# New Jersey 2020
# Strategic Highway Safety Plan

## Emphasis Area

## LANE DEPARTURE

**Team Leader: Vince Cardone**
**Room 101**

# Safety Summit #2

## Emphasis Area Breakout Session (90 minutes)

## Agenda

1. Review Goals of the Session (5 minutes)
2. Review Data and Identify Key Data Questions (20 minutes)
3. Review Existing Strategies (20 minutes)
4. Identify Additional Potential Strategies (15 minutes)
5. Discuss Prioritization of Strategies (30 minutes)

# Lane Departure Crash Data Sheet

**Summit #2** **January 21, 2020**

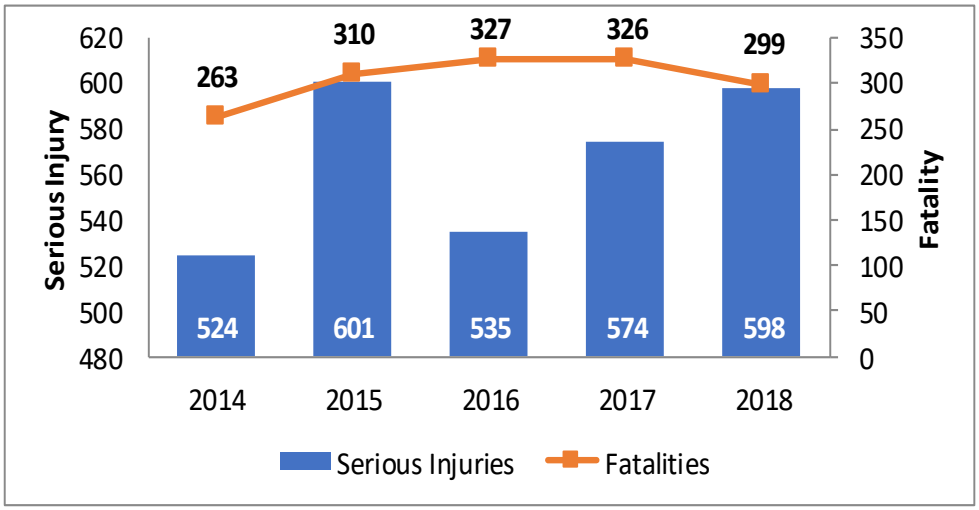
**Lane Departure Crash Quick Facts**

- Accounts for 51% of all NJ fatalities and serious injuries.
- 1,525 fatalities
- Increase of 3% from 2015 SHSP
- 2,832 serious injuries
- Decrease of 12% from 2015 SHSP


| | |
|---|---|
| Who was Involved | 1 |
| Where did Crashes Occur | 2 |
| When did Crashes Occur | 2 |
| Contributing Factors | 3 |
| Crash Types / Conditions | 3 |
| Strategies | 4 |

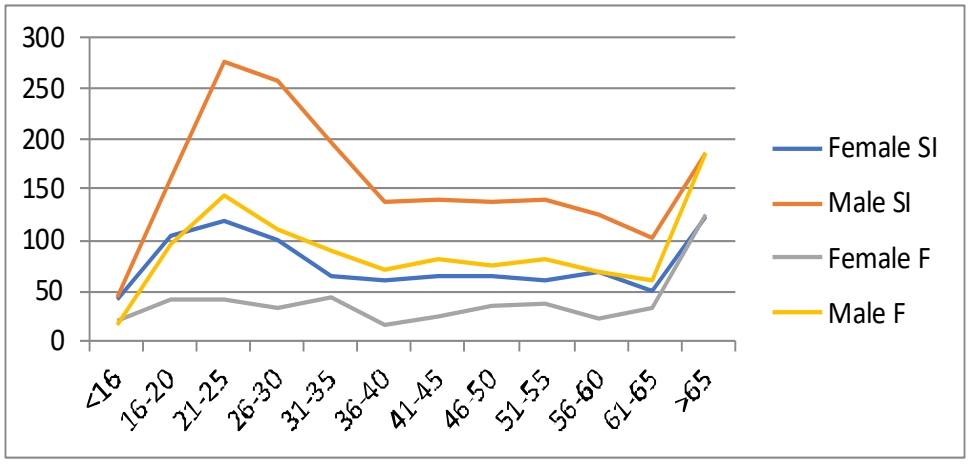

## Summary

This fact sheet provides many details of lane departure crash fatalities and serious injuries (FSI). It also provides suggested strategies to reduce lane departure fatalities and serious injuries in NJ.

