00	5	0	5	0
102-1	3.01-4.00	5	2	3	0
209-2	1.01-2.00	5	2	3	0
143-2	0.00-1.00	5	2	1	2
207-1	2.01-3.00	5	5	0	0

in the field evaluation. Table 2 summarizes the selected high risk roads in Laramie County.

Table 2. Selected high risk rural roads in Laramie County

Road No.	Road Name	Road Length	Evaluated Section
210-1	Crystal Lake	10.8	10.8
109-1 N	Gilchrist	9.48	9.48
124-2	Old Yellowstone	10.84	3
215-3 E	Railroad Hillside Ridge	18.47	11
136-1 S	Durham	8.23	5
209-2	Campstool	7.33	7.33
207-1	Arcola	17.18	4
143-2	Hillside North/Midway	28.38	7
212-7	Old Hwy Burns East	4.11	4.11
203-1	Chalk Bluff	36.8	16
102-1	Harriman	7.32	7.32
162-2	Albin/LaGrange	10.95	10.95
164-1	Cemetery/Pine Bluff South	12.26	2
120-1	Roundtop	26.81	9
149-1	A-149-1	0.69	0.69

Step 2: Level I field evaluation

Level I field evaluations should be performed on roadway sections which are identified as high risk locations based on the crash analysis. There are five categories used in the Level I field evaluation. The road should be evaluated in the field and analyzed for each one-mile segment. Each one-mile section will be given a rated score of 0 to 10 for five categories, with 0 being the worst and 10 being the best. The five categories are:

1. General
2. Intersection and Rail Road Crossings
3. Signage and Pavement Markings
4. Fixed Objects and Clear Zones
5. Shoulder and ROW.

The total sum of the five categories will provide the mile section segment score. The LTAP Cen-

ter developed a field data collection form for the Level I field evaluation. The total sum of the five categories gives the final score for the one-mile segment. Higher segment scores reflect safer field conditions. An example of Level I Field Evaluation of a one-mile segment in Laramie County is shown in Table 3. The Level I field evaluation process described in this article can be conducted on the selected fifteen locations in three to five days. It was designed so that it does not require a major time commitment from counties which are short on resources.

Step 3: Combined ranking to select roadways for Level II field evaluation:

In order to select the roadways to be included in the Level II field evaluation, a combined ranking should be obtained based on the Total Crashes rankings and the rankings from the Level I field evaluation. In step 1, road segments were ranked based on the total number of crashes. Road segments' field scores obtained from Step 2 should be also used to rank the sections. Lower field scores should result in lower field rank. Table 4 shows the crash and the field ranks for Laramie County.

Table 3. Level I Field Evaluation Example

Level I Field Evaluation	Evaluator: F. Jones	Date: 7/07/07	Page: 1 of 1
Notes:	Road Name: Test	Road Length: 5.8 Miles	
	Road No.: 100	Road Surface: Asphalt	
	Road Class: 9	Speed Limit: 55	

Mile Post	General	Intersections/ RR Crossings	Signage/ Pavement	Fixed Objects/ Clear Zones	Shoulder / ROW	Segment Score	Comments
2.01-3.00	3	5	0	9	2	19	Several Vertical & Horizontal Curves, 3 Intersections, No Signs

