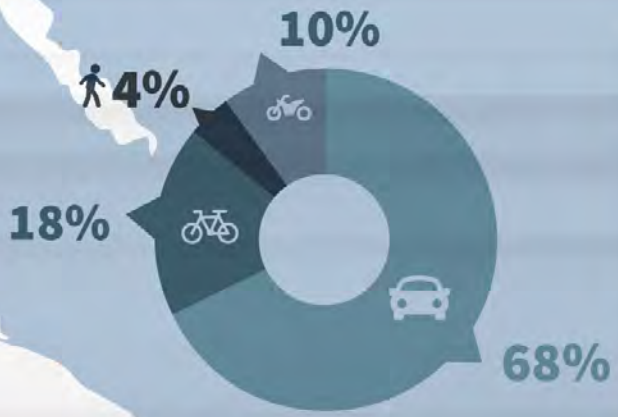
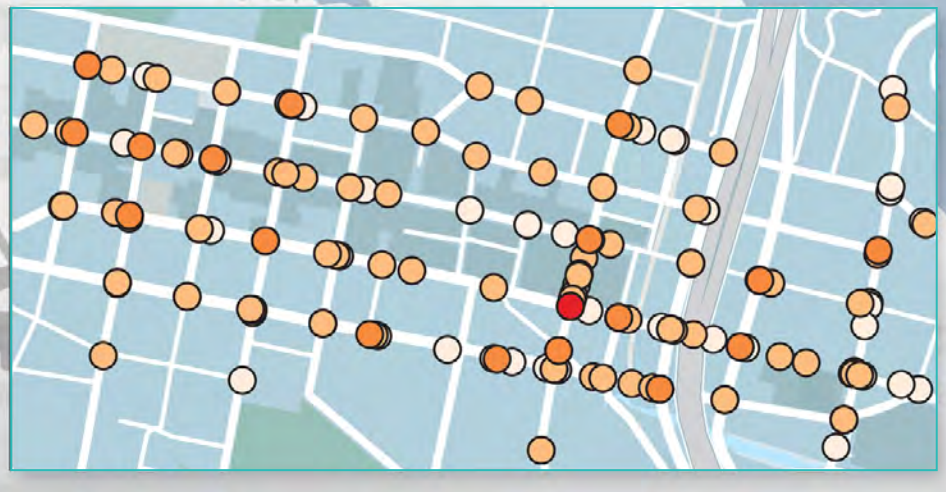
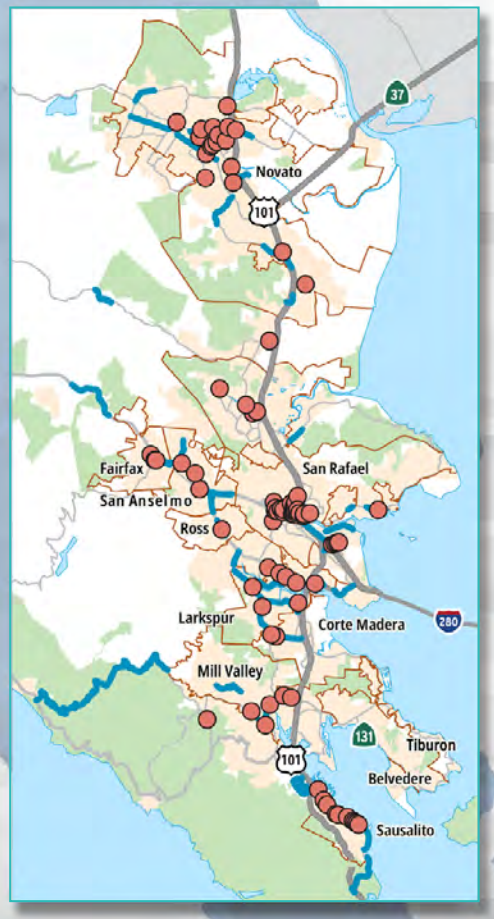
2024 MARIN COUNTY

Local Road Safety Plan **APPENDIX**







COUNTY OF MARIN

THE TOWN OF CORTE MADERA

MILL VALLEY

CITY OF NOVATO CALIFORNIA

TOWN OF ROSS

TOWN OF SAN ANSELMO

SAN RAFAEL

CITY OF SAUSALITO

TAM Transportation Authority of Marin

JANUARY, 2024

Parametrix | Parisi TRANSPORTATION CONSULTING

2024 MARIN COUNTY LOCAL ROAD SAFETY PLAN

Undertaken by the Transportation Authority of Marin and County of Marin
with Support from the 11 Cities and Towns in Marin County

TABLE OF CONTENTS

APPENDIX A. COUNTERMEASURE TOOLKIT

INTRODUCTION

The Countermeasure Toolkit provided within the following pages summarizes the measures found in the 2022 Caltrans Local Roadway Safety Manual (CA-LRSM). The CA-LRSM is a tool intended to provide focused roadway safety information in a single document. This data uses information from the Crash Modification Factor Clearinghouse and three other Federal Highway Administration (FHWA) published safety manuals — Roadway Departure Safety, Intersection Safety, and Roadways Safety Information Analysis — in conjunction with its own research with the Safe Transportation Research and Education Center (SafeTREC) to develop the CA-LRSM.

SUMMARY OF CONTENT

The toolkit lists Highway Safety Improvements Program (HSIP) countermeasures and non-HSIP countermeasures as well as crash type, crash reduction factors (CRF), federal funding eligibility for HSIP projects and the systemic opportunity. The countermeasures listed in this toolkit have been divided into four groups: signalized intersections, unsignalized intersection, roadway segments and countermeasure that do not currently apply for HSIP funding (not included in the CA-LRSM).

The information included in the countermeasure toolkit are:

- **CRASH TYPES – "All", "P & B" (Pedestrian and Bicycle), "Night", "Emergency Vehicle", or "Animal"**
- **CRF - Crash Reduction Factor used for HSIP calls-for-projects**
- **EXPECTED LIFE – 10 years or 20 years**
- **FEDERAL FUNDING ELIGIBILITY – The maximum federal reimbursement ratio**
- **SYSTEMIC APPROACH OPPORTUNITY – Opportunity to implement using a systemic approach: "Very High", "High", "Medium" or "Low"**

For countermeasures that are not eligible in Caltrans' local HSIP call for projects, "N/A" is placed in the above fields.