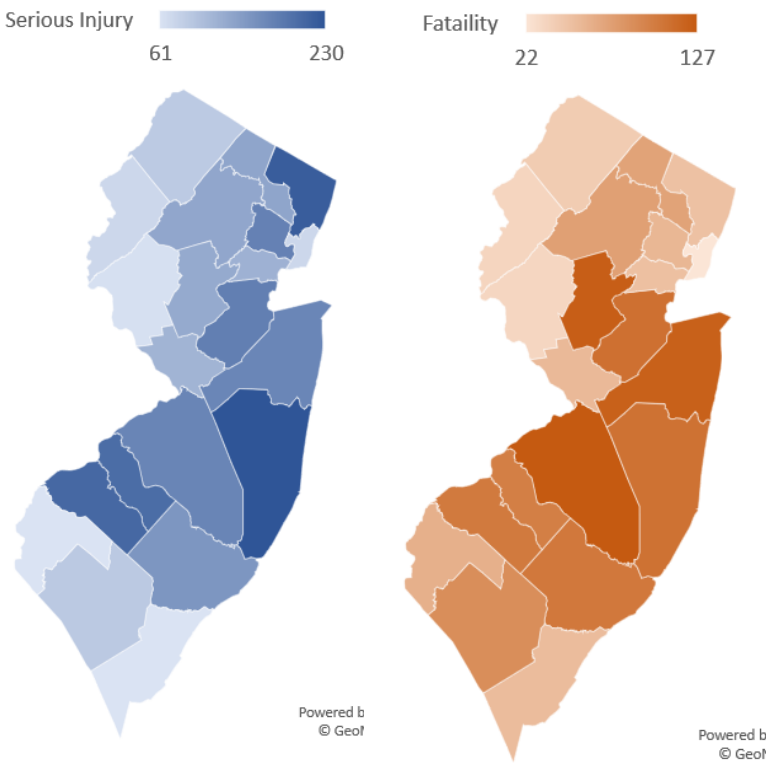



## Who Was Involved?

Male drivers aged 21-25 years old are involved in the most lane departure fatalities and serious injuries. The most serious injuries for female drivers is also in this age range.



# Where Did Crashes Occur?




Sixty percent (60%) of fatalities and serious injuries (FSI) as a result of lane departure

**FSI by Roadway Type**

| Roadway | Rural | | Urban | |
|---|---|---|---|---|
| Interstate | 38 | 1% | 367 | 8% |
| State | 206 | 5% | 1185 | 27% |
| County | 247 | 6% | 1039 | 24% |
| City | 20 | 0% | 222 | 5% |
| Unknown | 0 | 0% | 0 | 0% |
| Total | 511 | | 2,813 | |

24% FSI - Unknown Roadway Type

**FSI by Functional Class**

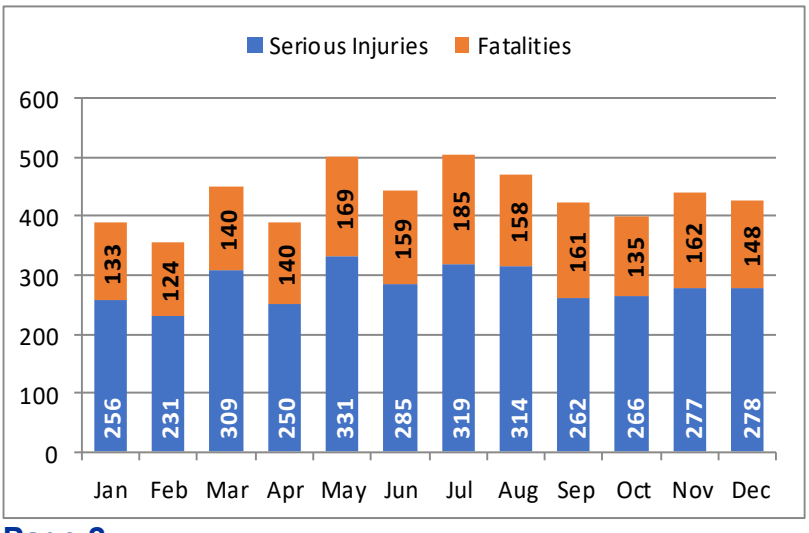
| Functional Class | <=25 mph | 30-45mph | 45+ mph |
|---|---|---|---|
| Interstate | 1 | 5 | 444 |
| Freeways | 2 | 27 | 388 |
| Principal Arterial | 54 | 416 | 429 |
| Minor Arterial | 135 | 476 | 240 |
| Major Collector | 68 | 206 | 186 |
| Minor Collector | 7 | 19 | 13 |
| Local | 40 | 50 | 34 |
| Other | 459 | 395 | 113 |