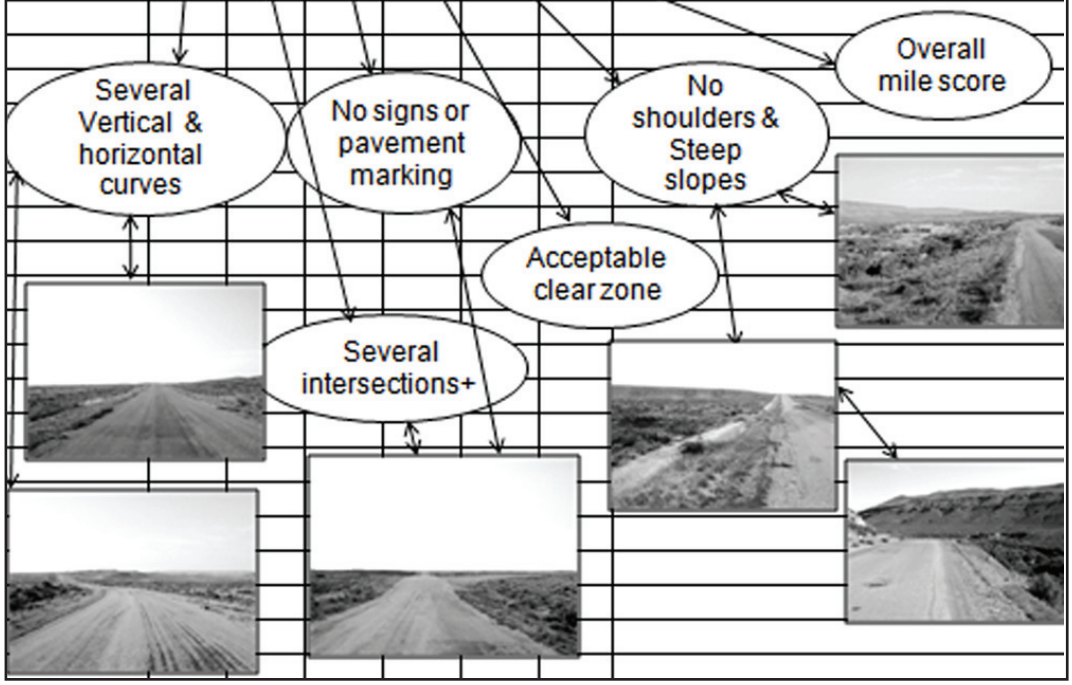

Table 4. Crash data and level I field rankings for Laramie County.								
TOTAL CRASHES	ROAD NO.	MILE POST	CRASH RANKING		LEVEL I FIELD SCORE	ROAD NO.	MILE POST	LEVEL I RANKING
9	210-1	5.01-6.00	1		16	210-1	5.01-6.00	1
9	215-3	2.01-3.00	1		17	136-1	3.01-4.00	2
9	109-1	1.01-2.00	1		18	124-2	1.01-2.00	3
8	124-2	1.01-2.00	4		18	109-1	6.01-7.00	3
8	215-3	0.00-1.00	4		19	210-1	4.01-5.00	5
7	162-2	9.01-10.00	6		19	164-1	11.01-12.00	5
7	215-3	1.01-2.00	6		20	210-1	0.00-1.00	7
6	210-1	4.01-5.00	8		20	102-1	0.00-1.00	7
6	203-1	17.01-18.00	8		20	124-2	2.01-3.00	7
6	212-7	3.01-4.00	8		21	102-1	2.01-3.00	10
5	210-1	6.01-7.00	11		21	109-1	3.01-4.00	10
5	102-1	3.01-4.00	11		21	124-2	0.00-1.00	10
5	209-2	1.01=2.00	11		21	102-1	1.01-2.00	10
5	143-2	0.00-1.00	11		22	210-1	6.01-7.00	14
5	120-1	4-5, 8-9	11		22	162-2	5.01-6.00	14
5	207-1	2.01-3.00	11		22	203-1	7.01-8.00	14

To obtain the combined rankings, the crash and Level I rankings for each segment should be added. The top 15 segments with the combined smallest numbers will be considered the most hazardous and they should be included in the Level II field evaluation. Table 5 shows the combined ranks for Laramie County. The LTAP Center conducted a sensitivity analysis to determine if different weights should be assigned to the crash and the field ranks. It was found that a difference of less than 10% in weight will not result in any significant change in the combined ranking. Therefore, the LRSAG recommended that equal weights should be assigned to both ranks.

Step 4: Level II field evaluation to identify safety concerns and countermeasures:

Level II field evaluations should be performed on roadways which are identified as high risk locations based on the combined score from the crash analysis and the Level I field evaluation. As an example, Table 5 clearly shows that in Laramie County roadway 210-1 has four segments ranked as high risk locations. Therefore, roadway 210-1 is a primary candidate for Level II field evaluation. At this point, traffic volumes and speeds should be collected on the selected roads for seven days. In addition to the traffic information, important specific information should be collected on the geometric features of the road, safety concerns, signs and pavement markings. The Level II field evaluation is similar in nature to road safety audits.

It should be mentioned here that crashes should be evaluated to determine the top three causes of crashes on each section prior to conducting the level II field evaluation. Specific safety countermeasures will be recommended to reduce the type of crashes experienced at the locations subjected to the level II field evaluations.