The toolkit refers to each countermeasure with an identification letter and number. The letters refer to the following:

- **'S' countermeasures apply to signalized intersections.**
- **'NS' countermeasures apply to unsignalized intersections.**
- **'R' countermeasures apply to roadway segments.**
- **'NH' countermeasures do not qualify for HSIP funding.**

The list of countermeasures in the following section is not all-inclusive and only consists of thoroughly researched countermeasures. The mix of countermeasure and CRFs included is intended to meet Caltrans' goal of a data-driven process for local agencies to follow. Where possible and appropriate, the CRF value listed in this toolkit is based on research studies that specifically established the CRF to be used for 'all' project areas, roadway types and traffic volumes. Where not all applicability factors have already been established by prior research, Caltrans worked closely with FHWA to approximate CRFs for countermeasures often utilized by local agencies.

SIGNALIZED INTERSECTIONS COUNTERMEASURES

S1. Add intersection lighting

Applicable at signalized intersections that have a disproportionate number of nighttime crashes and do not currently provide lighting at the intersection or at its approaches. Intersection lighting is of particular benefit to non-motorized users. Lighting not only helps them navigate the intersection, but also helps drivers see them better.

Crash Type	Night
CRF	40%
Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Medium

S2. Improve signal hardware: lenses, back-plates, mounting, size, and number

Install at signalized intersections with a high frequency of right-angle and rear-end crashes occurring because drivers may be unable to see traffic signals sufficiently in advance of the intersection. Signalized intersection improvements include new LED lighting, signal back plates, retro-reflective tape outlining the back plates, or visors to increase signal visibility, larger signal heads, relocation of the signal heads, or additional signal heads.

Crash Type	All
CRF	15%
Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Medium

S3. Improve signal timing (coordination, phases, red, yellow, or operation)

Install at locations that have a crash history at multiple signalized intersections along a corridor. Signalization improvements may include adding phases, lengthening clearance intervals, eliminating or restricting higher-risk movements, and coordinating signals at multiple locations.

Crash Type	All
CRF	15%
Expected Life (Years)	10
Federal Funding Eligibility	50%
Systemic Approach Opportunity	Very High

S5. Install emergency vehicle pre-emption systems

The target of this strategy is signalized intersections where normal traffic operations impede emergency vehicles and where traffic conditions create a potential for conflicts between emergency and nonemergency vehicles. These conflicts could lead to almost any type of crash, due to the potential for erratic maneuvers of vehicles moving out of the paths of emergency vehicles.

Crash Type	Emergency Vehicle
CRF	70%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	High

S6. Install left-turn lane & add turn phase (signal has no left-turn lane or phase before)

Many intersection safety problems can be traced to difficulties accommodating left-turning vehicles, in particular where there is currently no accommodation for left turning traffic. A key strategy for minimizing collisions related to left-turning vehicles (angle, rearend, sideswipe) is to provide exclusive left-turn lanes and the appropriate signal phasing, particularly on high-volume and high-speed major-road approaches.

Crash Type	All
CRF	55%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Low

S7. Provide protected left turn phase (left turn lane already exists)

Applicable at signalized intersections with existing left turn pockets that currently have a permissive left-turn or no left-turn protection and have a high frequency of angle crashes involving left turning, opposing through vehicles, and non-motorized road users. A properly timed protected left-turn phase can also help reduce rear-end and sideswipe crashes between left-turning vehicles and the through vehicles as well as vehicles behind them.

Crash Type	All
CRF	30%
Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Very High

S8. Convert signal to mast arm (from pedestal-mounted)

Install at intersections that are currently controlled by pedestal-mounted traffic signals (in medians and/or on outside shoulder) and that have a high frequency of right-angle and rear-end crashes occurring because drivers may be unable to see traffic signal in advance to safely negotiate the intersection. Intersections that have pedestal-mounted signals may have poor visibility and can result in vehicles not being able to stop in time for a signal change.

Crash Type	All
CRF	30%
Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Medium

S9. Install raised pavement markers and striping (through intersection)

Applicable at intersections where the lane designations are not clearly visible to approaching motorists and/or at intersections noted as being complex and experiencing crashes that could be attributed to a driver's unsuccessful attempt to navigate the intersection.

Crash Type	All
CRF	10%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Very High

S10. Install flashing beacons as advance warning

Applicable in advance of signalized intersections with crashes that are a result of drivers being unaware of the intersection or being unable to see the traffic control device in time to comply.

Crash Type	All
CRF	30%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Medium

Click here for an image example

https://roadtripchick.files.wordpress.com/2012/07/p1030110.jpg

S11. Improve pavement friction (High Friction Surface Treatments)

Install at signalized Intersections noted as having crashes on wet pavements or under dry conditions when the pavement friction available is significantly less than needed for the actual roadway approach speeds. This treatment is intended to target locations where skidding and failure to stop are determined to be problems in wet or dry conditions and the target vehicle is unable to stop due to insufficient skid resistance.

Crash Type	All
CRF	40%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Medium

S12. Install raised median on approaches

Effective at intersections noted as having turning movement crashes near the intersection as a result of insufficient access control. Raised medians must comply with Americans with Disabilities Act guidelines.

Crash Type	All
CRF	25%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Medium

S13PB. Install pedestrian median fencing on approaches

Applicable at signalized Intersections with high pedestrian-generators nearby (e.g., transit stops) that may experience high volumes of pedestrians jaywalking across the travel lanes at mid-block locations instead of walking to the intersection and waiting to cross during the walk-phase. When this safety issue cannot be mitigated with signal timing and shoulder/sidewalk treatments and a midblock crossing isn't viable, installing a continuous pedestrian barrier in the median may be a solution.

Crash Type	P&B
CRF	35%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	High

S14. Create directional median openings to allow (and restrict) left-turns and U-turns

Install at locations where crashes related to turning maneuvers include angle, rear-end, pedestrian, and sideswipe (involving opposing left turns) crashes. If any of these crash types are an issue at an intersection, restriction or elimination of the turning maneuver may be the best way to improve the safety of the intersection.

