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FHWA Proven Safety Countermeasures (PSCs)

- Fall 2021 FHWA released new list of PSCs
- Now total of **28** PSCs
- Information contained in this presentation is from FHWA:
<https://safety.fhwa.dot.gov/provencountermeasures/>

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NEW 

Speed Safety Cameras (SSCs)

Safety benefits

- Fixed Units**
 - 54%** reduction for all crashes
 - 47%** reduction for injury crashes
- Point-to-Point Units**
 - 37%** reduction for fatal and injury crashes (on urban expressways, freeways, and principal arterials)
- Mobile Units**
 - 20%** reduction for fatal and injury crashes (on urban and principal arterials)



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NEW 

Speed Safety Cameras (SSCs)

- Effective and reliable technology to supplement traditional enforcement
- SSCs offer fair and equitable enforcement of speeding regardless of age, race, gender, or socioeconomic status
- USDOT SSC guidelines can be utilized for planning, public involvement, stakeholder coordination, implementation, maintenance, evaluation, etc.
- Currently need legislation change to implement in NV

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NEW 

Variable Speed Limits (VSLs)

Safety benefits

Crash reductions on freeways

34% for total crashes

65% for rear-end crashes

51% for fatal and injury crashes

Benefit/Cost Ratios (BCRs) range between

9:1 to 40:1



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NEW 

Variable Speed Limits (VSLs)

- VSLs use prevailing information (traffic speed, volumes, weather, road surface conditions) to determine appropriate speed and display to drivers
- Improves safety performance and traffic flow by reducing speed variance
- Improve driver expectation by providing information in advance of slowdowns
- Reduces probability for secondary crashes
- May be implemented as regulatory or advisory

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Appropriate Speed Limits for All Road Users

Safety benefits

26% decrease in fatalities
(Seattle after city-wide implementation of speed management strategies and countermeasures)

Rural roads – setting a speed limit no more than 5 mph below the 85th percentile speed may result in fewer total and fatal plus injury crashes



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Appropriate Speed Limits for All Road Users

- Agencies should set appropriate speed limits to reduce the significant risks drivers impose on others – especially vulnerable road users
- To achieve desired speeds, agencies should implement other speed management strategies concurrently, such as self-enforcing roadways, traffic calming, and SSCs

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Roadway Departure

Wider Edge Lines
Enhanced Delineation for Horizontal Curves
Longitudinal Rumble Stripe/Strips
SafetyEdgeSM
Roadside Design Improvements at Curves
Median Barriers

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NEW 

Wider Edge Lines

Safety benefits

- 37%** reduction for non-intersection fatal and injury crashes on rural two-lane roads
- 22%** reduction for fatal and injury crashes on rural freeways

Benefit/Cost Ratio (BCR)

25:1 for fatal and serious injury crashes on two-lane rural roads

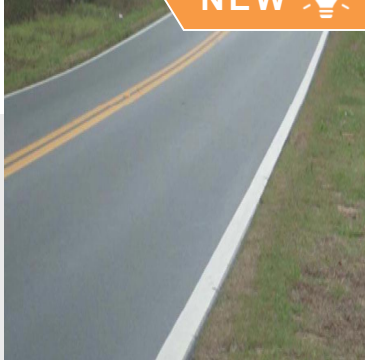





Photo Source: Texas Transportation Institute

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NEW 

Wider Edge Lines

- Roadway departure crashes account for more than half of all fatalities in the US
- Wider edge lines are **six inches** compared to **four inches**
- Increase drivers' perception of the edge of the travel lane
- Low cost – just cost for additional material
- Provides better guidance for automated vehicles

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Enhanced Delineation for Horizontal Curves

Safety benefits:

Chevron signs

25% reduction in nighttime crashes

16% reduction in non-intersection fatal and injury crashes

Oversized chevron signs

15% reduction in fatal and injury crashes

Sequential dynamic chevrons

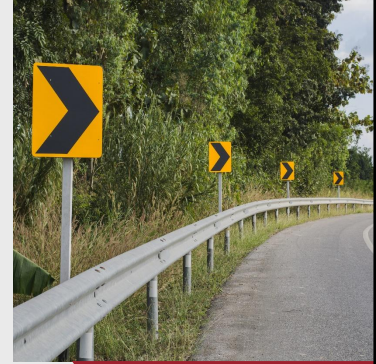
60% reduction in fatal and injury crashes

In-lane curve warning pavement markings

35-38% reduction in all crashes

Fluorescent curve signs

18% reduction in non-intersection, head-on, run-off-road, and sideswipe crashes in rural areas



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Enhanced Delineation for Horizontal Curves

- Treatments can alert drivers to upcoming curves, the direction and sharpness of the curve, and appropriate operating speed
- Systemic approach can be used to identify curves for additional treatments (radii, volume, intersection within/near curve, visual trap)
- Treatments can include
 - Pavement markings (standard or wider)
 - In-lane curve warning pavement markings
 - Retroreflective strips on signposts
 - Delineators
 - Chevrons
 - Enhanced conspicuity (larger, fluorescent, retroreflective signs)
 - Dynamic signs

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Longitudinal Rumble Strips/Stripes

Safety benefits

Centerline rumble strips

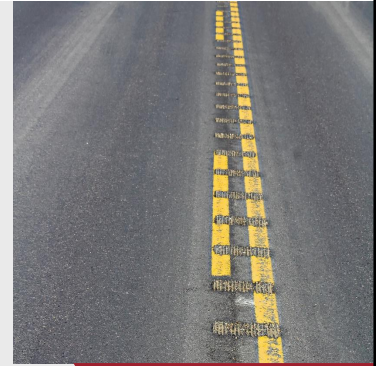
44-64% reduction in head-on fatal and injury crashes on two-lane rural roads

Shoulder rumble strips

13-51% reduction in single-vehicle run-off-road fatal and injury crashes on two-lane rural roads

Benefit/Cost Ratio (BCR)

>100:1



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Longitudinal Rumble Strips/Stripes

- Alert distracted, drowsy, or inattentive drivers leaving their lane
- Consider a design using an oscillating sine wave pattern (mumble strips) near residences
- Low-cost

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SafetyEdgeSM

Safety benefits

11% reduction in fatal and injury crashes

21% reduction in run-off-road crashes

19% reduction in head-on crashes

Benefit/Cost Ratio (BCR) range

700:1 to 1,500:1



Photo Source: FHWA

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SafetyEdgeSM

- Shapes edge of pavement at 30 degrees from pavement cross slope
- Eliminates vertical drop-off
- Minimal effect on cost
- Improves pavement durability – reduces edge raveling
- Gives drivers the opportunity to return to the travel lane while maintaining control of vehicle

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Roadside Design Improvements at Curves

Safety benefits

Flatten sideslope

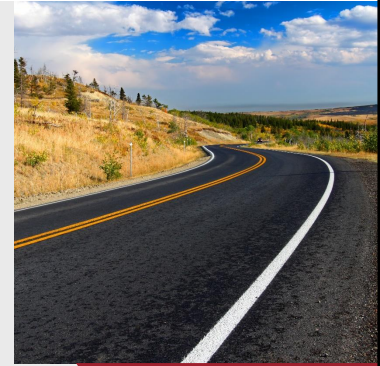
1V:3H to 1V:4H – **8%** reduction for single-vehicle crashes

1V:4H to 1V:6H – **12%** reduction for single-vehicle crashes

Increase distance to roadside features

3.3' to 16.7' – **22%** reduction for all crashes

16.7' to 30' – **44%** reduction for all crashes



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Roadside Design Improvements at Curves

- Roadside design improvements to provide a safe recovery
 - Added or widened shoulder
 - Flattened sideslopes
 - Widened clear zone
- Roadside design improvement to reduce crash severity
 - Considered when roadside hazards cannot be removed
 - Cable barrier
 - Metal-beam guardrail
 - Concrete barrier

