City of Patterson

LOCAL ROAD SAFETY PLAN

FINAL REPORT

September 2023

TJKM

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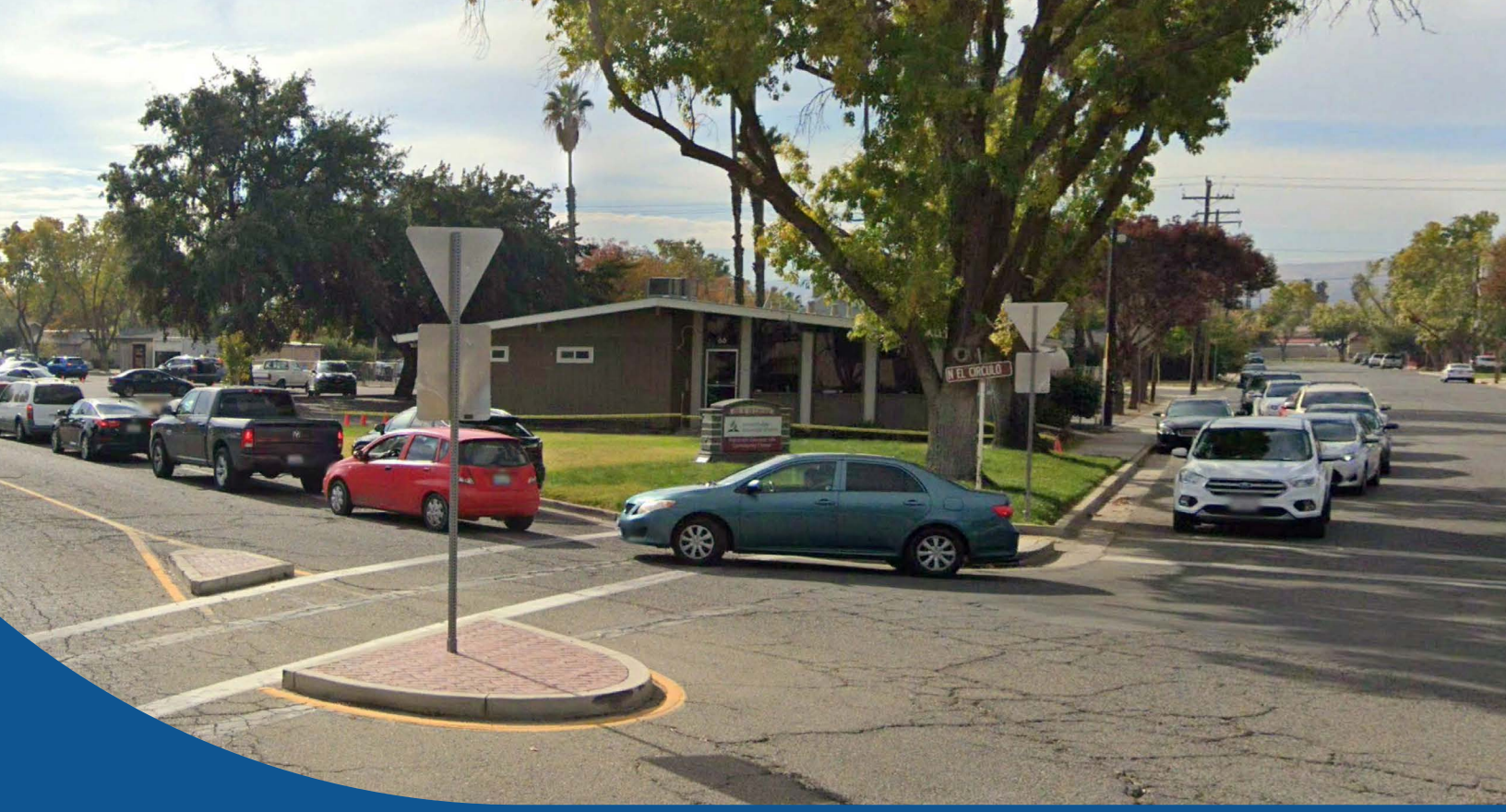

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GLOSSARY

5 E's – Abbreviation for Education, Enforcement, Engineering, Equity, Emergency Medical Services (EMS): A traffic engineering approach for improving safety on the roadways.

ACS – Abbreviation for American Community Survey: A U.S. Census survey that helps local officials, community leaders, and businesses understand the changes taking place in their communities.

ADT – Abbreviation for average daily traffic: Refers to vehicle traffic volumes.

BCR – Abbreviation for benefit-cost ratio: Indicator used to quantify project benefits in relation to project costs.

LRSP – Abbreviation for Local Road Safety Plan. A document that provides a framework for identifying, analyzing, and prioritizing roadway safety improvements on local roads.

CRF – Abbreviation for crash reduction factor: The percentage of expected effect of a countermeasure or safety project to decrease collisions.

Collision Severity – Defined as the intensity of collisions typically in the following categories: killed (K), severe injury (SI), other visible injury and complaint of pain (other), and property damage only (PDO).

EMS – Abbreviation emergency medical services.

EPDO – Abbreviation for equivalent property damage only.

FHWA – Abbreviation for Federal Highway Administration: The federal agency responsible managing the nation's highway system, including bridges and tunnels.

HSIP – Abbreviation for Highway Safety Improvement Program: A roadway safety funding program managed by Caltrans, California State Department of Transportation.

KSI – Abbreviation for killed and severe injury collisions.

LRSM – Abbreviation for Local Roadway Safety Manual: A Manual for California's Local Road Owners.

Primary Violation Factor/Primary Collision Factor – Defined as contributing causes of collisions.

SWITRS - Abbreviation for Statewide Integrated Traffic Records System: A database managed by California Highway Patrol that collects and processes data gathered from collision scenes.

TIMS - Abbreviation for Transportation Injury Mapping System: A collision database managed by UC Berkeley SafeTREC system.

RRFB - Abbreviation for Rectangular Rapid Flashing Beacon.

EXECUTIVE SUMMARY

The City of Patterson's Local Road Safety Plan (LRSP) is a comprehensive plan that creates a framework to systematically identify and analyze traffic safety related issues and recommend projects and countermeasures. It aims to reduce killed and severe injury (KSI) collisions through a prioritized list of improvements that can enhance safety on local roadways.

The LRSP takes a proactive approach to addressing safety needs. It is viewed as a guidance document that can be a source of information and ideas. It will also be a living document, one that is routinely reviewed and updated by City staff and their safety partners to reflect evolving collision trends and community needs and priorities. With the LRSP as a guide, the City will be able to apply for grant funds, such as the federal Highway Safety Improvement Program (HSIP). This document summarizes an analysis of collisions that occurred in Patterson, identifies high-injury locations, and recommends countermeasures at each of these high-risk locations. It is organized into eight sections as follows:

CHAPTER 1 – INTRODUCTION

The Introduction describes what an LRSP is and details the study area.

CHAPTER 2 – SAFETY PARTNERS

Involvement of safety partners is critical in the success of the LRSP. For the City of Patterson, this included City Staff, Patterson Police Department, Patterson Fire Department, Patterson Unified School District, Stanislaus County Transportation Authority, Caltrans, and Patterson residents. This chapter summarizes the involvement of the stakeholders in the LRSP process.

CHAPTER 3 – EXISTING PLANNING EFFORTS

This chapter summarizes City and regional planning documents and projects that are relevant to the LRSP. It ensures that the recommendations of the LRSP are in line with existing goals, objectives, policies, or projects.

CHAPTER 4 – COLLISION DATA AND ANALYSIS

This chapter summarizes the data analysis approach and presents preliminary as well as detailed collision analysis and findings in the study area. This analysis of KSI collisions is performed by facility type (intersection and roadway segment). Collision data was obtained and analyzed for a five-year period from 2016-2020 from the California Highway Patrol's Statewide Integrated Traffic Records System (SWITRS) and the University of California at Berkeley SafeTREC's Transportation Injury Mapping Service (TIMS). This time period was chosen because 2021 data were preliminary at the time of the analysis. It should be noted that in many situations for prior collisions, the safety measures are implemented post collision that may result in eliminating or reducing future collisions. For post 2020 collisions, future reviews and updates of the LRSP will capture those collisions.

CHAPTER 5 – EMPHASIS AREAS

Emphasis areas are a focus of the LRSP that are identified through the various collision types and factors resulting in fatal and severe injury collisions within the City of Patterson. The six emphasis areas for Patterson are:

- Address Hit Object Collisions
- Address Unsafe Speed Collisions
- Address Pedestrian Safety
- Address Nighttime Collisions
- Address Broadside Collisions
- Improve Sperry Avenue (Intersections)

CHAPTER 6 – COUNTERMEASURE IDENTIFICATION

Engineering countermeasures were selected for each of the high-risk locations and for the emphasis areas. These were based off of approved countermeasures from the Caltrans Local Roadway Safety Manual (LRSM) used in HSIP grant calls for projects. The intention is to give the City potential countermeasures for each location that can be implemented either in future HSIP calls for projects, or using other funding sources, such as the City's Capital Improvement Program. Non-engineering countermeasures were also selected using the 5 E's strategies, and are included with the emphasis areas.

CHAPTER 7 – SAFETY PROJECTS

A set of six safety projects were created for high-risk intersections and roadway segments, using HSIP approved countermeasures. These safety projects are:

- **Project #1:** Signalized Intersection: Improve signal hardware; lenses, back- plates with retroreflective borders, mounting, size, and number, Install advance stop bar before crosswalk (Bicycle Box), Modify signal phasing to implement a Leading Pedestrian Interval (LPI)
- **Project #2:** Citywide Signal Hardware and Retiming
- **Project #3:** Unsiginalized Intersections: Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs, Upgrade intersection pavement markings, Install Flashing Beacons at Stop-Controlled Intersections
- **Project #4:** Un-signalized Intersections: Convert intersection to mini- roundabout (under City's Review)
- **Project #5:** Roadway Segments: Add Segment Lighting, Install bike lanes, Install/ upgrade pedestrian crossing (with enhanced safety features)
- **Project #6:** Citywide Sign Upgrade

CHAPTER 8 – IMPLEMENTATION AND EVALUATION

The LRSP is a guidance document that is recommended to be updated every two to five years in coordination with the safety partners. The LRSP document provides engineering, education, enforcement, and emergency medical service-related countermeasures that can be implemented throughout the City to reduce fatal and severe injury collisions. After implementing countermeasures, the performance measures for each emphasis area should be evaluated annually. The most important measure of success of the LRSP should be reducing KSI collisions throughout the City. If the number of KSI collisions does not decrease over time, then the emphasis areas and countermeasures should be re-evaluated.

1 | INTRODUCTION

1 INTRODUCTION

What is an LRSP?

The LRSP is a localized data-driven traffic safety plan that provides opportunities to address unique roadway safety needs and reduce the number of KSI collisions. The LRSP creates a framework to systematically identify and analyze traffic safety-related issues, and recommend safety projects and countermeasures. It facilitates the development of local agency partnerships and collaboration, resulting in the development of a prioritized list of improvements that can qualify for HSIP funding. The LRSP is a proactive approach to addressing safety needs and is viewed as a living document that can be constantly reviewed and revised to reflect evolving trends, and community needs and priorities.

PROCESS

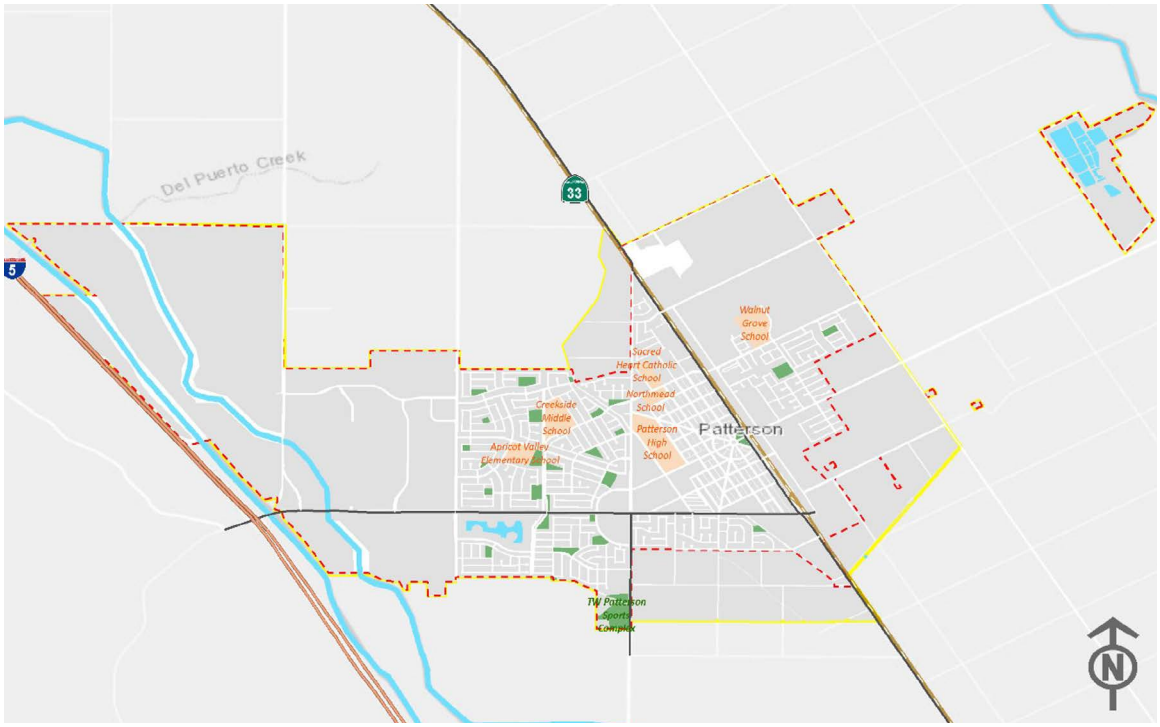
The systemic approach in preparing the LRSP involves the following steps:

- Develop plan goals and objectives
- Analyze collision data
- Meet with stakeholders/safety partners
- Determine focus areas and identify crash reduction strategies
- Prioritize countermeasures/projects
- Prepare the LRSP

Study Area

The City of Patterson is located in the mid-west of California in Stanislaus County. The City covers a total area of 7.8 square miles, of which 7.7 square miles is land and 0.1 square miles water. The City of Patterson is located off Interstate 5 and to the southwest of Modesto, the nearest metropolitan area. The City's estimated population is 23,517 (2021 ACS Five-Year Estimates). State Highway 130 (Sperry Avenue), State Highway 33 (North/South 2nd Avenue), and East/West Las Palmas are main thoroughfares within the City. Nearest cities include Tracy and Westley to the north, Turlock to the east, and Modesto to the northeast. The study area is mapped in **Figure 1**.

Figure 1. Study Area



According to five-year estimates from the American Community Survey (ACS) 2021 from the U.S. Census, 86% of Patterson commuters get to work by driving alone, which matches the County statistic, whereas the State comes in at 78%. The second most common method of commuting to work in Patterson is carpool at 12%. **Table 1** shows various modes of transportation used by Patterson residents to commute to work.