Step 5: Benefit/Cost Analysis:

The selected countermeasures in step 4 will have variable costs and effects in reducing or mitigating crashes. Therefore, a benefit/cost analysis should be performed to evaluate which countermeasures can most effectively reduce the crashes at the lowest cost. Two

Table 5. Combined ranking for high risk segments in Laramie County.			
ROAD NO.	MILE POST	OVERALL SCORE	COMBINED RANKING
210-1	5.01-6.00	2	1
124-2	1.01-2.00	7	2
210-1	4.01-5.00	13	3
136-1	3.01-4.00	19	4
109-1	6.01-7.00	20	5
164-1	11.01-12.00	22	6
210-1	0.00-1.00	24	7
210-1	6.01-7.00	25	8
102-1	2.01-3.00	27	9
109-1	3.01-4.00	27	10
124-2	0.00-1.00	27	11
102-1	3.01-4.00	29	12
209-2	1.01-2.00	29	13
162-2	5.01-6.00	31	14
162-2	9.01-10.00	31	15
203-1	7.01-8.00	31	16

worksheets were developed to perform the benefit/cost analysis based on the estimated costs and the anticipated reduction in crashes. The first worksheet is designed for a single segment while the second one can be used to perform the analysis on multiple segments. After all the required information is entered, the worksheets will automatically calculate the benefit and the benefit/cost ratio for each countermeasure and the combined value if multiple countermeasures are used. Higher benefit to cost ratios reflects more cost effective countermeasures.

When all five steps are completed; the resulting information can be used to justify allocating county funding for safety improvements. In addition, the information can be summarized in the spreadsheet shown in Table 6 to request funding for safety improvements.

WRRSP IMPLEMENTATION

The Wyoming LRSAG approved the Wyoming Rural Road Safety Program (WRRSP) described in this paper and recommended statewide implementation. In addition, WYDOT and the FHWA Division office approved the WRRSP for eligibility to receive funding from the High Risk Rural Road (HRRR) Program. Counties interested in applying for funding from the HRRR program would need to follow the methodology described in this paper. Requests from all Wyoming counties will be submitted to the Local Government Office of WYDOT. The Wyoming Safety Management System (SMS) Committee will select a subcommittee to allocate the funding from the HRRR program for eligible and cost-effective requests. The Wyoming LTAP Center is in the process of developing training materials to demonstrate to interested counties how they can implement this safety program. The workshops will be held on November 18th in Riverton and November 19th in Douglas. Brochures will be mailed in early October; for more information, contact Khaled at the Center.

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Table 6. Safety improvement request.

County: Laramie	**Road Name:** Gilchrist		**Road #:** 109-1		**Date:**	7/16/2008
Road Class: Minor Collector **ADT:** 179			**Road Surface:** Gravel			
Causative Factors Behind Crashes :	1. Overturns		4			
	2. Alignment		5			
	3		6			
Counter Measure	**Crash Type Affected**	**Quantity**	**Estimated Cost**	**Benefit/Cost**	**Approved Amount**	**Funding Source**
Advance warning signs	1 & 2	45	$22,500	58.63		
Replace Cattleguards	1 & 2	3	$21,000	70.67		
		Total Request:	$43,500	**Total Approved:**	$0	

REFERENCES

1. The Road Information Program 1726 M Street, NW, Suite 401Washington, DC 20036 Phone: (202) 466-6706 www.tripnet.org Growing Traffic in Rural America: Safety, Mobility and Economic Challenges in America's Heartland.
2. University of Minnesota's Center for Excellence in Rural Safety (CERS), 2007 Rural Safety Summer Institute. Center for Transportation Studies, University of Minnesota 200 Transportation & Safety Building 511 Washington Ave. SE, Minneapolis, MN 55455
3. The Community Investment Network, 100 East Second Street, Mineola, NY 11501, US Department of Transportation Rural Transportation Initiative
4. Federal Highway Administration, 1200 New Jersey Ave., SE, Washington, DC 20590, Safety fact sheet 1401

Upcoming Workshops

Concrete: What's New?

Casper - November 5
Cheyenne - November 6

Wyoming Rural Road Safety Program

Riverton - November 18
Douglas - November 19

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