




# Rural Roadway Departure Peer Exchange



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# Background

- Peer Exchange – Forum for exchanging information, knowledge, experiences and best practices
- Purpose – Discuss experiences with strategies related to FHWA's Focusing on Reducing Rural Roadway Departures (FoRRRwD) for public roads
  - Proven countermeasures
  - Systemic approaches
  - Safety action plans
- Past peer exchanges feedback requested more local agency/LTAP involvement

# New Orleans, Louisiana – April 4-5, 2023




Participating states:

- Iowa
- Louisiana
- Montana
- New York
- New Hampshire
- North Carolina

- Iowa – Brian Keierleber (Buchanan Co.), Jamie Johll (Webster Co.), William Rabenberg (Clay Co.), David Veneziano (LTAP)




# What was discussed?

- Addressing crashes on all public roads - trends
  - The systemic safety approach
  - Roadway departure countermeasures
    - Strategies to employ
    - Experiences using the countermeasures
  - Safety action plans
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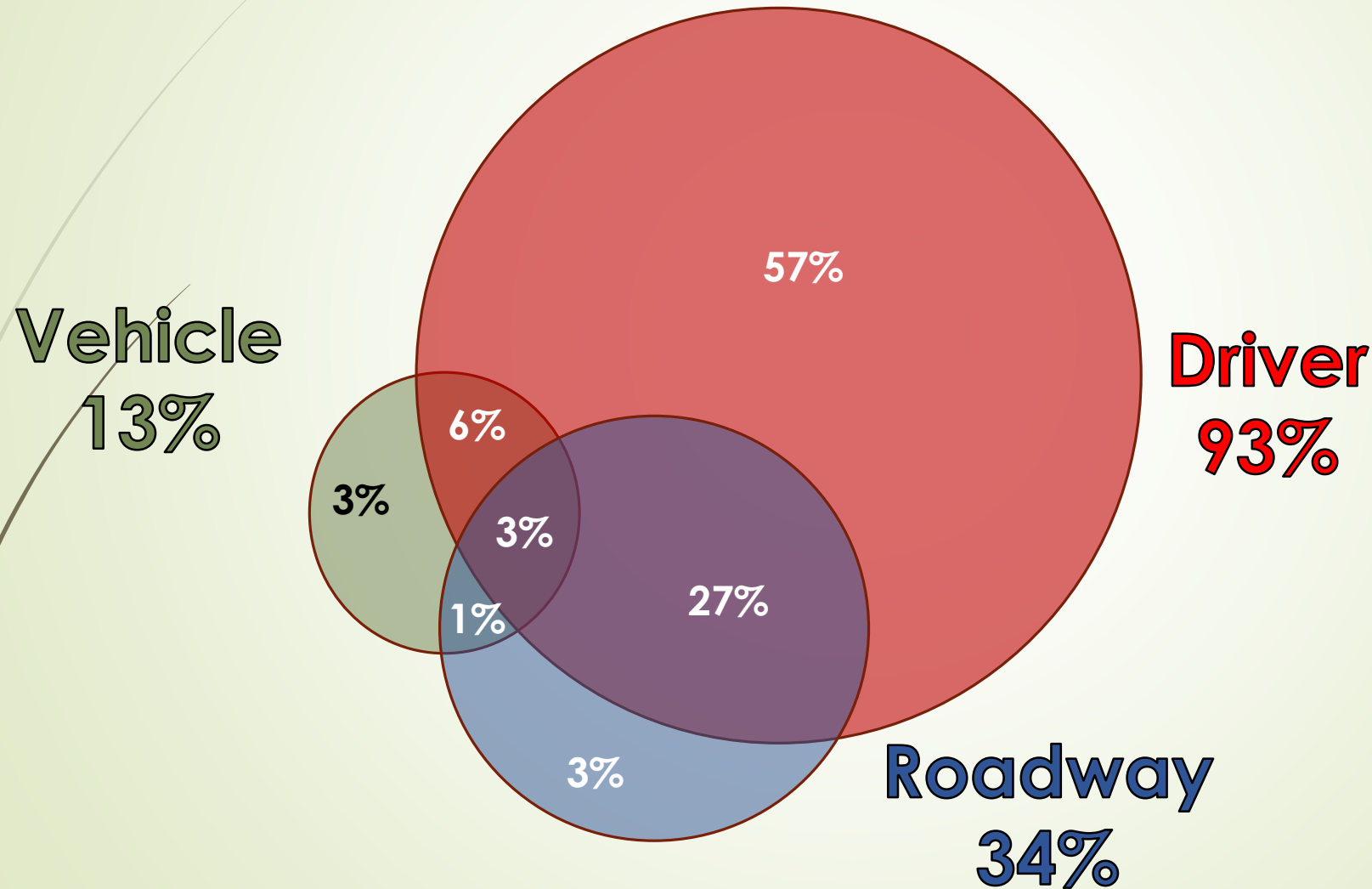