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Median Barriers

Safety benefits

97% reduction in cross-median crashes on rural four-lane freeways



Photo Source: Google Earth

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Median Barriers

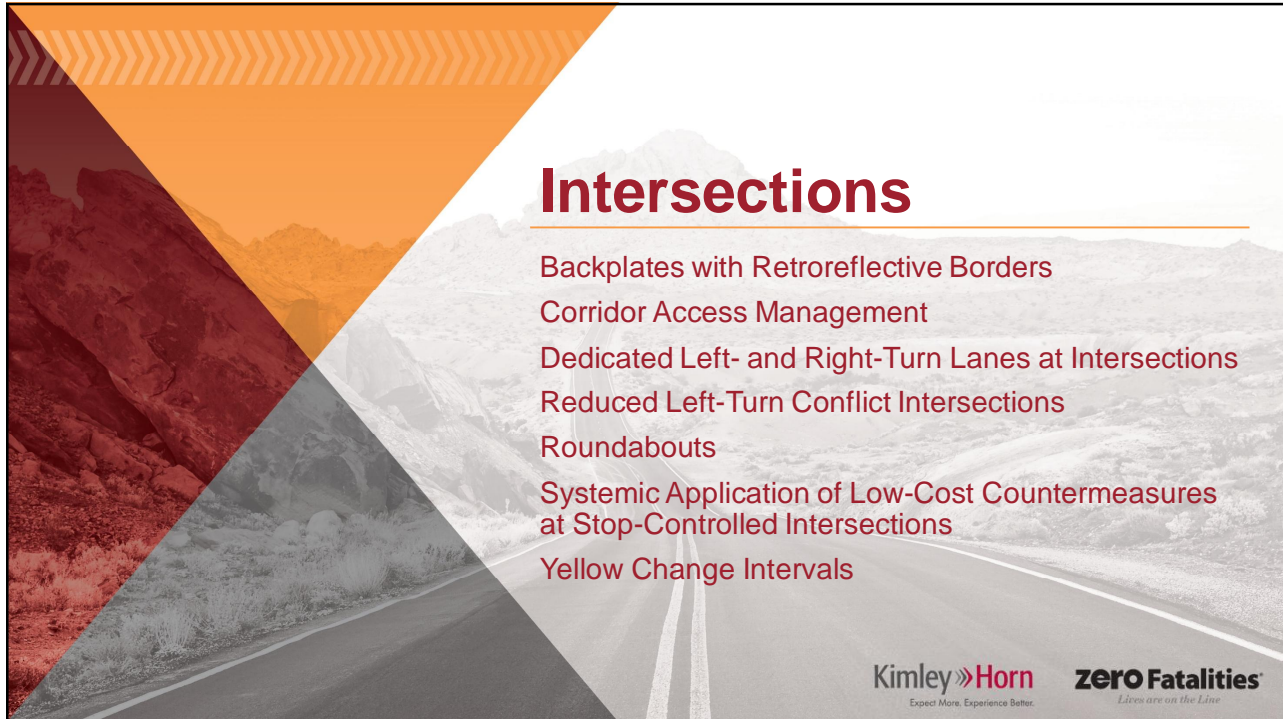
- Longitudinal barriers that separate opposing traffic on a divided highway
 - Cable
 - Metal beam
 - Concrete
- Significantly reduce cross-median crashes

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Intersections


- Backplates with Retroreflective Borders
- Corridor Access Management
- Dedicated Left- and Right-Turn Lanes at Intersections
- Reduced Left-Turn Conflict Intersections
- Roundabouts
- Systemic Application of Low-Cost Countermeasures at Stop-Controlled Intersections
- Yellow Change Intervals

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Backplates with Retroreflective Borders

Safety benefits
15% reduction in intersection crashes



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Backplates with Retroreflective Borders

