Reducing Roadway Departure

2022 NTICC

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Federal Highway Administration
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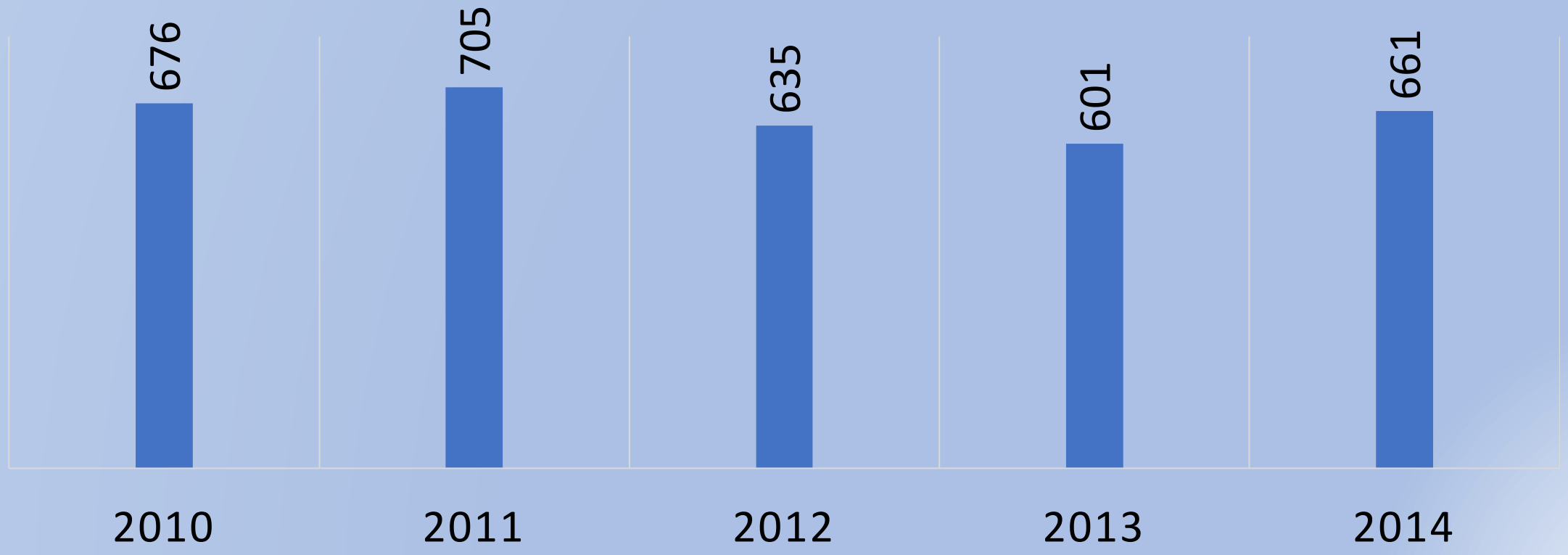
Overview

- Roadway Departure Data Overview
- Systemic Method
- Countermeasures to address Roadway Departure
- Tribal Transportation Program Safety Fund

Reported Motor Vehicle Fatalities in Tribal Areas

3,278 FATALITIES TOTAL



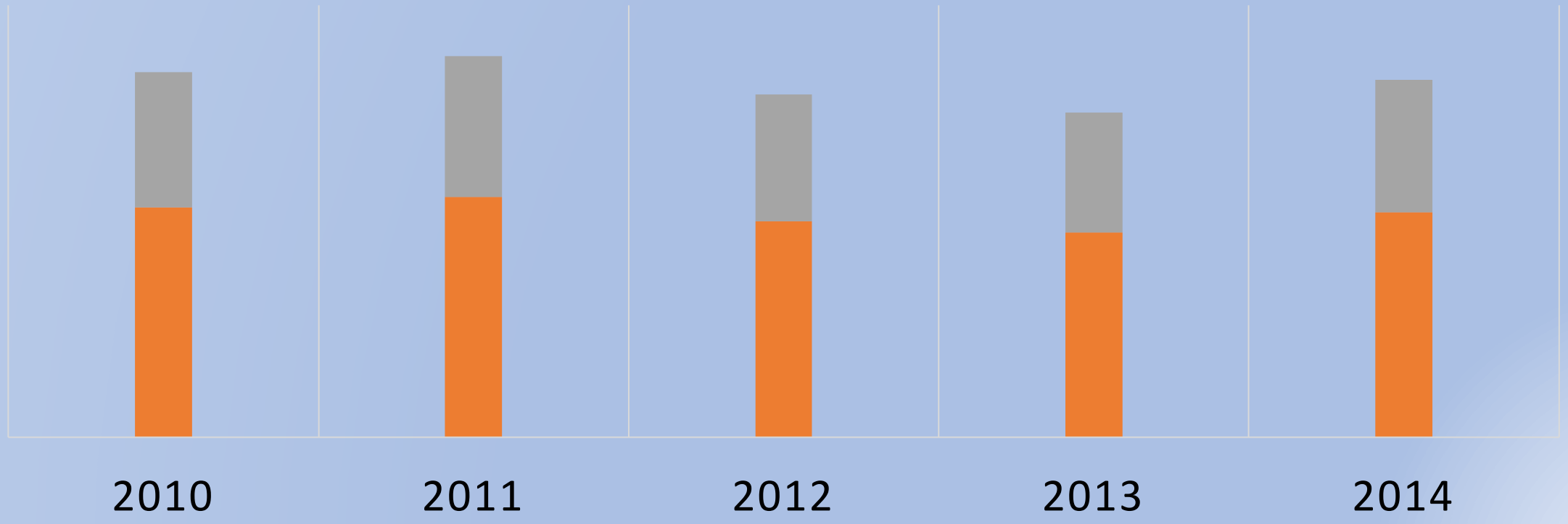
Source: FARS 2010-2014

Reported Motor Vehicle Fatalities in Tribal Areas

FARS 2010-2014

3,278 FATALITIES TOTAL

63% of fatal crashes in Tribal areas involve roadway departure



Definition

Roadway Departure Crash

A crash which occurs after a vehicle crosses an edge line or a center line, or otherwise leaves the traveled way.

One killed in Single Vehicle Crash

June 11, 2019

Emergency responders found a single vehicle over an open embankment. Three people were in the vehicle at the time of the accident. – My Columbia Basin

Tribal education leader dies in crash

Nov 29, 2019

…the wheels of the Chevy Equinox she was driving left the roadway on the right. She corrected, turning left, then once again to the right before the vehicle rolled… She was wearing a seatbelt

Wreck on reservation injures two

Apr 6, 2017

…the vehicle crossed into the northbound lane and ended up along the east side of the road, ultimately crashing into a utility pole. The cause of the crash is currently under investigation by the Umatilla Tribal Police Department. – East Oregonian

Port Gamble S'Klallam man kille

Nov 5, 2018

truck left the roadway, went into heavy brush and hit a tree… higher speed impact – Kitsap Sun

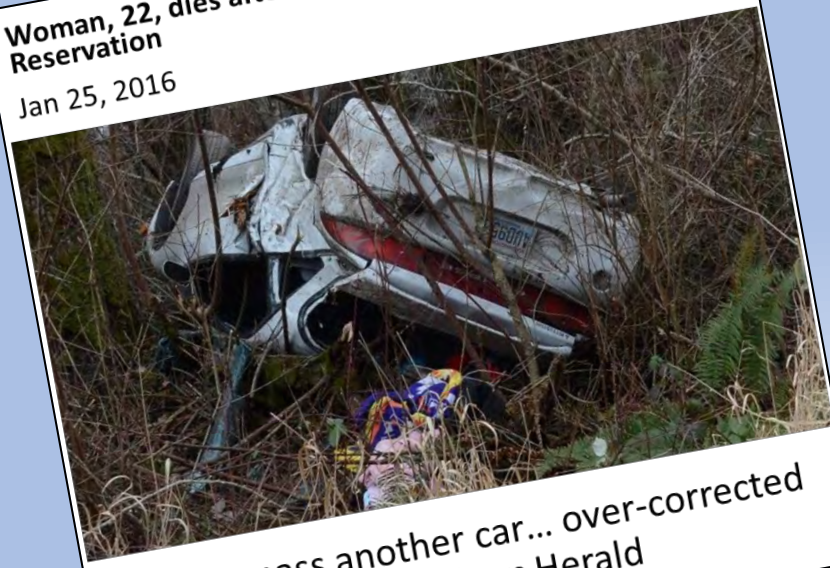
Sho-Ban tribal member dies in vehicle roll over

July 9

vehicle had side swiped a(n)… RV, rolled and was on its top… (Driver) was partially ejected. –Sho-Ban News

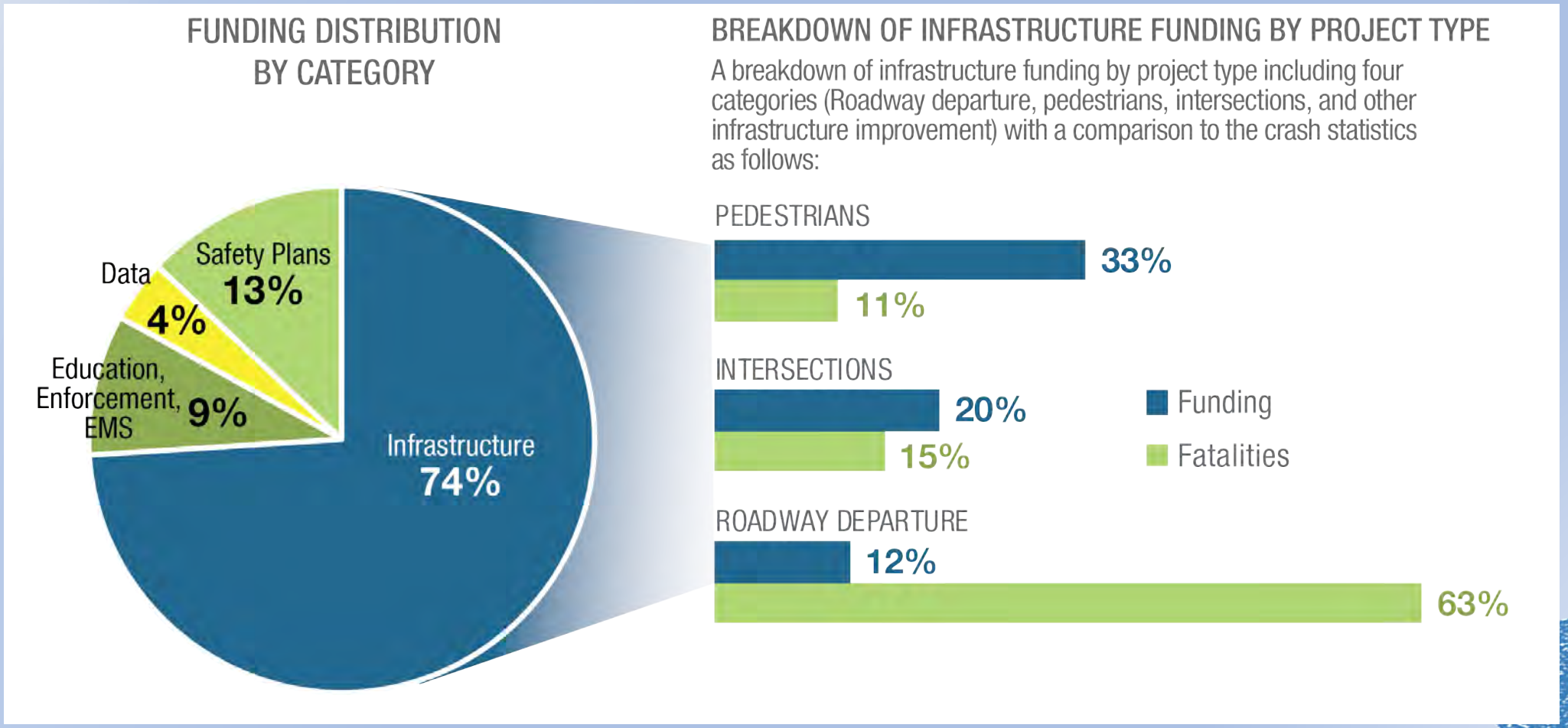
Woman, 22, dies after rollover crash on Lummi Reservation

Jan 25, 2016



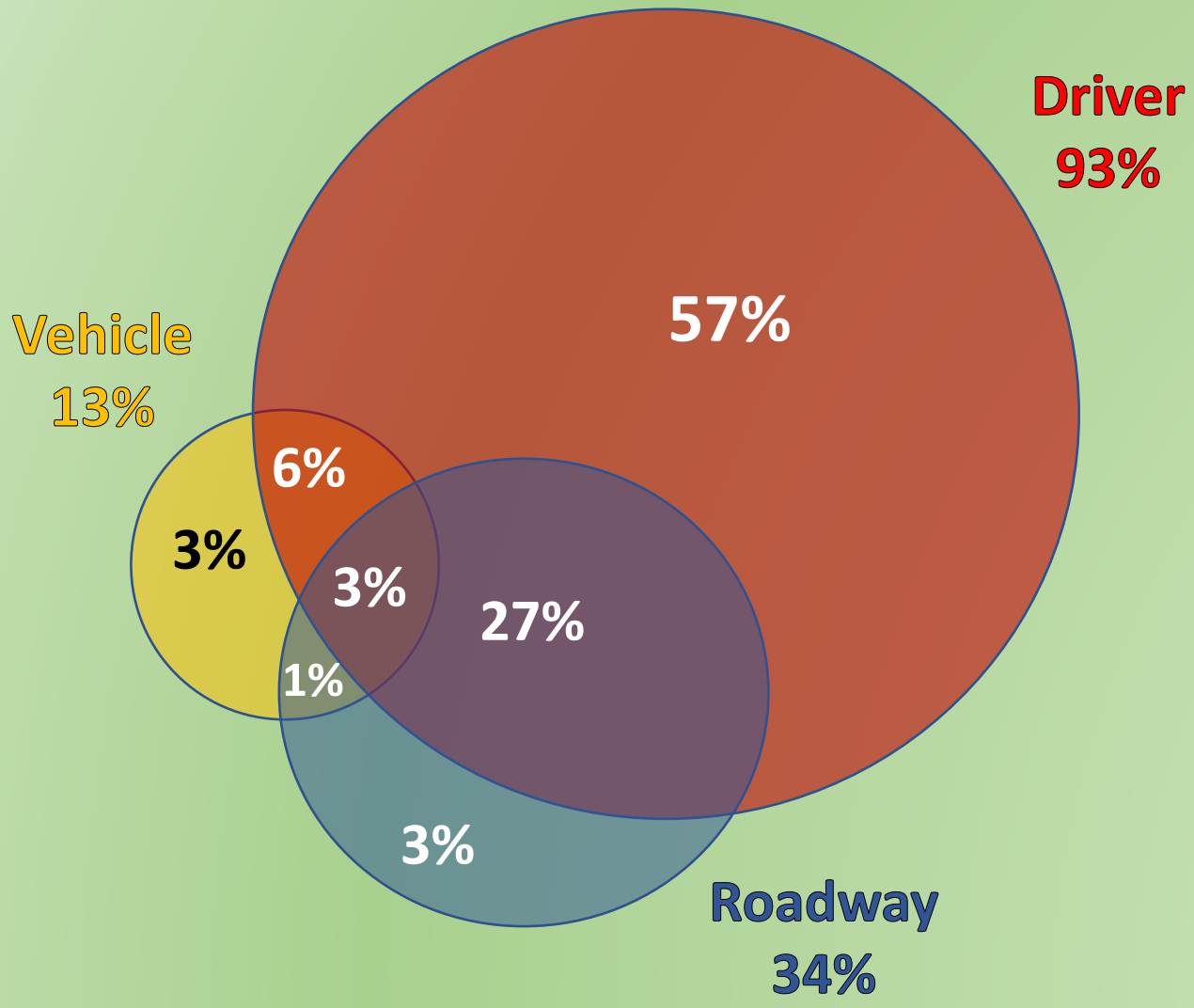
tried to pass another car… over-corrected to the right – Bellingham Herald

Funding by Project Type



Data Source: 2013-2019 TTPSF Grant Awards

Contributing Causes of Crashes



The Driver is weakest link in this system, so we must design around human needs.