Table 1. Patterson Commute to Work Data

Commute to Work	Patterson	Stanislaus County	California
Drive Alone	86%	86%	78%
Carpool	12%	10%	11%
Public Transportation	<1%	1%	5%
Walked	1%	1%	3%
Other	<1%	2%	3%

Source: Data from the Census Bureau ACS 5-year Estimate 2021

2 | SAFETY PARTNERS

2 SAFETY PARTNERS

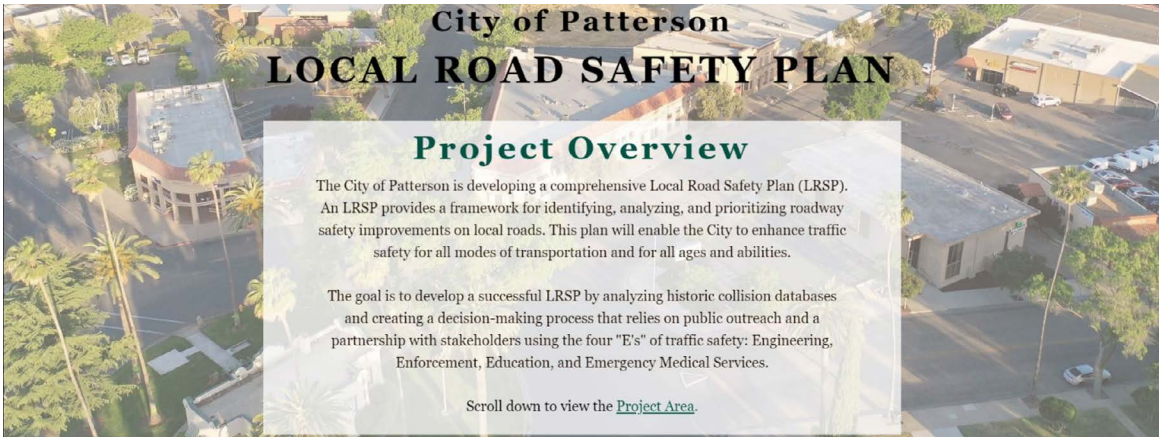
Safety partners are vital to the development and implementation of an LRSP. For the City of Patterson, these include City Staff, Patterson Police Department, Patterson Fire Department, Patterson Unified School District, Stanislaus County Transportation Authority, Caltrans, and Patterson residents. These stakeholders attended one virtual stakeholder meetings, which was held on May 25, 2022 to review project goals and findings, and to solicit feedback from the group. (See **Figure 2**).

In addition, four presentations were given to the Transportation Commission to review projects goals and findings, review website feedback, review countermeasures and safety projects, and provide feedback and comments. These virtual meetings were held on May 25, 2022, June 23, 2022, August 24, 2022, and May 30, 2023.

Figure 2. Zoom Meeting from Stakeholder Meeting #1

This stakeholder outreach was supplemented by a project website with an interactive platform. The interactive map was used to solicit from City of Patterson residents and stakeholder outside the confines of traditional meetings. (See **Figure 3**).

Figure 3. Patterson LRSP Project Website



In total, 160 comments were received through the project website for Patterson. The most comments were received about Sperry Avenue, South 3rd Street, and Ward Avenue, and the most common concerns were visibility, lighting, curves, speeding, and bicycle and pedestrian safety. The results of the interactive map are shown below in **Figure 4**, and summarized in **Figure 5**. In **Figure 4**, each dot and line represents a comment provided by a community member.

Figure 4. Interactive Map Comment Responses

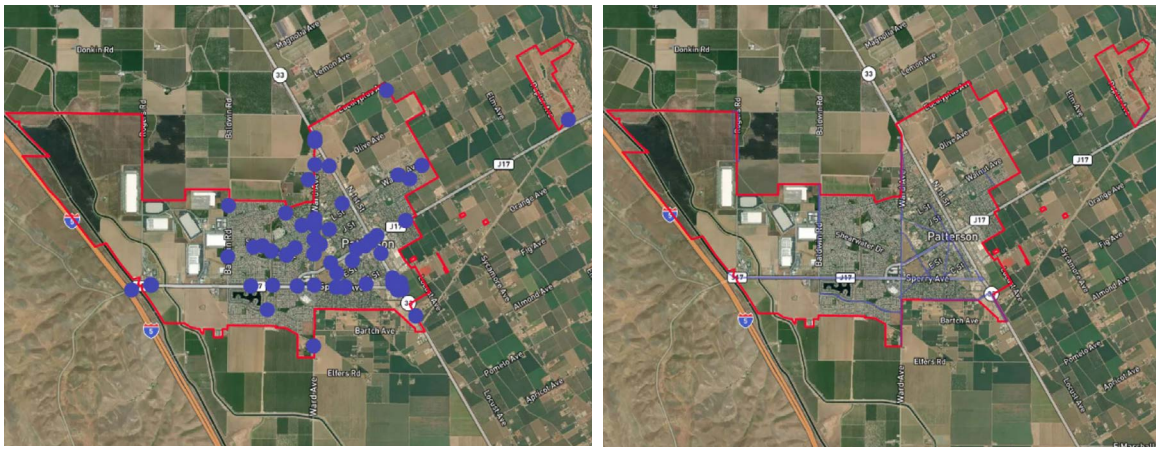
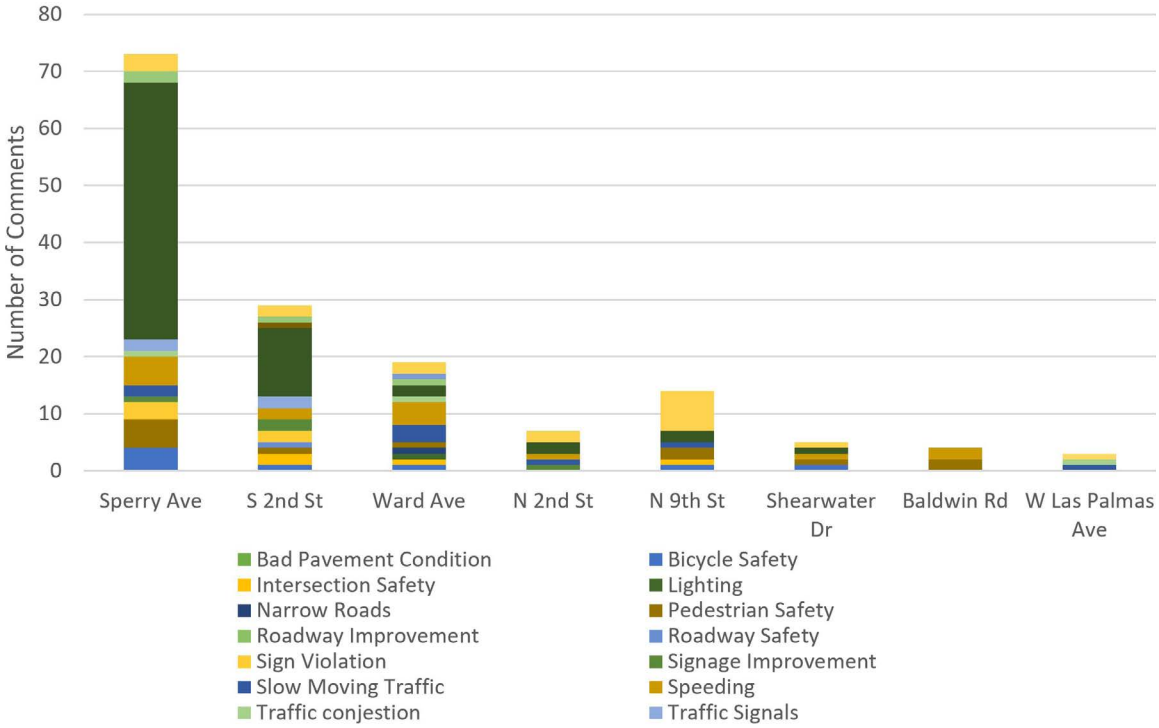


Figure 5. Public Comments on Traffic Safety by Location



Note: Corridors with less than two comments are not listed in this summary. Category was chosen based on the primary issue listed in the comment. Each comment was assigned to the major road if at an intersection.

3 | EXISTING PLANNING EFFORTS

3 EXISTING PLANNING EFFORTS

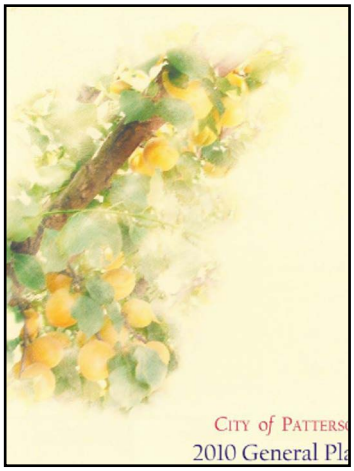
This chapter summarizes the planning documents, projects underway, and studies reviewed for the City of Patterson LRSP. The purpose of this chapter is to ensure the LRSP vision, goals, and 5 E's strategies (**E**ducation, **E**nforcement, **E**ngineering, **E**quity, and **E**mergency Medical Services (EMS)) are aligned with prior planning efforts, planned transportation projects, and non-infrastructure programs for the City. The documents reviewed are listed below:

- City of Patterson General Plan (2010)
- City of Patterson Active Transportation Plan (2021)
- Regional Transportation Plan (2018)
- City of Patterson Transportation Infrastructure Master Plan (TIMP) (2020)
- StanCOG Non-Motorized Transportation Master Plan

The following sections include brief descriptions of these documents and how they inform the development of the LRSP. A detailed list of relevant policies and projects is listed in **Appendix A**.

CITY OF PATTERSON GENERAL PLAN (2010)

The City of Patterson General Plan and its Circulation Element were adopted in November 2010. The purpose of the Circulation Element is to provide goals and policies aimed at meeting the transportation needs of the City. The Circulation Element has identified roadway deficiencies, as well as improvements to achieve and maintain established City standards. The Plan's goals and policies will guide the City of Patterson's LRSP report's countermeasure selection and proposed safety projects. This will assist the LRSP in supporting the City's mobility and transportation needs.

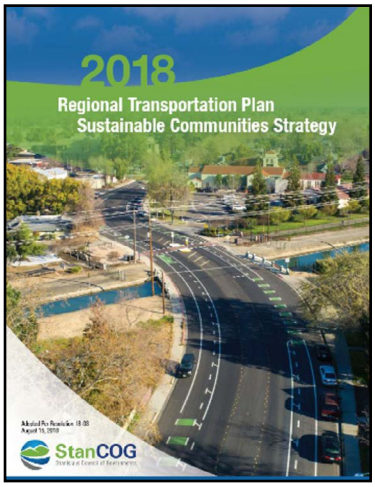


CITY OF PATTERSON ACTIVE TRANSPORTATION PLAN (2021)

The Patterson Active Transportation Plan is a planning effort aimed at enhancing non-motorized modes of transportation, promoting walking and bicycling, identifying community needs, proposing improvements, and identifying potential implementation mechanisms. The plan proposes 41 bicycle, 18 pedestrian projects, and additional supporting infrastructure throughout the City of Patterson. These recommendations will assist the LRSP in developing safety projects.

REGIONAL TRANSPORTATION PLAN

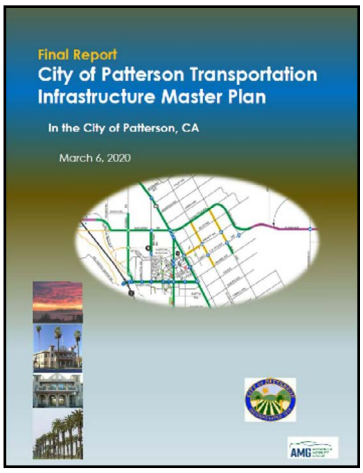
The Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS) for Stanislaus County was developed so that transportation improvements and future land development will be coordinated with each other. The RTP/SCS identifies policies, projects, and programs over 25 years to enhance the region's transportation network. The RTP/SCS was developed in accordance with state and federal guidelines, and supports California's climate goals. One of the key RTP/SCS improvement projects is to place "emphasis on bicycle/pedestrian improvements along central corridors, Class I multi-use trails, and complete street improvements."



CITY OF PATTERSON TRANSPORATION INFRASTRUCTURE MASTER PLAN (TIMP) (2020)

The City Patterson TIMP was prepared in March 2020 and provides transportation infrastructure recommendations based on two future scenarios:

- The 10-year near-term scenario based on a future population of 28,900 residents in Patterson (an increase from 22,524 residents in 2019), and 21,980 jobs in Patterson.
- Master Plan Buildout Scenario, to accommodate a buildout population of 66,300 residents and 81,300 jobs in Patterson.



The TIMP is intended to be used as a tool to help the City plan for anticipated growth in the future. The TIMP recommends to "establish and provide 'Complete Street' policies for all future roadways and will assist the LRSP in developing safety projects.

STANISLAUS COUNCIL OF GOVERNMENTS (STANCOG) NON-MOTORIZED TRANSPORTATION MASTER PLAN (2021)

The StanCOG Non-Motorized Transportation Plan (2021) makes strategic suggestions for improving walking and bicycling in the Stanislaus region based on community participation and technical analysis. The Plan builds on StanCOG's 2013 Non-Motorized Transportation Master Plan by providing new tools and analysis to prioritize regional non-motorized transportation projects that will aid the area in meeting its transportation goals and improve its walking and biking networks, thereby assisting the LRSP in developing safety projects.