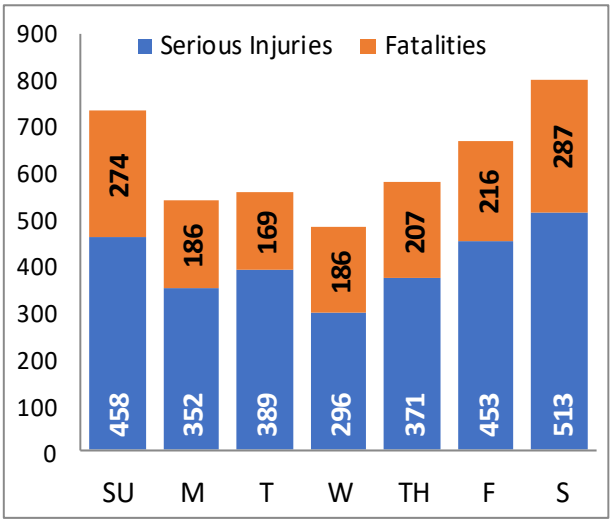
**FSI by County (top) and MPO (bottom)**

| MPO | Fatality | | Serious Injury | |
|---|---|---|---|---|
| DVRPC | 383 | 25% | 704 | 25% |
| NJTPA | 842 | 55% | 1768 | 62% |
| SJTPO | 300 | 20% | 360 | 13% |

# When Did Crashes Occur?

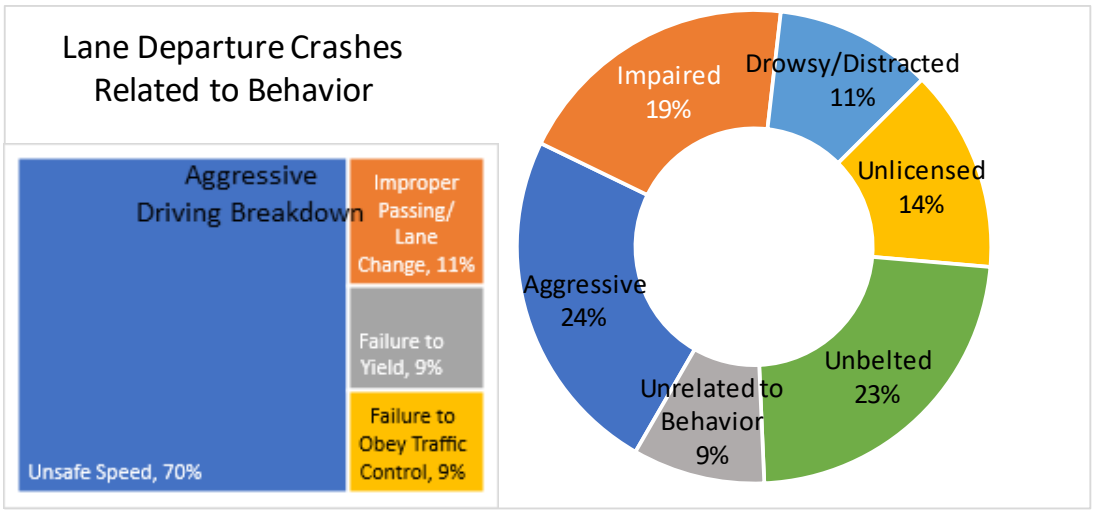
Both fatalities and serious injuries occurred mostly during the weekend. The most fatalities and serious injuries also happened primarily in July.