- One- to three-inch yellow retroreflective border
- More visible in daytime and nighttime
- Extreme benefit for older and color vision deficient drivers
- Advantageous during power outages
- Low-cost treatment

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Corridor Access Management

Safety benefits

Reducing driveway density

5-23% reduction in total crashes along two-lane rural roads

25-31% reduction in fatal and injury crashes along urban/suburban arterials



Photo Source: Google Earth

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Corridor Access Management

- All access points along a roadway provide potential for conflicts
- Techniques
 - Reduce density – closure, consolidation, or relocation
 - Manage spacing
 - Limit movements (right-in/right-out)
 - Raised medians
 - Roundabouts or reduced left-turn conflict intersections
- Balancing overall safety and mobility for all users along with the needs of adjacent land uses

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Dedicated Left- and Right-Turn Lanes

Safety benefits

Left-turn lanes

28-44% reduction in total crashes

Positive offset left-turn lanes

36% reduction in fatal and injury crashes

Right turn lanes

14-26% reduction in total crashes



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Dedicated Left- and Right-Turn Lanes

- Turn lanes provide physical separation between turning traffic and adjacent through traffic
- Countermeasure is for stop-controlled intersections
- Consider pedestrian and bicyclist activity and crossing distances
- Offset left- and right-turn lanes increase visibility and provide safety benefits

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Reduced Left-Turn Conflict Intersections

Safety benefits

Reduced Left-Turn Conflict (RCUT) intersection

Two-way stop-controlled to RCUT

54% reduction in fatal and injury crashes

Signalized intersection to signalized RCUT

63% reduction in fatal and injury crashes

Median U-Turn (MUT) intersection

30% reduction in intersection-related injury crashes



Photo Source: MnDOT

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Reduced Left-Turn Conflict Intersections

- Design alters how left turns occur
- Simplify decision-making for drivers
- Minimize high-severity crash types (head-on and angle)

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Roundabouts

Safety benefits

Two-way stop-controlled intersection
to roundabout

82% reduction in fatal and injury crashes

Signalized intersection to roundabout

78% reduction in fatal and injury crashes



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Roundabouts

- Minimizes conflict points
- Substantially reduces fatalities and injuries
- Utilized to manage speed and transition traffic from high-speed to low-speed environments

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Systemic Application of Low-Cost Countermeasures at Stop-Controlled Intersections

Safety benefits

10% reduction of fatal and injury crashes at all locations/types/areas

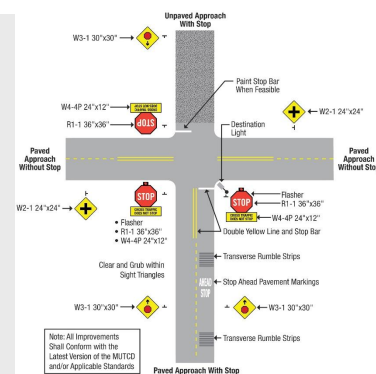
15% reduction of nighttime crashes at all locations/types/areas

27% reduction of fatal and injury crashes at rural intersections

19% reduction of fatal and injury crashes at two-lane by two-lane intersections

Benefit/Cost Ratio (BCR)

12:1



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Systemic Application of Low-Cost Countermeasures at Stop-Controlled Intersections

- Deploying a package of multiple low-cost countermeasures at numerous intersections
- Through approach
 - Double up oversize advance intersection warning signs
 - Street name plaques
 - Flashing beacon
 - Retroreflective sheeting on signposts
 - Enhanced pavement markings
- Stop approach
 - Double up oversize advance intersection warning signs
 - Double up oversize advance stop signs
 - Flashing beacon
 - Retroreflective sheeting on signposts
 - Clearing and grubbing