Crash Type	All
CRF	50%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Medium

S15. Reduced left-turn conflict intersections

Reduced left-turn conflict intersections are geometric designs that alter how left-turn movements occur to simplify decisions and minimize the potential for related crashes. Two highly effective designs that rely on U-turns to complete certain left-turn movements are known as the restricted crossing U-turn and the median U-turn.

Crash Type	All
CRF	50%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Medium

Click here for an image example

https://safety.fhwa.dot.gov/provencountermeasures/reduced_left.cfm

S16. Convert intersection to roundabout (from signal)

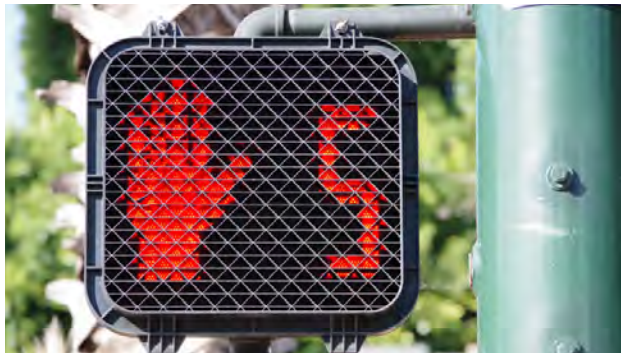
Install at signalized intersections that have a significant crash problem and the only alternative is to change the nature of the intersection itself. Roundabouts can also be very effective at intersections with complex geometries and intersections with frequent left-turn movements.

Crash Type	All
CRF	Varies
Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Low

S17PB. Install pedestrian countdown signal heads

Install at signals that have signalized pedestrian crossings with walk/don't walk indicators and where there have been pedestrian/vehicle crashes. Countdown signals can reassure pedestrians who are in the crosswalk when the flashing "DON'T WALK" interval appears that they still have time to finish crossing.

Crash Type	P & B
CRF	25%
Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Very High



S18PB. Install pedestrian crossing

Install at signalized Intersections with no marked crossings and pedestrian signal heads, where pedestrians are known to be crossing intersections that involve significant turning movements. Pedestrian crossings are especially important at intersections with multiphase traffic signals, school crossings, and double-right or double-left turns.

Crash Type	P & B
CRF	25%
Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Approach Opportunity	High

S19PB. Pedestrian Scramble

A pedestrian scramble is a form of pedestrian "walk" phase at a signalized intersection in which all vehicular traffic is required to stop, allowing pedestrians and bicyclists to safely cross through the intersection in any direction, including diagonally. A pedestrian scramble may be considered at signalized intersections with very high pedestrian/bicycle volumes, e.g. in an urban business district.

Crash Type	P & B
CRF	25%
Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Approach Opportunity	High

S20PB. Install advance stop bar before crosswalk (Bicycle Box)

Install at signalized Intersections with a marked crossing and where significant bicycle and/or pedestrians volumes are known to occur. Adding an advance stop bar before the striped crosswalk has the opportunity to enhance both pedestrian and bicycle safety. Stopping cars well before the crosswalk provides a buffer between the vehicles and the crossing pedestrians. It also allows for a dedicated space for cyclists, making them more visible to drivers.

Crash Type	P & B
CRF	15%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Very High

S21PB. Modify signal phasing to implement a Leading Pedestrian Interval (LPI)

Install at signalized intersection locations noted as having high turning vehicle volumes and that have had pedestrian/vehicle crashes. An LPI gives pedestrians the opportunity to enter an intersection about 3–7 seconds before vehicles are given a green indication.

Crash Type	P & B
CRF	60%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Very High

UNSIGNALIZED INTERSECTIONS COUNTERMEASURES

NS1. Add intersection lighting

Install at non-signalized intersections that have a disproportionate number of nighttime crashes and do not currently provide lighting at the intersection or at its approaches. Crash data should be studied to ensure that safety at the intersection could be improved by providing lighting. This strategy would be supported by a significant number of crashes that occur at night.

Crash Type	Night
CRF	40%
Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Medium

NS2. Convert to all-way STOP control (from two-way or Yield control)

Applicable at unsignalized intersection locations that have a crash history and have no controls on the major roadway approaches. However, all-way stop sign control is suitable only at intersections with moderate and relatively balanced volume levels on the intersection approaches. Under other conditions, the use of all-way stop control may create unnecessary delays and aggressive driver behavior. CA MUTCD warrants should always be followed.

Crash Type	All
CRF	50%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	High

NS3. Install signals

Traffic signals can be used to prevent the most severe type crashes (right-angle, left-turn). Consideration to signalize an unsignalized intersection should only be given after (1) less restrictive forms of traffic control have been utilized as the installation of a traffic signal often leads to an increased frequency of crashes (rear-end) on major roadways and introduces congestion; and (2) signal warrants have been met.

Crash Type	All
CRF	Varies
Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Low

NS4. Convert intersection to roundabout (from all way stop)

Applicable at intersections that have a high frequency of right-angle and left-turn type crashes. Whether such intersections have existing crash patterns or not, a roundabout provides an alternative to signalization. The primary target locations for roundabouts should be moderate-volume unsignalized intersections. Roundabouts may not be a viable alternative in suburban and urban settings where right-of-way is limited.

Crash Type	All
CRF	Varies
Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Low

NS5. Convert intersection to roundabout (from 2-way stop or yield control)

Applicable at intersections that have a high frequency of right-angle and left-turn type crashes. Whether such intersections have existing crash patterns or not, a roundabout provides an alternative to signalization. The primary target locations for roundabouts should be moderate-volume unsignalized intersections, or retrofitting existing moderate volume signalized intersections. Roundabouts may not be a viable alternative in suburban and urban settings where right-of- way is limited.

Crash Type	All
CRF	Varies
Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Low

NS5mr. Convert intersection to mini roundabout

Mini roundabouts generally have a diameter of 45-90 feet with traversable islands. They provide the benefits of a roundabout with a smaller footprint, ideal for areas that already have low speeds but also a constrained right-of-way.

Crash Type	All
CRF	30%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	

NS6. Install/upgrade larger or additional stop signs or other intersection warning/ regulatory signs

The target for this strategy should be approaches to unsignalized intersections with paerns of rear-end, right-angle, or turning collisions related to lack of driver awareness of the presence of the intersection.