4 | COLLISION DATA AND ANALYSIS

4 COLLISION DATA AND ANALYSIS

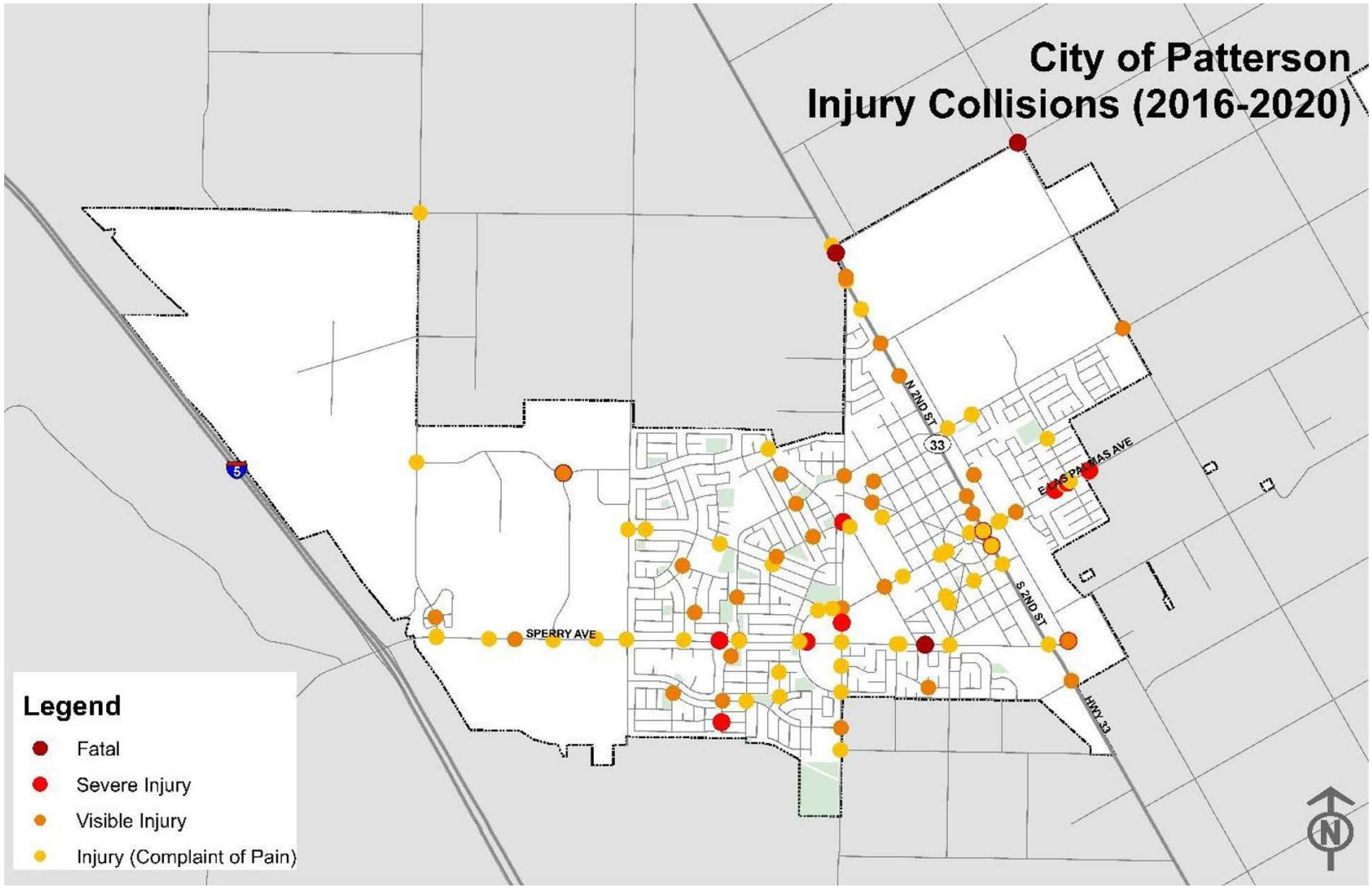
This chapter summarizes the results of the collisions analysis that have occurred in the City of Patterson between January 2016 and December 2020, as part of the LRSP. This chapter includes the following sections:

- Data Collection
- Collision Data Analysis
- KSI Collision Analysis
- Geographic Collision Analysis
- High Injury Network
- Summary

The LRSP focuses on systemically identifying and analyzing traffic safety issues and recommends appropriate safety improvements. The chapter starts with a comprehensive analysis of collisions of all severity in the City of Patterson, including comparison these with KSI collisions. Factors such as collision severity, type of collision, primary collision factor, lighting, weather, and time of the day were analyzed. Following this, a more detailed analysis was conducted for KSI collisions that have occurred on the City's roadways, including analyzing intersection and roadway segment collisions separately.

Figure 6 illustrates all the injury collisions that have occurred in the City of Patterson from January 1, 2016 to December 31, 2020.

Figure 6. Injury Collisions in the City of Patterson (2016-2020)



Data Collection

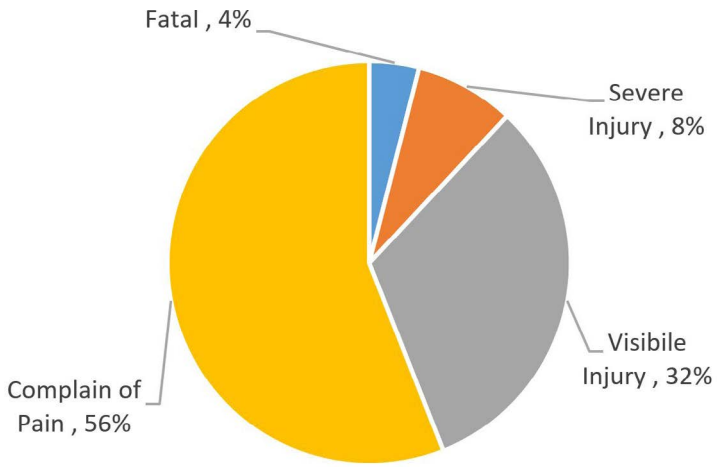
Collision data helps to understand different factors that might be leading to collisions and influencing collision patterns in a given area. For the purpose of this analysis, a five-years of jurisdiction-wide collision data (2016 to 2020) was retrieved from TIMS and SWITRS. Collisions that occurred on State Routes were excluded for this analysis. The collision data was analyzed and plotted in ArcMap to identify high-risk intersections and roadways segments.

Collision Data Analysis Results

COLLISION CLASSIFICATION

There were a total of 142 injury collisions reported on Patterson roads from 2016 to 2020. Out of these 79 collisions (56%) led to complaint of pain injury and 45 collisions (32%) led to a visible injury. There were 18 KSI collisions, of which 12 collisions (8%) led to sever injury and six collisions (4%) led to fatality. **Figure 7** illustrates the classification of all collisions based on severity.

Figure 7. Collisions by Severity (2016-2020)



The analysis first includes a comparative evaluation between all collisions and KSI collisions, based on various factors including (but not limited to): collision trend, primary collision factor, collision type, facility type, motor vehicle involved with, weather, lighting, and time of the day. Following this, a comprehensive analysis is conducted for only KSI collisions. KSI collisions cause the most damage to those affected and to infrastructure. The LRSP process thus focuses on these collision locations to proactively identify and counter safety issues leading to these KSI collisions.

The collision data was separated by facility type, i.e. based on collisions occurring on intersections and roadway segments. For the purposes of the analysis and in accordance with HSIP guidelines, a collision was designated to have occurred at an intersection if it occurred within 250 feet of it. The reported collisions categorized by facility type and collision severity are presented in **Table 2.**

The reported collisions categorized by facility type and collision severity are presented in **Table 2.**

Table 2. Collisions by Severity and Facility Type

Collision Severity	Roadway Segment	Intersection	Total
Killed	0	1	1
Severe Injury	2	13	15
Visible Injury	4	108	112
Complaint of Pain	1	82	83
PDO	10	257	267
Total	**17**	**462**	**478**

Preliminary Analysis

YEARLY TREND

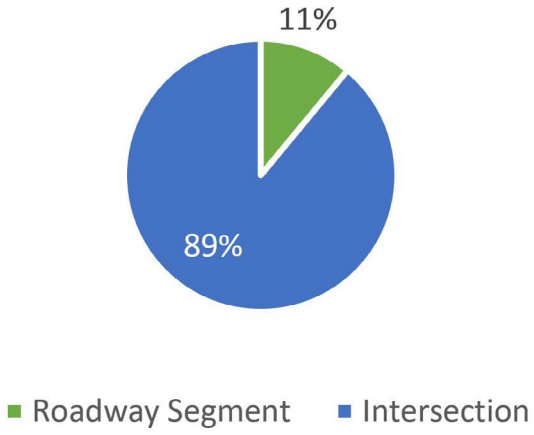
The number of reported collisions of all severity has overall increased from 2016 to 2020. The year with the highest number of collisions was 2020 (38 collisions), while the year with the lowest number of collisions were 2016 and 2017 (17 collisions each year). A total of 18 KSI collisions occurred in Patterson during the study period, overall increasing from 2016 to 2020. The least number of KSI collisions occurred in 2016 (one collision), while the most occurred in 2018 (six collisions). **Figure 8** illustrates the five-year collision trend for all collisions, and KSI collisions.

Figure 8. Five Year Collision Trend

ROADWAY SEGMENT VS. INTERSECTION

When evaluating the locations of collisions, the majority of collisions occurred at intersections. In the City of Patterson, 89% of all collisions (127 collisions) occurred at intersections whereas 11% (15 collisions) occurred on roadway segments. This classification by facility type can be observed in **Figure 9.**

Figure 9. Intersection vs Roadway Collisions – All Collisions



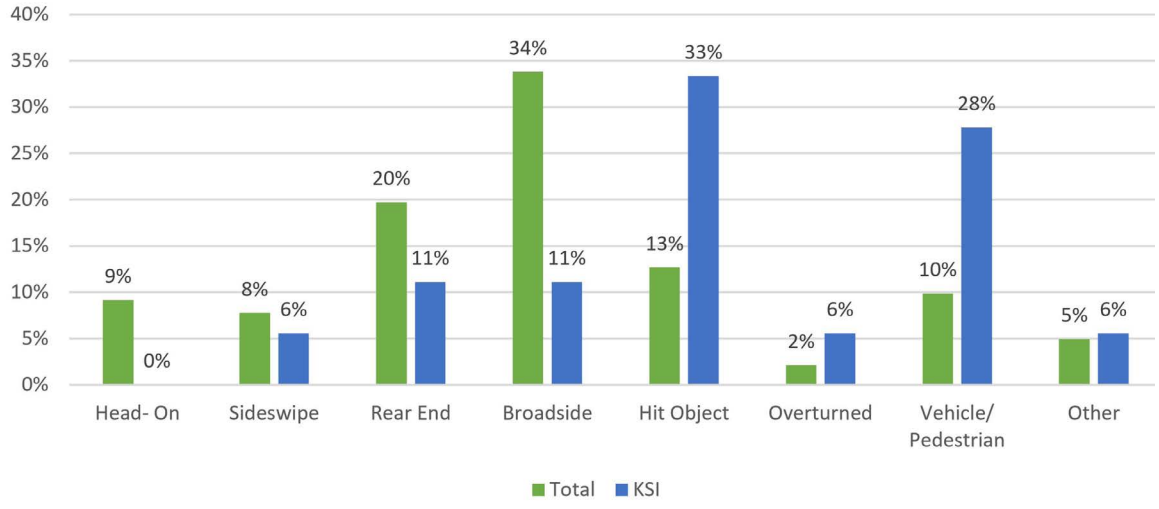
COLLISION TYPE

The most commonly occurring collision type was broadside collisions (34%) and rear end collisions (20%). The collision types for KSI collisions follow a different pattern, where the most commonly occurring collision type was hit object collisions (33%), followed by vehicle/pedestrian collisions (28%) and rear end and broadside collisions each constituting 11% of KSI.

Figure 10 illustrates the collision type for all collisions as well as KSI collisions. Examples of each collision type:

- Broadside: right angle crashes; front of vehicle collides with the side of another vehicle or bicyclist
- Vehicle/Pedestrian: Vehicle collides with a pedestrian
- Other: Specific collision type was not coded into the police report
- Sideswipe: Two vehicles (or with a bicyclist) collide side-by-side
- Rear End: Front of vehicle collides with the rear of another vehicle
- Hit Object: Vehicle typically leaves road and collides with a fixed object, such as a tree or power pole
- Overturned: Vehicle overturns in the collision
- Head-On: Front of vehicle collides with the front of another vehicle or bicyclist

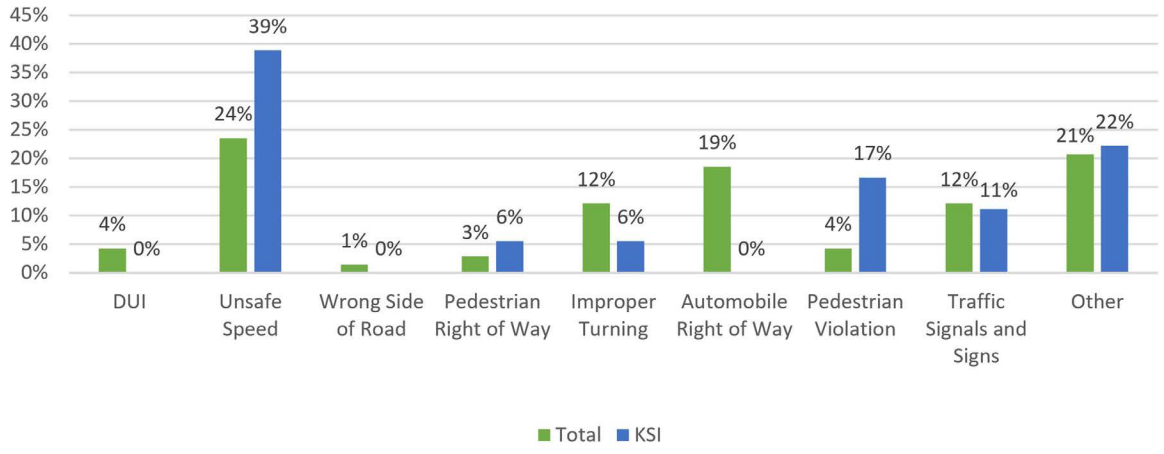
Figure 10. Collision Type – All Collisions vs. KSI Collisions



PRIMARY COLLISION FACTOR

For collisions of all severity, the most common violation category was observed to be unsafe speed (23%) followed by automobile right of way violations (18%). The most common primary violation categories for KSI collisions were unsafe speed (39%), and pedestrian violation (17%). **Figure 11** illustrates the violation category for all collisions and KSI collisions.

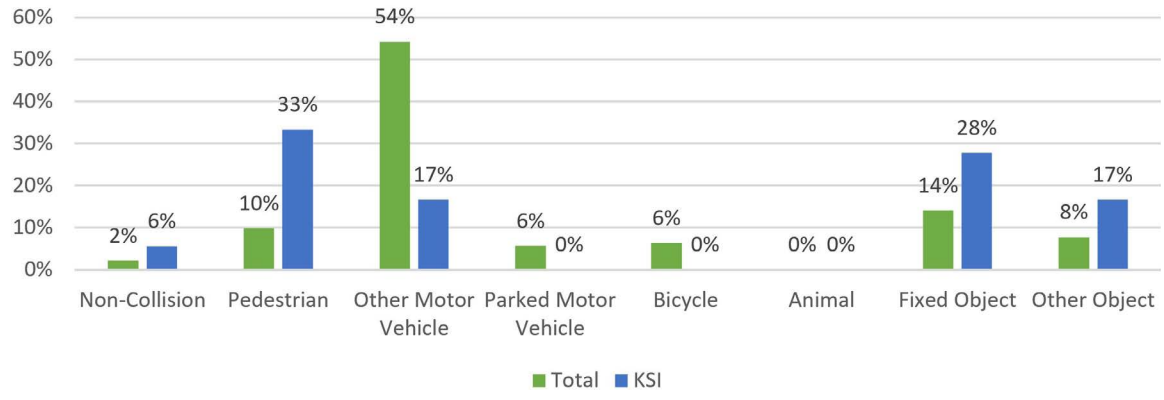
Figure 11. Violation Categories: All Collisions vs. KSI Collisions



MOTOR VEHICLE INVOLVED WITH

For collisions of all severity, 54% of the collisions occurred with other motor vehicles. This was followed fixed objects (14%), and pedestrian collisions (10%). For KSI collisions, 33% involved a pedestrian, 28% involved a fixed object, and 17% involved another motor vehicle. **Figure 12** illustrates the motor vehicle involved with category for all collisions as well as KSI collisions.