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

The Safe System Approach (SSA)

- Death/serious injury is unacceptable.
- Humans make mistakes.
- Humans are vulnerable.
- Responsibility is shared.
- Safety is proactive.
- Redundancy is crucial.

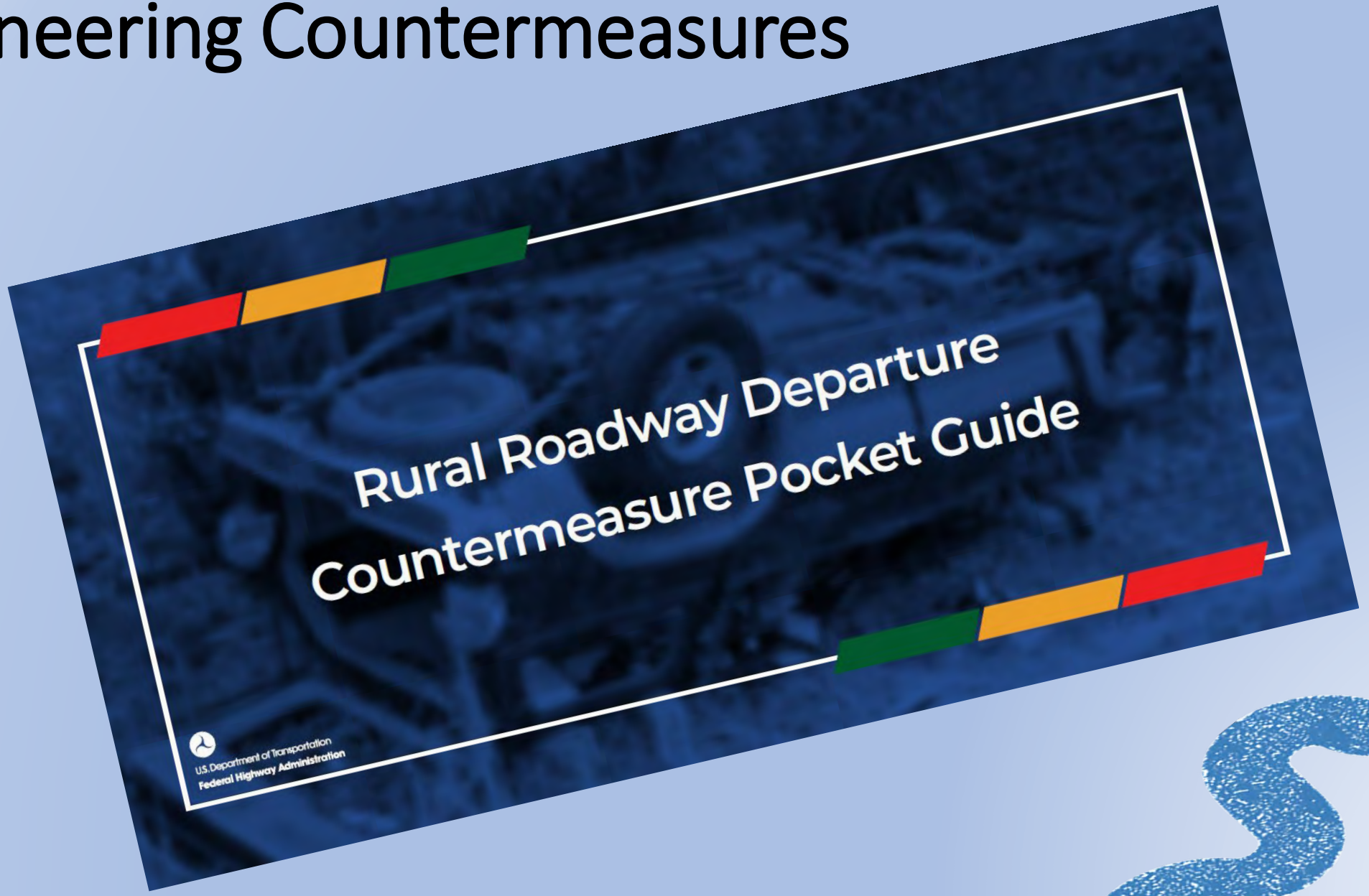
Source: FHWA[(1)].

[1]FHWA. 2020. The Safe System. FHWA-SA-20-015. Washington, DC: Federal Highway Administration. https://safety.fhwa.dot.gov/zerodeaths/docs/FHWA_SafeSystem_Brochure_V9_508_200717.pdf, last accessed November 24, 2021.

FoRRRwD Overview

- **Mission** - Reduce the potential for serious injury and fatal roadway departure crashes on **all public rural roads** by increasing the systemic deployment of proven countermeasures.

Engineering Countermeasures



Roadway Departure Strategy

1st - Keep vehicles on the road

2nd - Reduce the potential for crashes

3rd - Minimize severity

Proven Countermeasures

Curve Signing

Alert drivers to changes in the road alignment and improve visibility of curves.

Edge and Center Line Markings

Delineate the edges of the lane and provide a preview of alignment changes.

High Friction Surface Treatment

Provide durable skid resistant properties at high friction demand locations like curves.

Delineators

Delineate the edges and alignment of a paved or unpaved road.

Edge Line and Shoulder Rumbles

Alert inattentive drivers that they are encroaching on the roadside.

Center Line Rumbles

Alert inattentive drivers that they are encroaching into opposing lane.

Proven Countermeasures

SafetyEdge℠

Improve recovery at pavement edge without abrupt drop-offs.

Shoulder Widening

Provide drivers stable surface for recovery after leaving their lane.

Center Line Buffer Area

Provide extra space between opposing directions of traffic.

Clear Zone

Provide an area for drivers to recover control without encountering a fixed object or steep slope.

Proven Countermeasures

Barriers

Redirect vehicles from more severe obstacles.

Breakaway Features

Provide sign or light posts that reduce occupant impact severity.

U.S. Department of Transportation
Federal Highway Administration

www.safety.fhwa.dot.gov/FoRRRwD

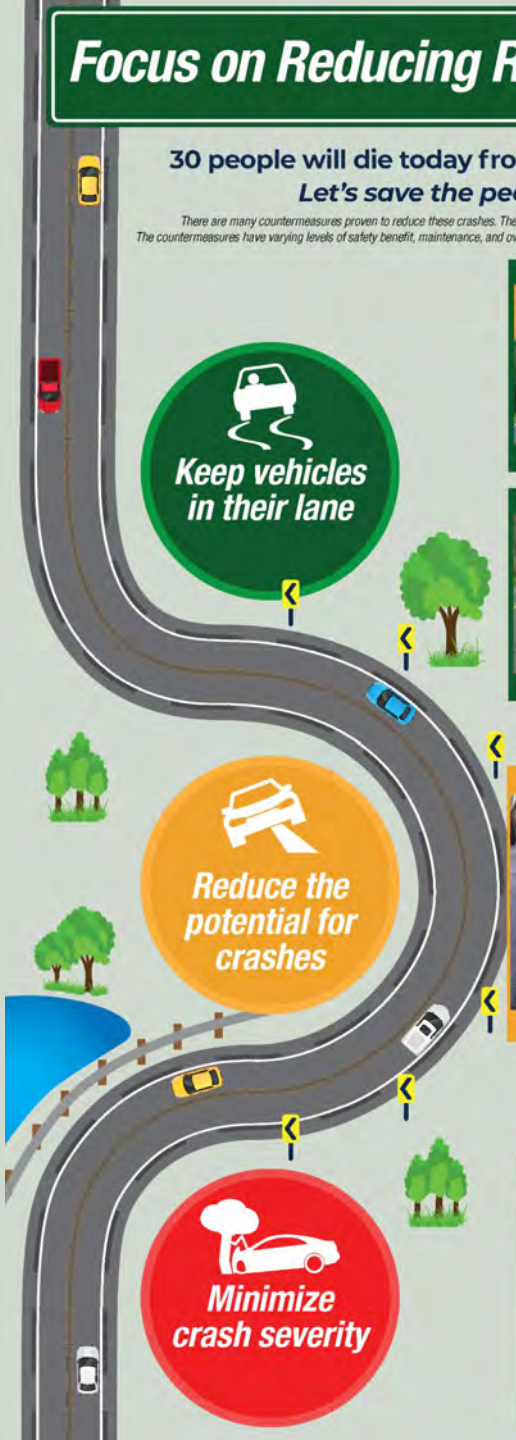
FHWA-SA-21-063

Focus on Reducing Rural Roadway Departures

30 people will die today from rural roadway departure crashes.

Let's save the people behind the numbers.

There are many countermeasures proven to reduce these crashes. They help keep vehicles in their lane, reduce the potential for crashes, or minimize crash severity. The countermeasures have varying levels of safety benefit, maintenance, and overall cost. Use them to help you focus on reducing rural roadway departure crashes in your community.



Keep vehicles in their lane

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Minimize crash severity

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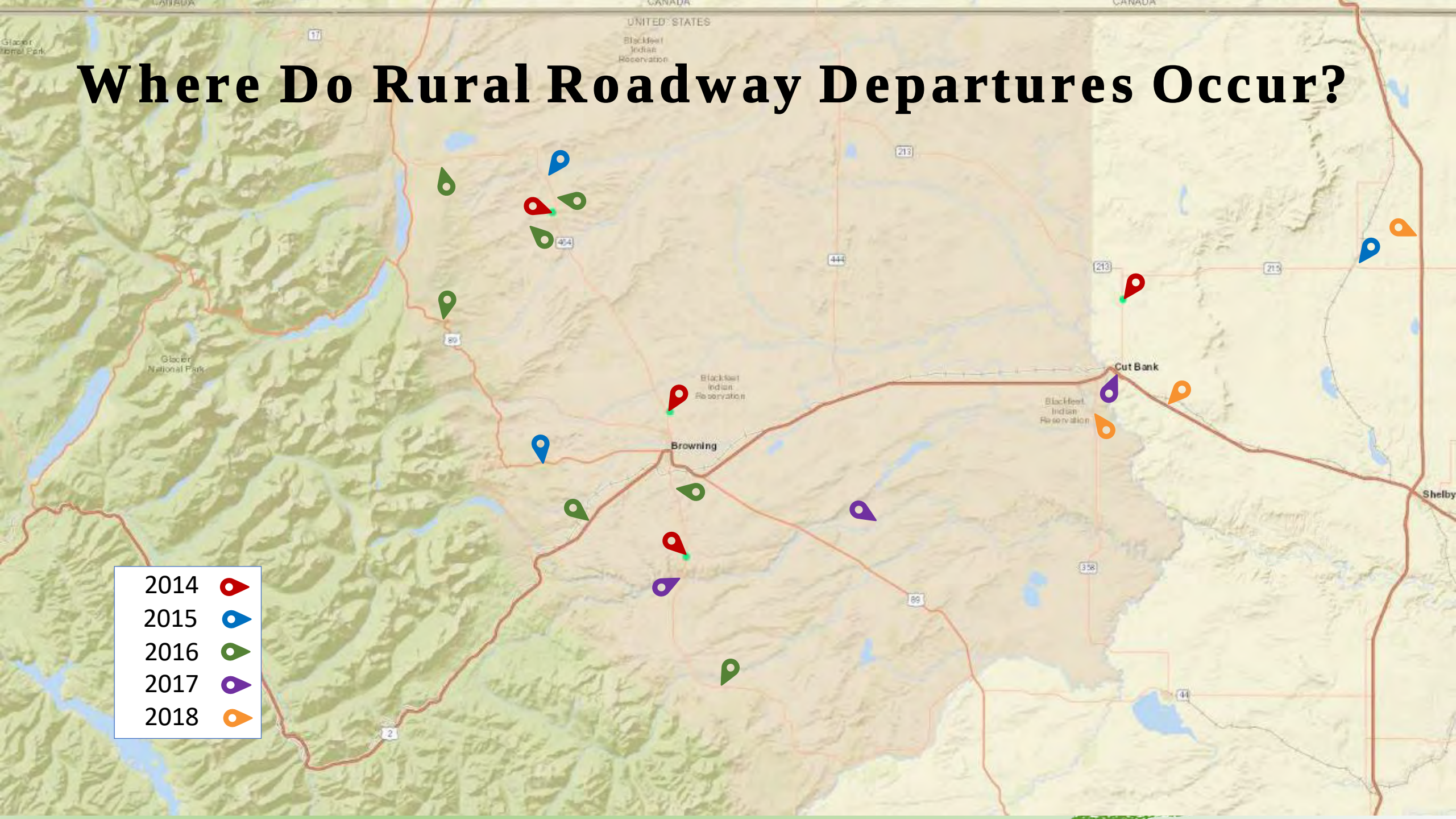
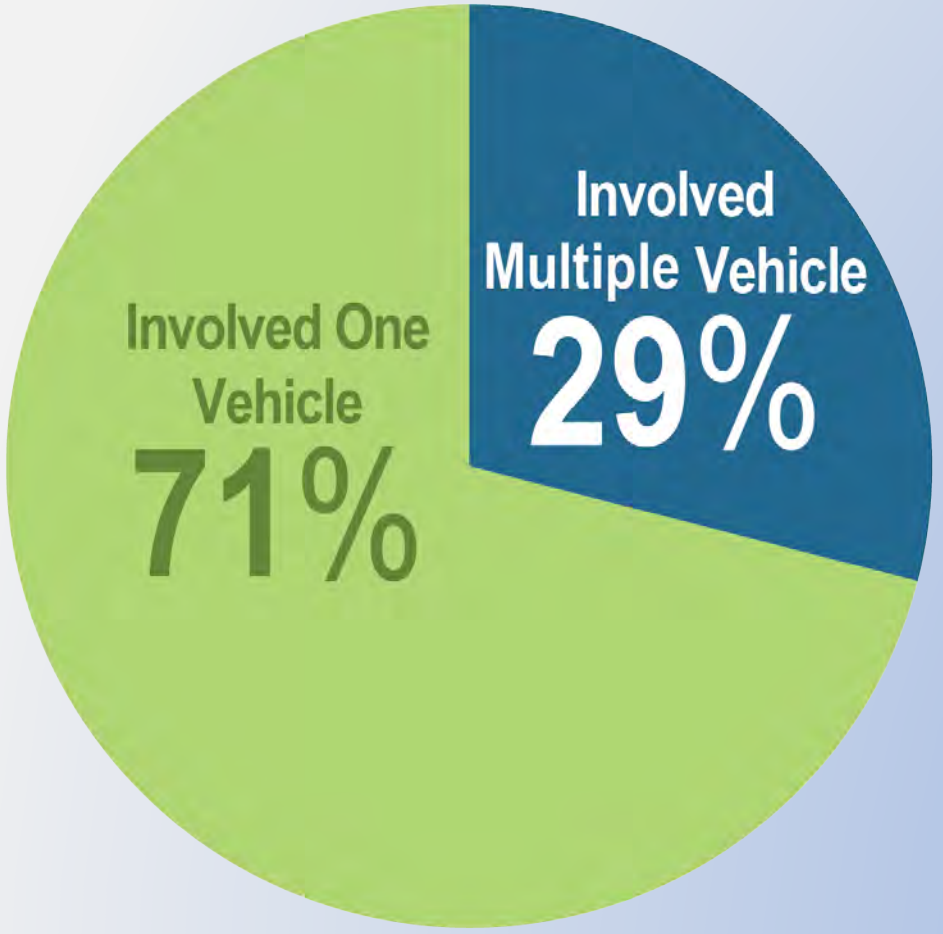
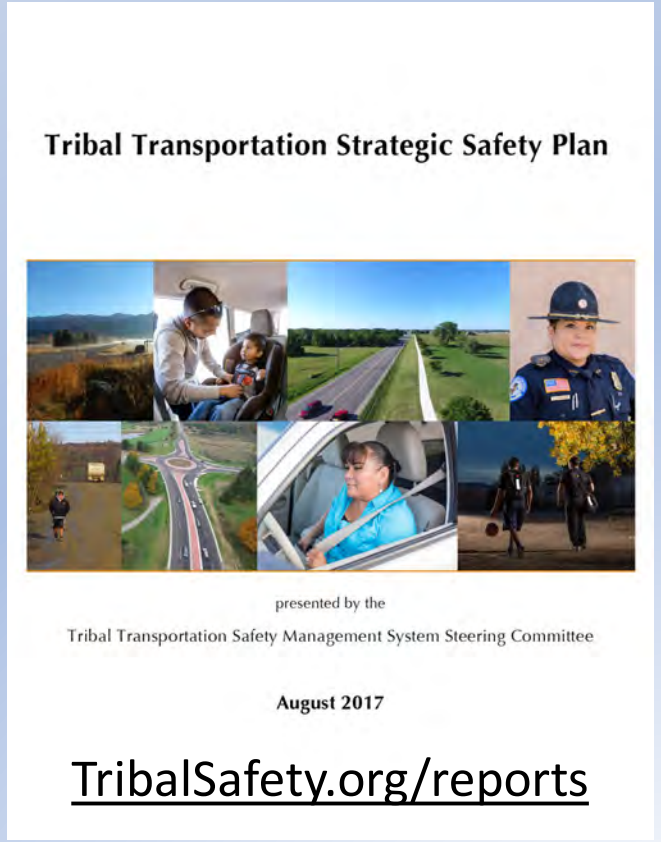
Where Do Rural Roadway Departures Occur?