Crash Type	All
CRF	15%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Very High

NS7. Upgrade intersection pavement markings

Install at unsignalized intersections that are not clearly visible to approaching motorists, particularly approaching motorists on the major road. The strategy is appropriate for intersections with patterns of rear-end, right-angle, or turning crashes related to lack of driver awareness of the presence of the intersection, also at minor road approaches where conditions allow the stop bar to be seen by an approaching driver at a significant distance from the intersection. Typical improvements include "Stop Ahead" markings and the addition of centerlines and stop bars.

Crash Type	All
CRF	25%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Very High

NS8. Install flashing beacons at stop-controlled intersections

Flashing beacons can reinforce driver awareness of the non-signalized intersection control and can help mitigate patterns of right-angle crashes related to stop sign violations. Post-mounted advanced flashing beacons or overhead flashing beacons can be used at stop-controlled intersections to supplement and call driver attention to stop signs.

Crash Type	All
CRF	15%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	High

NS9. Install flashing beacons as advance warning

Install in advance of non-signalized intersections with patterns of crashes that could be related to lack of a driver's awareness of the approaching intersection or controls at a downstream intersection.

Crash Type	All
CRF	30%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	High

Click here for an image example

https://carmanah.com/tag/school-zone-safety/page/11/

NS10. Install transverse rumble strips on approaches

Transverse rumble strips are installed in the travel lane to provide an auditory and tactile sensation for each motorist approaching the intersection. They can be used at any stop or yield approach intersection, often in combination with advance signing to warn of the intersection ahead. Due to the noise generated by vehicles driving over the rumble strips, care must be taken to minimize disruption to nearby residences and businesses.

Crash Type	All
CRF	N/A
Expected Life (Years)	10
Federal Funding Eligibility	90%
Systemic Approach Opportunity	N/A

NS11. Improve sight distance to intersection (clear sight triangles)

Install at unsignalized intersections with restricted sight distance and patterns of crashes related to lack of sight distance where sight distance can be improved by clearing roadside obstructions without major reconstruction of the roadway.

Crash Type	All
CRF	20%
Expected Life (Years)	10
Federal Funding Eligibility	90%
Systemic Approach Opportunity	High

NS12. Improve pavement friction (high friction surface treatments)

Install at non-signalized intersections noted as having crashes on wet pavements or under dry conditions when the pavement friction available is significantly less than needed for the actual roadway approach speeds. This treatment is intended to target locations where skidding and failure to stop are determined to be a problem in wet or dry conditions and the target vehicle is unable to stop due to insufficient skid resistance.

Crash Type	All
CRF	40%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Medium

NS13. Install splitter-islands on the minor road approaches

Applicable at minor road approaches to unsignalized intersections where the presence of the intersection or the stop sign is not readily visible to approaching motorists. The strategy is particularly appropriate for intersections where the speeds on the minor road are high. Creation of a splitter island allows for an additional stop sign to be placed in the median for the minor approach.

Crash Type	All
CRF	40%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Medium

NS14. Install raised median on approaches

Install at locations where turning movements affect the safety of an intersection. This countermeasure only applies to crashes occurring on the approaches or in the influence area of the new raised median. All new raised medians funded with federal HSIP funding must not include the removal of the existing roadway structural section and must be doweled into the existing roadway surface.

Crash Type	All
CRF	25%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Medium

NS15. Create directional median openings to allow (and restrict) left-turns and u-turns

Install at locations with crashes related to turning maneuvers including angle, rear-end, pedestrian, and sideswipe (involving opposing left turns). If any of these crash types are an issue at an intersection, restriction or elimination of the turning maneuver may be the best way to improve the safety of the intersection.

Crash Type	All
CRF	50%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Medium

NS16. Reduced left-turn conflict intersections

Reduced left-turn conflict intersections are geometric designs that alter how left-turn movements occur to simplify decisions and minimize the potential for related crashes. Two highly effective designs that rely on U-turns to complete certain left-turn movements are known as the restricted crossing U-turn and the median U-turn.

Crash Type	All
CRF	50%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	

NS17. Install right-turn lane

Many collisions at unsignalized intersections are related to right-turn maneuvers. A key strategy for minimizing such collisions is to provide exclusive right-turn lanes, particularly on high-volume and high-speed major-road approaches. When considering new right-turn lanes, potential impacts to non-motorized users should be considered and mitigated as appropriate.

Crash Type	All
CRF	20%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Low

NS18. Install left-turn lane (where no left-turn lane exists)

Many collisions at unsignalized intersections are related to left-turn maneuvers. A key strategy for minimizing such collisions is to provide exclusive left-turn lanes, particularly on high-volume and high-speed major-road approaches. When considering new left-turn lanes, potential impacts to non-motorized users should be considered and mitigated as appropriates.

Crash Type	All
CRF	35%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Low

NS19PB. Install raised medians / refuge islands

Applicable at intersections that have a long pedestrian crossing distance, a high number of pedestrians, or a crash history. Raised medians decrease the level of exposure for pedestrians and allow pedestrians to concentrate on (or cross) only one direction of traffic at a time.

Crash Type	P & B
CRF	45%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Medium

NS20PB. Install pedestrian crossing at uncontrolled locations (new signs and markings only)

Install at non-signalized intersections without a marked crossing, where pedestrians are known to be crossing intersections that involve significant vehicular traffic. They are especially important at school crossings and intersections with right and/or left turns pockets.

Crash Type	P & B
CRF	20%
Expected Life (Years)	10
Federal Funding Eligibilitty	100%
Systemic Approach Opportunity	High

NS21PB. Install/upgrade pedestrian crossing at uncontrolled locations (with enhanced safety features)

Install at non-signalized intersections with or without a marked crossing, where pedestrians are known to be crossing intersections with significant vehicular traffic. Rectangular rapid flashing beacons, overhead flashing beacons, curb extensions, advanced "stop" or "yield" markings, and other safety features can be added to complement standard crossing elements.

Crash Type	P & B
CRF	35%
Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Medium

NS22PB. Install rectangular rapid flashing beacon (RRFB)

A Rectangular Rapid Flashing Beacon (RRFB) includes pedestrian-activated flashing lights and additional signage that enhance the visibility of marked crosswalks and alert motorists to pedestrian crossings. It uses an irregular flash pattern that is similar to emergency flashers on police vehicles. RRFBs are installed at unsignalized intersections and mid-block pedestrian crossings.