# Contributing Factors

## Relationship to Other SHSP Emphasis Areas




17%—-Intersections

<u>Other Vulnerable Road Users:</u>

14%—mature drivers

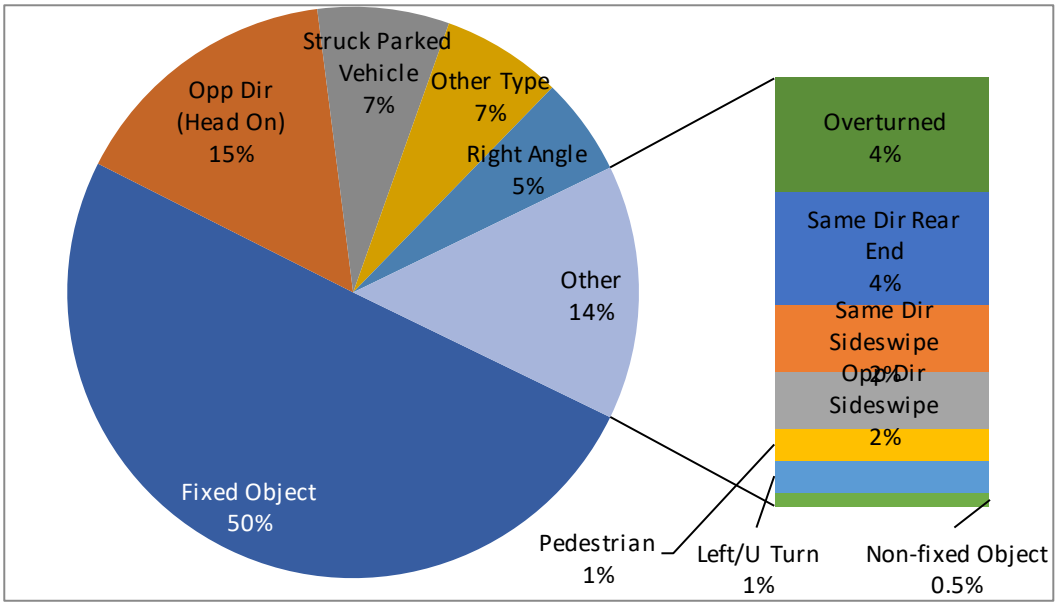
8%—younger drivers

8%—motorcyclists

2%—work zone

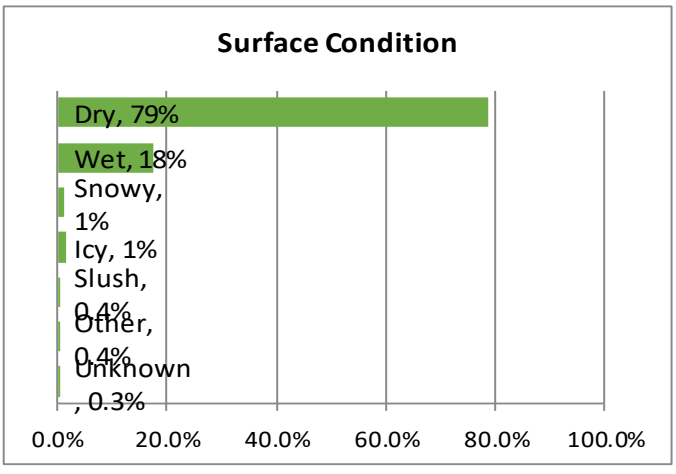
## Crash Type

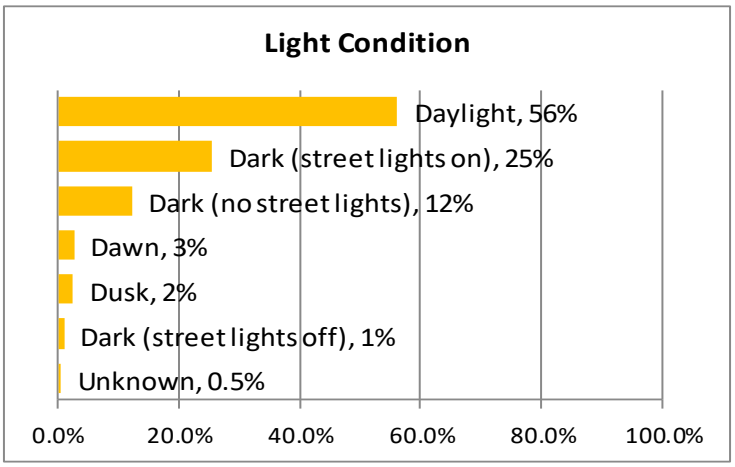
Lane departure fatalities and serious injuries resulted in fixed object and head on crashes as the top crash types.




## Surface and Light Conditions

Lane departure fatalities and serious injuries mainly occurred at night and on dry pavement conditions.



# Strategies

The NJ 2015 SHSP identified several strategies that have the greatest potential to reduce lane departure fatalities and serious injuries. Other strategies are also noted.

### Keep Vehicles from Encroaching on the Roadside

- Install shoulder rumble strips★.
- Install edge line profile markings, edge line rumble strips, or modified shoulder rumble strips on the sections with narrow or no paved shoulders.
- Provide enhanced shoulder, lighting, or delineation★ and pavement markings for sharp curves.
- Provide improved highway geometry for horizontal curves.
- Provide enhanced pavement markings.
- Provide skid-resistant pavement surfaces★.
- Apply shoulder treatments, such as eliminating shoulder drop-offs or widen and/or pave shoulders.

### Reduce the Severity of the Crash

- Improve design and application of barrier and attenuation systems.

### Minimize the Likelihood of Overturning or Crashing into an Object if the Vehicle Travels Off the Shoulder

- Design safer slopes and ditches to prevent rollovers★.
- Remove/relocate fixed objects in problematic locations★.
- Remove or improve awareness of conflicts with overhead fixed objects such as railroad passes.

### Reduce the Likelihood of a Head-On Vehicle Collision

- Install centerline rumble strips on two-lane roads.
- Implement road diets on urban roadways★.
- Use alternating passing lanes or four-lane sections at key locations.
- Install cable median barrier for narrow-width medians and multilane roads.