# FoRRRwD

- Traffic fatalities are overrepresented in rural areas
  - 29% of all fatalities on rural roads due to roadway departure
  - Equates to approximately 30 people per day
  - FoRRRwD aims to deploy countermeasures to address this trend
  - Breaks down roadway departures into three major areas: rollover, curve, and head on
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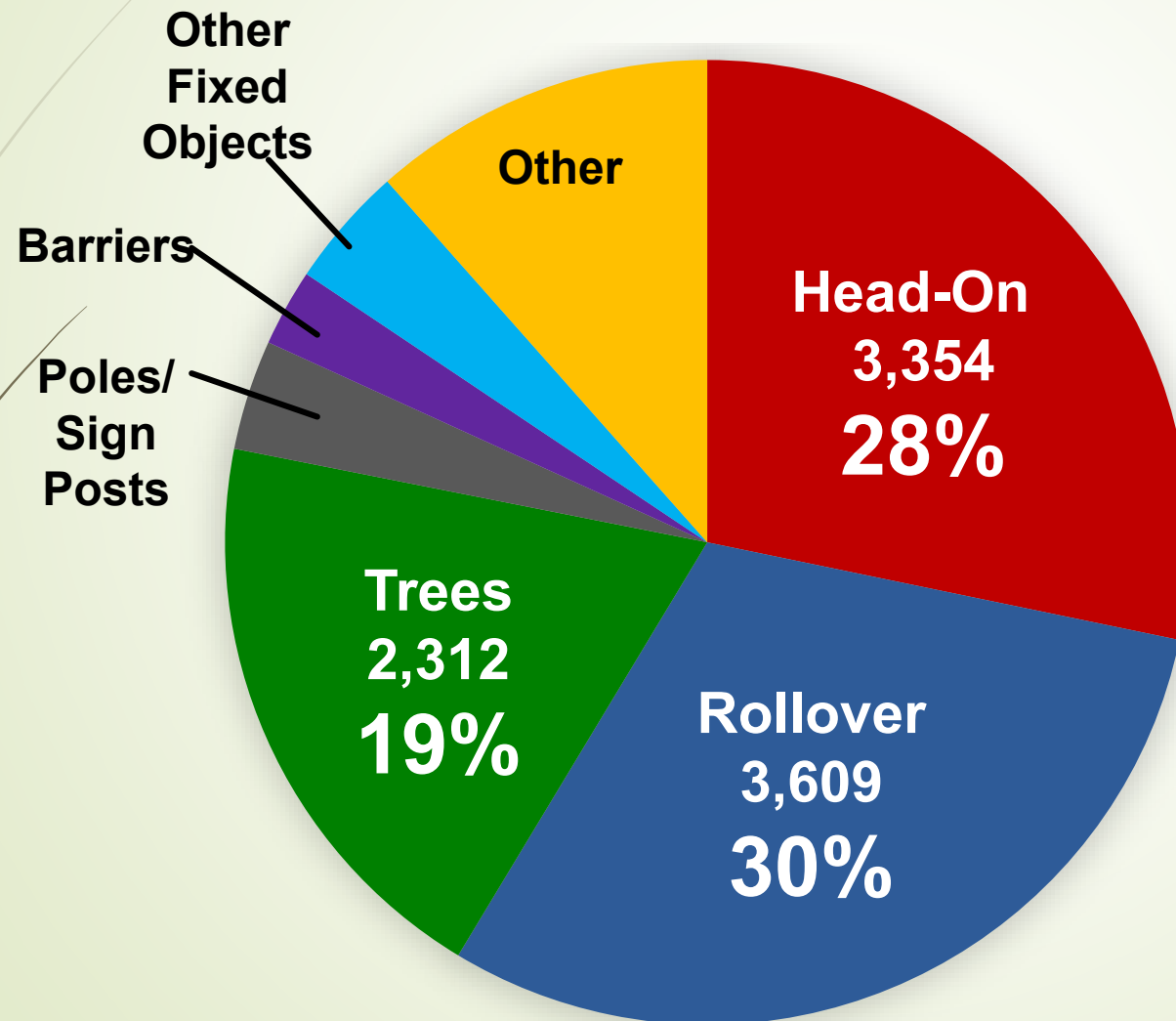
# Crashes Caused by Various Factors: Systems Approach



**The Driver is  
weakest link in  
this system...**

*FROM: Lum & Reagan,  
Public Roads Magazine,  
Winter 1995, "Interactive  
Highway Safety Design  
Module"*

# Most Harmful Event – Big Three



Over 75% of Rural Roadway Departures are due to 3 crash types

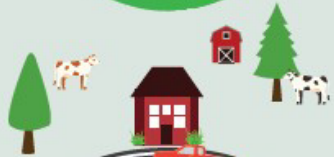
# Focus on Reducing Rural Roadway Departures

▶ **Thirty people will die today, and every day, in a rural roadway departure crash.**


There are many countermeasures proven to reduce these crashes. They help keep drivers on the roadway, provide for safe recovery if they do leave their travel lane, or reduce the severity of a crash if it happens. The countermeasures have varying levels of safety benefits, maintenance, and overall cost. These tables categorize them to help you focus on reducing rural roadway departure crashes in your community.