Crash Type	P & B
CRF	35%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	

NS23PB. Install pedestrian signal (including Pedestrian Hybrid Beacon (HAWK)

Intersections noted as having a history of pedestrian/vehicle crashes and in areas where the likelihood of a pedestrian is significant. Corridors should also be assessed to determine if there are adequate safe opportunities for non-motorists to cross and if a pedestrian signal, high-intensity activated crosswalk, or hybrid beacons are needed to provide an active warning to motorists when a pedestrian is in the crosswalk.

Crash Type	P & B
CRF	55%
Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Low

ROADWAY SEGMENTS COUNTERMEASURES

R1. Add segment lighting

Install at locations with a noted substantial patterns of nighttime crashes. In particular, patterns of rear-end, right-angle, turning or roadway departure collisions on the roadways may indicate that night-time drivers can be unaware of the roadway characteristics.

Crash Type	Night
CRF	35%
Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Medium

R2. Remove or relocate fixed objects outside of clear recovery zone

Applicable at locations or roadway segments prone to collisions with fixed objects such as utility poles, drainage structures, trees, and other fixed objects, such as the outside of a curve, end of lane drops, and in traffic islands. A clear recovery zone should be developed on every roadway, as space is available. In situations where public right-of-way is limited, steps should be taken to request assistance from property owners, as appropriate.

Crash Type	All
CRF	35%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	High

R3. Install median barrier

Applicable in areas where crash history indicates that drivers are unintentionally crossing the median and these cross-overs are resulting in high severity crashes. The installation of median barriers can increase the number of property damage only collisions and non-severe injuries. The net result in safety from this countermeasure is connected more to reducing the severity of crashes as opposed to the number of crashes.

Crash Type	All
CRF	25%
Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Medium

R4. Install guardrail

A guardrail is installed to reduce the severity of lane departure crashes. However, guardrails can reduce crash severity only for those conditions where striking the guardrail is less severe than going down an embankment or striking a fixed object. Guardrails should only be installed where it is clear that crash severity will be reduced, or there is a history of run-off-the-road crashes at a given location that have resulted in severe injury crashes.

Crash Type	All
CRF	25%
Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Approach Opportunity	High

R5. Install impact attenuators

Impact attenuators are typically used to shield rigid roadside objects such as concrete barrier ends, steel guardrail ends and bridge pillars from oncoming automobiles. Attenuators should only be installed where it is impractical for the objects to be removed.

Crash Type	All
CRF	25%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	High

R6. Flatten side slopes

Applicable at roadways experiencing frequent lane departure crashes that result in roll-over type crashes as a result of the roadway slope being so severe as to not accommodate a reasonable degree of driver correction. This countermeasure is appropriate when there is a need to reduce the severity of lane departure crashes without installing a barrier system that could result in increased numbers of crashes.

Crash Type	All
CRF	30%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Medium

R7. Flatten side slopes and remove guardrail

Install at locations where high number of crashes originate as a lane departure and result in collision with guardrail or a fixed object located on the side slope shielded by guardrail. The guardrail may or may not meet current standards. Even though guardrails are generally installed to reduce the severity of departure crashes, they still can result in severe crashes in some locations.

Crash Type	All
CRF	40%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Medium

R8. Install raised median

Install at locations experiencing head-on collisions that may be affected by both the number of vehicles that cross the centerline and by the speed of oncoming vehicles. Installing a raised median is a more restrictive approach in that it represents a more rigid barrier between opposing traffic.

Crash Type	All
CRF	25%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Medium

R9. Install median (flush)

Applicable at locations experiencing head-on collisions that may be affected by both the number of vehicles that cross the centerline and by the speed of oncoming vehicles. Roadways with oversized lanes offer an opportunity to restripe the roadway to reduce the lanes to standard widths and use the extra width for the median.

Crash Type	All
CRF	15%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Medium

R10PB. Install pedestrian median fencing on approaches

Roadway segments with high pedestrian generators and destinations nearby (e.g. transit stops) may experience a high volume of pedestrians jaywalking across the travel lanes at mid-block locations instead of walking to the nearest intersection or designated mid-block crossing. When this safety issue cannot be mitigated with shoulder, sidewalk and/or crossing treatments, then installing a continuous pedestrian barrier in the median may be a viable solution.

Crash Type	All
CRF	15%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Medium

R11. Install acceleration/ deceleration lanes

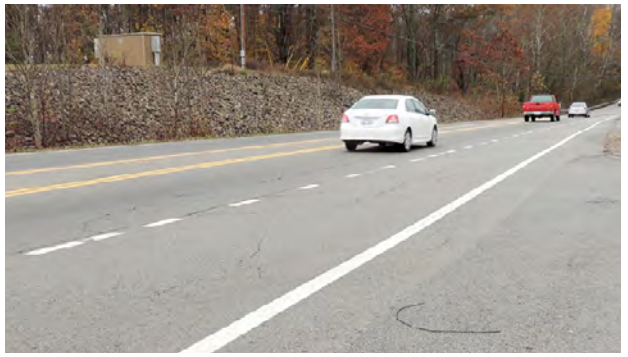
Install at locations proven to have crashes that are the result of drivers not being able to turn onto a high speed roadway to accelerate until the desired roadway speed is reached and areas that do not provide the opportunity to safety decelerate to negotiate a turning movement. This countermeasure can also be used to improve the safety of merging vehicles at a lane-drop location.

Crash Type	All
CRF	25%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Low

R12. Widen lane (initially less than 10 feet)

Install at horizontal curves or tangents and low speed or high speed roadways identified as having lane departure crashes, sideswipe or head-on crashes that can be attributed to an existing lane width less than 10 feet.

Crash Type	All
CRF	25%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Medium



R13. Add two-way left-turn lane (without reducing travel lanes)

Applicable at roadways having a high frequency of drivers being rear-ended while attempting to make a left turn across oncoming traffic. Also can be effective for drivers inadvertently crossing the centerline of an undivided multilane roadway.

