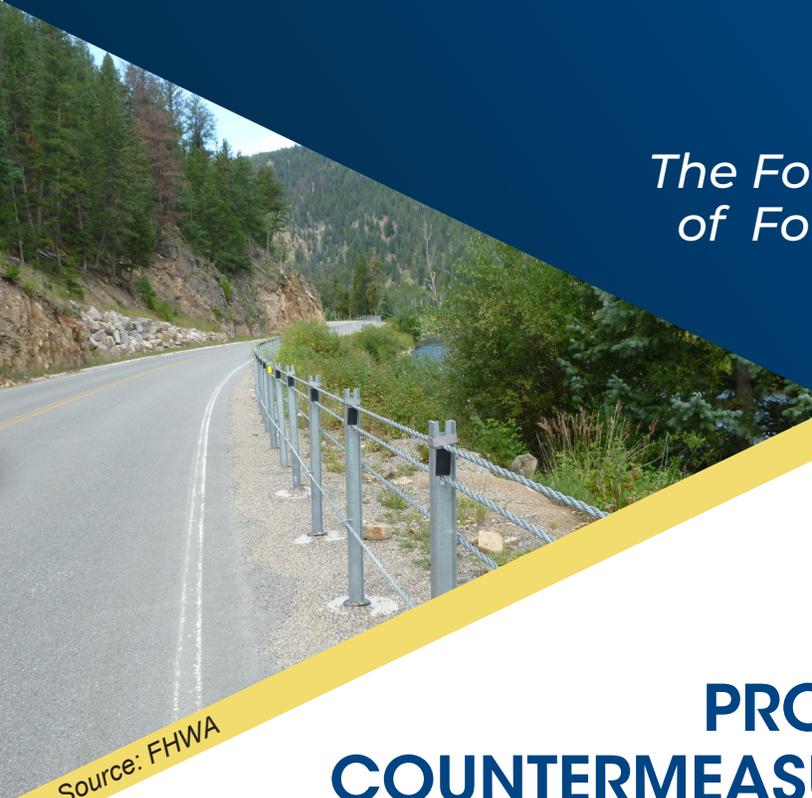


The Four Pillars of FoRRRwD



Source: FHWA

PROVEN COUNTERMEASURES



Roadway departures (aka lane departures) on the rural road network account for one-third of traffic fatalities. The FoRRRwD (Focus on Reducing Rural Roadway Departures) initiative encourages a systemic application of countermeasures that help keep vehicles in their travel lanes, reduce the potential for crashes, and decrease the severity of crashes that do occur.

FoRRRwD is supported by four pillars that work together to reduce rural roadway departures:

- ▶ **Proven Countermeasures**
- ▶ Systemic Approach
- ▶ Safety Action Plans
- ▶ All Public Roads

30 people will die today from rural roadway departure crashes. Let's save the people behind the numbers.

<https://safety.fhwa.dot.gov/FoRRRwD/>

There are many flexible, cost-effective countermeasures that are proven to reduce rural roadway departure crashes. They can be installed in various situations and on many types of roadways. Countermeasures can be used individually or in combination.

There are specific countermeasures that apply to each of FoRRRwD's three objectives:

1st Keep vehicles on the roadway

- ▶ Edge Line and Center Line Markings
- ▶ Curve Warning Signs
- ▶ High Friction Surface Treatments (HFST)
- ▶ Center Line and Shoulder Rumble Strips
- ▶ Delineators

2nd Reduce the potential for crashes

- ▶ Shoulder Widening
- ▶ SafetyEdgeSM
- ▶ Center Line Buffer Areas
- ▶ Remove Fixed Objects
- ▶ Flatten Slopes

3rd Minimize crash severity

- ▶ Barriers
- ▶ Breakaway Features



U.S. Department of Transportation
Federal Highway Administration

ZERO IS OUR GOAL
A SAFE SYSTEM IS HOW WE GET THERE

FHWA-SA-21-083

Noteworthy Practices

The following are examples of how state and local agencies have successfully implemented countermeasures in their area. By combining funding opportunities with data analysis, these agencies were able to target key locations and methods for improvements. The results have led to safer roads with fewer roadway departure fatalities and serious injuries.

Edge Lines and Delineators at Horizontal Curves *Bonner County, Idaho*

Most of Bonner County's 700 miles of roads are rural, narrow, in mountainous terrain, have roadside trees, limited guardrail, reduced visibility, and under 3,000 average daily traffic (ADT). Crash data in Bonner County indicated that roadway departure crashes are the most frequent crash type. To improve roadway safety, Bonner County, like other local Idaho agencies, can apply for safety project funding through the Local Highway Safety Improvement Program (LHSIP).

Because horizontal curves are locations with a greater risk of a roadway departure, Bonner County used LHSIP funds to improve visibility at curves using edge lines and delineators on 31 roadways.