Source: Pixabay

Roadway Departure Data in Tribal Areas





TribalSafety.org/reports

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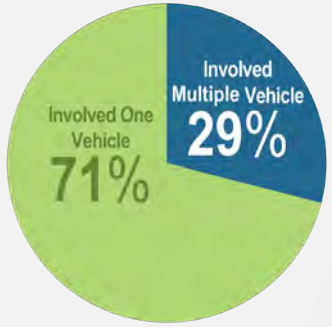

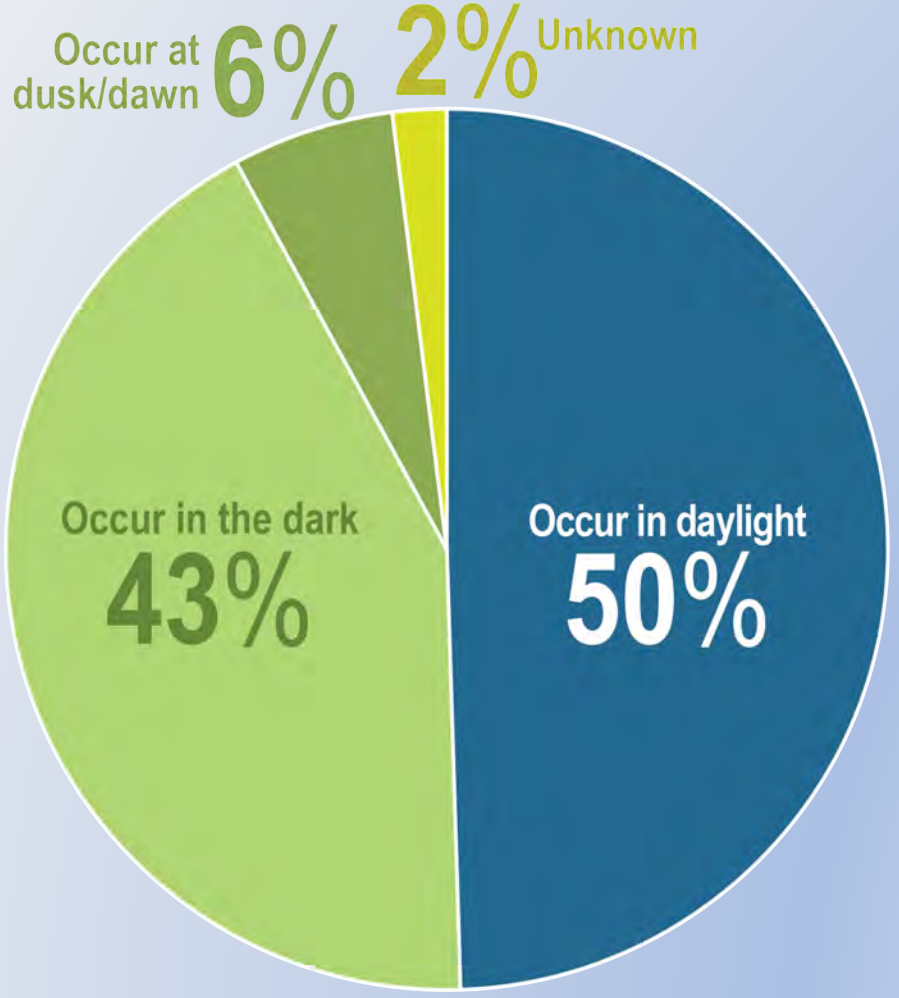

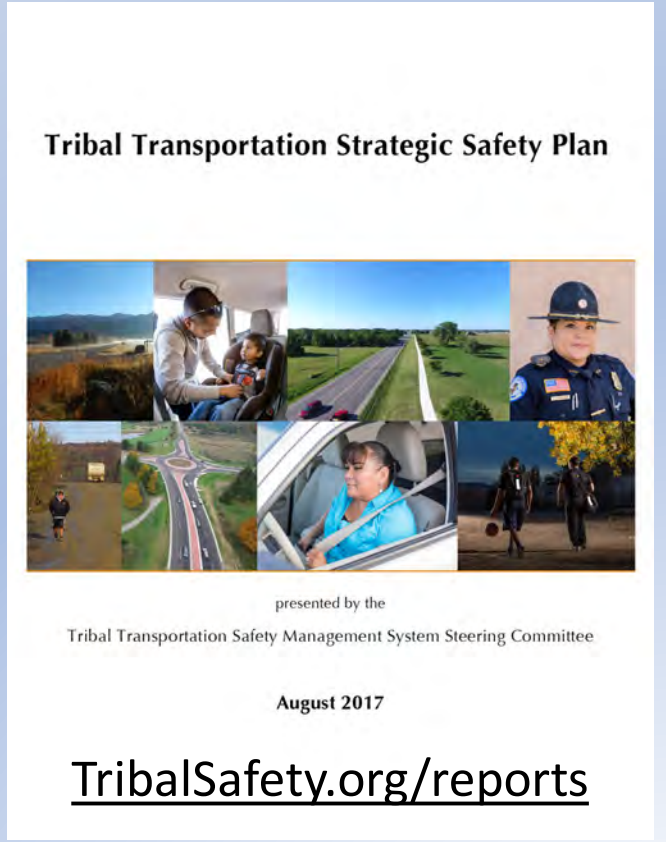

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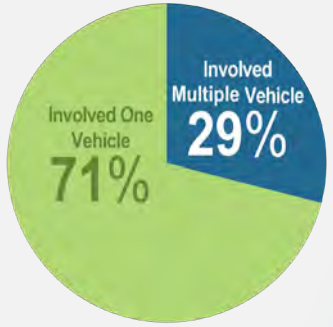
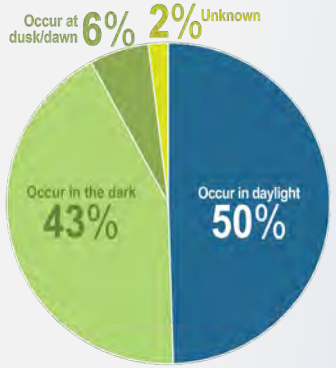


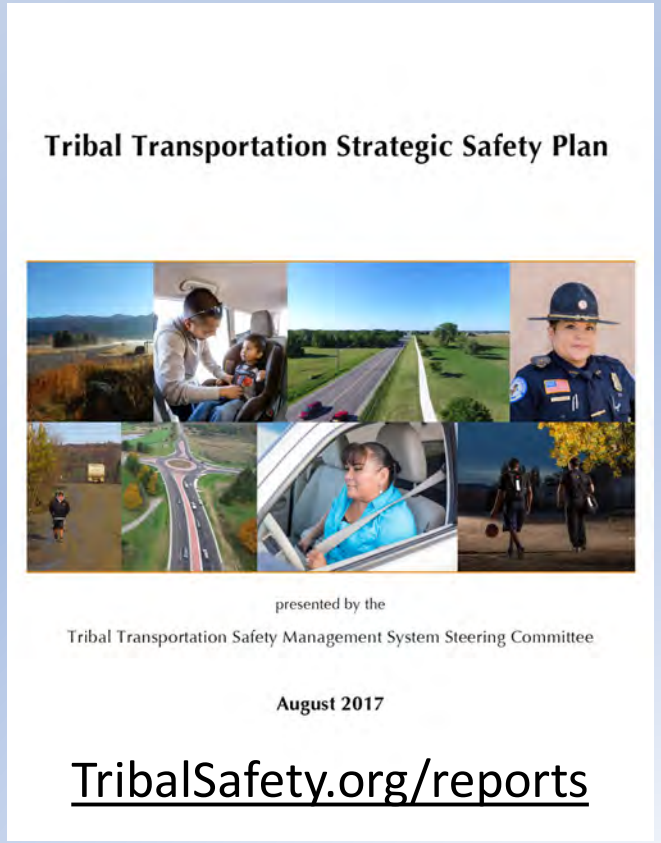


Horizontal Alignment

Straight
No Curve
63%

Horizontal Curve
34%

Unknown
3%



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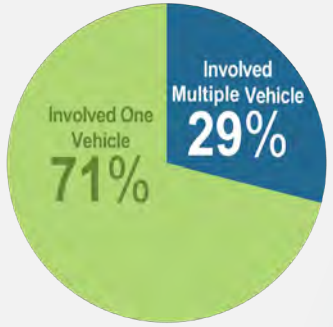

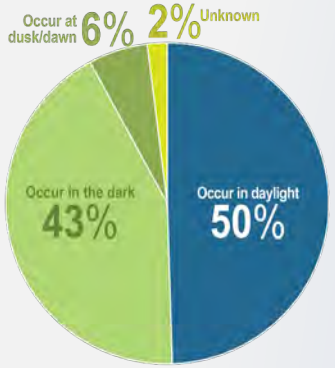

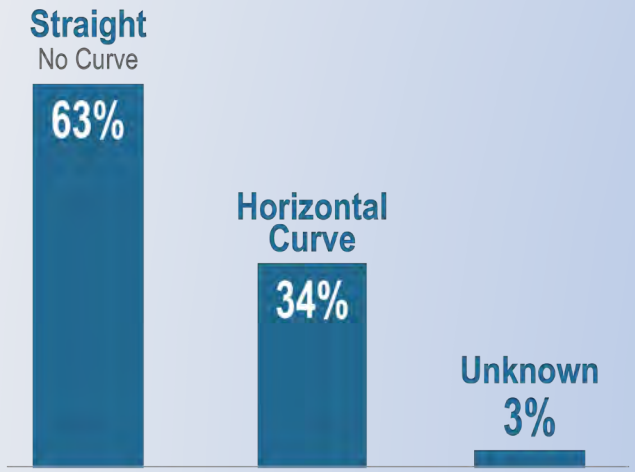

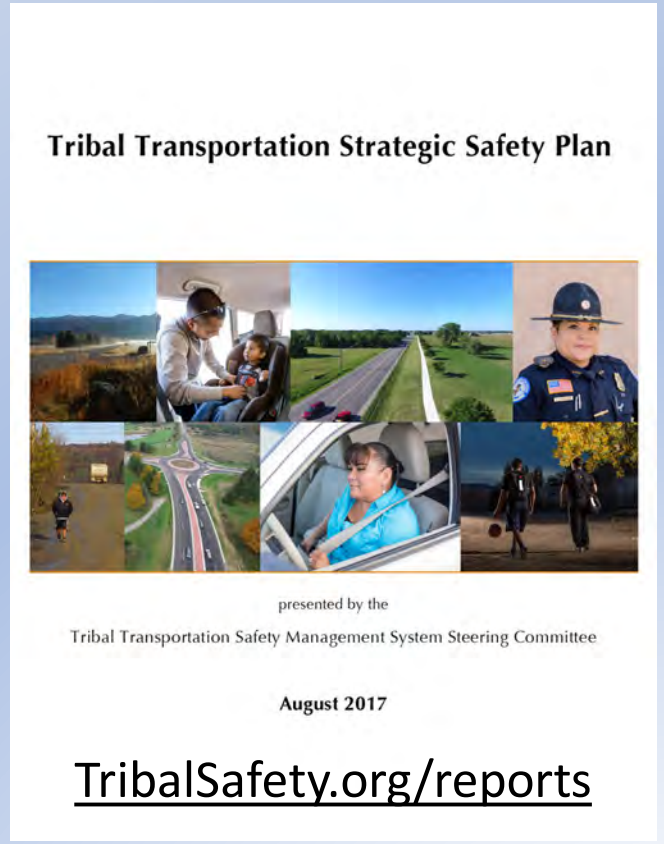

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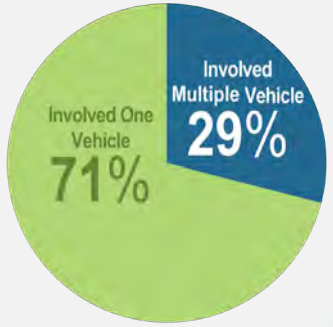
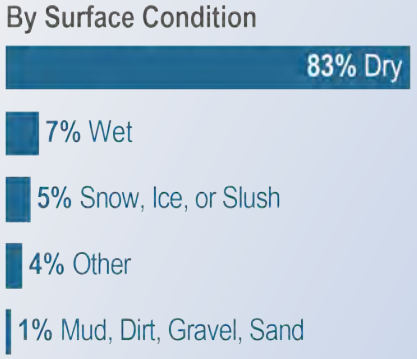
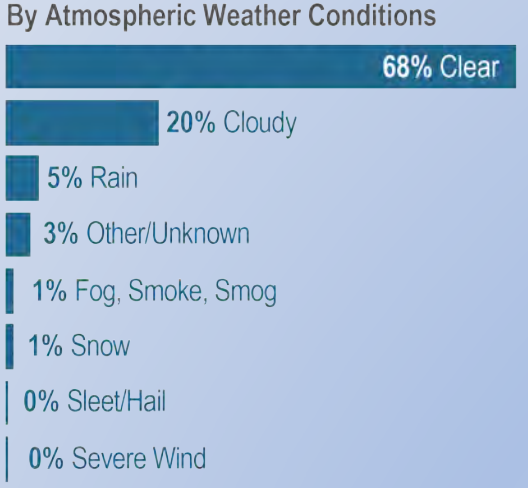
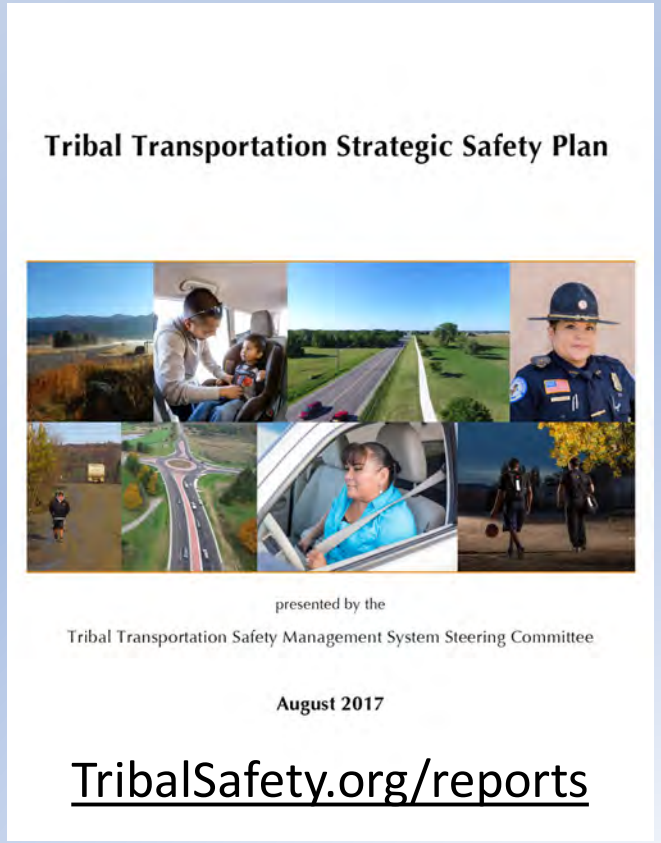
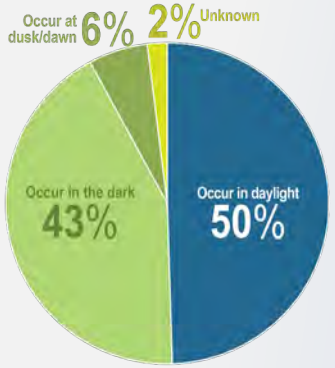
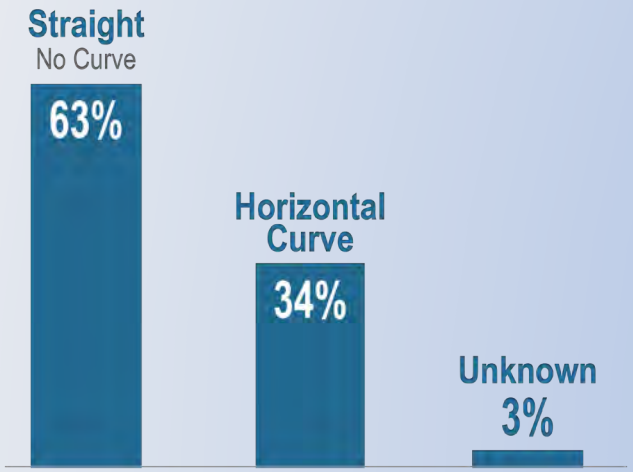