**Overview of the Lane Departure Crash Query**

- NJDOT Crash Records Database (100% of records)
- Sequence of events and crash type noted in NJTR-1
- Ran Off Road—Right or Left
- Crossed Median /Centerline (multi vehicle only)
- Excludes Wrong Way
- Single Vehicle: Fixed Object
- Multi Vehicle:
  - Opposite Direction (Head On, Angular, Side Swipe)
  - Struck Parked Vehicle

### *Additional Considerations*

### Enhanced Corridor Enforcement and Education

- Target sections of highways with concentrations of lane departure crashes resulting from other factors (e.g. speed, impairment, or unbelted).
- Use a combination of targeted education and highly visible enforcement strategies (e.g. speed monitoring, buckle up campaigns, sobriety checkpoints).

★ *FHWA Proven Safety Countermeasure*

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# PROVEN SAFETY COUNTERMEASURES

# Enhanced Delineation and Friction for Horizontal Curves

## SAFETY BENEFITS:

### CHEVRON SIGNS

**25%**
Reduction in nighttime crashes

**16%**
Reduction in non-intersection fatal and injury crashes

Source: CMF Clearinghouse, CMF IDs 2438 and 2439

### HIGH FRICTION SURFACE TREATMENTS

**52%**
Reduction in wet road crashes

**24%**
Reduction in curve crashes

Source: CMF Clearinghouse, CMF IDs 7900 and 7901

This proven safety countermeasure for reducing crashes at curves includes a variety of potential strategies that can be implemented in combination or individually. These strategies fall into two categories: enhanced delineation and increased pavement friction.

Chevron signs installed along a curve.

Source: Thinkstock

## Enhanced Delineation

Enhanced delineation treatments can alert drivers in advance of the curve and vary by the severity of the curvature and operating speed. Price ranges for these strategies are low to moderate. Treatments include the following:

- Pavement markings.
- Post-mounted delineation.
- Larger signs and signs with enhanced retroreflectivity.
- Dynamic advance curve warning signs and sequential curve signs.

## Increased Pavement Friction

High friction surface treatment (HFST) is another highly cost-effective countermeasure. HFST compensates for the high friction demand at curves where the available pavement friction is not adequate to support operating speeds due to one or more of the following situations:

- Sharp curves.
- Inadequate cross-slope design.
- Wet conditions.
- Polished roadway surfaces.
- Driving speeds in excess of the curve advisory speed.

To implement these proven safety countermeasures, agencies can take the following steps:

1. Develop a process for identifying and treating problem curves.
2. Use the appropriate application for the identified problem(s), consider the full range of enhanced delineation and friction treatments.
3. Improve consistency in application of horizontal curve guidance provided in the *Manual on Uniform Traffic Control Devices* for new and existing devices.
4. Review signing practices and policies to ensure they comply with the intent of the new guidance.

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FHWA-SA-17-058

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# Longitudinal Rumble Strips and Stripes

Shoulder rumble strips and center line rumble stripes are installed on this roadway.

Source: FHWA

***Longitudinal rumble strips*** are milled or raised elements on the pavement intended to alert drivers through vibration and sound that their vehicles have left the travel lane. They can be installed on the shoulder, edge line of the travel lane, or at or near center line of an undivided roadway.

***Rumble stripes*** are edge line or center line rumble strips where the pavement marking is placed over the rumble strip, which can result in an increased visibility of the pavement marking during wet, nighttime conditions.

## SAFETY BENEFITS:

### CENTER LINE RUMBLE STRIPS

**44-64%**

Head-on, opposite-direction, and sideswipe fatal and injury crashes

### SHOULDER RUMBLE STRIPS

**13-51%**

Single vehicle, run-off-road fatal and injury crashes

Source: NCHRP Report 641, *Guidance for the Design and Application of Shoulder and Centerline Rumble Strips.*

With roadway departure crashes accounting for more than half of the fatal roadway crashes annually in the United States, rumble strips and stripes are designed to address these crashes caused by distracted, drowsy, or otherwise inattentive drivers who drift from their lane. They are most effective when deployed in a systemic application since driver error may occur on all roads.

Example of an edge line rumble stripe.

Source: Missouri DOT

Transportation agencies should consider milled center line rumble strips (including in passing zone areas) and milled edge line or shoulder rumble strips with bicycle gaps for systemic safety projects, location-specific corridor safety improvements, as well as reconstruction or resurfacing projects.

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# Median Barriers

**8%**

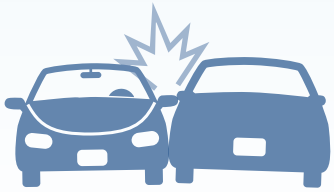
**OF ALL FATALITIES ON DIVIDED HIGHWAYS ARE DUE TO HEAD-ON CRASHES[1]**

**SAFETY BENEFIT:**

**MEDIAN BARRIERS INSTALLED ON RURAL FOUR-LANE FREEWAYS**

**97%**

**Reduction in cross-median crashes[2]**



Median cable barrier prevents a potential head-on crash.