Crash Type	All
CRF	30%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Medium

R14. Road Diet (reduce travel lanes from four to three and add a two-way left-turn and bicycle lanes)

Install at areas noted as having a high frequency of head-on, left-turn, and rear-end crashes with traffic volumes that can be handled by only two free flowing lanes. Using this strategy in locations with traffic volumes that are too high could result in diversion of traffic to routes that are less safe than the original four-lane design. It may also result in congestion levels that contribute to other crashes.

Crash Type	All
CRF	30%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Medium

R15. Widen shoulder

Applicable at roadways that have a frequent incidence of vehicles leaving the travel lane resulting in an unsuccessful attempt to reenter the roadway. The probability of a safe recovery is increased if an errant vehicle is provided with an increased paved area in which to initiate such a recovery.

Crash Type	All
CRF	30%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Medium

R16. Curve shoulder widening (outside only)

Install at roadway curves noted as having frequent lane departure crashes due to inadequate or no shoulders, resulting in an unsuccessful attempt to reenter the roadway. Curve shoulder widening creates a recovery area in which a driver can regain control of a vehicle, as well as lateral clearance to roadside objects.

Crash Type	All
CRF	45%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	

R17. Improve horizontal alignment (flatten curves)

Applicable at roadways with horizontal curves that have experienced lane departure crashes as a result of a roadway segment having compound curves or a severe radius. This strategy should generally be considered only when less expensive strategies involving clearing of specific sight obstructions or modifying traffic control devices have been tried and have failed to ameliorate the crash patterns.

Crash Type	All
CRF	50%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Low

R18. Flatten crest vertical curve

The target for this strategy is usually unsignalized intersections with restricted approach sight distance due to vertical geometry and with patterns of crashes related to that lack of sight distance that cannot be ameliorated by less expensive methods. This strategy should generally be considered only when less expensive strategies involving clearing of specific sight obstructions or modifying traffic control devices have been tried and have failed to ameliorate the crash patterns.

Crash Type	All
CRF	25%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Low

R19. Improve curve superelevation

Applicable for roadways noted as having frequent lane departure crashes and inadequate or no superelevation. Safety can be enhanced when the superelevation is improved or restored along curves where the actual superelevation is less than the optimal.

Crash Type	All
CRF	45%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Medium

R20. Convert from two-way to one-way traffic

One-way streets can offer improved signal timing and accommodate irregular-spaced signals. One-way streets can simplify crossings for pedestrians, who must look for traffic in only one direction. While studies have shown that conversion of two-way streets to one-way generally reduces pedestrian crashes and the number of conflict points, one-way streets tend to have higher speeds that can create new problems.

Crash Type	All
CRF	35%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Medium

R21. Improve pavement friction (high friction surface treatments)

Applicable at locations with a noted amount of crashes on wet pavement or under dry conditions when pavement friction is significantly less than actual roadway speeds; including but not limited to curves, intersections, and areas with short stopping or weaving distances. This treatment is intended to target locations where skidding is a problem and the target vehicle is one that runs (skids) off the road or is unable to stop due to insufficient skid resistance.

Crash Type	All
CRF	40%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Medium

R22. Install/upgrade signs with new fluorescent sheeting (regulatory or warning)

This countermeasure only applies to crashes occurring within the influence area of the new/upgraded signs. This countermeasure is not eligible unless it is done as part of a larger sign audit project, including the study of: 1) the existing signs' locations, sizes, and information per MUTCD standards; 2) missing signs per MUTCD standards; and 3) sign retroreflectivity.

Crash Type	All
CRF	15%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Very High

R23. Install chevron signs on horizontal curves

Install at roadways that have an unacceptable level of crashes on relatively sharp curves during periods of light and darkness. Ideally this type of safety countermeasure would be combined with other sign evaluations and upgrades.

Crash Type	All
CRF	40%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Very High

R24. Install curve advance warning signs

Applicable at roadways that have an unacceptable level of crashes on relatively sharp curves during periods of light and darkness. This countermeasure may also include horizontal alignment and/or advisory speed warning signs. Ideally this type of safety countermeasure would be combined with other sign evaluations and upgrades.

Crash Type	All
CRF	25%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	High

R25. Install curve advance warning signs (flashing beacon)

Install at roadways that have an unacceptable level of crashes on relatively sharp curves. Flashing beacons in conjunction with warning signs should only be used on horizontal curves that have an established severe crash history to help maintain their effectiveness.

Crash Type	All
CRF	30%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	High

R26. Install dynamic/variable speed warning signs

Dynamic speed feedback signs can reduce vehicle speeds by alerting motorists that they are operating above the speed limit. The signs include a speed measuring device and a message sign that displays feedback to drivers who exceed a predetermined speed threshold. The feedback can include displaying the driver's actual speed, showing a message such as SLOW DOWN, or activating some warning device, such as beacons or a curve warning sign.

Crash Type	All
CRF	30%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	High

https://www.pexco.com/traffic/products/roadside-delineator-posts/fg-400-500-posts/

R27. Install delineators, reflectors and/or object markers

Applicable at roadways that have an unacceptable level of crashes on curves (relatively flat to sharp) during periods of light and darkness. Many roadways with a history of fixed object crashes can be candidates for this treatment, as can roadways with similar fixed objects along the roadside that have yet to experience crashes.

Crash Type	All
CRF	15%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Very High

Click here for an image example

https://www.pexco.com/traffic/products/roadside-delineator-posts/fg-400-500-posts/

R28. Install edge-lines and centerlines

Install on roadways with a history of run-off-road right, head-on, opposite-direction-sideswipe, or run-off-road left crashes. Install where the existing lane delineation is not sufficient to assist the motorist in understanding the existing limits of the roadway.

Crash Type	All
CRF	25%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Very High

R29. Install no-passing line

Applicable at roadways that have a high percentage of head-on crashes suggesting that many head-on crashes may relate to failed passing maneuvers. No-passing lines should be installed where drivers' passing sight distance is not available due to horizontal or vertical obstructions.

Crash Type	All
CRF	45%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Very High

R30. Install centerline rumble strips/stripes

Centerline rumble strips/stripes can be used on many roadways – especially those with a history of head-on crashes. It is recommended that rumble strips/stripes be applied systematically along an entire route instead of only at spot locations. For all rumble strips/stripes, pavement condition should be sufficient to accept milled rumble strips. Care should be taken when considering installing rumble strips in locations with residential land uses or in areas with high bicycle volumes.