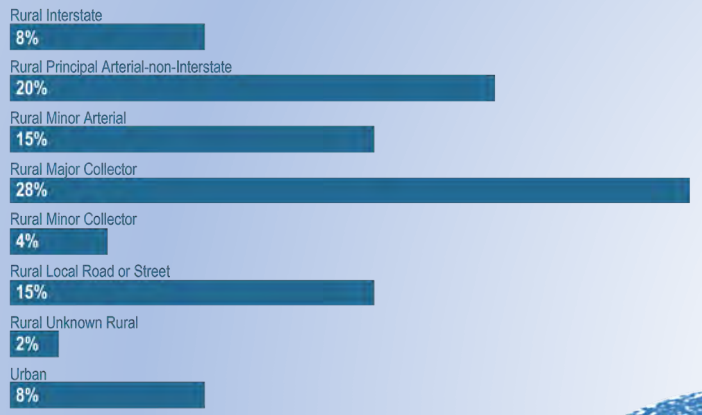












Source: Pixabay

Definitions

- Systemic – Deploying countermeasures at locations with the *greatest risk* of safety improvement

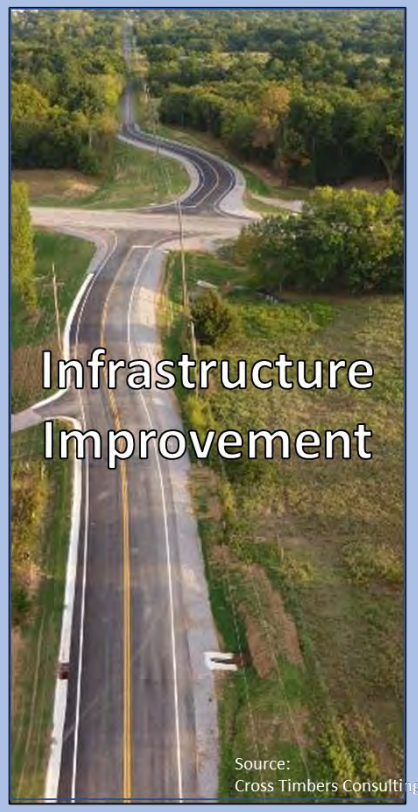
Systemic Example:
providing enhanced delineation on curves with radii between 500-700 feet which were over-represented in severe crashes

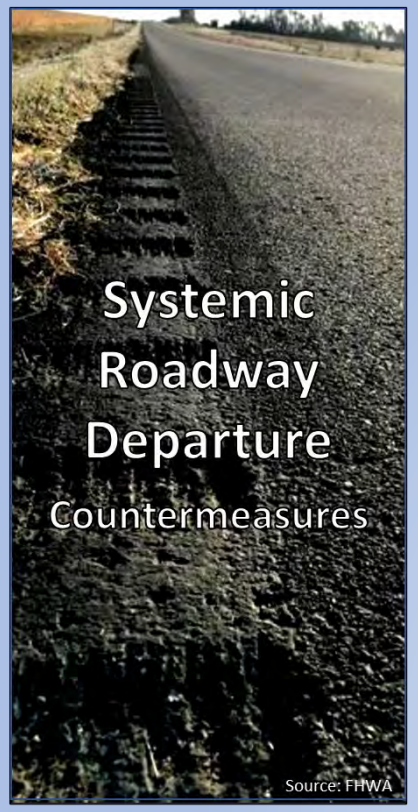
Using TTPSF to Address Roadway Departure

1. Install low-cost countermeasures on highest risk routes
2. Develop Systemic Roadway Departure Implementation Plan

Safety Plans

Data Assessment, Improvement, and Analysis





Systemic Roadway Departure Countermeasures Category

- Strategically address Roadway Departure which is involved in 2 out of every 3 fatal crashes in Tribal areas
- 25% funding goal (about $5-million/year)
- Reduced application burden
- Only specific countermeasures eligible
- Can still submit multiple applications

Source: Sisseton Wahpeton Oyate

Application Form

Required Data

Additional Risk Data

Countermeasures

CURVE - SYSTEMIC ROADWAY DEPARTURE COUNTERMEASURE REQUEST

Required Data - Minimum information to demonstrate the eligibility and significance of this curve site.

1| Curve Name | 2|Road Owner
3| NTTFI Route | 4|NTTFI Section | 5|AADT

Risk Data - The following data elements will be evaluated to determine the risk level at candidate locations. You are not required to complete all risk fields.

6| Speed Limit | 7|Curve Advisory Speed | 8| Advisory Method
9| Site specific crash data
10| Curve deflection angle
11| Curve radius
12| Lane width
13| Surface type
14| Shoulder paved width
15| Shoulder aggregate width
16| Roadside Rating
17| Describe additional risk considerations
Geometric features, sight-distance, visual trap, friction, vertical curvature, distance from other horizontal curves, or other risk considerations. See instructions.

18| **Site Photos** - Insert pictures as documentation of risk considerations.

Click Here to Add Photo | Click Here to Add Photo

19| **Countermeasures** - Indicate existing countermeasures at this site and the additional improvements for which funding is requested. Also indicate the amount of funding requested for the proposed improvements. See instructions.

	Existing	Request	Requested Funding
a. Required or Recommended horizontal alignment warning signs per MUTCD Section 2C.06.			
b. Optional horizontal alignment warning signs per MUTCD Section 2C.06.			
c. Delineators (Flexible or post mounted) as described in Chapter 3F of the MUTCD			
d. First installation of center line and edge line markings up to 300 feet approaching and through curve			
e. Center and/or Edgeline rumble stripes up to 300 feet approaching and through curve			
f. Mitigation of roadside hazards to establish or widen clear zone in curve			

20| **Comments** | Add New Curve

TANGENT SEGMENT - SYSTEMIC ROADWAY DEPARTURE COUNTERMEASURE REQUEST

Required Data - Minimum information to demonstrate the funding eligibility and countermeasure applicability for this tangent segment.

1| Road Name | 2| Road Owner
3| NTTFI Route | 4| NTTFI Section(s) | 5| Length
6| Posted Speed Limit | 7| AADT | 8| Shoulder paved width

Additional Data (optional) - When provided, the following data elements will be evaluated to determine the risk level for this tangent segment.

9| Site specific crash data
10| Shoulder aggregate width
11| Terrain
12| Lane width
13| Roadside Rating
14| 85th percentile speed
15| Typical Roadside Slope (V:H)
16| Surface Type
17| Describe additional risk considerations
Significant number of horizontal curves, high truck usage, limited passing, etc.

18| **Site Photos** (optional)- Insert photos as documentation of risk considerations.

Click Here to Add Photo | Click Here to Add Photo

19| **Countermeasures** - Indicate existing countermeasures on this route and the additional improvements for which funding is requested. See instructions.

	Existing	Request	Requested Funding
a. Delineators (flexible or post mounted) as described in Chapter 3F of the MUTCD			
b. Rumble Strips or Stripes (attach detail drawing or description of the proposed rumble strips/stripes)			
c. First installation of center line and edge line pavement markings			
d. Mitigation of roadside hazards to establish or widen clear zone (attach description of proposed work)			

20| **Comments** | Add New Segment

Systemic Roadway Departure Countermeasures Category

Eligible Improvements
Curve Warning Signs
Delineators
New Center/Edge Striping
Edge Rumbles
Center Rumbles
Clear Zones

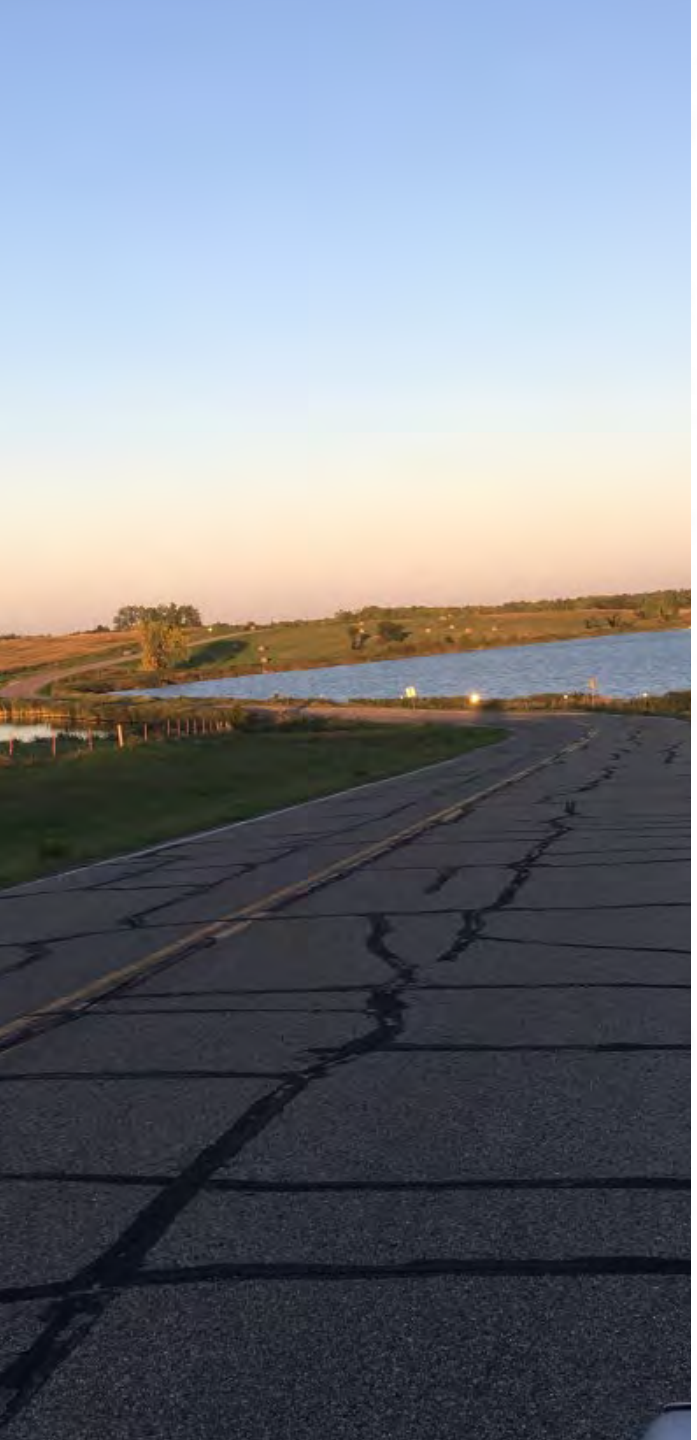

Navajo Nation


Native Village of Minto


Lake Traverse Reservation, SD


Coeur d'Alene Tribe


Ohkay Owingeh



CURVE - SYSTEMIC ROADWAY DEPARTURE COUNTERMEASURE REQUEST

Required Data - Minimum information to demonstrate the eligibility and significance of this curve site.

1| Curve Name	BIA 5, Enemy Swim Road, S-curves			2|Road Owner	BIA
3| NTTFI Route	0500	4|NTTFI Section	020	5|AADT	378.00

Additional Risk Data - The following data elements will be evaluated to determine the risk level at candidate locations. See instructions.

6| Speed Limit	55 mph	7|Curve Advisory Speed	n/a mph	8| Advisory Method	Design Calculation

9| Site specific crash data: All state patrol data can be captured and analyzed, but site-specific tribal crash data is unavailable. Within a five mile radius of this site, one fatality and fifteen injury crashes have been documented on roadways with other ownership but similar width and geometric layout.

10| Curve deflection angle	35°
11| Curve radius	701 to 1,250 feet
12| Lane width	12 ft
13| Surface type	Paved
14| Shoulder paved width	1 ft
15| Shoulder unpaved width	0 ft
16| Roadside Rating	6 ft

17| Describe additional risk considerations

Geometric features, sight-distance, visual trap, friction, vertical curvature, distance from other horizontal curves, or other risk considerations. See instructions.

The roadside has a sideslope that is unusable by vehicles. The S-curves occur as the roadway passes through the edge of a small lake, so the sideslopes are lined with erosion control riprap that is too large for a normal passenger vehicle to traverse and is unusable as a recovery area. This riprap is concealed by vegetation that has grown in between the rocks.

18| **Site Photos** - Insert pictures as documentation of risk considerations.

Click Here to Add Photo

19| **Countermeasures** - Indicate existing countermeasures at this site and the additional improvements for which funding is requested. Also indicate the amount of funding requested for the proposed improvements. See instructions.

	Existing	Requested	Requested Funding
a. Required or Recommended horizontal alignment warning signs per MUTCD Section 2C.06.		✓	$ 4,785.29
b. Optional horizontal alignment warning signs per MUTCD Section 2C.06.			
c. Delineators (Flexible or post mounted) as described in Chapter 3F of the MUTCD		✓	$ 2,315.46
d. First installation of center line and edge line markings up to 300 feet approaching and through curve		✓	$ 21,405.17
e. Center and/or Edgeline rumble strip/stripes up to 300 feet approaching and through curve	✓	✓	$ 4,222.93
f. Mitigation of roadside hazards to establish or widen clear zone in curve			

20| **Comments** Edgeline rumblestrips are present, and centerline rumblestrips are being requested.