Source: Washington State DOT

Median barriers are longitudinal barriers that separate opposing traffic on a divided highway and are designed to redirect vehicles striking either side of the barrier. Median barriers significantly reduce the severity of cross-median crashes, which are attributed to the relatively high speeds that are typical on divided highways. Approximately 8 percent of all fatalities on divided highways are due to head-on crashes.

In the past, median barriers were typically only used when medians were less than 30 feet wide, but many States realized they were experiencing cross-median fatal crashes in medians that exceeded 30 feet. AASHTO's *Roadside Design Guide* was revised in 2006 to encourage consideration of barriers in medians up to 50 feet wide.

The application of cable median barriers is a very cost-effective means of reducing the severity of median crossover crashes. Median barriers can be **cable, concrete,** or **beam guardrail**.

- **Cable barriers** are softer, resulting in less impact force and redirection, are more adaptable to slopes typically found in medians, and can be installed through less invasive construction methods.
- **Concrete barriers** are rigid, yielding little to no deflection upon impact, and absorbing little crash energy. Although this system is expensive to install, it performs well when hit and only requires repair in the most extreme circumstances.
- **Beam guardrails** are considered semi-rigid barriers. When impacted, they deform and deflect, absorbing some of the crash energy, and usually redirecting the vehicle. Beam guardrails are less expensive to install than rigid barriers, and are more resilient than cable barriers.

To reduce the number and severity of cross-median crashes, transportation agencies should review their median crossover crash history to identify the locations where median barriers are most warranted. Agencies should also consider implementing a systemic median barrier policy based on cross-median crash risk factors.

[1] Fatality Analysis Reporting System (FARS).

[2] NCHRP Report 794, *Median Cross-Section Design for Rural Divided Highways*.

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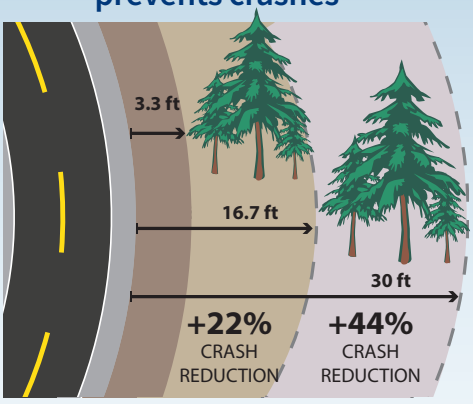
# Roadside Design Improvements at Curves

Roadside design improvement at curves is a strategy encompassing several treatments that target the high-risk roadside environment along the outside of horizontal curves. These treatments prevent roadway departure fatalities by giving vehicles the opportunity to recover safely and by reducing crash severity.

Roadside design improvements can be implemented alone or in combination and are particularly recommended at horizontal curves—where data indicates a higher-risk for roadway departure fatalities—and where cost effectiveness can be maximized.

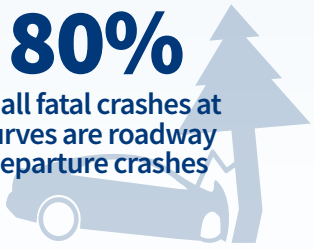
## Increasing the Clear Zone prevents crashes




Source: Leidos. Data Source: CMF Clearinghouse (CMF IDs 35 and 36)

**27%**
of all fatal crashes occur at curves

**80%**
of all fatal crashes at curves are roadway departure crashes



Source: Fatality Analysis Reporting System (FARS)

## Roadside Design Improvements to Provide for a Safe Recovery

In cases where a vehicle leaves the roadway, strategic roadside design elements, including clear zone addition or widening, slope flattening, and shoulder addition or widening, can provide drivers with an opportunity to regain control and re-enter the roadway.

- A **clear zone** is an unobstructed, traversable area beyond the edge of the through traveled way for the recovery of errant vehicles. Clear zones are free of rigid fixed objects such as trees and utility cabinets or poles. AASHTO's *Roadside Design Guide* details the clear zone width adjustment factors to be applied at horizontal curves.
- **Slope flattening** reduces the steepness of the sideslope to increase drivers' ability to keep the vehicle stable, regain control of the vehicle, and avoid obstacles.
- **Adding or widening shoulders** gives drivers more recovery area to regain control in the event of a roadway departure.

## Roadside Design Improvements to Reduce Crash Severity

Since not all roadside hazards can be removed at curves, installing roadside barriers to shield unmovable objects or embankments may be an appropriate treatment. Roadside barriers come in three forms:

- **Cable barrier** is a flexible barrier made from wire rope supported between frangible posts.
- **Guardrail** is a semi-rigid barrier, usually either a steel box beam or W-beam. These deflect less than flexible barriers, so they can be located closer to objects where space is limited.
- **Concrete barrier** is a rigid barrier that does not deflect. These are typically reserved for use on divided roadways.