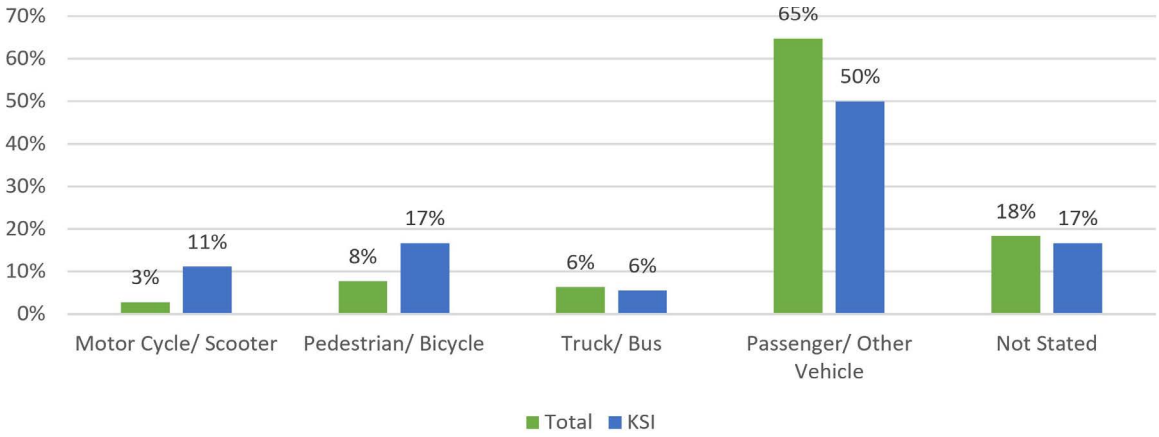
Figure 12. Motor Vehicle Involved with: All Collisions vs. KSI Collisions



MODES

In addition to motor vehicle involved with, modes include a more detailed breakdown of the vehicle type at fault in the accident, including motorcycles and trucks. For collisions of all severity, the majority (besides not stated) were caused by passenger/other vehicles (65%), followed by pedestrian/bicycle (8%). Crashes caused by passenger/other vehicles also makes up the majority of KSI collisions (50%), followed by pedestrian/bicycle caused collisions (17%). **Figure 13** illustrates the percentage for all collisions as well as KSI collisions by mode.

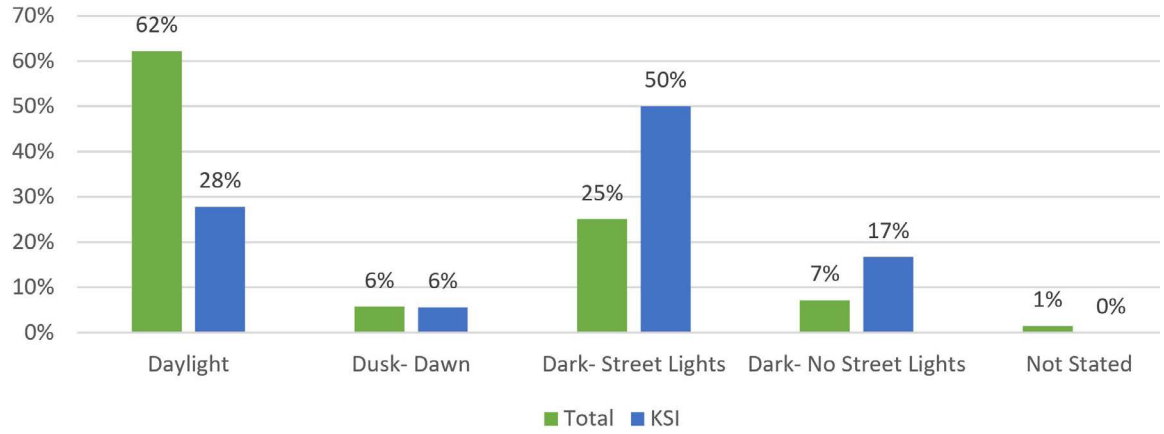
Figure 13. Modes: All Collisions vs. KSI Collisions



LIGHTING

For collisions of all severity, 62% of collisions occurred in daylight, while 25% of collisions occurred in the dark on streets with streetlights. For KSI collisions, lighting conditions follow a different trend, with 50% of collisions having occurred in the dark on streets with streetlights and 28% of collisions occurred in daylight. **Figure 14** illustrates the lighting condition for all collisions and KSI collisions.

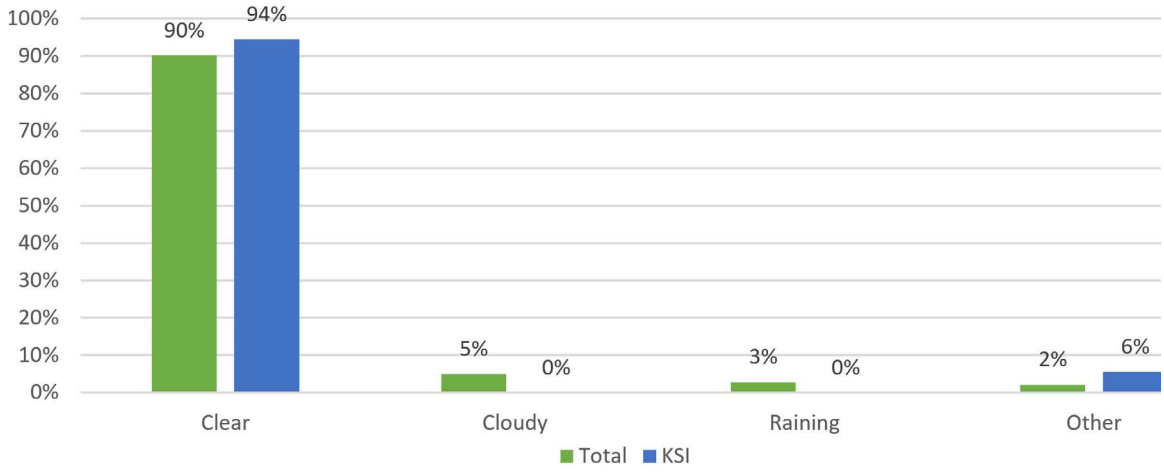
Figure 14. Lighting Conditions: All Collisions vs. KSI Collisions



WEATHER

For all collisions, the vast majority occurred during clear weather conditions (90%). For KSI collisions similar trends have been observed, with 94% of the collisions having occurred during clear weather conditions. **Figure 15** illustrates the percent distribution of weather conditions during occurrence of collisions of all severity as well as KSI collisions.

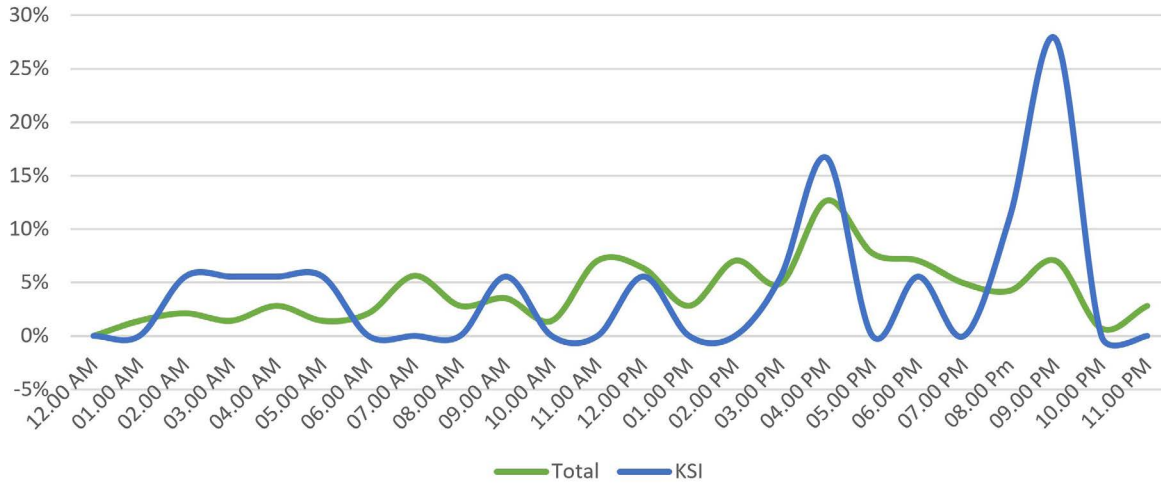
Figure 15. Weather Conditions: All Collisions vs. KSI Collisions



TIME OF THE DAY

For collisions of all severity, the hour with the most number of collisions was between 4:00 PM to 5:00 PM (13%), while the hour with the fewest number of collisions was 12:00 AM to 1:00 AM with zero collisions. For all KSI collisions, maximum number of collisions occurred between 9:00 PM to 10:00 PM (28%). **Figure 16** illustrates the percentage of collisions occurring during each hour of the day for all collisions as well as KSI collisions.

Figure 16. Time of Day: All Collisions vs. KSI Collisions



KSI Collisions

This section describes a detailed collision analysis performed for KSI collisions occurring at roadway segments and intersections in the City of Patterson. Of the total 18 KSI collisions that occurred during the study period, 14 collisions (78%) occurred at intersections, and four collisions (22%) occurred on roadway segments. This distribution is illustrated in **Figure 17.**

Figure 17. Intersection vs. Roadway Segment Collisions – KSI Collisions

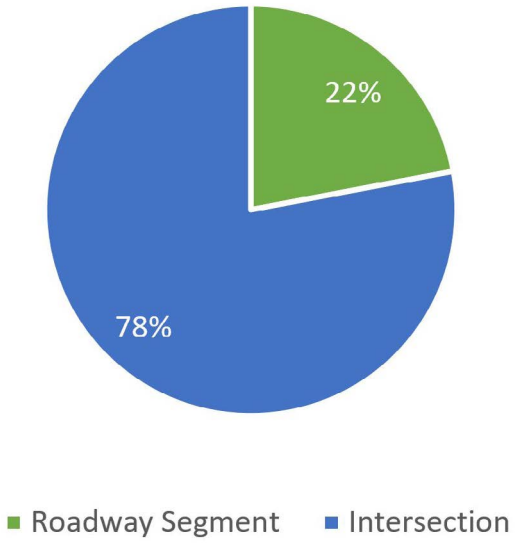
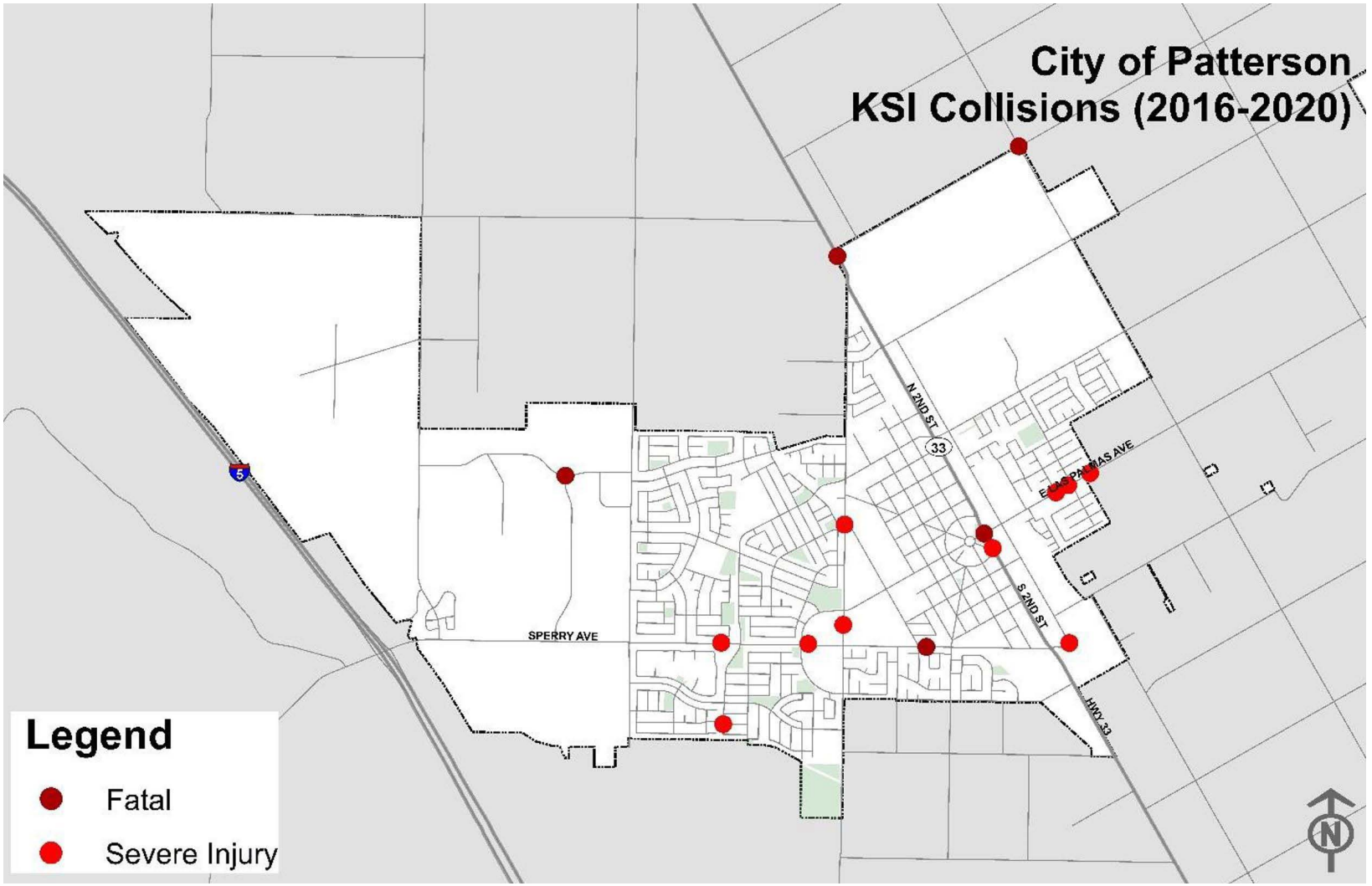


Figure 18 maps the KSI collisions that occurred in the City of Patterson during the study period.

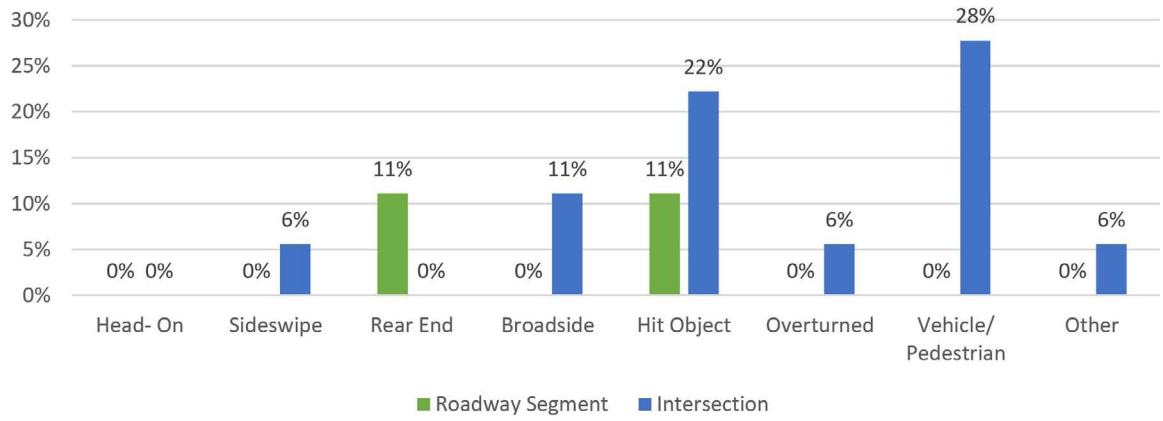
Figure 18. City of Patterson KSI Collisions (2016-2020)



COLLISION TYPE AND LOCATION TYPE

The most common KSI collision type was hit object collisions. These collisions were more likely to occur at intersections vehicle/pedestrian collisions that led to a KSI were the most common intersection collision, while hit object and rear end collisions were most common at roadway segments. **Figure 19** shows KSI collisions locations as well as the collision type.