Add New Curve

Systemic Roadway Departure Countermeasures

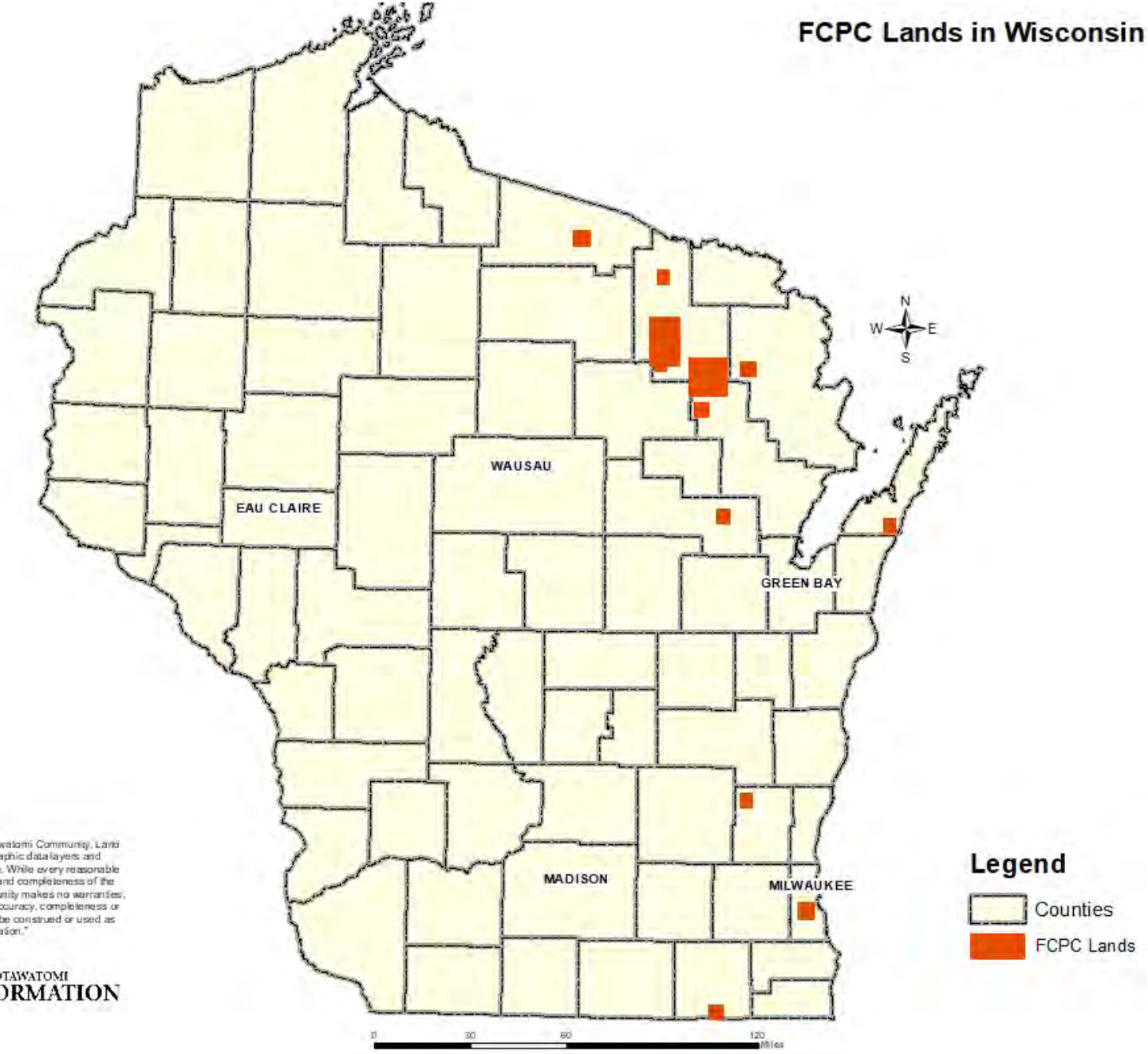
Source: Sisseton Wahpeton Oyate

FOREST COUNTY POTAWATOMI
Keeper of the Fire

Partnering to Reduce Roadway Departures

Todd Mulvey, P.E.
Roads Program Manager
Forest County Potawatomi Community

FCPC Lands in Wisconsin



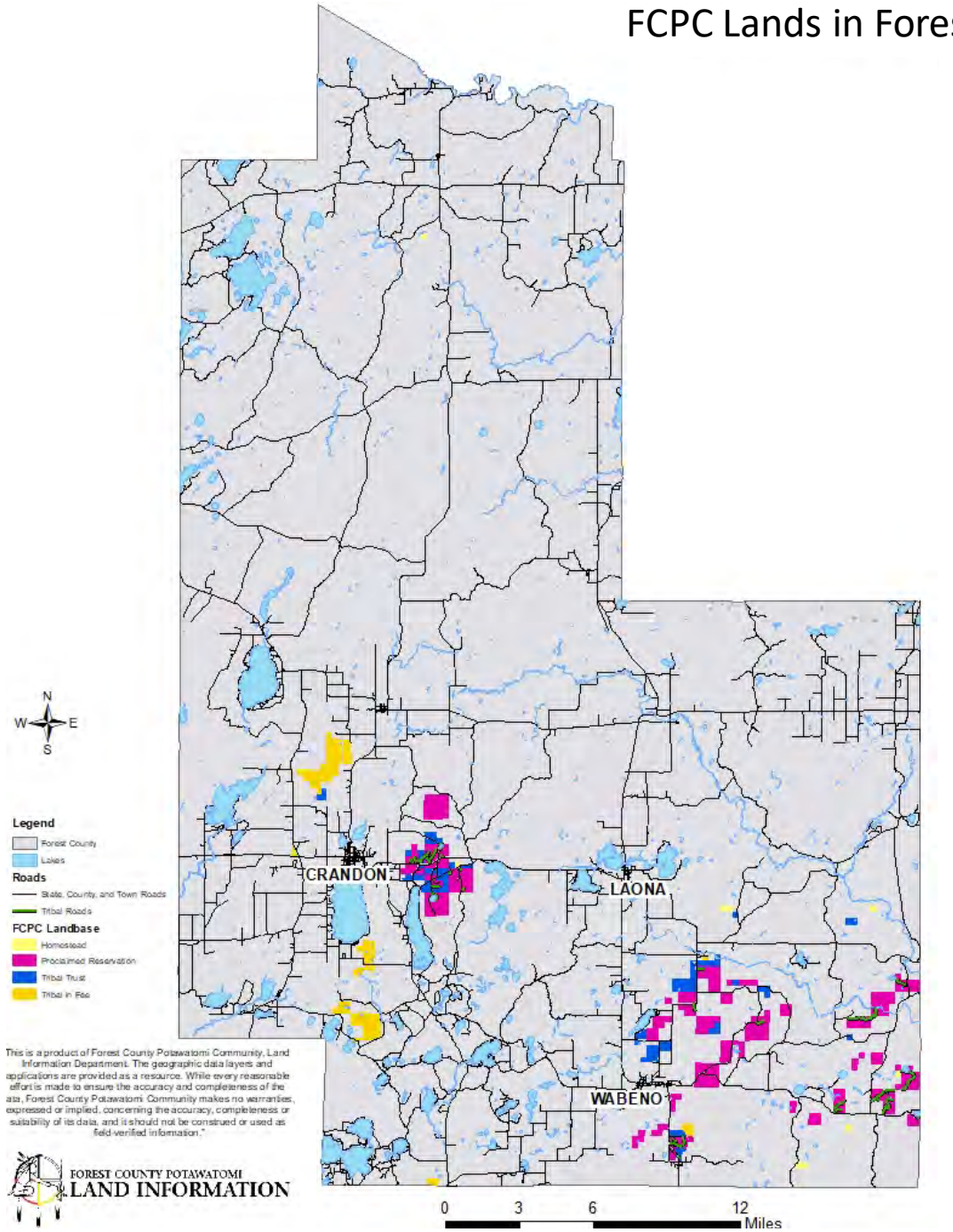
Legend

- Counties
- FCPC Lands

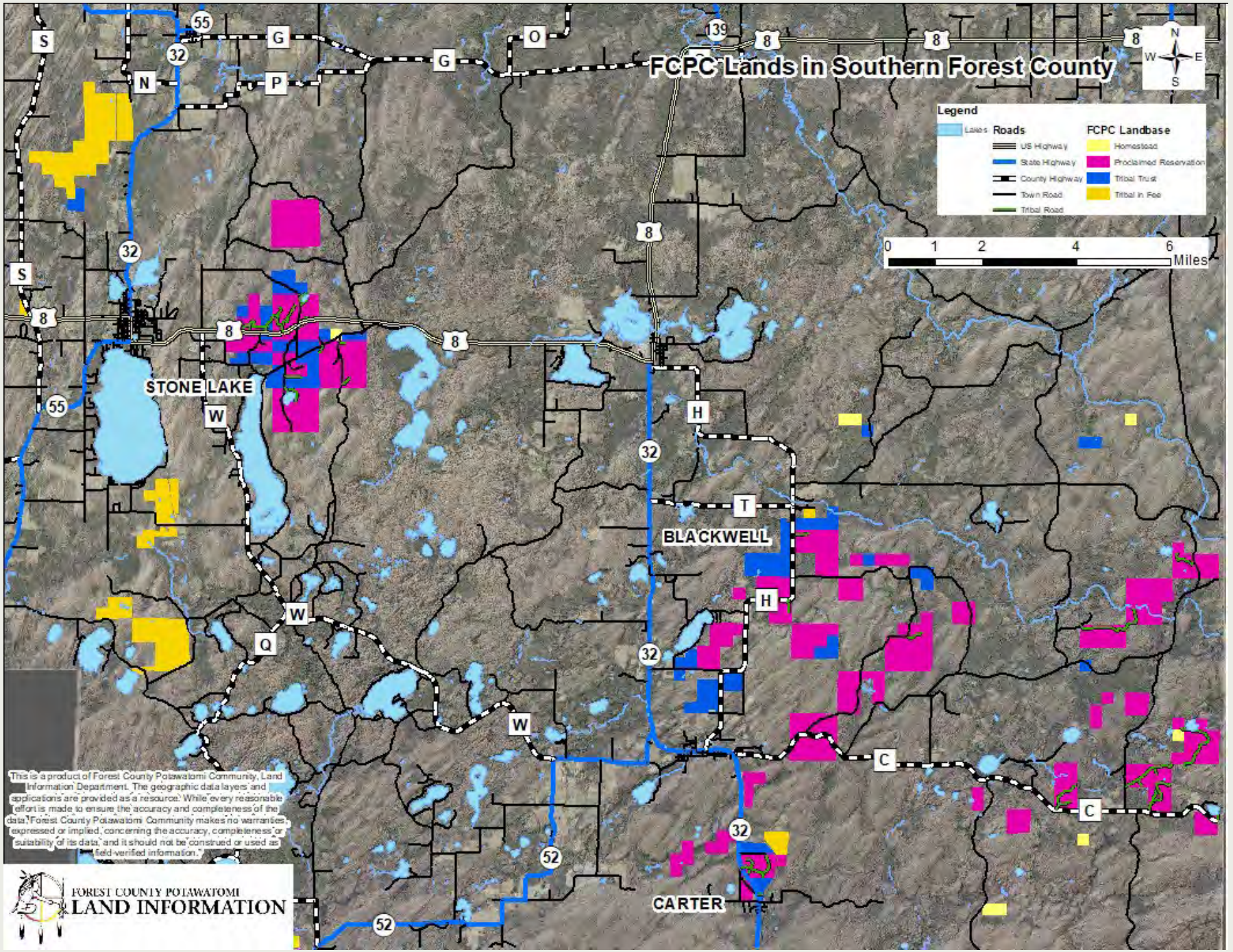
FOREST COUNTY POTAWATOMI
LAND INFORMATION

FOREST COUNTY
POTAWATOMI
Keeper of the Fire

FCPC Lands in Forest County, WI



FOREST COUNTY
POTAWATOMI
Keeper of the Fire



Transportation Partners

- Federal
  - USDOT
  - FHWA
  - BIA
  - USDA Forest Service
- State
  - Wisconsin Department of Transportation
- Local
  - Forest County
  - Town of Lincoln
  - Town of Wabeno

FOREST COUNTY POTAWATOMI
Keeper of the Fire

Transportation Partnership Projects & Agreements

- FHWA
  - Tribal Transportation Program (TTP)
- Bureau of Indian Affairs (BIA)
  - Road Maintenance Funding
- USDA Forest Service
  - Co-operative Roads Agreement
  - Mineral Use Permits
- WisDOT
  - Torpee Creek crossing at STH 32
  - US 8 Pathway to Wellness
  - US 8 Intersection Safety Improvements
  - Partnership Agreement with 11 Tribes, WisDOT, BIA, and FHWA
  - US 8 and STH 32 Corridors Safety MOU
- Forest County
  - North Branch Oconto River bridge at County C
  - County Highways H, C, and W Roadway Departure Reductions
  - Annual Service Agreement – Crack Sealing, Roadside Cutting, Paving
  - Materials Source – Salt, Salt Sand, Brine, Gravel, Cold Patch
- Town of Lincoln
  - Town road paving projects
  - Young's Lane intersection safety
  - Road Maintenance MOU
- Town of Wabeno
  - Rummels Road Reconditioning
  - North Branch Oconto River bridges at Soper Street & Cavour Ave
  - Road Maintenance MOU

PARTNERSHIP AGREEMENT

Between

Wisconsin's Eleven Federally Recognized Tribes

Bad River Band of Lake Superior Chippewa Indians,
Forest County Potawatomi Community,
Ho-Chunk Nation,
Lac Courte Oreilles Band of Lake Superior Chippewa Indians,
Lac Du Flambeau Band of Lake Superior Chippewa Indians,
Menominee Indian Tribe of Wisconsin,
Oneida Nation,
Red Cliff Band of Lake Superior Chippewa Indians,
Sokaogon Chippewa Community,
St. Croix Band of Chippewa Indians,
Stockbridge-Munsee Community;

And

Wisconsin Division-Federal Highway Administration;

And

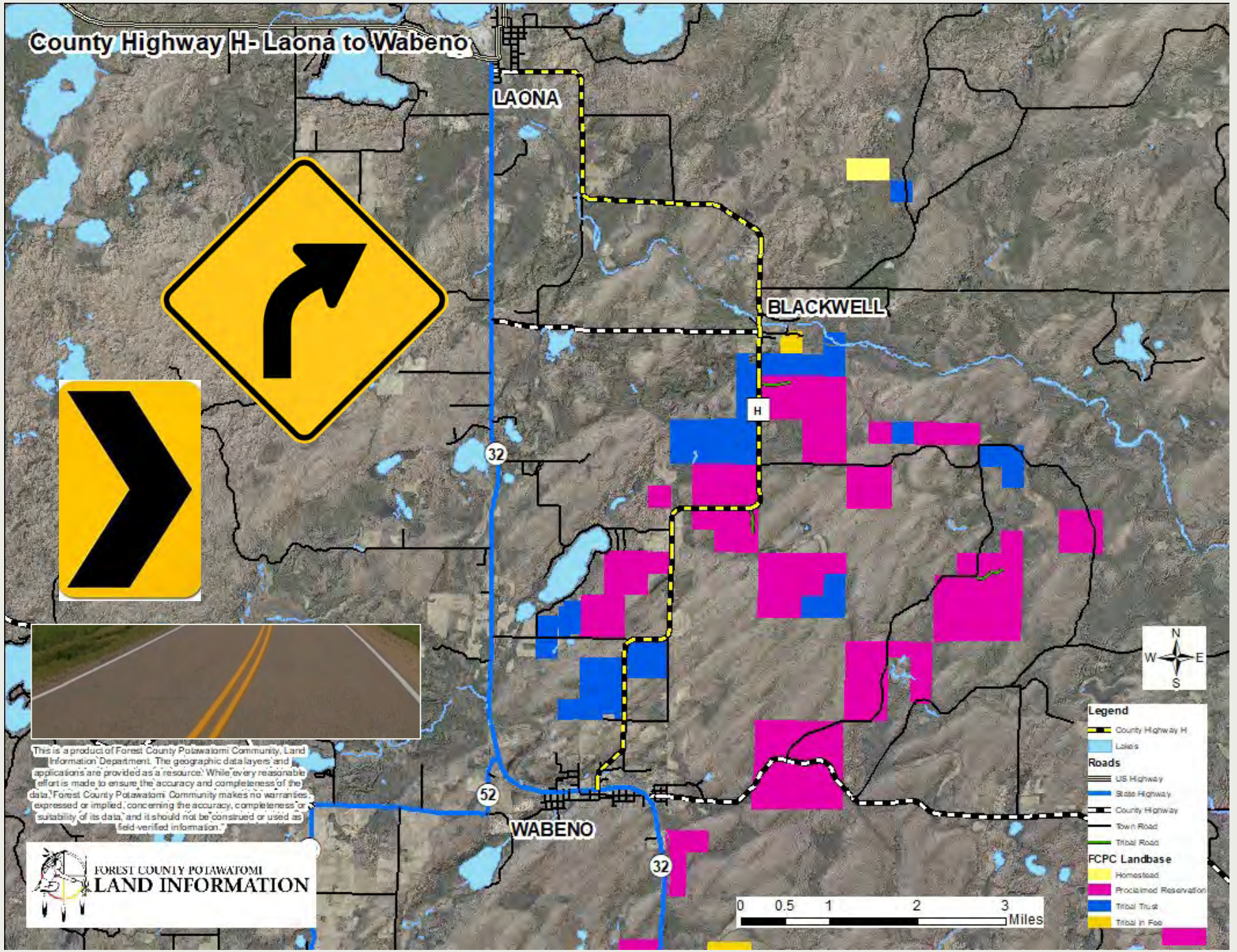
Wisconsin Department of Transportation

And

Bureau of Indian Affairs

September 30, 2019

FOREST COUNTY POTAWATOMI
Keeper of the Fire



County H

- Road info
  - 12.2 miles
  - 2 – 11’ Asphalt Lanes
  - Gravel Shoulders
  - 45 mph
  - Horizontal Curves at 45mph minimum radius
  - Centerline and Edgeline Paint
- Countermeasures Implemented
  - Chevron Signs
  - Advanced Curve Signs
  - 4” Centerline Epoxy
  - 4” Edgeline Epoxy
- Other Countermeasures Considered
  - Paved Shoulders
  - Shoulder rumble strips
  - Centerline rumble strips
  - Safety Edge
- Project Completed in 2021
  - Tribal Transportation Program Safety Fund (FY19)
  - Forest County provided labor and equipment for sign installation
  - Pavement Marking was competitively bid