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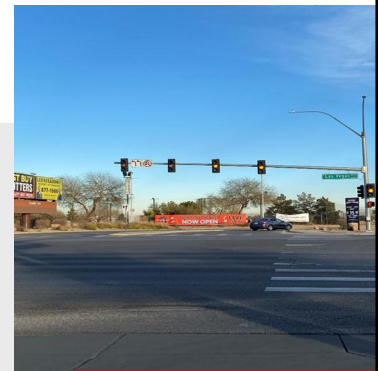
Yellow Change Intervals

Safety benefits

36-50% reduction in red light running

8-14% reduction in total crashes

12% reduction in injury crashes



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Yellow Change Intervals

- Increases safety and reduces red light running
- Retime to consider speed, driver perception-reaction time, vehicle deceleration, and intersection geometry
- Conduct regular evaluation and adjustment protocols for existing traffic signal timing

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Pedestrians/Bicycles

Crosswalk Visibility Enhancements
Bicycle Lanes
Rectangular Rapid Flashing Beacons (RRFBs)
Leading Pedestrian Interval (LPI)
Medians and Pedestrian Refuge Islands
Pedestrian Hybrid Beacons (PHBs)
Road Diets (Roadway Reconfiguration)
Walkways

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NEW 



Crosswalk Visibility Enhancements

Safety benefits

- High-visibility crosswalks**
40% reduction in pedestrian injury crashes
- Intersection lighting**
42% reduction in pedestrian crashes
- Advance yield or stop markings and signs**
25% reduction in pedestrian crashes



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Crosswalk Visibility Enhancements

- Three main enhancements
 - High-visibility crosswalks
 - Improved lighting
 - Enhanced signing and markings
- Also assist users in determining where to cross

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NEW 

Bicycle Lanes

Bicycle lane addition can reduce crashes up to

- 57%** for total crashes on urban four-lane undivided collectors and local roads
- 30%** for total crashes on urban two-lane undivided collectors and local roads




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Bicycle Lanes


- Most fatal and serious injury bicyclist crashes occur at non-intersection locations
- Providing bicycle lanes can mitigate or prevent interactions, conflicts, and crashes between bicyclists and motor vehicles
- Align with Safe System Approach – separating users in space

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NEW 

Rectangular Rapid Flashing Beacons (RRFBs)

Safety benefits

- 47%** reduction for pedestrian crashes
- Up to **98%** increase in motorist yielding rates




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NEW 

Rectangular Rapid Flashing Beacons (RRFBs)

- RRFBs flash with an alternating high frequency when activated by pedestrians
- Enhances pedestrian conspicuity
- Increases driver awareness at uncontrolled marked crosswalks

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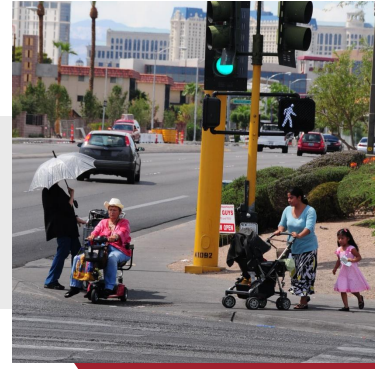
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Leading Pedestrian Interval (LPI)

Safety benefits

13% reduction in pedestrian-vehicle crashes at intersections



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Leading Pedestrian Interval (LPI)

- Gives pedestrians the opportunity to enter the crosswalk three to seven seconds before vehicles are given a green indication
- Establishes pedestrians' presence in the crosswalk
- Increases pedestrian visibility
- Reduces conflict between pedestrians and vehicles
- Increases likelihood of motorists yielding to pedestrians
- Enhances safety for pedestrians who may be slower to enter the intersection

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Medians and Pedestrian Refuge Islands

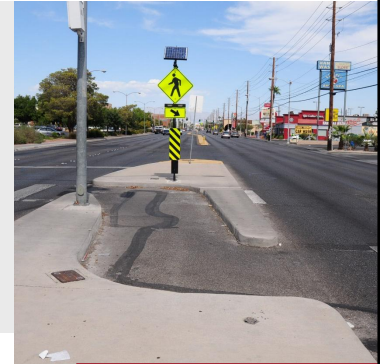
Safety benefits

Median with marked crosswalk

46% reduction in pedestrian crashes

Pedestrian refuge island

56% reduction in pedestrian crashes



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Medians and Pedestrian Refuge Islands