Before this effort, county roads often only had center lines striped and did not have edge lines due to limited budget. Bonner County prioritized installation of edge lines and delineators on horizontal curves based on risk factors, including degree of curvature, traffic volumes, and crash history. The edge lines are a durable pavement marking (methyl methacrylate) with a 10-year expected life. Delineators are installed at a 200-ft spacing (closer on sharp curves), are low-cost, can be installed by maintenance crews, and are visible in snow conditions.

Bonner County is currently waiting for 5 years of crash data after installation to conduct an evaluation; however, anecdotal evidence from the public indicates a positive reception of the countermeasures, with requests for more installations.



Figure 1. Edge lines and delineators improve visibility on horizontal curves. Source: Matt Mulder, Bonner County, Idaho.

Center Line Rumble Stripes on County Roads *Mercer County, New Jersey*

Mercer County maintains 180 miles of pavement, encompassed by the Delaware Valley Regional Planning Commission (DVRPC). In 2012, DVRPC allocated federal funding toward center line rumble stripes, which were an innovative countermeasure for local agencies at that time. Although most county roads in Mercer County are urban and carry over 5,000 vehicles per day, the county has had a history of head-on crashes on its two-lane rural roads. Prior to this effort, Mercer County had not deployed center line rumble stripes. Recognizing the potential to save lives, the county volunteered for the opportunity to implement this countermeasure with DVRPC support.

To identify and prioritize treatment locations, Mercer County used crash data available through the New Jersey Department of Transportation and conducted a network analysis for head-on and run-off-road crashes. Furthermore, the county identified roads that were resurfaced within the past five years, focusing on roadways with good pavement condition. The objective was to avoid installations where the rumble stripes would be filled in by any scheduled milling and resurfacing projects. Following the analysis, Mercer County installed nearly 6 miles of center line rumble stripes on 18 segments of roadway, varying in length from 1,000 ft. to 4 miles.

After installation, Mercer County received noise complaints from the public; however, after communicating the safety benefits the complaints decreased.



Figure 2. Center line rumble stripes in Mercer County reduce head-on crashes. Source: George Fallat, Mercer County, New Jersey.

Cable Barrier

Gunnison County, Colorado and Central Federal Lands

Taylor River Road is located in the Gunnison National Forest in central Colorado. As the name suggests, the roadway is along the Taylor River with scenic views of the Rocky Mountains and the river. However, the physical landscape also poses safety risks and space constraints on both sides of the road. On one side of the road there is a steep drop-off toward the river and a rock slope on the opposite side, where loose rock can fall onto the road. The road has a posted speed limit of 35 mph and is used by both local traffic and tourists accessing the river and campgrounds. It is not uncommon to see bicyclists and RVs using the road.

Since Taylor River Road is a county-owned road that goes through a national forest, Gunnison County partnered with Central Federal Lands (CFL) and the National Forest to identify a potential solution to shield vehicles from the drop-off toward the river. It was clear that the roadway needed a barrier based on known crashes where vehicles were removed from the river. There are several types of barrier that CFL uses, such as w-beam, steel-backed timber, concrete, and high-tension cable barrier. The agencies weighed the benefits and drawbacks of each type and decided to use a high-tension cable barrier. The cable barrier allows for unobstructed views of the landscape, without sacrificing safety. The cable barrier also allows snow to be plowed over and through it, unlike a w-beam guardrail, and fallen rock is more easily brushed off the roadway past the cable barrier. Another benefit of the cable barrier is the shallow profile, which allows more usable roadway width for bicyclists and RVs.

Gunnison County used Federal Land Access Program (FLAP) funds to implement this project. FLAP is designed to provide flexibility for a wide range of projects that improve transportation facilities that provide access to, are adjacent to, or are located within Federal lands.



Figure 3. A high-tension cable barrier preserves views of the landscape while shielding vehicles from a steep drop-off. Source: FHWA.

High Friction Surface Treatment

Thurston County, Washington State

In 2012, Thurston County conducted a data-driven safety analysis to identify and prioritize potential safety projects that would be eligible for Highway Safety Improvement Program (HSIP) funds. In Thurston County, roadway departure crashes coded as skidding/out of control accounted for 27 percent of fatal and severe crashes from 2006 to 2010. Further analysis revealed wet/icy pavement contributed to 47 percent of crashes. These patterns led the County to identify high friction surface treatment (HFST) as an effective solution for crash reduction.

To prioritize locations for HFST, the county used risk factors for arterial and collector roads including posted speed limit of 50 mph or more, traffic volumes, presence of horizontal curves, and shoulder type and width. Thurston County had no prior experience with HFST and worked with the Washington Local Technical Assistance Program (LTAP) and FHWA to coordinate a peer exchange and pilot project. The peer exchange featured an HFST installation demonstration applied by Thurston County traffic and road maintenance crews, and was followed by a detailed overview of HFST by national experts. This and other installations across the country have demonstrated that quality HFST installations can be obtained with automated, semi-automated, or hand application. Thurston County's success with hand application can be attributed to the use of demonstration pilot sites and learning from other's experiences through the peer exchange. Quality materials and construction practices are needed regardless of application method.