**Keep Vehicles on Roadway**




**Provide for Safe Recovery**

**Reduce Crash Severity**

Countermeasure	Cost			Safety			Maintenance		
	High	Medium	Low	High	Medium	Low	High	Medium	Low
<b>Prevent Markings</b>									
Center Lines			⊕			⊕	⊕		
Edge Lines			⊕	⊕		⊕			
Open Arrow Markings in Lane			⊕			⊕			
Post-Advanced Delineators			⊕	No Data Available				⊕	
Reflective Barrier Delineators			⊕	No Data Available				⊕	
Wider Edge Markings			⊕	No Data Available				⊕	

Countermeasure	Cost			Safety			Maintenance		
	High	Medium	Low	High	Medium	Low	High	Medium	Low
<b>Signs</b>									
Advance Warning Signs			⊕	No Data Available					⊕
Advance Speed Plaques			⊕	No Data Available					⊕
Channel Alignment Signs			⊕			⊕			
One-Direction Large Arrow Sign			⊕	No Data Available					
Overhead Warning Signs			⊕	No Data Available					⊕
Overhead-up Warning Signs			⊕	No Data Available					⊕
Retro-Reflective Stripes on Warning Sign Posts			⊕	No Data Available					⊕
Fluorescent Yellow Reflective Sheeting			⊕	⊕		⊕			
Flashing Beacon on Warning Signs			⊕			⊕			
Dynamic Curve Warning Systems			⊕			⊕			
Curve Delineators			⊕	No Data Available					⊕
Curve System Maintenance			⊕	No Data Available					⊕

Countermeasure	Cost			Safety			Maintenance		
	High	Medium	Low	High	Medium	Low	High	Medium	Low
<b>Prevention</b>									
Roadside Prevention Plants			⊕	⊕		⊕			⊕
High Friction Surface Treatment			⊕			⊕			⊕
Graveling			⊕			⊕			⊕
Chip Seal			⊕			⊕			⊕

Countermeasure	Cost			Safety			Maintenance		
	High	Medium	Low	High	Medium	Low	High	Medium	Low
<b>Geometric Design</b>									
Wider Travel Lane Width			⊕			⊕			⊕
Center Two-Way Left-Turn Lane			⊕			⊕			⊕
Parking Lane (or Short Four-Lane Section)			⊕			⊕			⊕
Adoptive Super-elevation Rate			⊕			⊕			⊕

Countermeasure	Cost			Safety			Maintenance		
	High	Medium	Low	High	Medium	Low	High	Medium	Low
<b>Runoff Strips</b>									
Milled Shoulder Runoff Strips			⊕	⊕		⊕			⊕
Edge Line Runoff Strips			⊕	⊕		⊕			⊕
Grass Accumulation Edge Runoff Strips			⊕	⊕		⊕			⊕
Unimproved Runoff Strips			⊕	No Data Available					⊕



Countermeasure	Cost			Safety			Maintenance		
	High	Medium	Low	High	Medium	Low	High	Medium	Low
<b>Prevention Markings</b>									
Double Edge			⊕			⊕			⊕
Wider Flare Shoulder			⊕			⊕			⊕
Roadside Panel Delineators			⊕			⊕			⊕
Prevent Clear Zone			⊕			⊕			⊕
Maintain Clear Zone			⊕			⊕			⊕
Edge Planting			⊕			⊕			⊕
Center Line Buffer			⊕			⊕			⊕



Countermeasure	Cost			Safety			Maintenance		
	High	Medium	Low	High	Medium	Low	High	Medium	Low
<b>Reduce Crash Severity</b>									
Roadside Barrier			⊕			⊕			⊕
Roadside Existing Roadside Barrier			⊕			⊕			⊕
Upgrade Existing Barrier Terminal/End-of-Runway Support			⊕			⊕			⊕
End-of-Runway Support			⊕			⊕			⊕

## Three Considerations




# Roadway Departure Countermeasures



# 1) Keep Vehicles on the Road

- Pavement Markings
- Improved curve delineation

**COUNTERMEASURE**  
**Curve Signing**




Advance curve warning signs alert a driver to changes in the road alignment and chevrons delineate the curve. These countermeasures are effective to reduce:

- Curve crashes
- Nighttime crashes

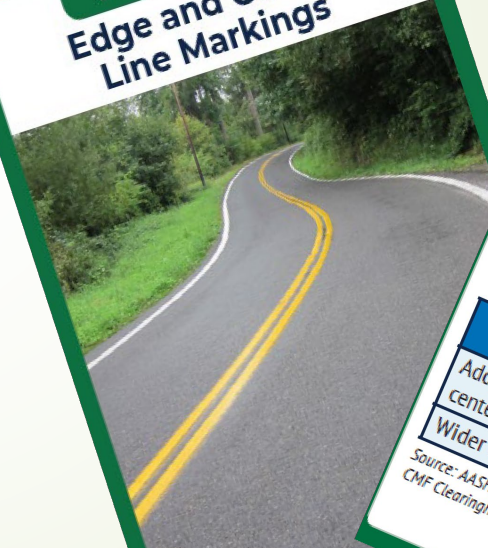
[https://safety.fhwa.dot.gov/provencountermeasures/enhanced\\_delineation/](https://safety.fhwa.dot.gov/provencountermeasures/enhanced_delineation/)

Crash Reductions for Installing Chevrons	
Nighttime Crashes on curves	25%
Non-intersection Fatal and Injury crashes	16%



Source: Thurston County, WA  
Source: CMF Clearinghouse IDs 2438 and 2439

**COUNTERMEASURE**  
**Edge and Center Line Markings**




Retroreflective pavement markings improve nighttime highway visibility. Wider lines (6"-8") have an increased safety effect, reducing:

- Curve crashes
- Nighttime crashes
- Head-on crashes

[https://safety.fhwa.dot.gov/roadway\\_dept/night\\_visib/pavement-markings.cfm](https://safety.fhwa.dot.gov/roadway_dept/night_visib/pavement-markings.cfm)

Crash Reductions	
Adding edge and center line marking	24%
Wider edge lines	22%



Source: AASHTO Highway Safety manual, CMF Clearinghouse IDs 101 and 4792  
Source: Thurston County, Washington



# Marking Enhancement - Wider Normal Lines



# Marking Retroreflectivity

- All markings that must be visible at night shall be retroreflective unless ambient illumination assures that the markings are adequately visible.
- Pavement markings are made retroreflective by adding glass beads or other optics
- The retroreflectivity degrades quicker than the marking material



Photo: FHWA



# Addressing Lane Departures - Curves

- ▶ Apply reflective strips to sign and chevron posts
- ▶ Two schools of thought:
  - ▶ Apply systemically (i.e. all curve locations)
  - ▶ Apply at highest-risk locations to draw drivers' attention.



Photos:  
Brian Keierleber

# Curve Sign Enhancements

In some cases, additional treatments may be appropriate

- Bigger signs
- Doubling-up
- Fluorescent Yellow prismatic sheeting
- Overhead placement
- Wig-Wag style flasher





# Delineators

- Delineators provide guidance at night and during adverse weather
- Remain visible when roadway is wet or snow covered





# Keep Vehicles on the Road cont'd

- Friction treatments in curves and other spot locations

**COUNTERMEASURE**  
**High Friction Surface Treatment**

HFST is a pavement surface treatment using calcined bauxite that provides exceptional skid-resistant properties at high friction demand locations such as curves, ramps, or intersections where problems with wet conditions, speed, or geometrics contribute to:

- Run-off-road crashes
- Head-on crashes

[https://safety.fhwa.dot.gov/roadway\\_dept/pavement\\_friction](https://safety.fhwa.dot.gov/roadway_dept/pavement_friction)

Crash Reductions on Curves	
Total	
Wet Crashes	24%
	52%

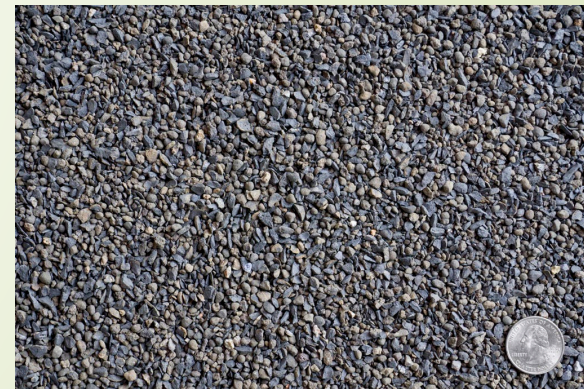
Source: CMF Clearinghouse (CMF ID's 7900 and 7901)