Shoulder is provided along roadway curve.

Source: Alaska DOT

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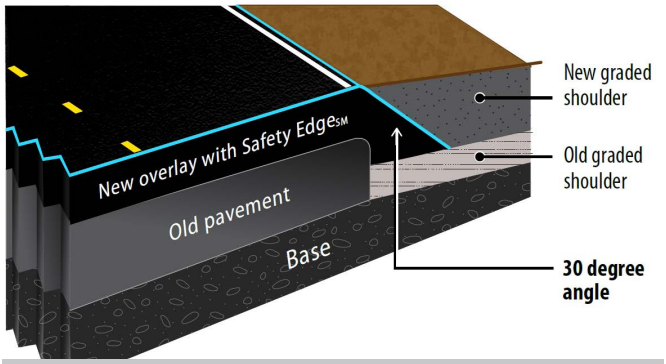
# PROVEN SAFETY COUNTERMEASURES

## SafetyEdge$_{SM}$

Example of SafetyEdge$_{SM}$ after backfill material settles or erodes.

Source: FHWA

SafetyEdge$_{SM}$ technology shapes the edge of the pavement at approximately 30 degrees from the pavement cross slope during the paving process. This systemic safety treatment eliminates the vertical drop-off at the pavement edge, allowing drifting vehicles to return to the pavement safely. It has minimal effect on asphalt pavement project cost with the potential to improve pavement life.




Source: FHWA-SA-17-044

Vehicles may leave the roadway for various reasons, ranging from distracted driver errors to low visibility, or to the presence of an animal on the road. Exposed vertical pavement edges can cause vehicles to be unstable and prevent their safe return to the roadway. SafetyEdge$_{SM}$ gives drivers the opportunity to return to the roadway while maintaining control of their vehicles.

For both SafetyEdge$_{SM}$ and traditional edge, agencies should bring the adjacent shoulder or slope flush with the top of the pavement. Since over time the edge may become exposed due to settling, erosion, and tire wear, the gentle slope provided by SafetyEdge$_{SM}$ is preferred versus the traditional vertical pavement edge.

Transportation agencies should develop standards for implementing SafetyEdge$_{SM}$ on all new asphalt paving and resurfacing projects where curbs are not present, while encouraging standard application for concrete pavements.

### SAFETY BENEFIT:

**11 %**

Reduction in fatal and injury crashes

Source: Safety Effects of the SafetyEdge$_{SM}$, FHWA-SA-17-044.

SafetyEdge$_{SM}$ adds nominal cost to repaving a road.

**Calculated benefit-cost ratios typically range between**

**50 to 400**

Source: Safety Effects of the SafetyEdge$_{SM}$, FHWA-SA-17-044.

Rural road crashes involving edge drop-offs are

**2 to 4 times**

**more likely to include a fatality than other crashes on similar roads.**

Source: S.L. Hallmark, et al., Safety Impacts of Pavement Edge Drop-offs, (Washington, DC: AAA Foundation for Traffic Safety: 2006), p 93.

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# Road Diets

## (Roadway Reconfiguration)

**A "Road Diet," or roadway reconfiguration, can improve safety, calm traffic, provide better mobility and access for all road users, and enhance overall quality of life.**

**SAFETY BENEFIT:**

**4-LANE → 3-LANE ROAD DIET CONVERSIONS**

**19-47%**

**Reduction in total crashes**


Before and after photos of a Road Diet project.

Source: City of Orlando, Florida

A Road Diet typically involves converting an existing four-lane undivided roadway to a three-lane roadway consisting of two through lanes and a center two-way left-turn lane (TWLTL).

Benefits of Road Diet installations may include:

- An overall crash reduction of 19 to 47 percent.
- Reduction of rear-end and left-turn crashes due to the dedicated left-turn lane.
- Reduced right-angle crashes as side street motorists cross three versus four travel lanes.
- Fewer lanes for pedestrians to cross.
- Opportunity to install pedestrian refuge islands, bicycle lanes, on-street parking, or transit stops.
- Traffic calming and more consistent speeds.
- A more community-focused, "Complete Streets" environment that better accommodates the needs of all road users.

A Road Diet can be a low-cost safety solution when planned in conjunction with a simple pavement overlay, and the reconfiguration can be accomplished at no additional cost.

Road Diet project in Honolulu, Hawaii.

Source: Leidos

Source: *Evaluation of Lane Reduction "Road Diet" Measures on Crashes,* FHWA-HRT-10-053.