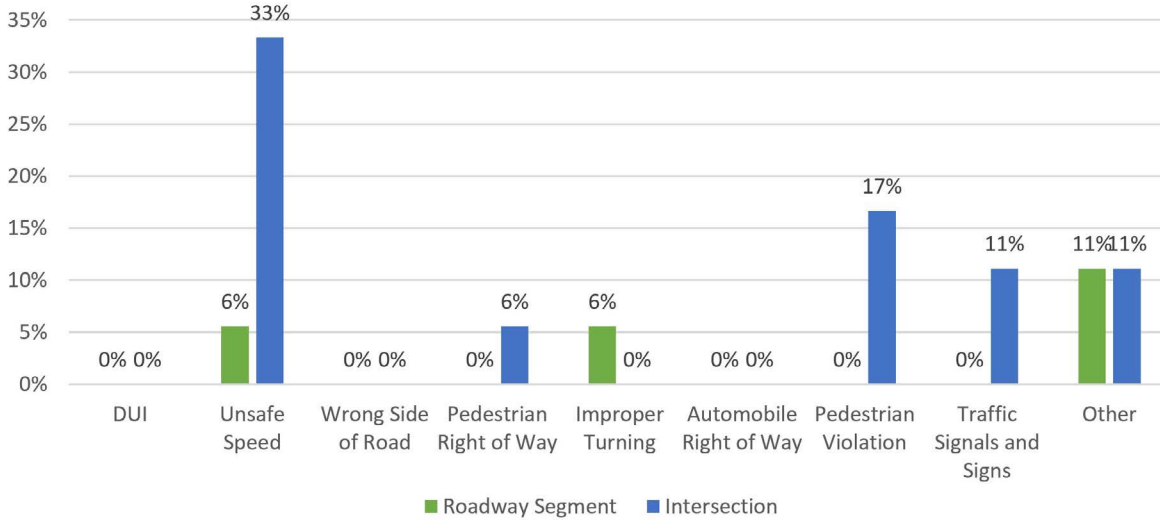
Figure 19. KSI Collisions: Collision Type vs Location Type (2016-2020)



VIOLATION CATEGORY AND LOCATION TYPE

The most common KSI collision type were unsafe speed collisions. These KSI collisions primarily occurred at intersections. On roadway segments, the most common violation categories were improper turning and unsafe speed. **Figure 20** shows KSI collisions as well as the location type and violation category.

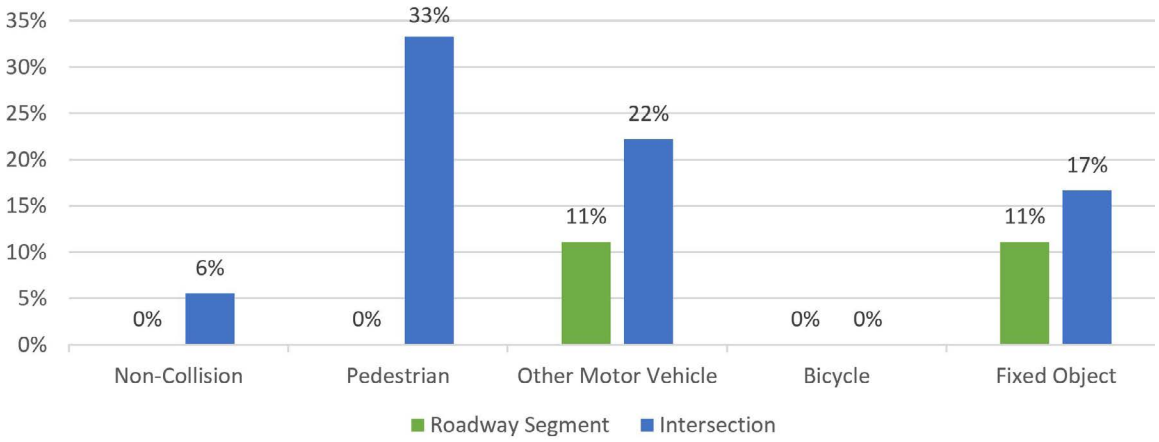
Figure 20. KSI Collisions: Violation Category vs Location Type (2016-2020)



MOTOR VEHICLE INVOLVED WITH AND LOCATION TYPE

KSI collisions involving pedestrian and other motor vehicle followed by fixed object were the most common types occurring at intersection. Other motor vehicle and fixed object collisions occurred on roadway segments. **Figure 21** shows KSI collisions locations as well as the collision type.

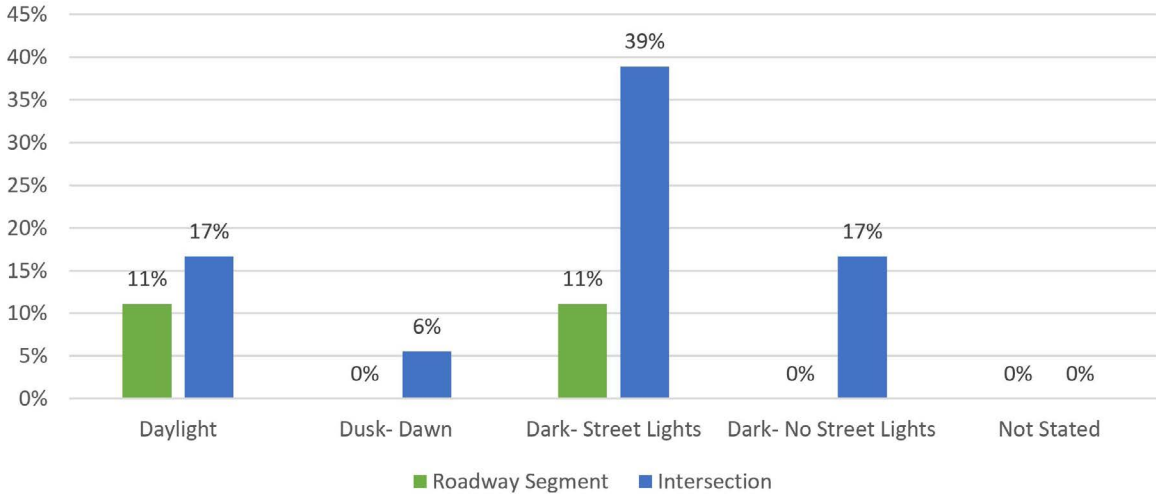
Figure 21. KSI Collisions: Motor Vehicle Involved With vs Location Type (2016-2020)



LIGHTING AND LOCATION TYPE

Most KSI collisions occurred in the dark with streetlights at intersections. The second most common lighting for KSI collisions was collisions that occurred at daylight at intersections, as well as collisions that occurred in the dark on streets with no streetlights at intersections. **Figure 22** shows KSI collisions locations as well as lighting conditions.

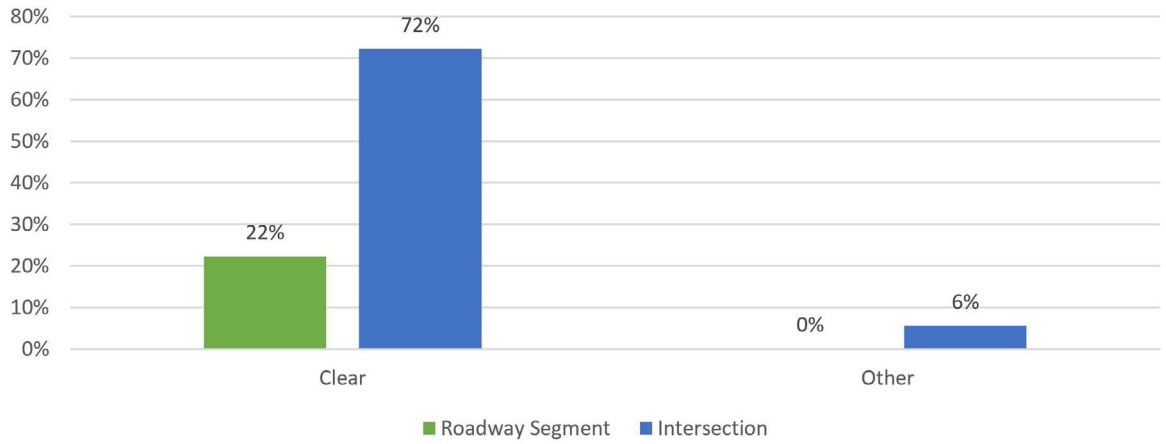
Figure 22. KSI Collisions: Lighting vs Location Type (2016-2020)



WEATHER AND LOCATION TYPE

The majority of KSI collisions occurred during clear weather at both intersections and along roadway segments. **Figure 23** shows KSI collisions locations as well as weather conditions.

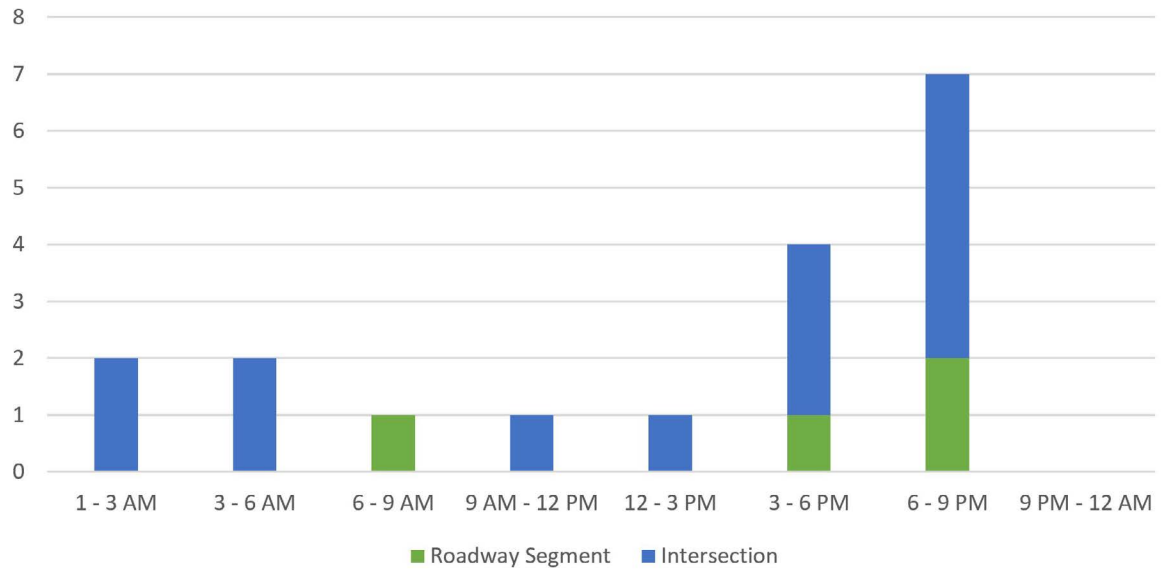
Figure 23. KSI Collisions: Weather vs Location Type (2016-2020)



TIME OF DAY AND LOCATION TYPE

The time period with the most KSI collisions at intersections was during 6:00 PM to 9:00 PM, followed by 3:00 PM to 6:00 PM. For roadway segments, the time period between 6:00 PM to 9:00 PM had the most number of collisions. **Figure 24** shows KSI collisions by location type and time of day.

Figure 24. KSI Collisions: Time of Day vs Location Type (2016-2020)

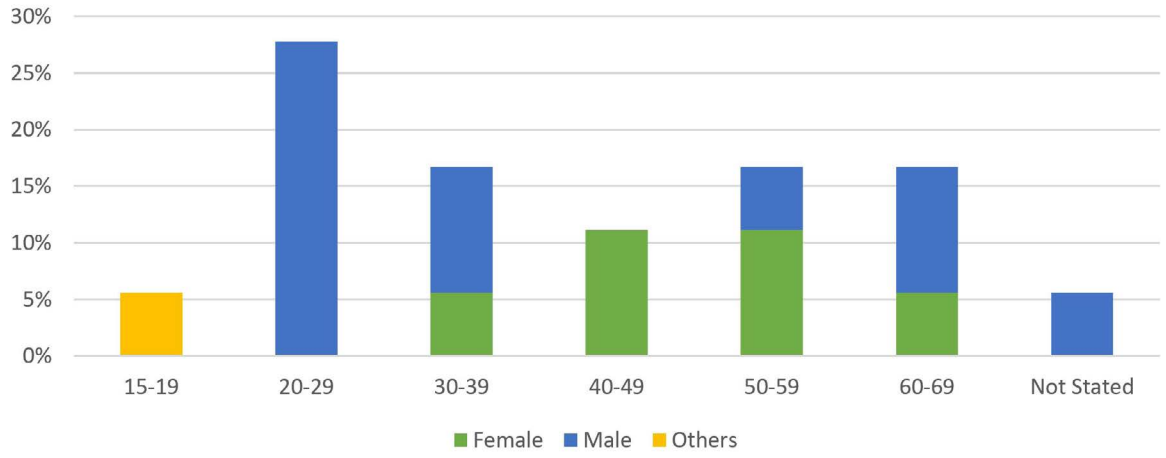


GENDER VS. AGE

For KSI collisions, the gender of the party at fault was much more likely to be male than female (61% of KSI collisions were caused by a male). The party at fault was also slightly more likely to be young adults, with the largest age group being 20-29 years (28%). Parties at fault under 40 years of age accounts for more than half (50%) of all KSI collisions.

Figure 25 illustrates the gender and age of the party at fault for KSI collisions.

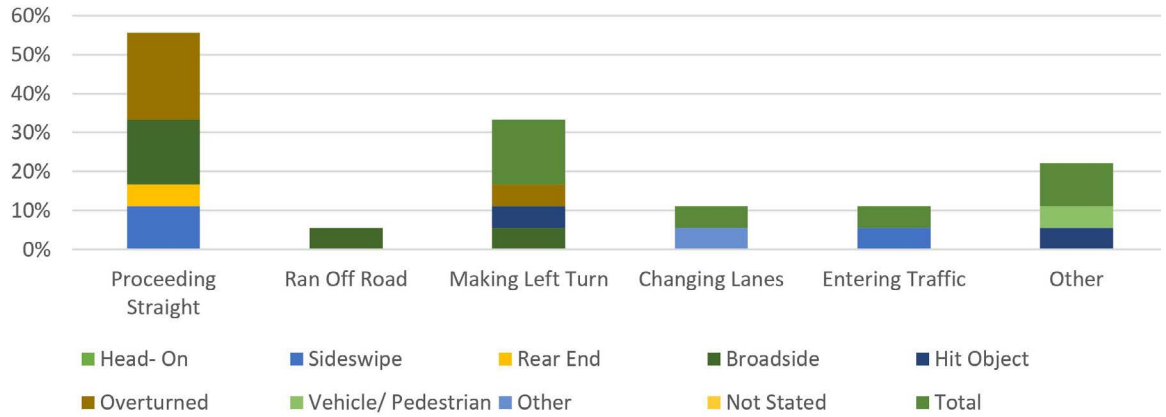
Figure 25. KSI Collisions: KSI Collisions by Gender and Age



COLLISION TYPE VS. MOVEMENT PRECEDING COLLISION OF PARTY AT FAULT

The most common type of collision for KSI collisions was hit object collisions. Of these collisions, other was the most common movement preceding the collision of the party at fault (78%), followed by making right turn (17%) proceeding straight (6%). **Figure 26** shows this distribution.