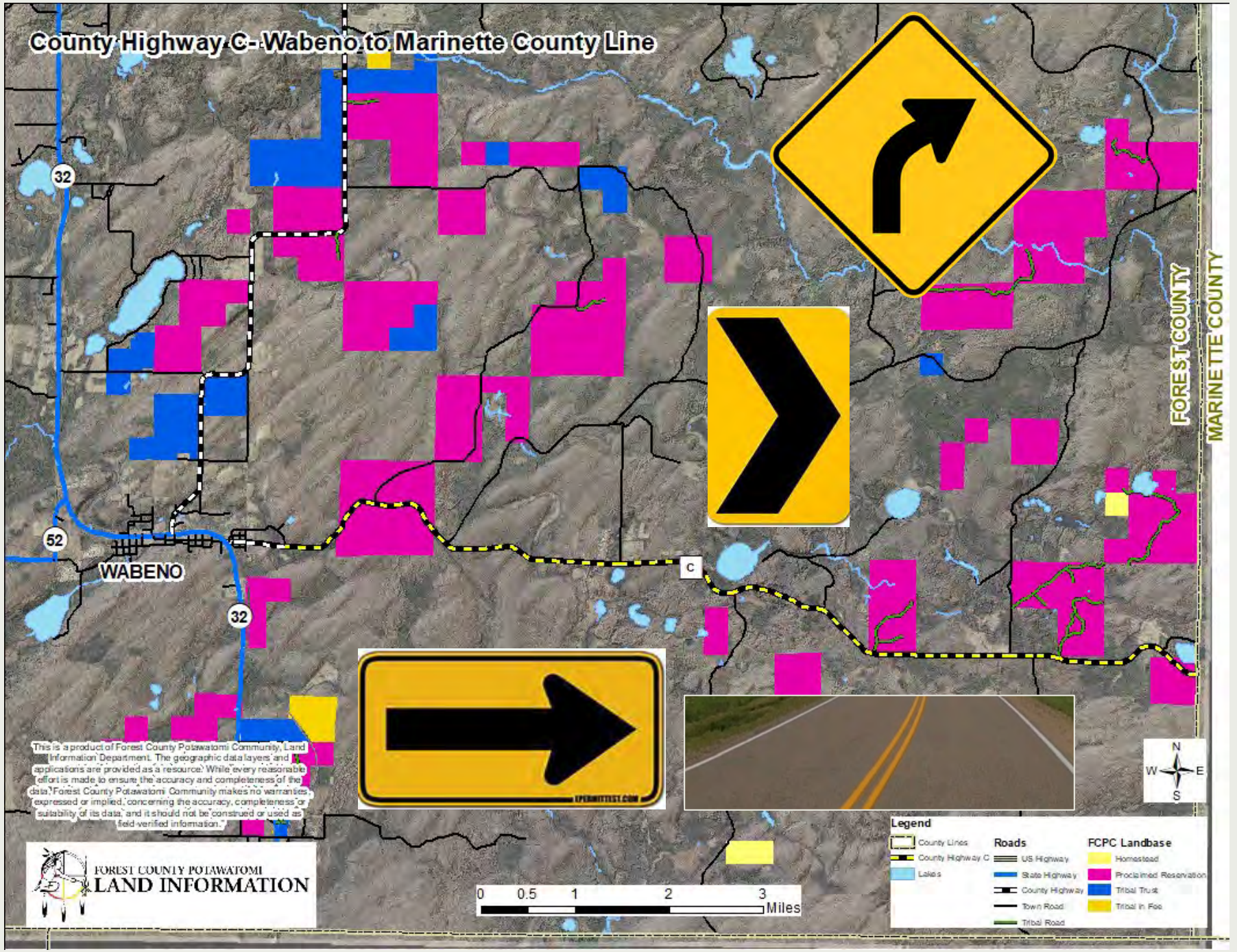
FOREST COUNTY POTAWATOMI
Keeper of the Fire

County H

BEFORE->

<-AFTER

FOREST COUNTY POTAWATOMI
Keeper of the Fire



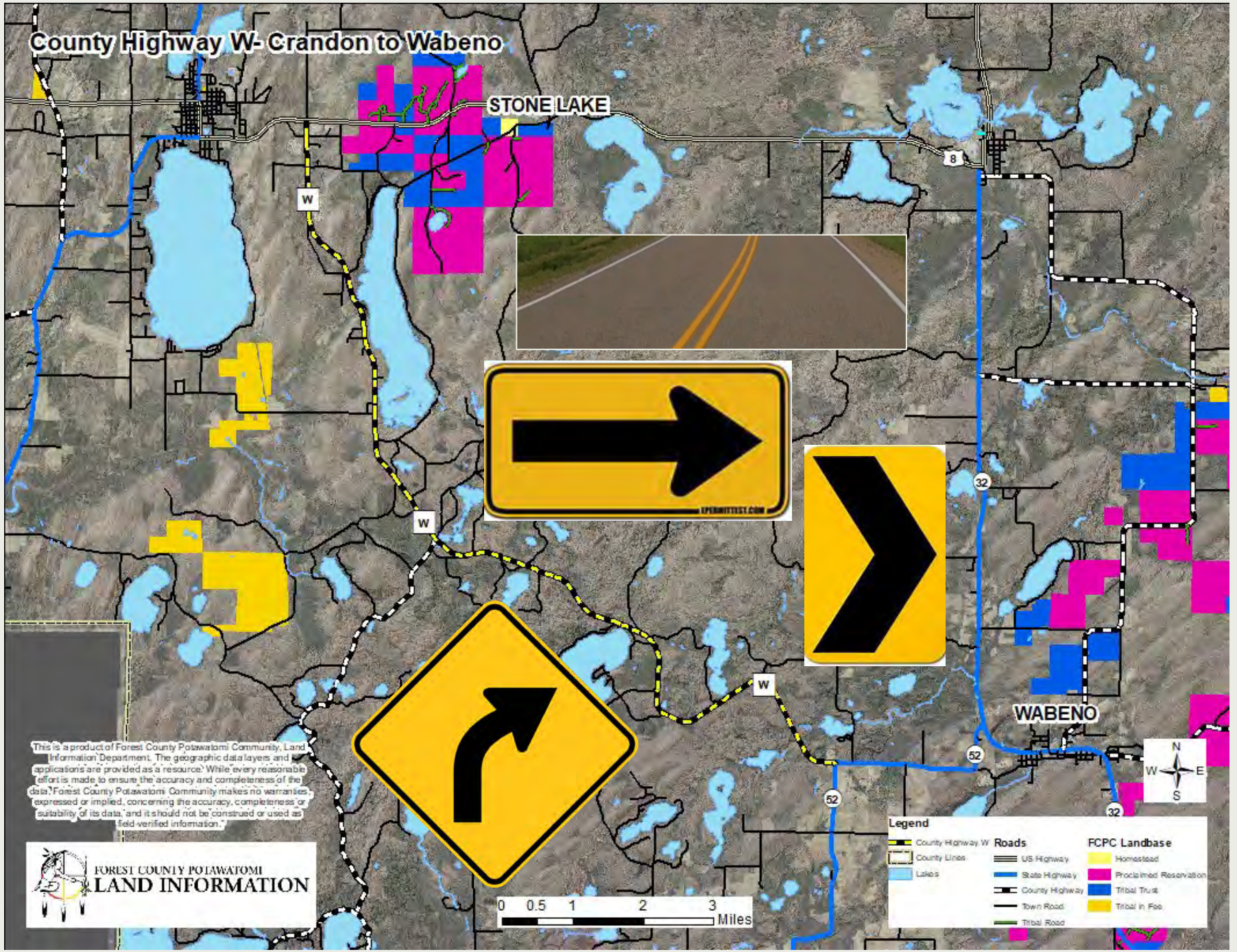
County C

- Road info
  - 11.3 miles
  - 2 – 11’ Asphalt Lanes
  - Gravel Shoulders
  - 45 mph
  - Horizontal Curves at 45mph minimum radius
  - Centerline Epoxy
  - Edgeline Paint
- Countermeasures Proposed
  - Chevron Signs
  - Night Arrow Signs
  - Advanced Curve Signs
  - 4” Edgeline Epoxy
- Other Countermeasures Considered
  - Paved Shoulders
  - Shoulder rumble strips
  - Centerline rumble strips
  - Safety Edge
- Project Scheduled for 2023
  - Tribal Transportation Program Safety Fund (FY21)
  - Forest County to provide labor & equipment for sign installation
  - Pavement Marking will be competitively bid

FOREST COUNTY POTAWATOMI
Keeper of the Fire

County C

FOREST COUNTY POTAWATOMI
Keeper of the Fire



County W

- Road info
  - 14.3 miles
  - 2 – 11’ Asphalt Lanes
  - Gravel and Paved Shoulders
  - 45 mph
  - Some Segments with Epoxy Markings
  - Most Segments with Paint Markings
- Countermeasures being Considered
  - Chevron Signs
  - Night Arrow Signs
  - Advanced Curve Signs
  - 4” Centerline & Edgeline Epoxy
  - Roadside improvements
  - Paved Shoulders
  - Shoulder rumble strips
  - Centerline rumble strips
  - Safety Edge
- Project Pending Funding
  - Tribal Transportation Program Safety Fund (FY22)
  - Forest County to provide labor & equipment for sign installation
  - Pavement Marking will be competitively bid

FOREST COUNTY POTAWATOMI
Keeper of the Fire

County W

FOREST COUNTY POTAWATOMI
Keeper of the Fire

Questions?

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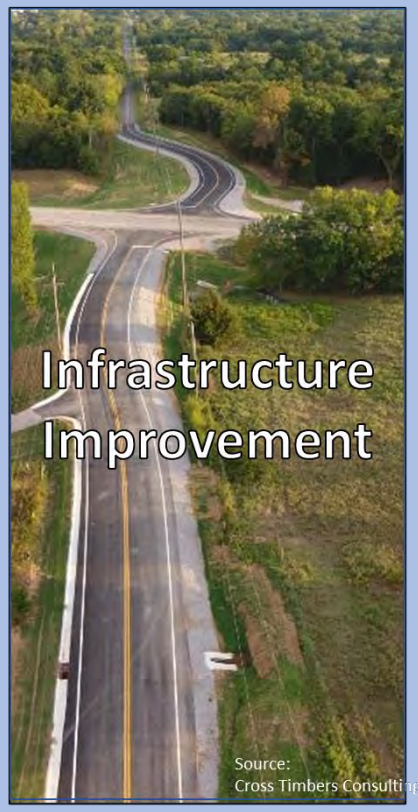
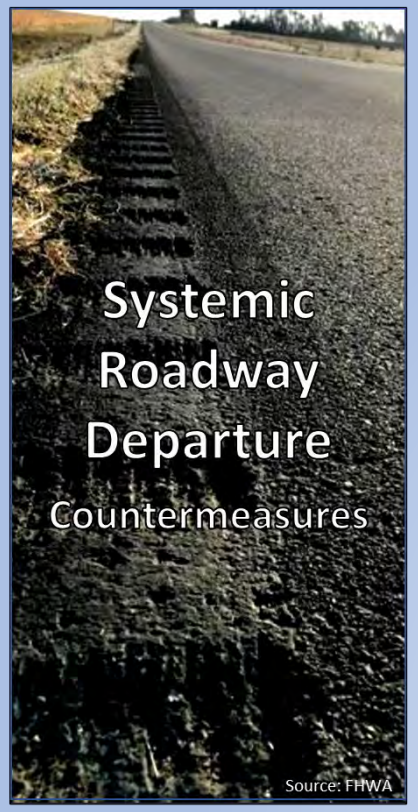
Using TTPSF to Address Roadway Departure

1. Install low-cost countermeasures on highest risk routes
2. Develop Systemic Roadway Departure Implementation Plan

Safety Plans

Data Assessment, Improvement, and Analysis





Safety Studies can supplement safety plans

- Road Safety Audits
- Roadway Departure Implementation Plan
- Other Studies
- Infrastructure Improvement
- Behavioral Programs
- Policies

Systemic Safety Planning Process

Step 1 **Identify Focus Crash Types & Risk Factors**

Step 2 **Screen & Prioritize Candidate Locations**

Step 3 **Select Countermeasures**

Step 4 **Prioritize Projects**

https://safety.fhwa.dot.gov/systemic/fhwasa13019/sspst.pdf

TTPSF can fund Systemic Roadway Departure Implementation Planning

Systemic Method

Symptoms

Severe roadway departure crashes on curves.

Possible Risk Factors:

- Avg. Daily Traffic > 1,000 vehicles
- Curve Radius < 1,000 feet
- Intersection within Curve
- Visual Trap within Curve
- Severe Crash within Curve

Diagnosis

11% of all curves have 3 or more risk factors.

Lab Results:

- **Curve A**
- **Curve B**
- **Curve C**
- **Curve D**
- **Curve E**

https://safety.fhwa.dot.gov/systemic/

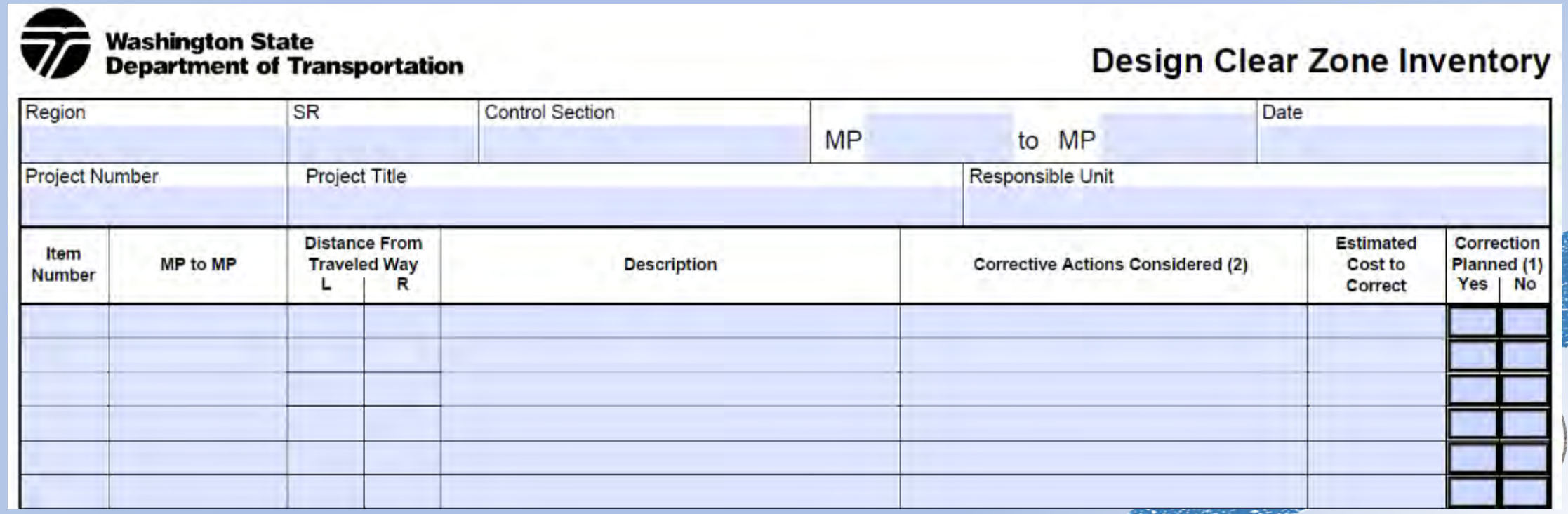
Video:
Systemic Approach to Roadway Departure

https://www.youtube.com/embed/WfdBrrl0WwU?start=94

Roadside Inventory

N32

Inventory of roadside objects can help agencies plan safety improvements



Washington State Department of Transportation

Design Clear Zone Inventory

Region	SR	Control Section	MP to MP	Date

Project Number	Project Title	Responsible Unit

Item Number	MP to MP	Distance From Traveled Way L	Distance From Traveled Way R	Description	Corrective Actions Considered (2)	Estimated Cost to Correct	Correction Planned (1) Yes	Correction Planned (1) No

Questions?