Source: FHWA



# Some Common Methods to Restore or Add Friction

- Thin HMA Overlay
- Open Graded Friction Course (OGFC)
- Ultra-Thin Bonded Wearing Course (UTBWC)
- Slurry Seal, Microsurfacing
- Chip Seal, Seal Coat
- Diamond Grinding
- Grooving
- High Friction Surfacing (critical spot improvement)



Photos: FHWA

# Why Use HFST?

- Resists polishing when compared to other aggregates
- High quality binders improve aggregate retention





# Keep Vehicles on the Road cont'd

- Edge line, shoulder & center line rumble strips

**COUNTERMEASURE**  
**Edge Line and Shoulder Rumbles**

Edge rumble strips are milled corrugations in pavement to alert inattentive drivers that they are leaving the roadway to reduce:

- Run-off-road crashes
- Fixed object crashes
- Rollovers
- Distracted/drowsy driver crashes

[https://safety.fhwa.dot.gov/roadway\\_dept/pavement/rumble\\_strips](https://safety.fhwa.dot.gov/roadway_dept/pavement/rumble_strips)

Fatal and Injury Reductions	
Run-Off-Road (two-lane rural)	36%
Run-Off-Road (rural freeways)	17%

Source: CMF Clearinghouse IDs 3394 and 3447

**COUNTERMEASURE**  
**Center Line Rumbles**

Center rumble strips are milled corrugations in pavement to alert inattentive drivers that they are crossing the center line to reduce:

- Head-on crashes
- Run-off-road left crashes
- Distracted/drowsy driver crashes

[https://safety.fhwa.dot.gov/roadway\\_dept/pavement/rumble\\_strips](https://safety.fhwa.dot.gov/roadway_dept/pavement/rumble_strips)

Fatal and Injury Reductions	
Head-On RwD (two-lane rural)	45%

Source: CMF Clearinghouse ID 3360

# Milled Rumble Strips



Shoulder

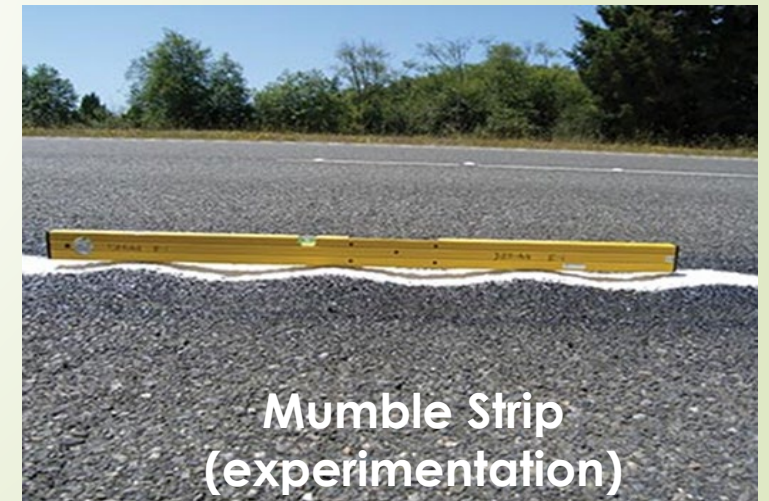


Edgeline

- Perpendicular Length
  - Shoulder rumble: 12" to 16"
  - Edge Line rumble: 8" to 12"
  - Some narrow applications: 4" to 6"
- Alternate grinding pattern for reduced external noise



Narrow



Mumble Strip  
(experimentation)



# Centerline Rumble Strips/Stripes



Photos: FHWA

Centerline rumble strips milled across joint, then stripe over rumble



Centerline rumble stripes with variable spacing



Centerline rumble strips on each side of yellow centerline markings  
*(least common)*



# Centerline Rumble Strips



Photo: Brian Keierleber



# Rumble Stripes



Photo: Brian Keierleber



# Operational Effects of Rumble Strips on Two-Lane Undivided Roads

- ▶ Centerline (CLRS)
  - ▶ No adverse impacts on lanes  $\geq 10'$
  - ▶ Helps to center vehicle in the lane when shoulders are 1'-2' wide
- ▶ Centerline (CLRS) and Edge Line (ELRS)
  - ▶ No adverse impacts on lanes  $\geq 11'$
  - ▶ Helps to center vehicle in the lane when shoulders are 3' wide



Photos: FHWA

## 2) Reduce the Potential for Crashes

- Shoulder widening
- SafetyEdge (SM)
- Maintain clear zones
- Center line buffer area
- Traversable roadside slopes

**COUNTERMEASURE**  
**Shoulder Widening**

Adding a paved shoulder provides a driver an opportunity to regain control. Shoulders have been shown to reduce crash rates.