Since the peer exchange, the Washington State Department of Transportation (WSDOT) has funded HFST projects at 182 sites on local roads in 8 counties and 3 cities. In 2016, WSDOT awarded Thurston County more than \$2 million for HFST at 29 locations. In the time since installation, the HFST projects at horizontal curves have seen substantial reductions in average crashes per year, including 46 percent for total lane departure crashes, 70 percent for wet lane departure crashes, and 100 percent for fatal and serious injury lane departure crashes.



Figure 4. HFST at a Thurston demonstration site. Source: FHWA.



Figure 5. Roadside tree removal is followed up with mowing to reduce the chances of fixed-object crashes. Source: Destain Gingell, Lapeer CRC.



Figure 6. Paving a Delaware roadway with SafetyEdgeSM. After paving, a graded shoulder will become flush with top of the pavement, covering the sloped edge. Source: FHWA.

Tree Removal Program

Lapeer County, Michigan

The Lapeer County Road Commission (CRC) desired to improve roadway safety with a limited budget. Lapeer County maintains 1,310 miles of two-lane roads (510 paved) that are mostly in a rural, rolling terrain. Crashes into fixed objects, primarily trees, account for a significant number of the serious and fatal crashes on these roads but these crashes are spread out over the system, so it is difficult to identify improvement locations based on crash history.

To combat this problem, Lapeer County established a proactive tree removal and trimming program. The program uses a systemic approach to identify locations throughout the roadway network based on risk factors like higher posted speed limits, vertical and horizontal curves, and poor sight distance. To prioritize locations, focus was on removing trees closest to the road, in critical locations such as the outside of horizontal curves, dead or leaning trees, and areas where canopy prohibited sunlight from drying the road surface. Lapeer CRC also established a roadside mowing program for the entire right-of-way that follows up on segments recently cleared to prevent growth of new trees.

Lapeer CRC budgets \$500,000 annually on County Primary Roads for tree removal and trimming and matches up to \$90,000 annually to local townships that spend over \$180,000.

Safety benefits of tree removal include decreases in crash frequency and severity, greater sight distance, improved visibility of animals crossing the road, and a decrease in ice/snow caused by shading of trees and brush. The latter reduces winter maintenance costs and improves the nearby environment through reduced salting. In the past, the public voiced complaints about tree removal; however, complaints have been reduced substantially through the use of press releases on social media or local newspapers to communicate the safety benefits and provide an opportunity to discuss issues with property owners.

SafetyEdgeSM

Delaware Department of Transportation (DelDOT)

The SafetyEdgeSM can help save lives by allowing drivers who drift off highways to return to the road safely due to the edge of the pavement being shaped to 30 degrees, instead of a vertical drop-off. DelDOT first implemented SafetyEdgeSM in a resurfacing project on a narrow, rural collector in 2010. The project was about 5 miles long and included repair of extensive cracking and distortion, widening the pavement from approximately 20 feet to 22 feet, and providing a 2-inch warm-mix asphalt overlay with SafetyEdgeSM.

Since SafetyEdgeSM was a new, innovative countermeasure at the time, DelDOT conducted a project showcase that was attended by almost 60 people from DelDOT, contractors, local agencies, 3 other mid-Atlantic State highway agencies, and the FHWA Eastern Federal Lands Highway Division. The showcase included a basic presentation, Q&A session, and a visit to the project site to watch the paving operation. The opportunities to see the treatment first-hand, discuss with peers, and ask questions of the contractor spurred several other agencies to consider this innovation. DelDOT used the results of the demonstration project to adopt a design guidance memorandum in late 2010. DelDOT continued to implement SafetyEdgeSM and, in 2018, DelDOT included it in their standard detail to be implemented systematically into paving projects on all State roads. DelDOT noted the importance of education and training to both internal and external personnel (i.e., contractors), and using professional organizations like the American Society of Highway Engineers (ASHE) and the Institute of Transportation Engineers (ITE) as a conduit.

When estimating asphalt for this project, DelDOT assumed a small amount of extra material, but it was found to be negligible in the field. The contractor purchased a commercially available device for about \$3,000, which was used for future projects.

Resources

Roadway Departure Safety https://safety.fhwa.dot.gov/roadway_dept/

Proven Countermeasures <https://safety.fhwa.dot.gov/FoRRRwD/countermeasures.cfm>

Crash Modification Factors Clearinghouse <http://www.cmfclearinghouse.org/>

Countermeasure Pocket Guide <https://safety.fhwa.dot.gov/FoRRRwD/RwDPocketGuide.pdf>