Crash Type	All
CRF	20%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	Very High

R31. Install edgeline rumble strips/stripes

Shoulder and edgeline milled rumble strips/stripes should be used on roads with a history of roadway departure crashes. It is recommended that rumble strips/stripes be applied systematically along an entire route instead of only at spot locations. For all rumble strips/stripes, pavement condition should be sufficient to accept milled rumble strips. Special requirements may apply and care should be taken when considering installing rumble strips in locations with residential land uses or in areas with high bicycle volumes.

Crash Type	All
CRF	15%
Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Approach Opportunity	High

R32PB. Install bicycle lanes

Applicable along roadway segments noted as having crashes between bicycles and vehicles or crashes that may be preventable with a buffer/shoulder. Most studies suggest that bicycle lanes may provide protection against bicycle/motor vehicle collisions. Striped bicycle lanes can be incorporated into a roadway when it is desirable to delineate which available road space is for exclusive or preferential use by bicyclists.

Crash Type	P & B
CRF	35%
Expected Life (Years)	10
Federal Funding Eligibility	90%
Systemic Approach Opportunity	High

R33PB. Install separated bicycle lanes

Separated bicycleways are most appropriate on streets with high volumes of bicycle traffic and/or high bicycle-vehicle collisions. Separation types range from simple, painted buffers and flexible delineators to more substantial separation measures including raised curbs, grade separation, bollards, planters, and parking lanes. These options range in feasibility due to roadway characteristics, available space, and cost.

Crash Type	P & B
CRF	45%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	

R34PB. Install sidewalk/pathway (to avoid walking along roadway)

Install at areas noted as not having adequate or no sidewalks and a history of walking along roadway pedestrian crashes. In rural areas asphalt curbs and/or separated walkways may be appropriate.

Crash Type	P & B
CRF	80%
Expected Life (Years)	10
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Medium

R35PB. Install pedestrian crossing (with enhanced safety features)

Install on roadway segments with no controlled crossing for a significant distance in high-use midblock crossing areas and/or multilane roads locations. Rectangular rapid flashing beacons, overhead flashing beacons, curb extensions and other safety features can be added to complement standard crossing elements. For multi-lane roadways, advance "yield" markings can be effective in reducing the 'multiple-threat' danger to pedestrians.

Crash Type	P & B
CRF	30%
Expected Life (Years)	10
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Medium

R36PB. Install raised pedestrian crossing

Applicable on lower-speed roadways where pedestrians are known to be crossing roadways that involve significant vehicular traffic. In these cases, raised crossings can be added to complement the standard crossing elements. Special requirements may apply and extra care should be taken when considering installing raised crossings to ensure unintended safety issues are not created, such as emergency vehicle access or truck route issues.

Crash Type	P & B
CRF	35%
Expected Life (Years)	10
Federal Funding Eligibility	90%
Systemic Approach Opportunity	High

R37PB. Install rectangular rapid flashing beacon (RRFB)

A Rectangular Rapid Flashing Beacon (RRFB) includes pedestrian-activated flashing lights and additional signage that enhance the visibility of marked crosswalks and alert motorists to pedestrian crossings. It uses an irregular flash pattern that is similar to emergency flashers on police vehicles. RRFBs are installed at unsignalized intersections and mid-block pedestrian crossings.

Crash Type	P & B
CRF	350%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	

R38. Install animal fencing

Install at locations with high percent of vehicular/ animal crashes (reactive) or where there is a known high percent of animals crossing due to migratory patterns (proactive).

Crash Type	Animal
CRF	80%
Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Approach Opportunity	Medium

Click here for an image example

https://www.flickr.com/photos/tranbc/50020523007

COUNTERMEASURES THAT DO NOT QUALIFY FOR HSIP FUNDING

NH1. Implement traffic safety education programs

Education programs such as Street Smarts Marin can raise awareness and improve driver, pedestrian, and bicyclist behaviors. Aimed as "hot spot" locations, education programs can be successful in encouraging safe traffic behavior.

Crash Type	All
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A

NH2. Implement targeted enforcement programs

Enforcement programs can be effective at reducing common violation types such as speeding, failure to yield, red light running, aggressive driving, failure to wear safety belts, distracted driving, and driving while impaired. They can be especially effective when combined with education programs.

Crash Type	All
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A

NH3. Install cameras to detect red-light running

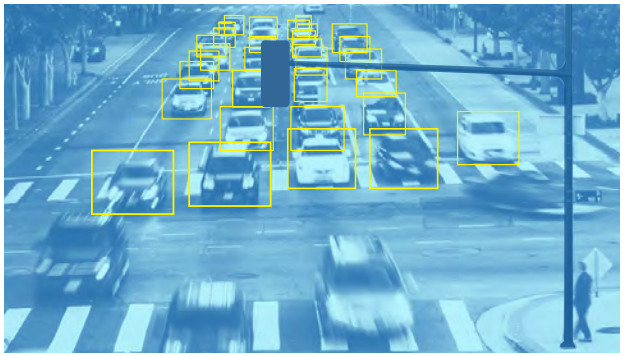
Install at signalized intersections with a high frequency of crashes attributed to drivers who intentionally disobey red signal indications. This type of automated enforcement refers to the use of photo and video camera systems connected to the signal controller. Such systems record vehicles proceeding through the intersection after the signal displays red.

Crash Type	All
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A

NH4. Provide advanced dilemma zone detection for high speed approaches

Effective in remote areas that have a high frequency of right-angle and rear-end crashes. The advanced dilemma zone detection system enhances safety at signalized intersections by modifying traffic control signal timing to reduce the number of drivers that may have difficulty deciding whether to stop or proceed during a yellow phase. This may reduce rear-end crashes associated with unsafe stopping and angle crashes due to illegally continuing into the intersection during the red phase.

Crash Type	All
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A



NH5. Fill sidewalk and pathway gaps

Filling gaps in existing sidewalk and pathway networks increases safety and comfort for active transportation users. Gaps should be filled in a way that meets specifications for best practices in terms of width, accessibility, and other attributes.