Figure 26. KSI Collisions by Broadside Collisions and Movement Preceding Collision of Party at Fault



Geographic Collision Analysis

This section describes a detailed geographic collision analysis performed for injury collisions occurring on roadway segments and at intersections in the City of Patterson. The above collision analysis was used to identify five main collision factors that highlight the top trends among collisions in Patterson. These five collision factors were identified to be hit object collisions, unsafe speed violation, nighttime collisions, pedestrian and bicycle collisions, and broadside collisions.

HIT OBJECT COLLISIONS

For KSI collisions in Patterson, 33% were hit object collisions. This is much higher than its share of collisions of all severity (13%). **Figure 27** shows the distribution of hit object collisions throughout the City of Patterson between 2016 and 2020. Las Palmas Avenue has a higher concentration of hit object collisions, compared to other Patterson roads.

UNSAFE SPEED COLLISIONS

For KSI collisions in the City of Patterson, 39% occurred due to unsafe speed violation (compared to 23% of all collisions). **Figure 28** shows the distribution of unsafe speed collisions throughout the City of Patterson between 2016 and 2020. The 2nd Street has a higher concentration of unsafe speed collisions, compared to other Patterson roads.

NIGHTTIME COLLISIONS

For KSI collisions in the City of Patterson, 50% occurred in nighttime (dark with streetlights) compared to only 25% of collisions of all severities. **Figure 29** shows the distribution of nighttime collisions throughout the City of Patterson between 2016 and 2020. Sperry Avenue has a higher concentration of nighttime collisions, compared to other Patterson roads.

PEDESTRIAN AND BICYCLE COLLISIONS

For KSI collisions in the City of Patterson, 33% of collisions occurred due to involvement of pedestrians (compared to only 16% of collisions of all severities). **Figure 30** shows the distribution of pedestrian collisions throughout the City of Patterson between 2016 and 2020. The 2nd Street has a higher concentration of pedestrian collisions, compared to other Patterson roads.

BROADSIDE COLLISIONS

For KSI collisions in the City of Patterson, 11% occurred due broadside collisions (compared to 34% of collisions of all severities). **Figure 31** shows the distribution of broadside collisions throughout the City of Patterson between 2016 and 2020. The 2nd Street has a higher concentration of broadside collisions, compared to other Patterson roads.