- Allows pedestrians to cross one direction of traffic at a time
- Should be considered in areas with significant pedestrians, >9,000 vpd, >35 mph
- Four feet minimum, eight feet preferred

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Pedestrian Hybrid Beacons (PHBs)

Safety benefits

- 55%** reduction in pedestrian crashes
- 29%** reduction in total crashes
- 15%** reduction in fatal and serious injury crashes



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Pedestrian Hybrid Beacons (PHBs)

- Intermediate option between a RRFB and a full pedestrian signal
- Typically used on higher-speed, multi-lane roadways
 - Three or more lanes to cross
 - >9,000 vpd

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Road Diets (Roadway Reconfiguration)

Safety benefits

Four- to three-lane conversions

19-47% reduction in total crashes



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Road Diets (Roadway Reconfiguration)

- Typically, four- to three-lane conversion
- Calms traffic
- Provides better mobility and access for all road users
- Enhances overall quality of life
- Low-cost when planned in conjunction with a pavement overlay
- <25,000 vpd

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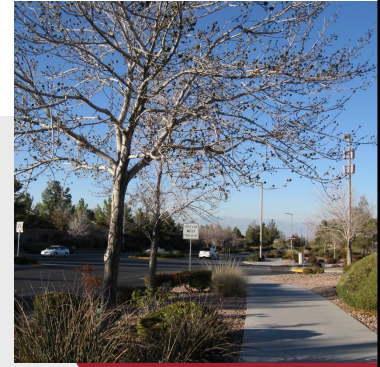
Walkways

Sidewalks

65-89% reduction in crashes involving pedestrians walking along roadways

Paved shoulders

71% reduction in crashes involving pedestrians walking along roadways



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Walkways

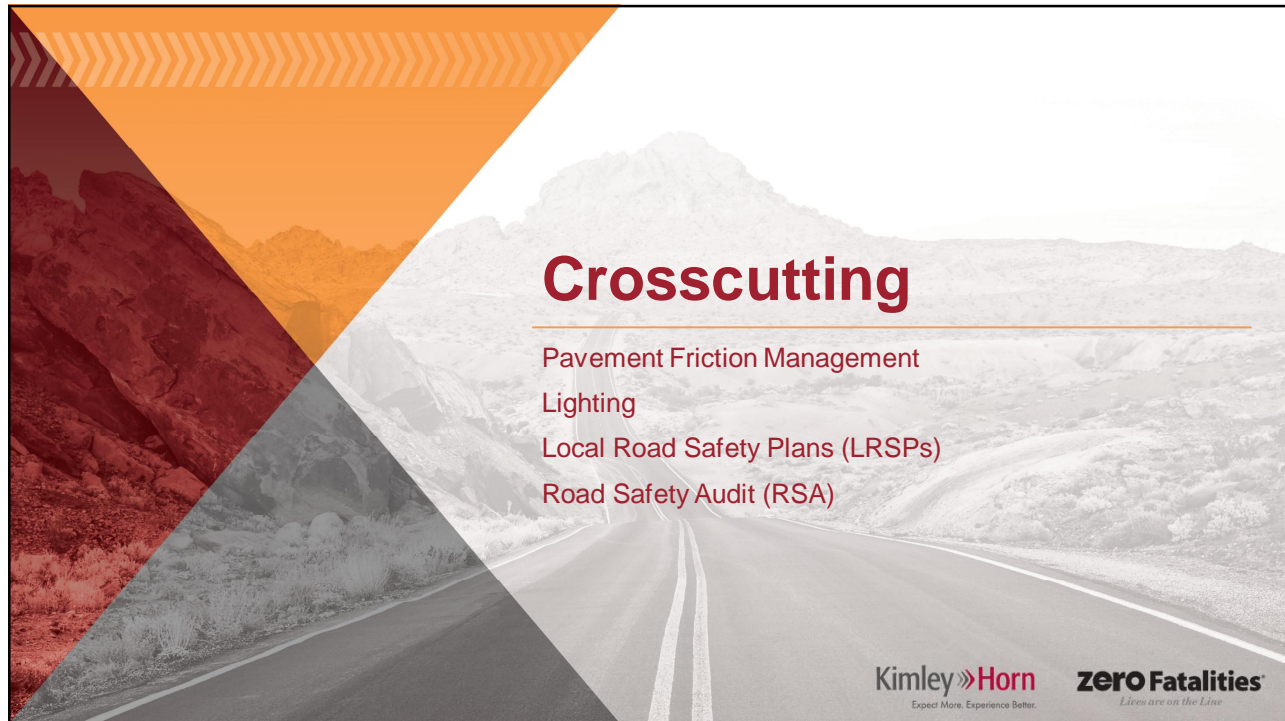
- Any defined space or path for use by a person traveling by foot or wheelchair
- Should be incorporated into all projects unless exceptional circumstances exist