Crash Type	P & B
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A

NH6. Add pedestrian scale lighting

Pedestrian scale lighting increases the visibility of pedestrians at night, especially at intersections and when crossing the street. Lighting should be implemented in a way so as to illuminate pedestrians and reduce glare to motorists.

Crash Type	P & B
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A

NH7. Wayfinding

This treatment can reduce pedestrian and bicycle collisions. Wayfinding can be deployed to route bicycles and pedestrians to safer facilities and avoid hazardous routes.

Crash Type	P & B
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A

NH8. Install sharrows

Sharrow markings increase the visibility of bicyclists, clarifies where bicyclists are expected to ride and reminds motorists to expect bicyclists on the road.

Crash Type	P & B
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A

NH9. Install 'Bikes May Use Full Lane' sign

Regulatory 'Bikes May Use Full Lane' sign increases the visibility of bicyclists, clarifies where bicyclists are expected to ride, and reminds motorists to expect bicyclists on the road.

Crash Type	P & B
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A

NH10. Deploy smart signal technology

Smart traffic signals are equipped with sensing, video capture, and connectivity technologies to collect real-time data from the environment. They can improve the flow of traffic as well as detect pedestrians and bicyclists at intersections.

Crash Type	All
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A

NH11. Install protected intersection

Protected intersections separate bicyclists from vehicles at intersections, increasing safety for all users. The bicycleway is set back from vehicle traffic and bicyclists are given a dedicated path through the intersection and have right-of-way over turning vehicles.

Crash Type	P & B
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A

NH12. No right turn on red restrictions

No right turn on red (RTOR) restrictions can benefit pedestrians with minimal impacts on traffic. They should be done in locations with substantial pedestrian volume and places where children cross. Part-time RTOR prohibitions during the busiest times of day may be sufficient to address the problem. Blank out signs can be used to reinforce turn restrictions and encourage motorist compliance.

Crash Type	All
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A

NH13. Refresh signage/ striping

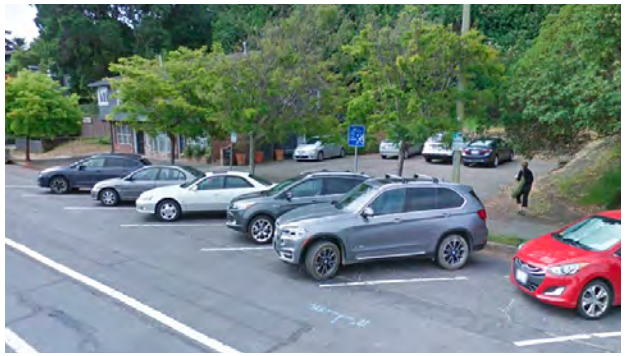
Refresh signage and striping that has faded with age. Faded striping and signs can lead to confusion and poor nighttime visibility.

Crash Type	All
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A

NH14. Back-in angle parking

Back-in angle parking provides motorists with better visibility of bicyclists, pedestrians, cars, and trucks as they exit a parking space and enter moving traffic. Back-in angle parking also removes the difficulty that drivers, particularly older drivers, have when backing into moving traffic.

Crash Type	All
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A



NH15. Reduced lane widths

Reduced lane width encourages slower speeds and frees up additional right of way for bicycle and pedestrian facilities. Residential streets may be reduced to 10-foot lanes, arterial streets may be reduced to 11 foot lanes, and turn lanes may be reduced to 10 feet, as determined by individual jurisdictions.

Crash Type	All
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A

NH16. Square up intersection

Irregular angled intersections present safety hazards for all road users. Intersections less than 90 degrees reduce visibility for motorists, while intersections greater than 90 degrees allow for high-speed turns. These intersections also create unnecessarily long pedestrian crossings. Redesign intersections as close to 90 degrees as possible.

Crash Type	All
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A

NH17. Relocate parking

Parked vehicles can block sight distances. Relocate parking, or remove parking at the approaches to intersections and driveways to improve visibility.

Crash Type	All
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A

NH18. Mumble strip

Mumble strips are modified rumble strips. They use noise and vibrations to alert drivers who are leaving their lanes. Mumble strips generate less outside noise than rumble strips, which are less disruptive to nearby residents, through a sinusoidal wave pattern. Mumble strips should be installed on facilities where roadway departures collisions have occurred.

Crash Type	All
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A

Click here for an image example

https://micountyroads.org/news/mumble-strips-are-the-new-rumble-strips-in-macomb-county/

NH19. Provide tapered edge for pavement edge drop-off

This treatment is designed to be a standard policy for any overlay project. Instead of an overlay project ending with a 90-degree asphalt or concrete face at the edge of pavement, the tapered edge provides an approximate 30-degree angle at the edge.

Crash Type	All
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A

NH20. Pave existing shoulder

Install at roadways with an unpaved existing shoulder and exhibiting a high incidence of vehicles leaving the travel lane resulting in an unsuccessful attempt to reenter the roadway. Paving the existing shoulder provides a wider recovery area with a smooth surface that has a higher friction factor.

Crash Type	All
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A

NH21. Widen shoulder (unpaved)

Consider for roadways with a high incidence of vehicles leaving the travel lane resulting in an unsuccessful attempt to reenter the roadway. The probability of a safe recovery is increased if an errant vehicle is provided with an area in which to initiate such a recovery. Unpaved shoulders usually have flatter cross sections and some structural integrity as compared to areas of "flatten side slopes".

Crash Type	All
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A

NH22. Remove slip lane

This treatment addresses pedestrian and sideswipe collisions. Slip lanes should be avoided as they allow vehicles to travel through intersections at larger speeds and allow less visibility of pedestrians waiting to cross. Removing one will result in a shorter crossing distance for pedestrians and slower speeds at the intersection.

Crash Type	All
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A

NH23. Upgrade bridge railing

Open-faced railings can present a snagging hazard, which may produce high deceleration forces leading to occupant injuries. Curbs or walkways between the driving lane and the bridge railing are another common hazard of older railing systems. Impacted vehicles may go over the railing or roll over.

Crash Type	All
CRF	N/A
Expected Life (Years)	N/A
Federal Funding Eligibility	N/A
Systemic Approach Opportunity	N/A

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