**COUNTERMEASURE**  
**SafetyEdge<sup>SM</sup>**

SafetyEdge<sup>SM</sup> is a paving technique producing a durable 30-degree edge to prevent tire-scrubbing, which often results in:

- Head-on crashes
- Rollovers

**COUNTERMEASURE**  
**Clear Zone**

Establishing and maintaining a clear zone provides an undisturbed traversable area where a driver can recover to avoid a crash.

- Fixed Object Crashes
- Rollovers

**COUNTERMEASURE**  
**Slope Flattening**

Flattening steep slopes provides a better opportunity for vehicles to traverse the slope, reducing the likelihood of:

- Rollovers
- Fixed object crashes

Before Sideslope	Crash Reductions (%) for Single Vehicle Crashes		
	After Sideslopes		
1V:2H	1V:4H	1V:5H	1V:6H
1V:3H	10	15	21
1V:4H	8	14	19
1V:5H	—	6	12
		—	6

Source: AASHTO Highway Safety Manual.

**COUNTERMEASURE**  
**Center Line Buffer Area**

A center line buffer area provides extra space between the two solid center line markings, further reducing opposing directions of travel crashes.

Buffer Width	*Head-on Rwd Crash Reduction
2 feet	35%
4 feet	64%
10 feet	90%
	Not significant

Results from NCHRP Project 17-66



# Flatten Slopes and Widen Shoulders



Photo: Brian Keierleber



# Slope Flattening in Curves



Photo: Brian Keierleber



# SafetyEdge



Photos: FHWA



# Maintain Clear Zones



Photos: FHWA



# Centerline Buffer Area

- ▶ Providing a buffer area between opposing directions of traffic can reduce head-on crashes





# Challenges Discussed w/ Strategies

- Funding can be an issue
- Right of way availability sometimes isn't there
- Cultural – i.e. Amish, Mennonite, etc. bring different roadway safety needs



### 3) Minimize the Severity

- Breakaway Features
  - Signs and luminaire supports
  - Utility poles
- Barriers to shield obstacles including:
  - Trees and shrubbery
  - Other fixed objects
  - Slopes

**COUNTERMEASURE**  
**Barriers**

Roadside and median barriers are designed to redirect and slow vehicles while shielding them from obstacles likely to result in a more severe crash, such as:

- Rigid fixed objects
- Bodies of water
- Steep slopes
- Opposing traffic

[https://safety.fhwa.dot.gov/roadway\\_dept/countermeasures/reduce\\_crash\\_severity/](https://safety.fhwa.dot.gov/roadway_dept/countermeasures/reduce_crash_severity/)

The crashworthiness of barriers is evaluated through crash testing. The current crash test criteria is contained in the AASHTO Manual for Assessing Safety Hardware (MASH) 2016.



# Minimize Severity



Photos: Google  
and FHWA



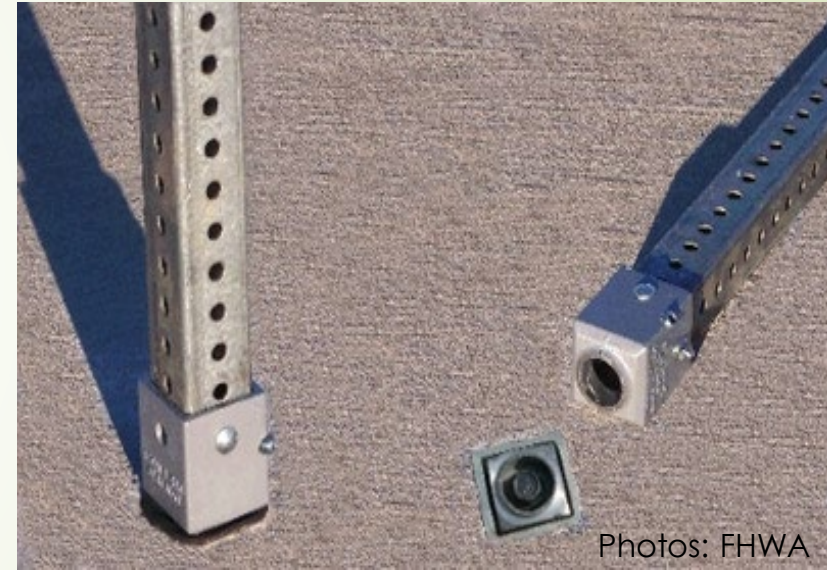
# Breakaway



Bending or  
Yielding/soil driven



Slip Base



Breakaway

Photos: FHWA



# Utility Poles

- Place utilities underground
- Relocate further from roadway
- Decrease number of poles