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Pavement Friction Management

NEW

Safety benefits

- 63%** for injury crashes at ramps
- 48%** for injury crashes at horizontal curves
- 20%** for total crashes at intersections

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NEW 

Pavement Friction Management

- Agencies should utilize Continuous Pavement Friction Measurement (CPFM) equipment
 - Utilize results to analyze friction and crash data to prioritize locations
- High Friction Surface Treatment (HFST) in locations with increased friction demand

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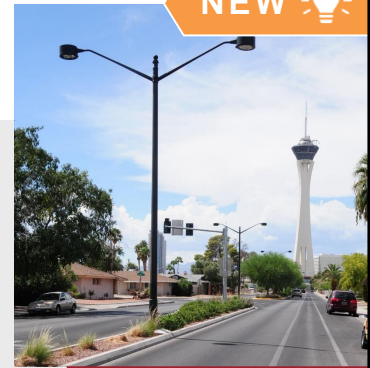
57

NEW 

Lighting

Safety benefits

- 42%** for nighttime pedestrian injury crashes at intersections
- 33-38%** for nighttime crashes at rural and urban intersections
- 28%** for nighttime injury crashes on rural and urban highways



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Lighting

- Nighttime fatality rate is three times the daytime fatality rate
- Lighting can be applied continuously along segments and at spot locations
- It can also provide personal security for active transportation users
- Modern lighting technology gives precise control with minimal excessive light affecting the nighttime sky or spilling over to adjacent properties

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Local Road Safety Plans (LRSPs)

Safety benefits

25% reduction in county road fatalities in MN

17% reduction in fatal and serious injury crashes on county-owned roads in WA state

35% reduction in severe curve crashes in Thurston County, WA



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Local Road Safety Plans (LRSPs)

- Safety analysis at the local level to determine target crash types and risks along the system
- Prioritized list of improvements for local roads
- Tailored to local agency findings

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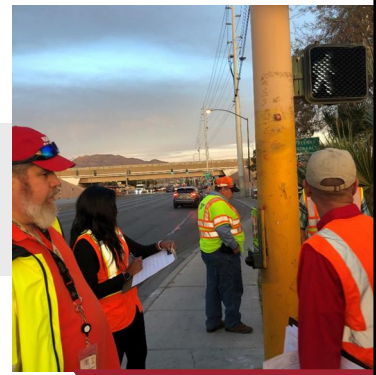
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Road Safety Audit (RSA)

Safety benefits

10-60% reduction in total crashes



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Road Safety Audit (RSA)

- Multidiscipline team independent of the project
- Explore opportunities to integrate proven safety countermeasures
- Consider human factors
- Communication and collaboration among stakeholders
- Consider all road users
- Documented findings in formal report