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Resources

Roadway Departure Webinar Recordings

Summer 2020

www.TribalSafety.org/Roadway-Departure

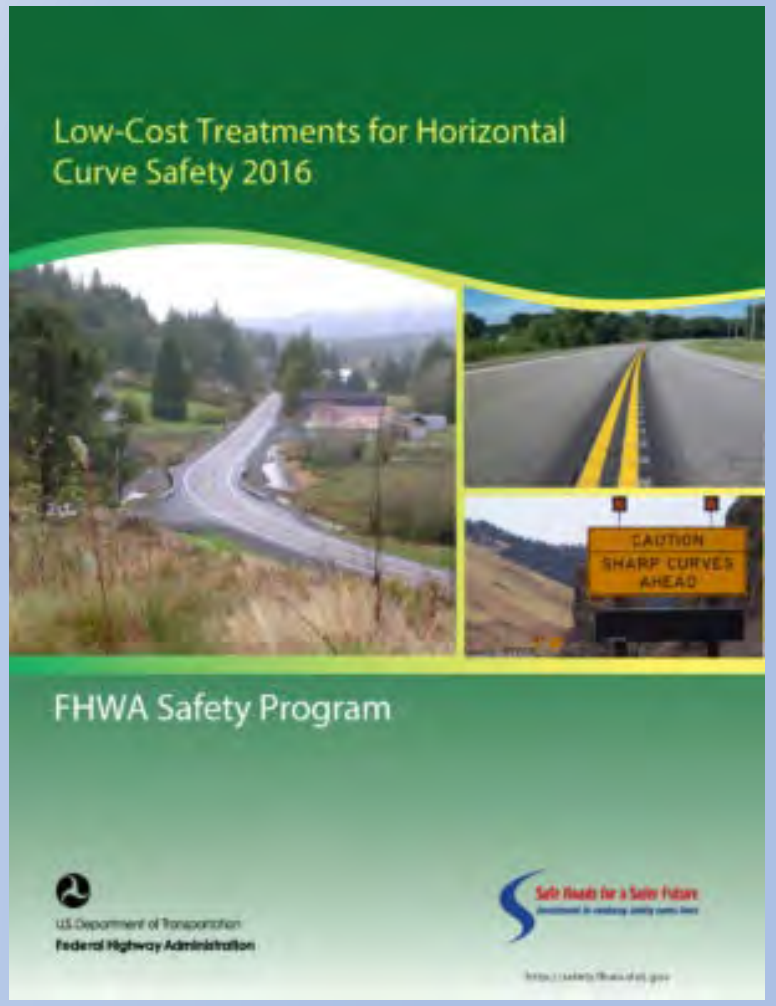
1. Intro to Roadway Departure
2. Keeping Drivers in their Lane
3. When Vehicles Leave the Road

Resources

FHWA Focus on Reducing Rural Roadway Departures (FoRRRwD) Initiative

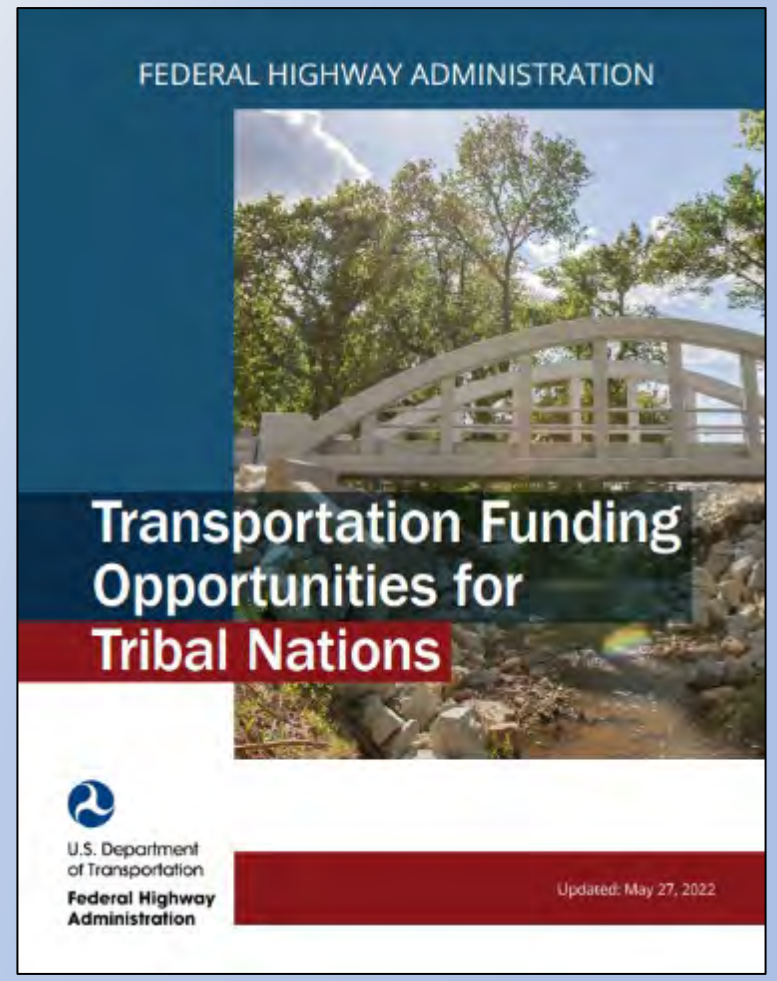
https://safety.fhwa.dot.gov/FoRRRwD/

Resources



More information about risk in horizontal curves can be found in the FHWA publication Low-Cost Treatments for Horizontal Curves, 2016, Report # FHWA-SA-15-084

FHWA Focused Approach to Safety

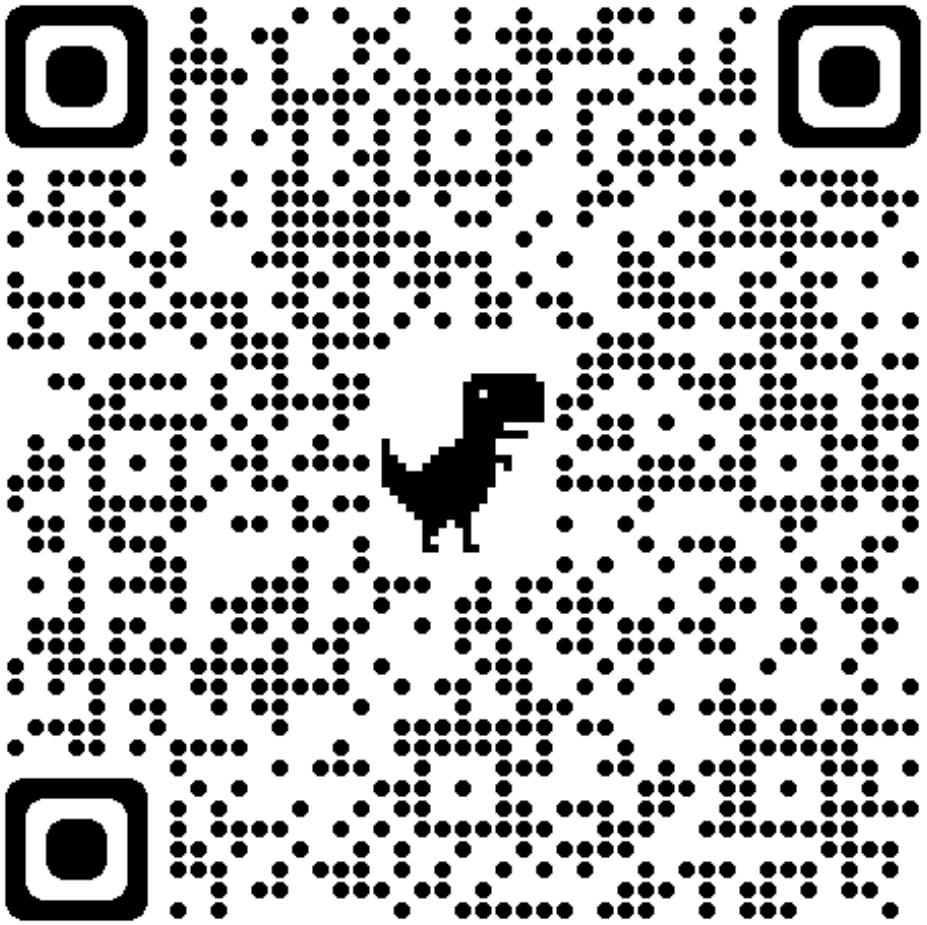


Transportation Safety Funding Opportunities

- State-managed
  - Highway Safety Improvement Program
  - Transportation Alternatives
  - Safe Routes to School
  - Highway-Rail Grade Crossing Program
- Federal Discretionary Grants
  - Tribal Transportation Program Safety Fund
  - Safe Streets and Roads for All
  - Rural Surface Transportation Grants
  - Wildlife Crossing Pilot Program
  - BIA Indian Highway Safety Program

https://highways.dot.gov/federal-lands/programs-tribal

www.TribalSafety.org/Funding



U.S. Department of Transportation
Federal Highway Administration

Transportation Safety Grant Opportunities Available to Tribes at a Glance

Comparison of two programs available to Tribes for projects that reduce fatalities and injuries on roadway facilities.
Additional detail can be found in the applicable Notices of Funding Opportunities (NOFO).

	Safe Streets and Roads for All (SS4A)	Tribal Transportation Program Safety Fund (TTPSF)
Purpose	Reduce or eliminate fatal and serious injury on roadway facilities.	
Amount of Funding	Up to $1 billion per year	Approximately $22 million per year
Award Size	The NOFO provides expected minimum and maximum ranges, but there is no statutory minimum or maximum. In general, those expected ranges are: Action Plan Grants • $200,000 expected minimum for all applicants. Smaller grant awards may be considered. • $1,000,000 expected maximum for individual applicants; $5,000,000 expected maximum if a Metropolitan Planning Organization (MPO) or a regional joint application. Implementation Grants • $3,000,000 expected minimum and $30,000,000 expected maximum for Federally recognized Tribal Governments. Smaller grant awards may be considered. • $50,000,000 expected maximum if an MPO or regional joint application.	• $10,000-$15,000 for transportation safety plans. • No minimum or maximum project size; Typical awards have been under $1 million although larger projects may be considered.
Eligible applicants	• Federally recognized Tribal Governments. • Cities, counties, and similar political subdivisions of a State. • MPOs and multijurisdictional group comprised of eligible applicants.	Federally recognized Tribal Governments must be the primary applicant.
Matching Resources	20% non-Federal match, which can be funding or in-kind matches. Tribal Transportation Program funds cannot be used for the non-Federal match.	No match requirement. Priority consideration may be given to projects that show a commitment of other resources.
Eligible projects	• Comprehensive safety action plans and supplemental action plan activities. • Planning, design, and development activities for projects and strategies identified in an action plan. • Infrastructure, behavioral, and operational safety projects and strategies identified in an action plan.	• Transportation safety plans. • Data assessment/improvement/analysis. • Infrastructure projects.
Safety Planning Requirement	Grant funds are to implement projects and strategies that are already identified in an action plan (applicants must self-certify that existing roadway safety plans qualify) or to develop a comprehensive safety action plan.	A Tribes' transportation safety plan, state or local safety plan, or RSA must support infrastructure and data improvement applications.
Data requirements for applications	Crash history and other safety data are used to identify implementation projects. SS4A Action Plan Grant applications require fatal crash count and population count information.	
Effective Strategies	Prioritizes projects that include evidence-based projects or strategies that improve safety.	
2022 Deadline	September 15, 2022	
More Information	www.Transportation.gov/SS4A SS4A@DOT.GOV	https://highways.dot.gov/federal-lands/programs-tribal/safety/funds TTPSF@DOT.GOV

Other transportation safety funding opportunities can be found at https://www.tribalsafety.org/funding and https://highways.dot.gov/federal-lands/programs-tribal/funding-opportunities

Questions?

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Source: Forest County Potawatomi Community

Additional Risk Considerations – Visual Trap

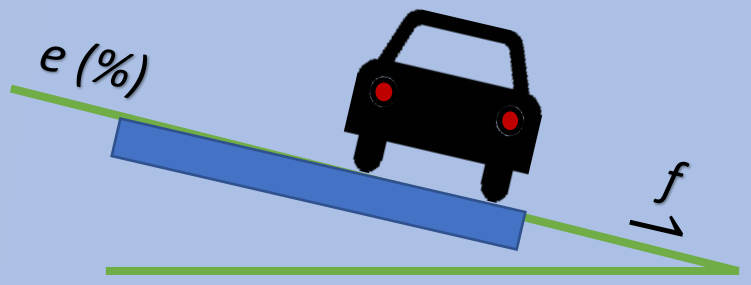
- *Visual trap* - Visual cues that contradict the roadway alignment such as a fence, tree clearing, another roadway, or power poles may cause a driver to assume that the road continues straight when there is actually a horizontal curve.

Additional Risk Considerations

Distance from other horizontal curves - Drivers may be surprised by the first horizontal curve after a long stretch of roadway with little or no curvature.

Additional Risk Considerations

- *Superelevation issues* - Engineered horizontal curves will often be superelevated (or banked) with a slope that helps guide vehicles through the curve at the highest safe speed without loss of control. Some roads have been built without proper engineering and others have deteriorated over time resulting in superelevation that is less than desirable or even reversed.



Section a-a

Additional Risk Considerations

- *Edge drop-off* – Tire wear or erosion of aggregate/dirt shoulders can expose a vertical pavement edge. Such conditions can contribute to drivers over-correcting after leaving the roadway. Edge drop-off can be described by an average measurement in inches.

Questions?