**→ For more information on this and other FHWA Proven Safety Countermeasures, please visit https://safety.fhwa.dot.gov/provencountermeasures.**

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# PROVEN SAFETY COUNTERMEASURES

# Road Safety Audits

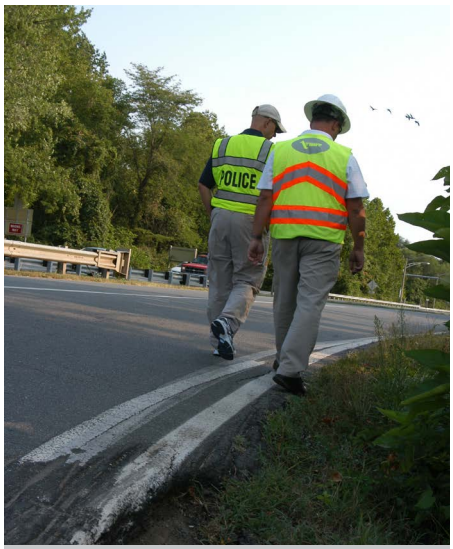
**A road safety audit is a proactive, formal safety performance examination of an existing or future road or intersection by an independent and multi-disciplinary team.**

**SAFETY BENEFIT:**

**10-60%**
**Reduction in total crashes**

Source: *Road Safety Audits: An Evaluation of RSA Programs and Projects*, FHWA-SA-12-037; and *FHWA Road Safety Audit Guidelines*, FHWA-SA-06-06.

While most transportation agencies have established traditional safety review procedures, a road safety audit (RSA) is unique. RSAs are performed by a multi-disciplinary team independent of the project. RSAs consider all road users, account for human factors and road user capabilities, are documented in a formal report, and require a formal response from the road owner. (See the eight steps for conducting an RSA below.)




Multi-disciplinary team performs field review during an RSA.

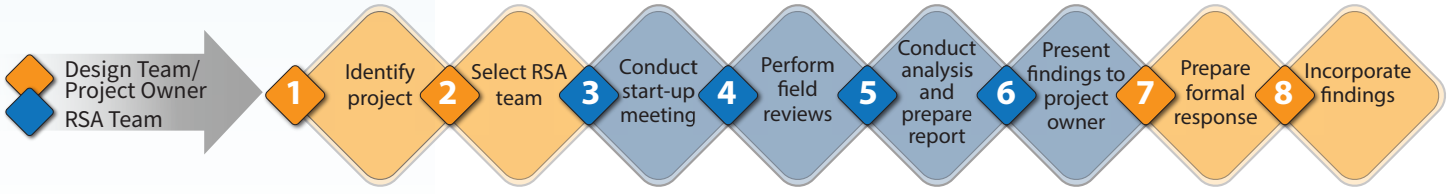
Source: FHWA

RSAs provide the following benefits:

- Reduced number and severity of crashes due to safer designs.
- Reduced costs resulting from early identification and mitigation of safety issues before projects are built.
- Improved awareness of safe design practices.
- Increased opportunities to integrate multimodal safety strategies and proven safety countermeasures.
- Expanded ability to consider human factors in all facets of design.

RSAs can be performed in any phase of project development, from planning through construction. RSAs can also be conducted on any size project, from minor intersection and roadway retrofits to large-scale construction projects. Agencies are encouraged to conduct an RSA at the earliest stage possible, as all roadway design options and alternatives are being explored.

## CONDUCTING AN RSA

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# Local Road Safety Plans

Local roads experience

**3x the fatality rate**

of the

**Interstate Highway System.**

Source: FARS and FHWA Highway Statistics Series (2014)

Source: Delaware Valley Regional Planning Commission

A local road safety plan (LRSP) provides a framework for identifying, analyzing, and prioritizing roadway safety improvements on local roads. The LRSP development process and content are tailored to local issues and needs. The process results in a prioritized list of issues, risks, actions, and improvements that can be used to reduce fatalities and serious injuries on the local road network.


While local roads are less traveled than State highways, they have a much higher rate of fatal and serious injury crashes. Developing an LRSP is an effective strategy to improve local road safety for all road users and support the goals of a State's overall strategic highway safety plan.

Although the development process and resulting plan can vary depending on the local agency's needs, available resources, and targeted crash types, aspects common to LRSPs include:

- Stakeholder engagement representing the 4E's – engineering, enforcement, education, and emergency medical services, as appropriate.
- Collaboration among municipal, county, Tribal, State and/or Federal entities to leverage expertise and resources.
- Identification of target crash types and crash risk with corresponding recommended proven safety countermeasures.
- Timeline and goals for implementation and evaluation.

Local road agencies should consider developing an LRSP to be used as a tool for reducing roadway fatalities, injuries, and crashes.[1] The plan should be viewed as a living document that can be updated to reflect changing local needs and priorities.

[1] *Developing Safety Plans: A Manual for Local Rural Road Owners*, FHWA-SA-12-017, provides guidance on developing an LRSP.

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FHWA-SA-17-069

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