Figure 27. Hit Object Collisions

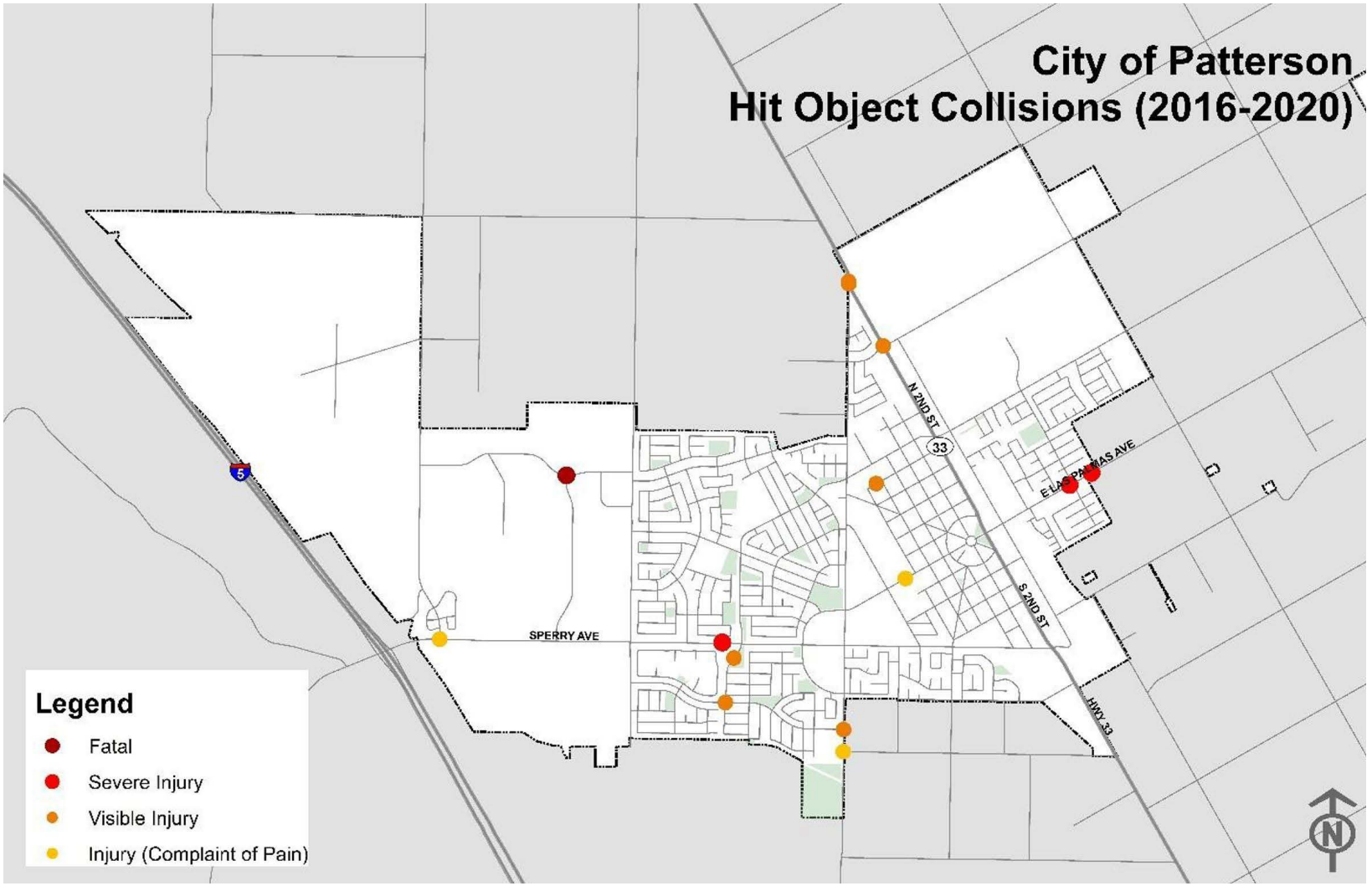


Figure 28: Unsafe Speed Collisions

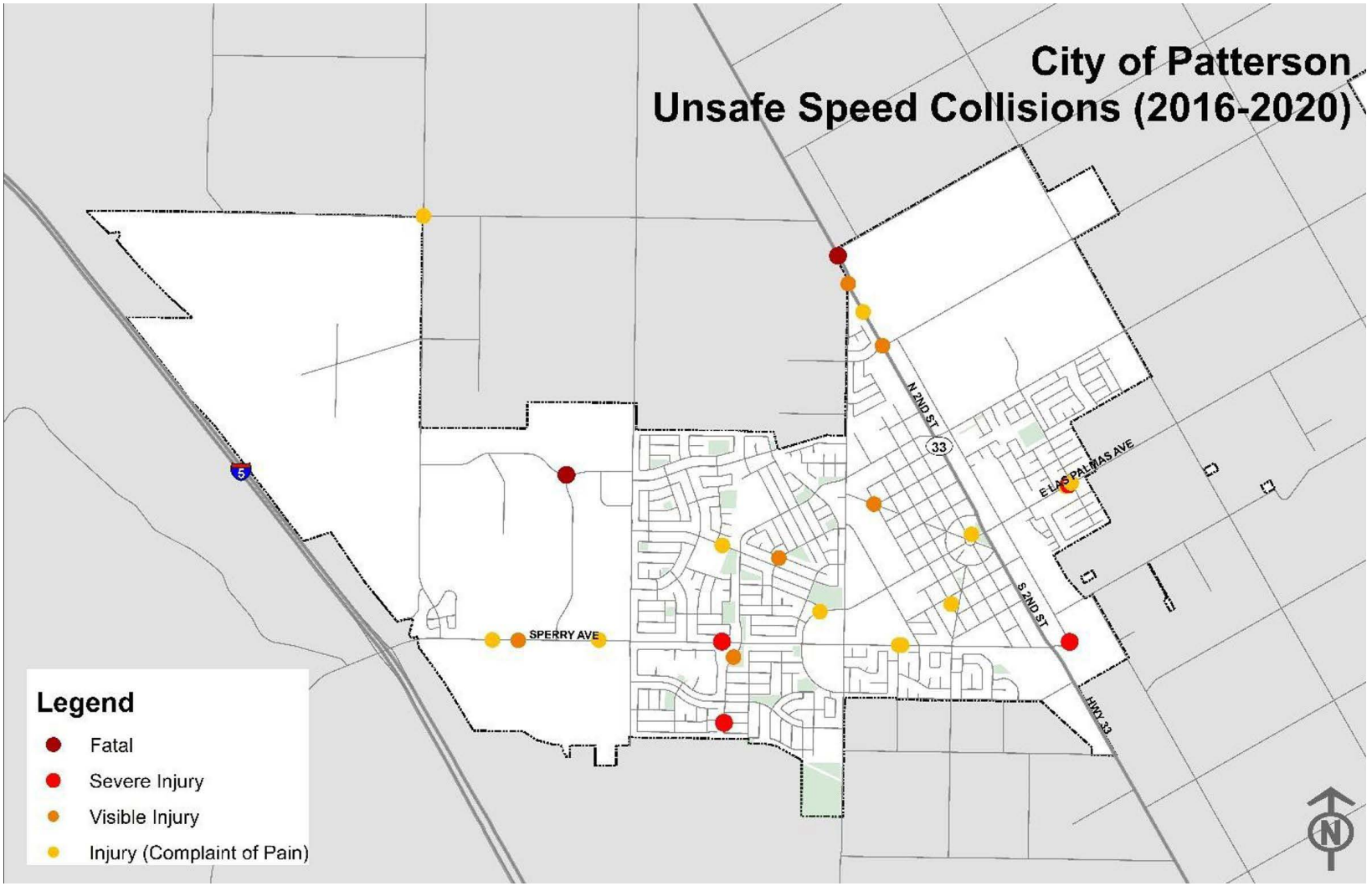


Figure 29: Nighttime Collisions

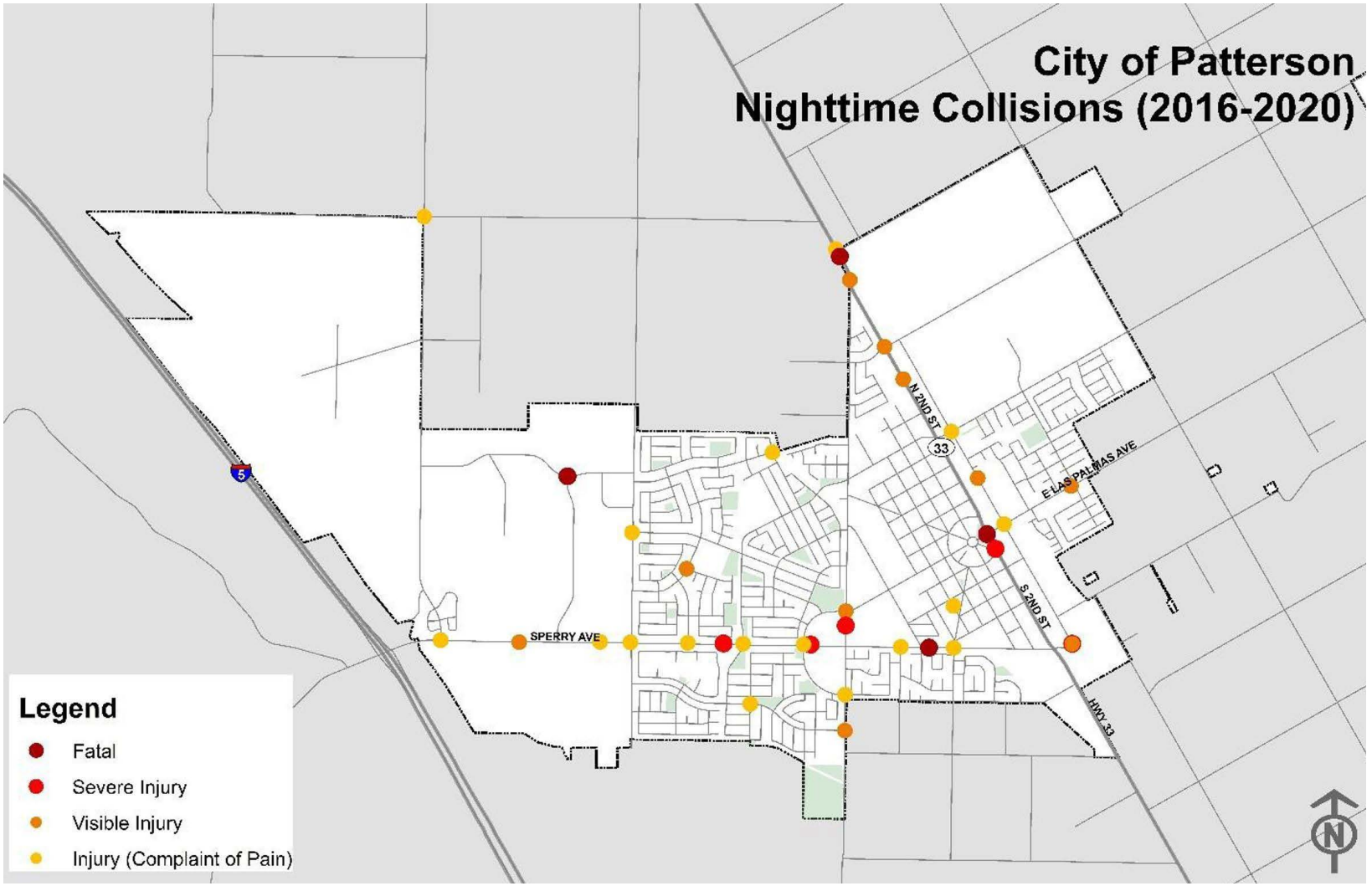


Figure 30: Pedestrian and Bicycle Collisions

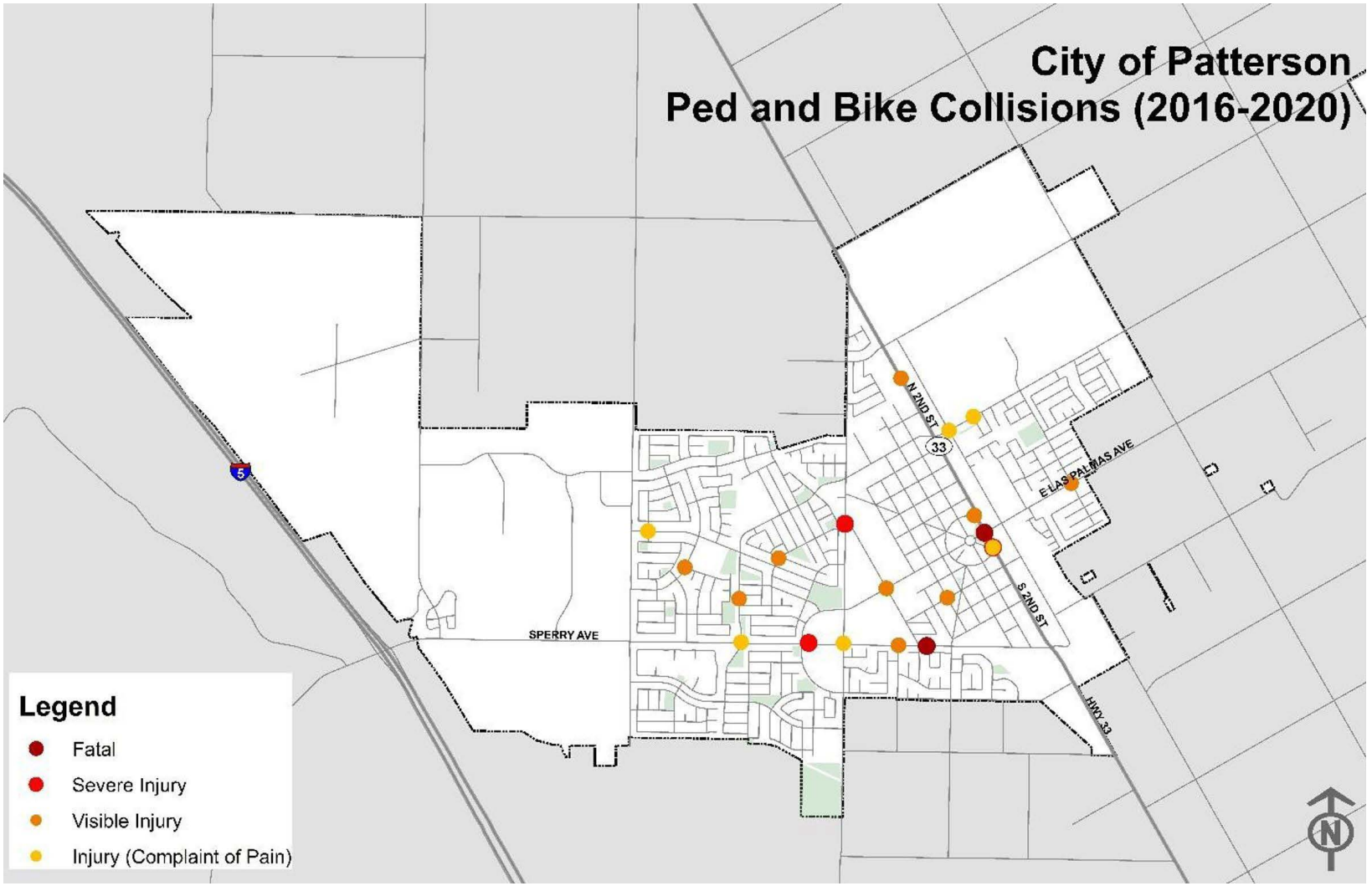
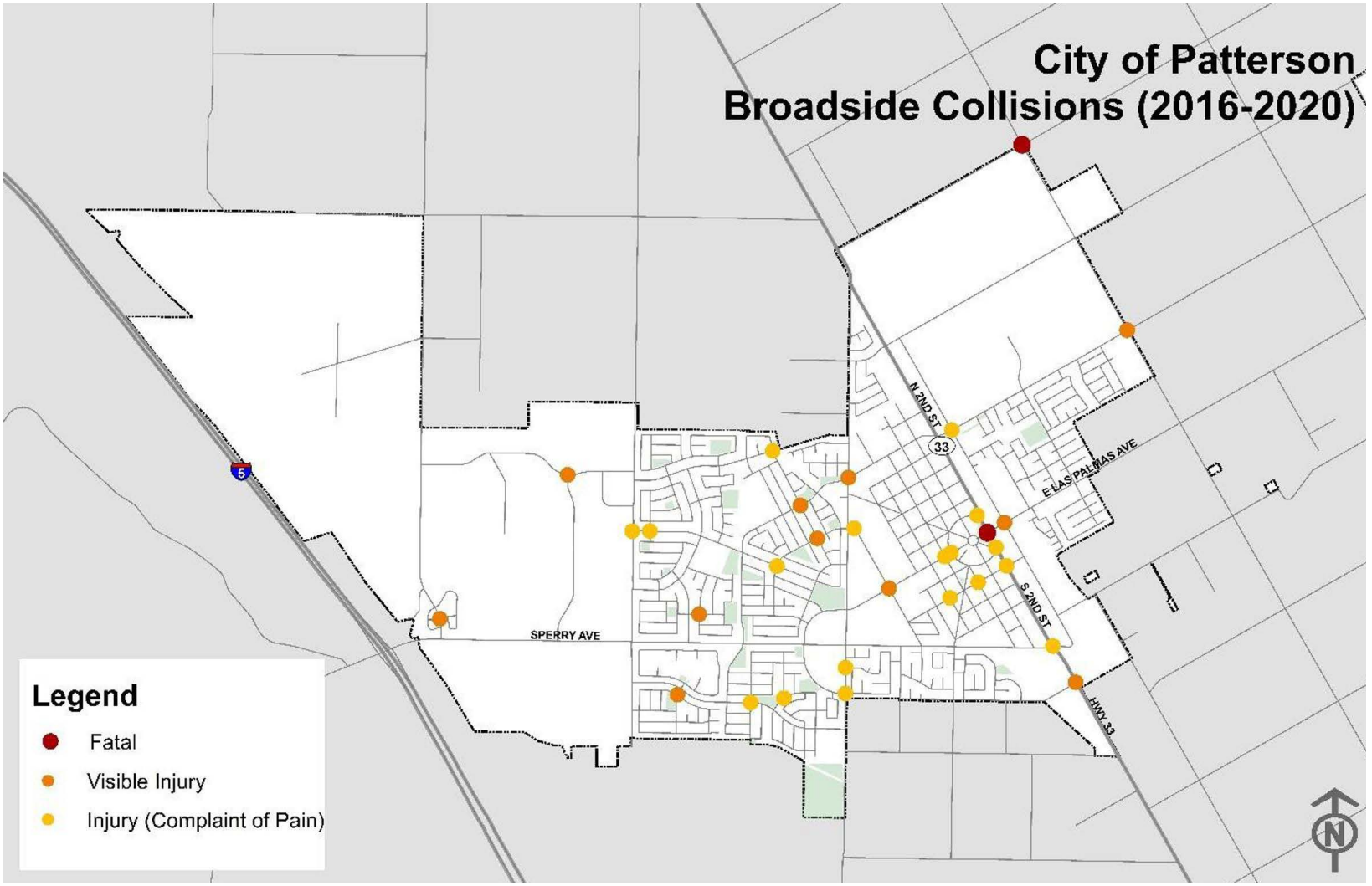


Figure 31: Broadside Collisions



Equivalent Property Damage Only (EPDO) Score

The EPDO method was used to identify the high severity collision network. The EPDO method accounts for both the severity and frequency of collisions by converting each collision to an equivalent number of property damage only (PDO) collisions. The EPDO method assigns a crash cost and score to each collision according to the severity of the crash weighted by the comprehensive crash cost. These EPDO scores are calculated using a simplified version of the comprehensive crash costs per HSIP Cycle 10 application. The weights used in the analysis are shown below in **Table 3**.

Table 3. EPDO Score used in HSIP Cycle 11

Collision Severity	EPDO Score
Fatal and Severe Injury Combined	165*
Visible Injury	11
Possible Injury	6
PDO	1

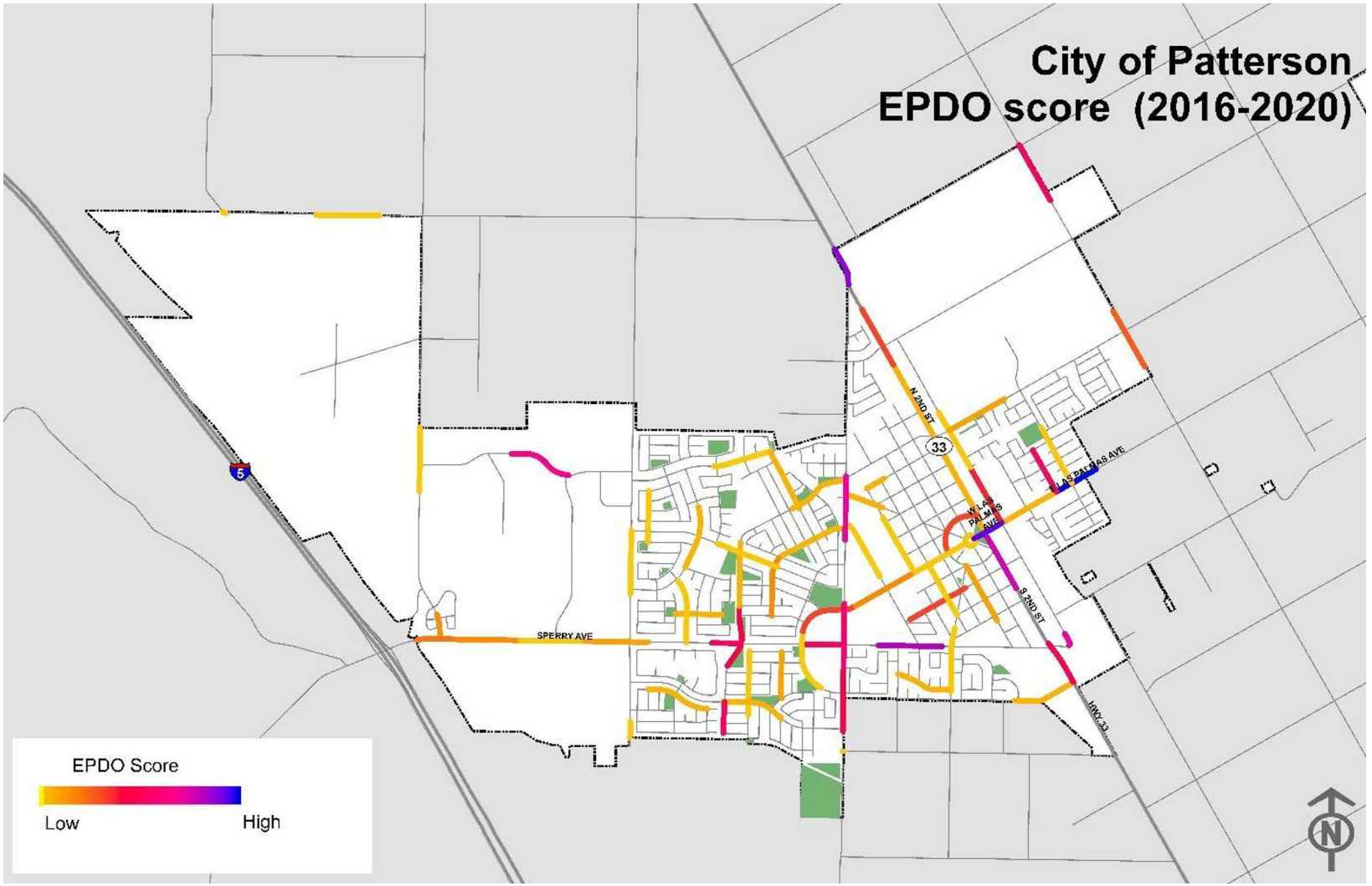
*This is the score used in HSIP Cycle 11 for collisions on roadways segments, to simplify the analysis this study uses the same score for all KSI collisions regardless of location.

EPDO is used because it provides a methodology for the project team to understand the locations in Patterson that are experiencing the most severe crashes. Because of the high score given to KSI crashes, locations that have these types of crashes are more likely to receive a higher EPDO score than other locations that may have more collisions, but fewer KSI collisions. Locations that have the highest EPDO scores are selected for inclusion in the High Injury Network. Identified intersections are scored based on collisions occurring at or within 250 feet of the intersection, while roadway segment locations are identified based on collisions that occur along the segment, except directly at an intersection (zero feet from intersection per the collision data). Identifying the locations with the most severe crashes allows the team to focus recommended solutions and countermeasures at these locations.

The EPDO scores for all collisions can then be aggregated in a variety of ways to identify collision patterns, such as location hot-spots. The weighted collisions for the City of Patterson were geolocated onto Patterson's road network. For the purposes of this analysis (and future analyses), PDO collisions were included. GIS is then used to calculate the EPDO score for each roadway segment and intersection citywide, which is then ranked according to its score.

Figure 32 shows the location and geographic concentration of collisions by their EPDO score.

Figure 32. City of Patterson EPDO Score

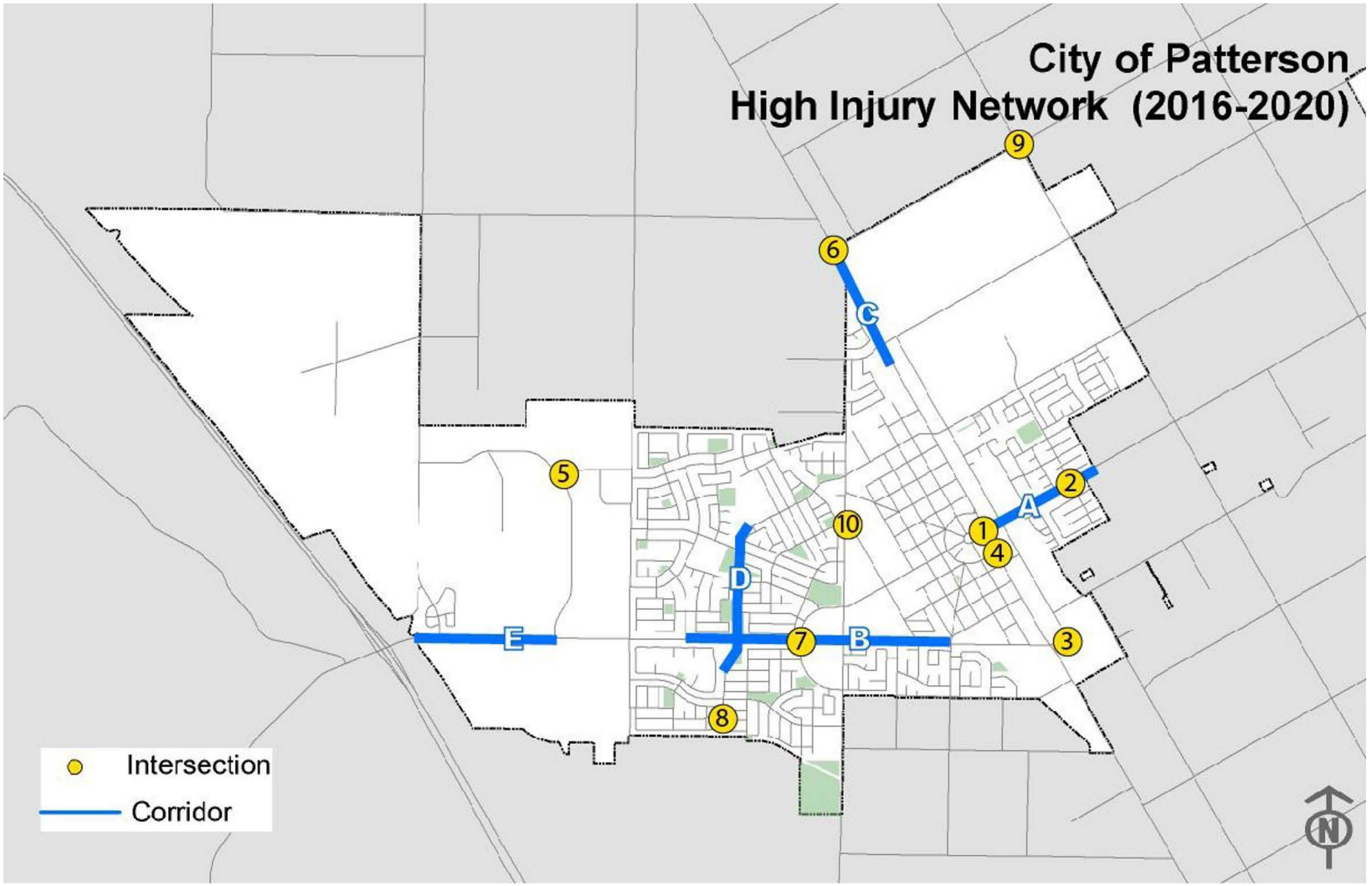


High Injury Network

The EPDO method was used to identify the high severity collision network. The EPDO method accounts for both the severity and frequency of collisions by converting each collision to an equivalent number of PDO collisions. The EPDO method assigns a crash cost and score to each collision according to the severity of the crash weighted by the comprehensive crash cost. These EPDO scores are calculated using a simplified version of the comprehensive crash costs per HSIP Cycle 11 application. The weights used in the analysis are shown in **Table 4.**

Figure 33 illustrates high injury network for intersections and corridors.