Source: FHWA



# Roadside Vegetation

- ▶ Work with local landowners to clear roadsides





# Barriers

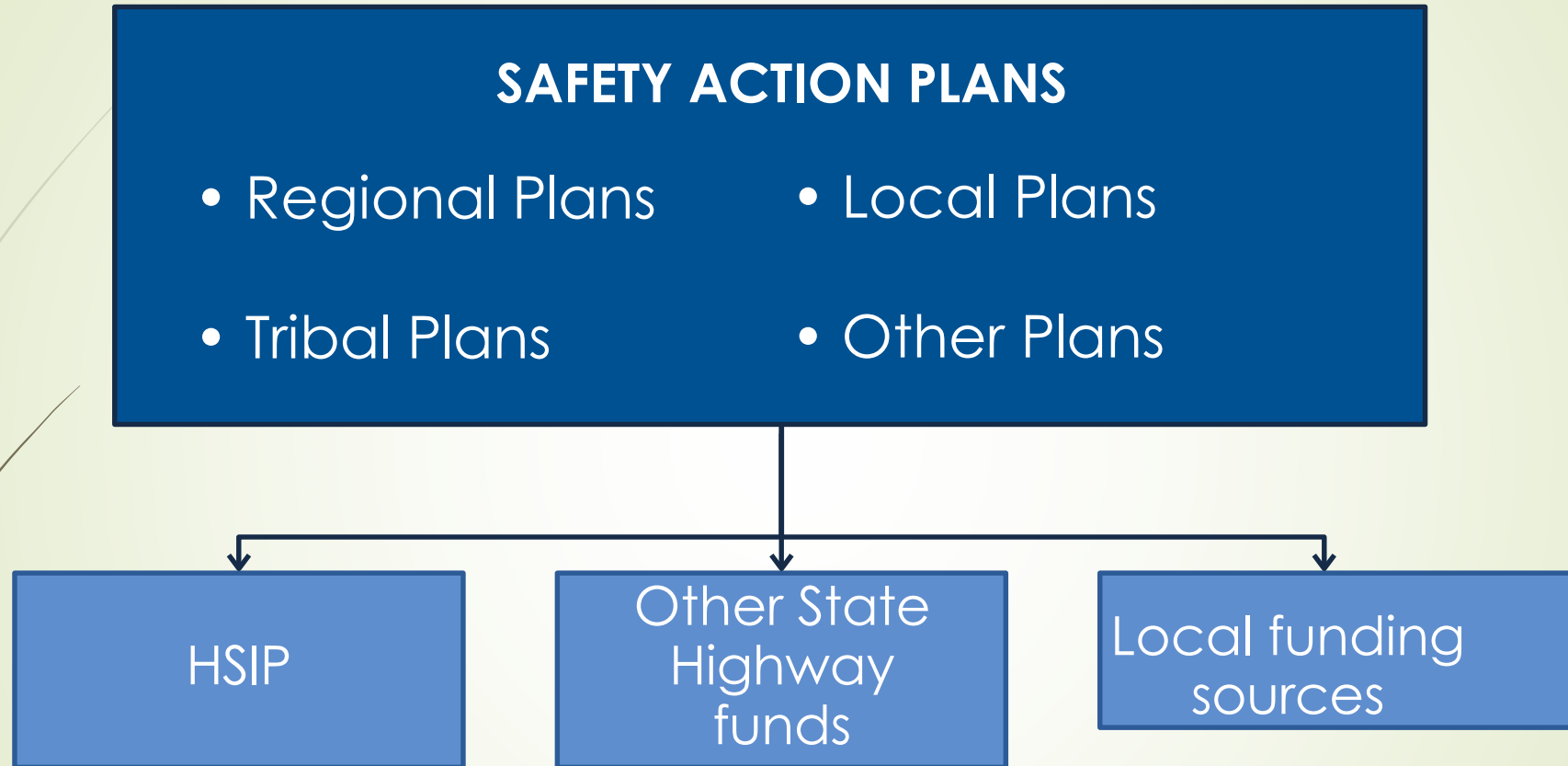






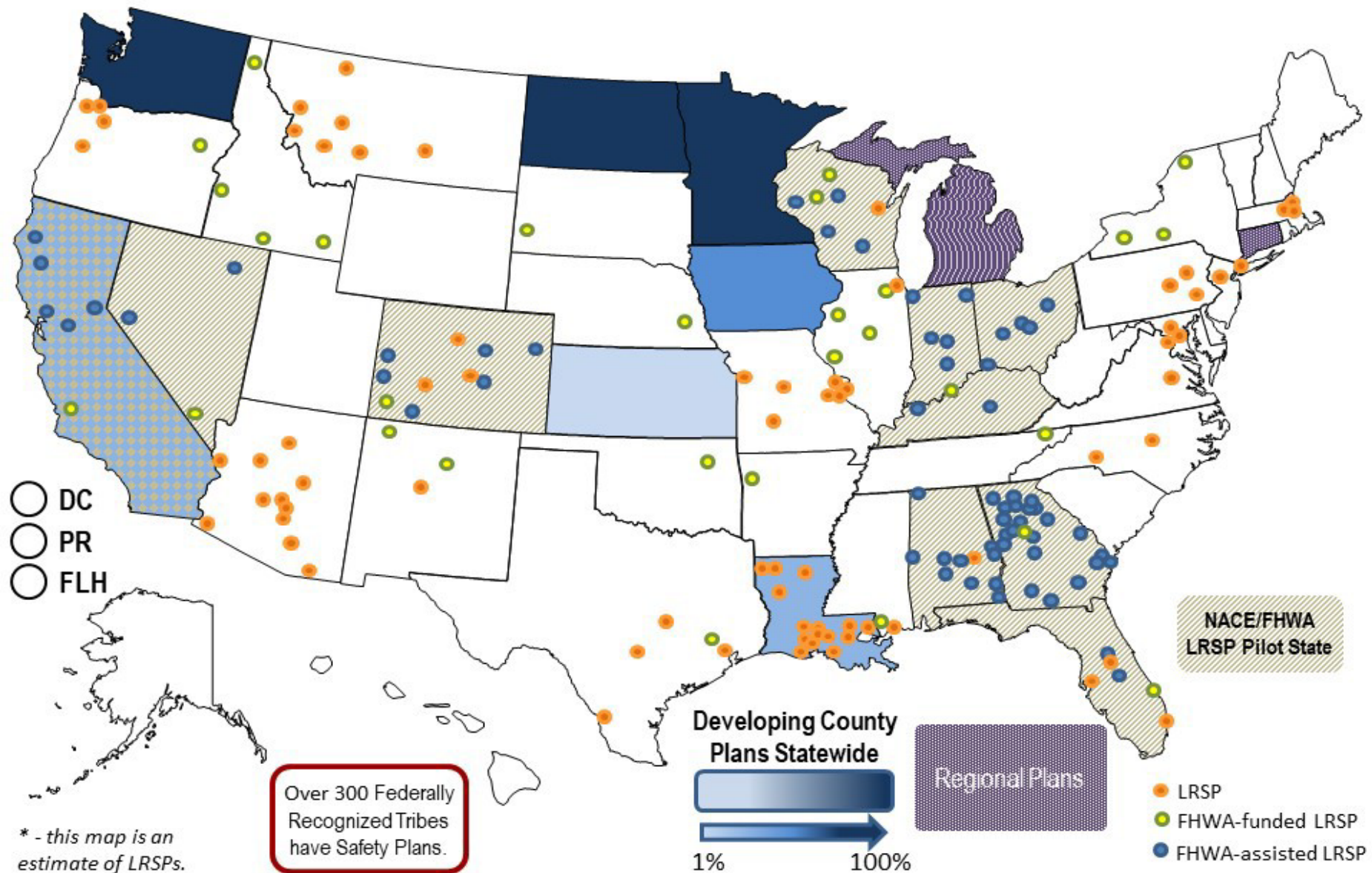
# Safety Action Plans

# What Are They?





# Local Road Safety Plans - 2022\*





# Steps for Successful Implementation

- 
- 1. MAINTAIN BUY-IN AND SUPPORT**
  - 2. IDENTIFY FUNDING MECHANISMS**
  - 3. IDENTIFY AND PRIORITIZE PROJECTS**
  - 4. DETERMINE PROJECT DELIVERY METHODS**
  - 5. EVALUATE EFFECTIVENESS**
  - 6. CONTINUE COMMUNICATION AND COORDINATION**





# Challenges and Opportunities

- Partners/Stakeholders
- Who is missing from the discussion?
- Consider who will lead each activity
- Share responsibility: no one individual or agency can do it all.
- Buy-In
- What policies/laws will affect the implementation of the LRSP?
- Consider funding opportunities
- Data limitations
- Consider priorities
- How each chosen activity will be measured and evaluated?
- Time and duration to implement



# Lessons Learned/Takeaways

- ▶ Roadway departure strategies can be effective for distracted driver behaviors
- ▶ Making small, simple solutions consistently can make roads safer
- ▶ Some countermeasures come with maintenance costs (i.e. guardrail), so strategic placement is a priority
- ▶ Iowa is a leader in crash data availability and plans
  - ▶ Participating states have the data, but not the level of access and detail Iowa does





# Lessons Learned/Takeaways

- ▶ Include elected officials in drafting safety plans
  - ▶ Make sure the plan includes a simple summary to help understand the issues and vision
- ▶ Some agencies may not be interested in working with crash data because funds are not available to apply treatments
  - ▶ Even with grants available, grant writing support is lacking'
  - ▶ Liability is a concern – if you know where the problems are and something happens...
- ▶ Agriculture is an underserved community and that opens the door to a lot of opportunities with SS4A



Questions