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Systemic Roadway Departure Countermeasures Category

Eligible Improvements
Curve Warning Signs
Delineators
New Center/Edge Striping
Edge Rumbles
Center Rumbles
Clear Zones


Navajo Nation


Native Village of Minto


Lake Traverse Reservation, SD


Coeur d'Alene Tribe


Ohkay Owingeh

Horizontal Alignment Warning Signs

- Horizontal alignment warning signs <u>required, recommended, or optional</u> by Table 2C-5 of the Manual on Uniform Traffic Control Devices (MUTCD);

Chevron Signs

25%

Reduction in nighttime crashes

16%

Reduction in non-intersection fatal and injury crashes

Coeur d'Alene Tribe

Delineators

Crash Reduction
Installing post mounted delineators
20-30%

Delineators in curves and/or tangents as described in Chapter 3F of the MUTCD;

Native Village of Minto

Guardrail Delineators


Source: FHWA


Source: FHWA


Source: Thurston County, WA

Striping

Photo: La Jolla Band of Luiseno Indians

Upgrade or first installation, including design, of center line and edge line markings:

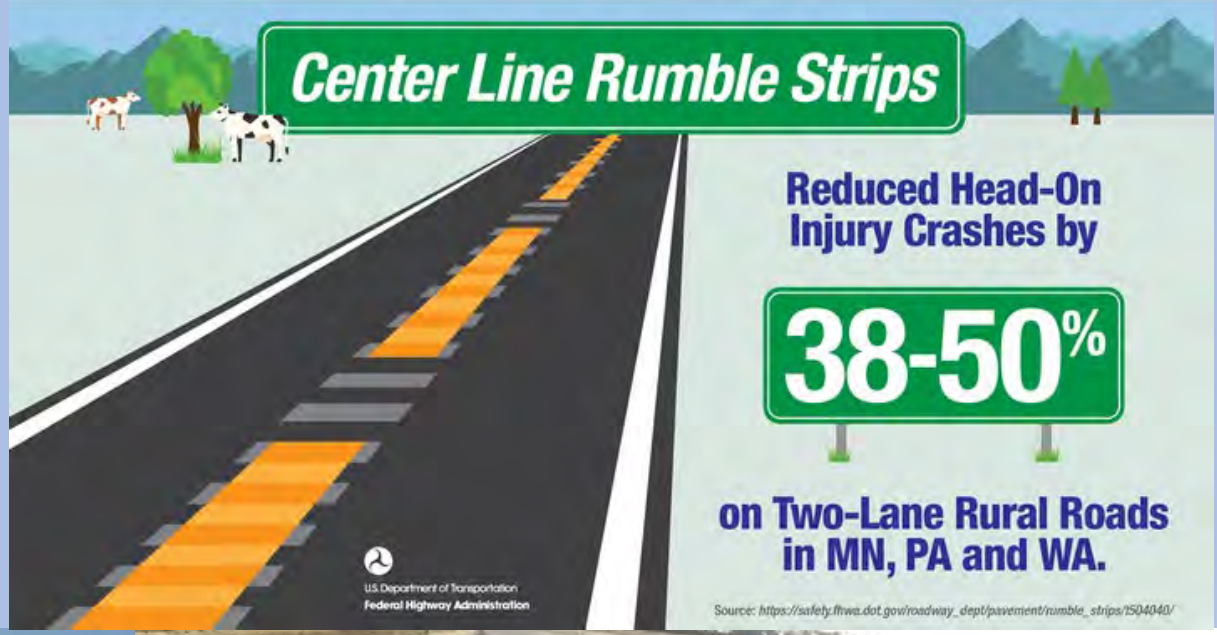
- up to 300 feet approaching and through a horizontal curve;
- on tangent sections of roadway;

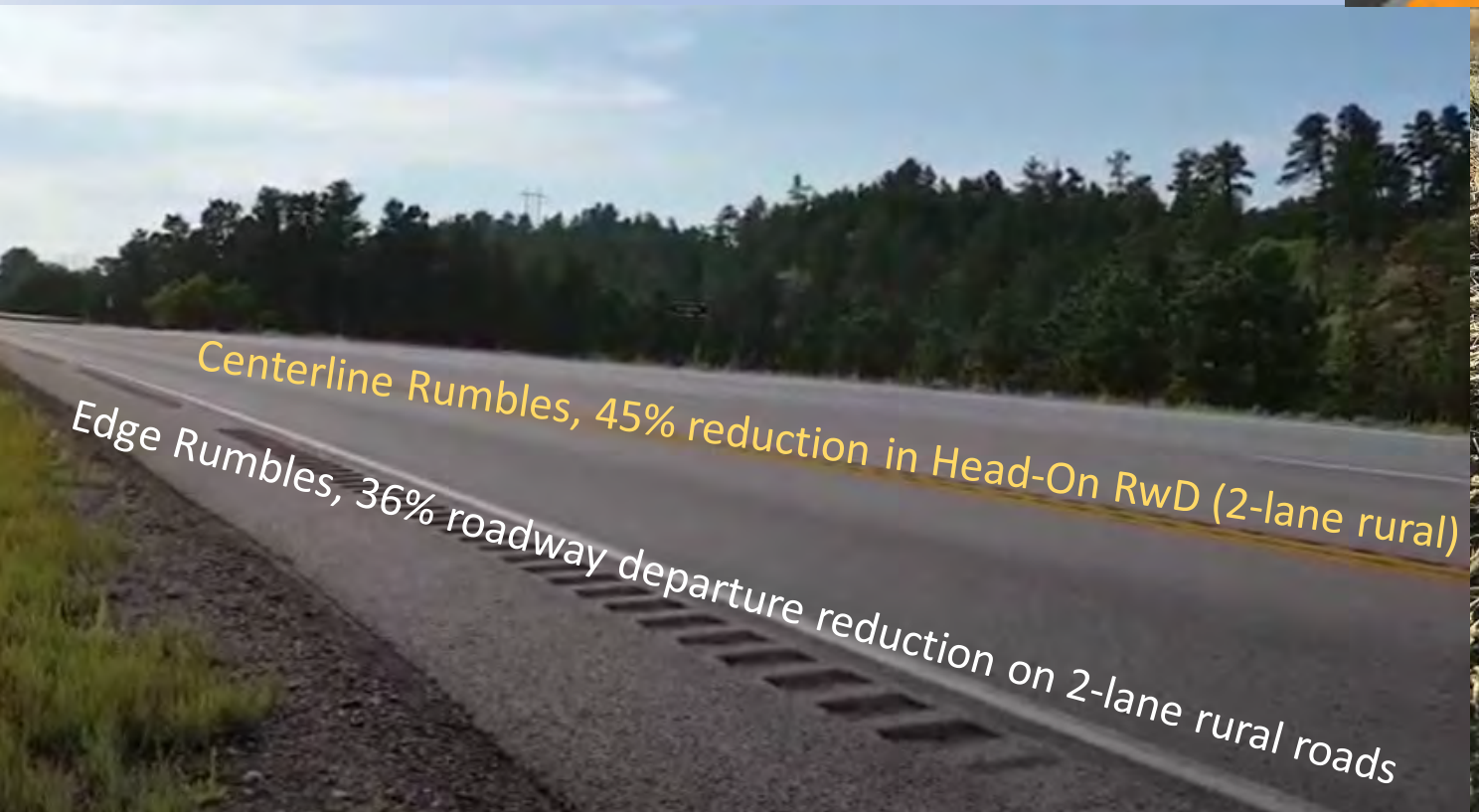
Crash Reduction

Adding edge and center line marking, 24%

Wider edge lines, 22%

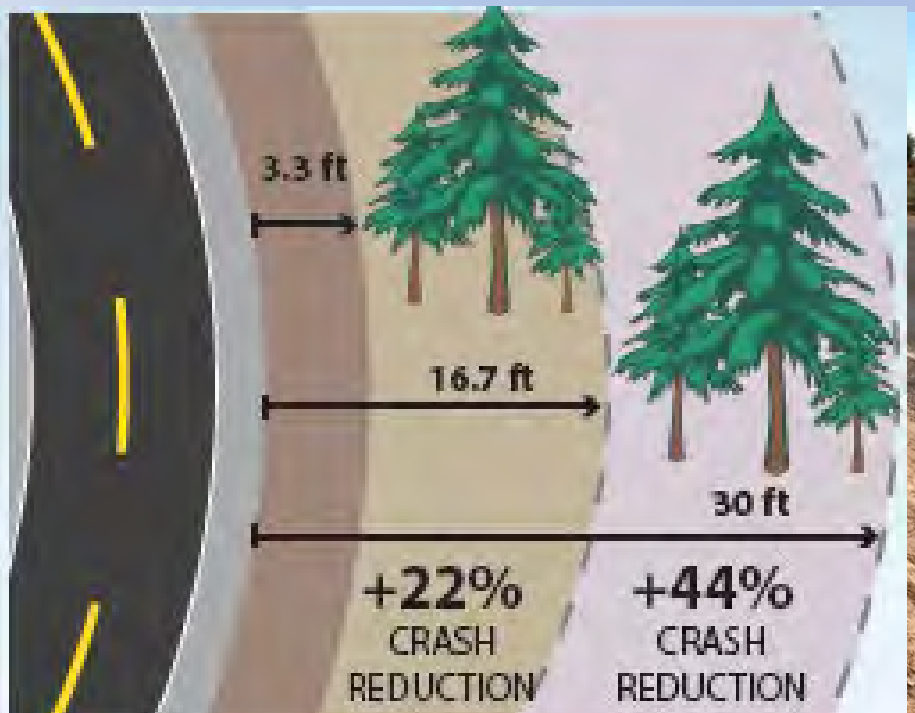
Rumble Strips





Clear Zone Widening

- Mitigation of roadside hazards to establish or widen clear zones
- Includes clearing and grubbing, removal of fixed objects, and replacement with crashworthy devices



Muckleshoot Indian Tribe

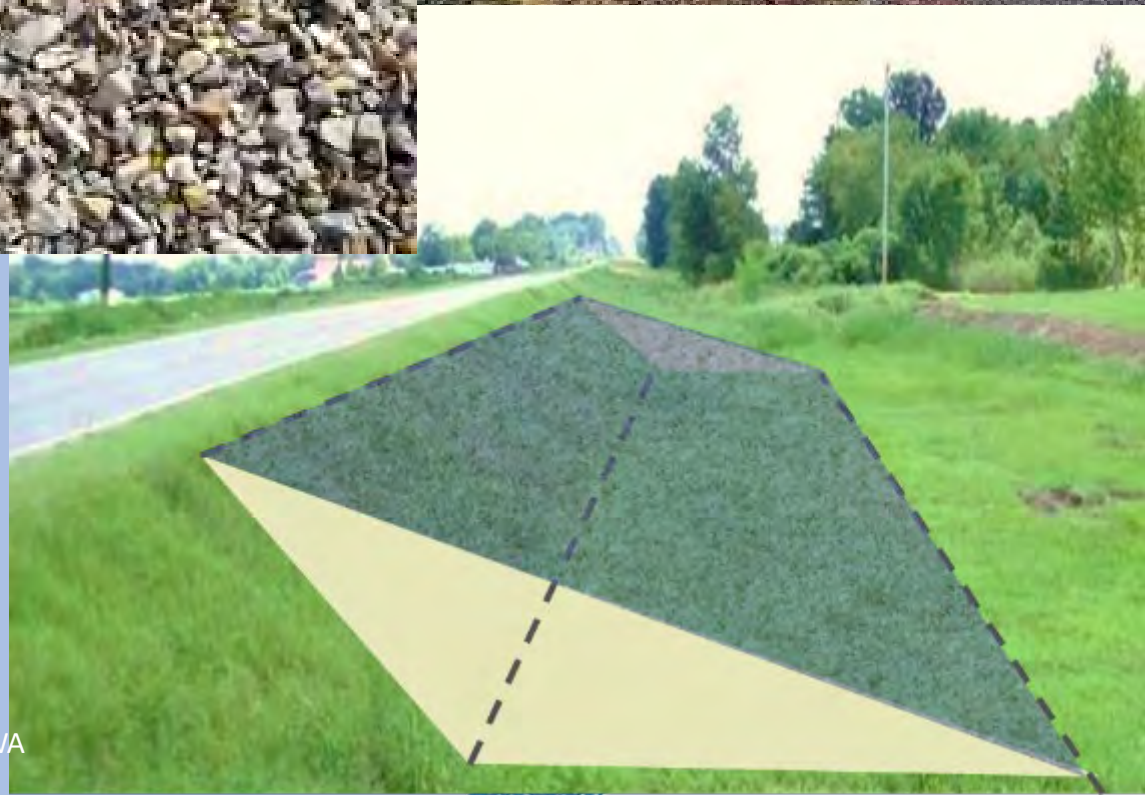
Ohkay Owingeh

Roadway Departure Example

Source: Forest County Potawatomi Community

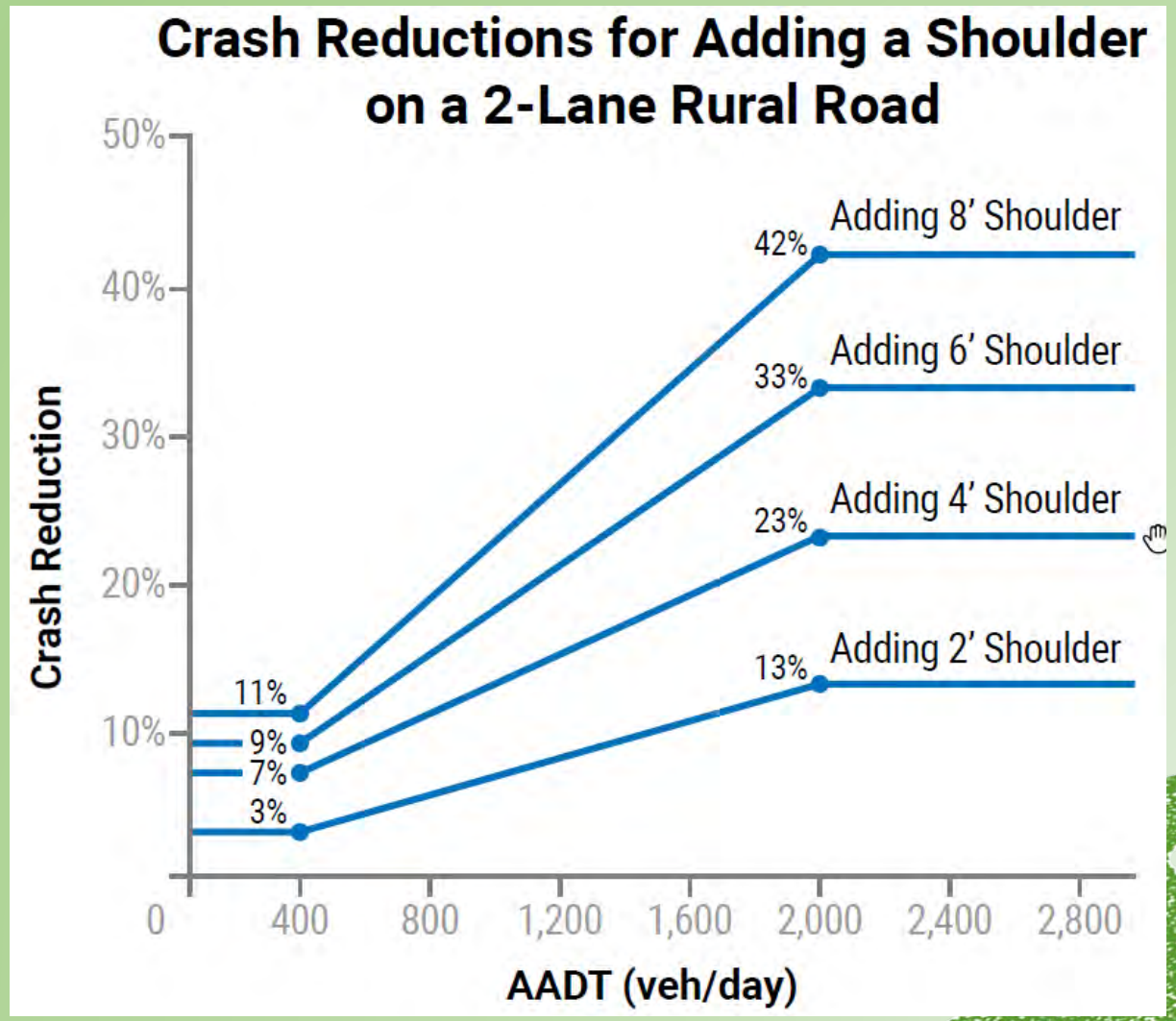
Infrastructure Improvement Category

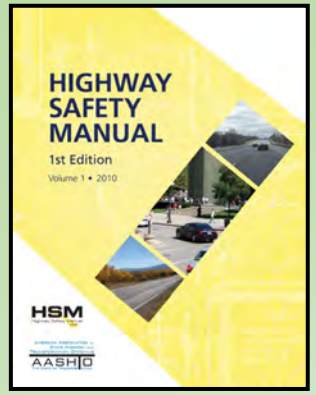
Other Roadway Departure Strategies
Guardrail New/Upgrades
Widen Shoulders
Pave Shoulders
Safety Edge
Reconstruction
Side Slope Grading
High Friction Surface



FHWA

Shoulder Widening





Adapted from the AASHTO Highway Safety Manual (HSM) for 2 lane rural roads with no existing shoulder.

What Makes Up a High Friction Surface Treatment?

The Polymer Resin Binder **&** **The Aggregate**

Three Types which are all proprietary blends

- Epoxy
- Polyester
- Acrylic

One Type

- Calcined Bauxite

Why Use High Friction Surface Treatment ?

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

Pavement Edge Dropoff

- **Pavement edge drop-offs:**
- following resurfacing
- settling or erosion
- tire wear

https://www.youtube.com/watch?v=a1PjxqOtwNI

SafetyEdge^{SM}

- Consolidating the pavement edge into 30° shape during paving to provide stability for vehicles recovering from a roadway departure
- Implement as a standard practice for paving and resurfacing projects

Crash Reductions on Two-Lane Rural Roads	
Drop-Off	35%
Run-Off-Road	21%
Head-On RwD	19%
Fatal & Injury	11%

https://safety.fhwa.dot.gov/safetyEdge/fhwasa17044/fhwasa17044.pdf

Flatten Non-Traversable Slopes

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

Source: AASHTO Highway Safety Manual

FHWA

Guardrail / Barrier


Source: FHWA


Source: FHWA


Source: Thurston County, WA

Questions?

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