Figure 33. City of Patterson High Injury Network



Intersection Ranking

A total of 10 intersections were identified as high injury intersections. There were a total of 11 KSI collisions that occurred at these intersections. The intersection of 2nd Street and Las Palmas Avenue has the highest EPDO score with 342.

Table 4 lists the EPDO score of the top 10 identified high injury intersections along with the type of collisions and the number of KSI collisions that occurred at these locations.

Table 4. High Injury Intersections

ID	Intersection	Total	KSI	Hit Object	Unsafe Speed	Night time	Bike/ Ped	Broad side	EPDO Score
		Collisions							
1	2nd Street and Las Palmas Avenue	4	2			1	1		342
2	Las Palmas Avenue and Hartley Street	6	1	1	4	1	1		205
3	1st Street and Sperry Avenue	3	1	1	2	1			182
4	2nd Street and El Circulo	3	1			1	1		177
5	Keystone Pacific Parkway and Park Center Drive	2	1	1	2	1		1	176
6	Eucalyptus Avenue and Highway 33	2	1		1	1			171
7	Sperry Avenue and Las Palmas Avenue	2	1			1	1		165
8	Cornflower Avenue and American Eagle Avenue	1	1		1				165
9	Eucalyptus Avenue and Sycamore Avenue	1	1					1	165
10	9th Street and Ward Avenue	1	1					1	165

CORRIDOR RANKING

A total of five corridors were identified as high injury corridors. There were a total five KSI collisions on these corridors. The corridor with the highest EPDO score is Las Palmas Avenue from City boundary to 2nd Street.

Table 5 lists the collision rate of the top five identified high collision corridors along with the number of KSI collisions, total collisions and EPDO score.

Table 5. High Injury Corridors

ID	Corridors	Total	KSI	Hit Object	Unsafe Speed	Night time	Bike/ Ped	Broad side	Length (miles)	EPDO Score
		Collisions								
A	Las Palmas Avenue from East City Limit to 2nd Street	5	2	2		3	2	2	0.8	358
B	Sperry Avenue from Del Puerto Avenue to Walker Ranch Parkway	4	2				6		1.1	342
C	2nd Street from North City Limit to 0.2 miles south of Walnut Avenue	4	1	2			3	2	0.6	188
D	American Eagle Avenue from Creekside Middle School to Fawn Lily Drive	3		1			3	1	0.8	33
E	Sperry Avenue from West City Limit to Park Center Drive	2		1			1	1	0.5	17

During the study period of 2016-2020, a total of 478 collisions occurred on Patterson roads, of which 16 resulted in either a killed or severe injury. The number of collisions occurring each year has been overall decreasing, with the most occurring in 2016 (the most KSI collisions occurred in 2018). A majority of collisions occurred at intersections not along roadway segments. Based on the collision data, five prominent trends emerged: broadside collisions, improper turning, pedestrian collisions, bicycle collisions, and rear end collisions. Each of these were selected because they were prominent factors in causing collisions on the City's roadways, with a particular emphasis on KSI collisions. A more detailed geographic analysis was conducted for each of the five identified trends.

Broadside Collisions: For KSI collisions in Patterson, 25% of collisions were broadside collisions. This is slightly higher than its share of collisions of all severity (22%). Broadside collisions can potentially be mitigated by increasing the visibility of an intersection through updated pavement markings, new or updated signage, lighting, advance rectangular rapid flashing beacons, and improving sight distance.

Improper Turning Collisions: For KSI collisions in the City of Patterson, 13% of collisions occurred due to improper turning violation, the most of any category. It also contributed to 19% of all collisions. Countermeasures such as improving sight distance at intersections, installing dedicated left turn lanes, median splitter islands on minor road approaches, and raised medians can help to mitigate improper turning caused collisions.

Pedestrian Collisions: 25% of KSI collisions in Patterson involved a pedestrian, compared to just 8% of collisions of all severity. Countermeasures such as traffic calming, high visibility crosswalks, Rectangular Rapid Flashing Beacon (RRFB), sidewalk bulb outs, advanced flashing warning signs, can all help to address pedestrian collisions.

Bicycle Collisions: 19% of KSI collisions in Patterson involved a bicycle, compared to 8% of collisions of all severity. These collisions can potentially be mitigated with enhanced bicycle infrastructure, such as protected bike lanes, bicycle boxes at signalized intersections, green paint for enhanced visibility, additional lighting, or adding bike lanes/widening shoulders.

Rear End Collisions: 26% of collisions of all severity were rear end collisions, the most of all collision types. It also makes up 6% of KSI collisions. Rear end collisions can potentially be mitigated through upgrading signal hardware or adding retroreflective borders, improving signal timing, upgrading/adding intersection warning signs, or adding flashing beacons in advance of intersections. Methods to reduce speeding, such as traffic calming, can also help to address rear end collisions.

The Emphasis Areas identified are based on the collision analysis presented in this report. The most prominent collision types, violations, and human behaviors have been selected for inclusion as an Emphasis Area, as these represent the most prominent traffic safety issues in Patterson. Each Emphasis Area is accompanied with strategies corresponding to the 5 E's of safety to comprehensively make the City of Patterson safer for all modes of transportation.

5 | EMPHASIS AREAS

5 EMPHASIS AREAS

Emphasis areas are focus areas for the LRSP that are identified through the comprehensive collision analysis of the identified high injury locations within the City of Patterson. Emphasis areas help in identifying appropriate safety strategies and countermeasures with the greatest potential to reduce collisions occurring at these high injury locations. They can include (but not be limited to): specific collision types, human behaviors, facility types, and specific locations or corridors.

This section summarizes the top six emphasis areas identified for Patterson. These emphasis areas were derived from the consolidated high injury collision database (**Appendix B**) where top injury factors were identified by combing the data manually. The high injury collision database contains only collisions occurring at the high injury intersections or along the high injury corridors. Along with findings from the data analysis, stakeholder input was to refine the emphasis areas specific to Patterson.

The following are the identified emphasis areas:

- Address Hit Object Collisions
- Address Unsafe Speed Collisions
- Address Pedestrian Safety
- Address Nighttime Collisions
- Address Broadside Collisions
- Improve Sperry Avenue (Intersections)

The 5 E's of Traffic Safety

The LRSP utilizes a comprehensive approach to safety incorporating "5 E's of traffic safety": **E**ngineering, **E**nforcement, **E**ducation, **E**quity, and **E**MS. This approach recognizes that not all locations can be addressed solely by infrastructure improvements. Incorporating the 5 E's of traffic safety is often required to ensure successful implementation of significant safety improvements and reduce the severity and frequency of collisions throughout a jurisdiction.

Some of the common violation types that may require a comprehensive approach are speeding, failure-to-yield to pedestrians, red light running, aggressive driving, failure to wear safety belts, distracted driving, and driving while impaired. When locations are identified as having these types of violations, coordination with the appropriate law enforcement agencies is needed to arrange visible targeted enforcement to reduce the potential for future driving violations and related crashes and injuries.

To improve safety, education efforts can be used to supplement enforcement and improve the efficiency of each strategy. Education can also be employed in the short-term to address high crash locations until the recommended infrastructure project can be implemented. Similarly, EMS entails strategies around supporting organizations that provide rapid response and care when responding to collisions causing injury, by stabilizing victims and transporting them to facilities.

Existing Traffic Safety Efforts in Patterson

The City of Patterson and partner agencies have already implemented safety strategies corresponding to the 5 E's of traffic safety. The strategies detailed in this chapter can supplement these existing programs and concentrate them on high injury collision locations and crash types. These initiatives are summarized **Table 6.**

Table 6. Existing Programs Summary

Document/ Program	Description	E's Addressed
City of Patterson Active Transportation Program	The Active Transportation Plan identifies pedestrian and bicycle infrastructure deficiencies throughout Patterson, recommend solutions, and addresses future Active Transportation expansion demands.	Education and Engineering
Patterson Urban Bicycle Trail Project	This project will fill in existing gaps to create a continuous bike and pedestrian path along Salado Creek and American Eagle Avenue, connecting two schools and three public parks.	Engineering, Encouragement, Enforcement, and Evaluation
Local Road Safety Plan	LRSP will address mobility and transportation safety concerns throughout Patterson. The purpose of this project is to evaluate current conditions, identify potential roadway hazards, and utilize historical collision data to help prevent traffic fatalities and improve the safety of motorized and non-motorized stakeholders who utilize public right-of-way roadways.	Engineering, Encouragement, Education, Enforcement, and Evaluation
The Patterson Police Department	The Patterson Police Department is responsible for the preservation of public peace, enforcement of laws, protection of life and property, and providing police related services to the community.	Education, Enforcement, and EMS
The Patterson Fire Department	The Patterson Fire Department provides all-risk emergency services to the City of Patterson and, through an automatic-aid agreement, portions of the West Stanislaus Fire Protection District service area. The department provides a wide variety of services to an expanding and diverse population.	Education, Enforcement, and EMS

Factors Considered in the Determination of Emphasis Areas

This section presents collision data analysis of collision types, collision factors, facility types, roadway geometries, and party level data, analyzed to identify the various emphasized areas. Emphasis areas were determined by factors that led to the highest amount of injury collisions, with a specific emphasis on KSI injury collisions. City of Patterson experienced a total of 39 collisions (27% compared to all collisions) at high injury network locations during the 2016-2020 study period, including 15 (83% compared to all KSI collisions) KSI collisions. The data presented below in each emphasis area is based on these collisions.

Each emphasis area is accompanied by comprehensive programs, policies, and countermeasures to reduce collisions on City roads in that specific emphasis area. It will provide the basis by which the countermeasure toolbox will be developed for each identified high-risk location.

EMPHASIS AREA 1 – ADDRESS HIT OBJECT COLLISION

Seven collisions (18%) on the high injury network were hit object collisions, including four (27% compared to all high injury network) KSI collisions. The major cause to hit object on high injury network were due to unsafe speed violations (71%) that also caused three (75%) out of four KSI collisions. The analysis also shows that majority (60%) of the hit object collisions due to unsafe speed violations on high injury networks happened at intersections. The following collision data is based on only hit object collisions on the high injury network within the City of Patterson, followed by 5 E's strategies to address them. These strategies are summarized in **Table 7** below:

40%
Hit Object (KSI) Collisions Caused due Unsafe Speed at Corridors

50%
Occurred at Nighttime (KSI collisions)

71%
Involved Fixed Object

Table 7. Emphasis Area 1 Strategies

Objective: Reduce the number of KSI hit object collisions			
	Strategy	**Performance Measure**	**Agencies/ Organizations**
Education	Conduct public information and education campaigns on risks that can lead to hit object collisions, such as unsafe speeds, distracted driving, improper turning, and driving under the influence.	Number of education campaigns or residents reached	City/Police Department
Enforcement	Targeted enforcement at high-injury locations where hit object collisions are more common.	Decrease in number of citations and/ or warnings issued over time due to increased driver compliance	Police Department
Engineering	• S10/NS09, Install flashing beacon as advance warning • NS06, Install/upgrade larger or additional stop signs or other intersection warniwng/regulatory signs • R01, Add Segment Lighting • R02, Remove or relocate fixed objects outside of Clear Recovery Zone • R04, Install Guardrail • R15, Widen shoulder • R22, Install/Upgrade signs with new fluorescent sheeting (regulatory or warning) • R23, Install chevron signs on horizontal curves • R24 or R25, Install curve advance warning signs • R26, Install dynamic/variable speed warning signs • R27, Install delineators, reflectors and/or object markers • R28, Install edge-lines and centerlines • R31, Install edge-line rumble strips/stripes	Number of intersections improved.	City
EMS	Improve resource of deployment for emergency responses to collision sites. Ensure emergency routes are clear and well defined	EMS vehicle response time	Fire District and EMS Response Teams

EMPHASIS AREA 2 – ADDRESS UNSAFE SPEED VIOLATION

Unsafe Speed violations led to a total of 17 (44%) collisions on high injury networks within the City of Patterson, including six (40%) KSI collisions. Five (83%) collisions of the six KSI collisions occurred at intersections compared to only one (17%) KSI collision occurred on corridors. Considering all collision severity, the greatest number of collisions due to unsafe speed violations were rear end (35%) collisions. The following collision data is based on only unsafe speed violations on the high injury network within the City of Patterson, followed by 5 E's strategies to address them. These strategies are summarized in **Table 8** below:

41%
Involved another motor vehicle (all collisions)

50%
Involved Fixed Objects (KSI collisions)

67%
Occurred at Nighttime (KSI collisions)

Table 8. Emphasis Area 2 Strategies

Objective: Reduce the number of KSI collisions caused due to unsafe speed violations			
	Strategy	**Performance Measure**	**Agencies/ Organizations**
Education	Conduct public information and education campaign for safety laws regarding unsafe speed and its dangers.	Number of education campaigns	City/Police Department
Enforcement	Targeted enforcement at high-risk locations to monitor unsafe speed. Deploy a radar trailer at locations where instances of unsafe speed is more prevalent.	Number of tickets issued	Police Department
Engineering	• NS07, Upgrade intersection pavement markings (NS.I.) • NS09, Install flashing beacons as advance warning (NS.I.) • NS10, Install transverse rumble strips on approaches • NS12, Improve pavement friction (High Friction Surface Treatments) • R22, Install/Upgrade signs with new fluorescent sheeting (regulatory or warning) • R27, Install delineators, reflectors and/or object markers • R26, Install dynamic/ variable speed warning signs • R28, Install edge-lines and centerlines • R36PB, Install/upgrade pedestrian crossing (with enhanced safety features) • S16/NS04/NS05, Convert intersection to roundabout • Implement traffic calming strategies where appropriate • Decrease width of travel lanes • Increase curb radius of intersections	Number of locations improved to mitigate broadside collisions	City
EMS	Improve resource of deployment for emergency responses to collision sites. Ensure emergency routes are clear and well defined.	EMS vehicle response time	City/Fire District and EMS Response Teams

EMPHASIS AREA 3 – ADDRESS PEDESTRIAN SAFETY

Nine (23%) collisions on the high injury network involved pedestrians, however, of these nine collisions, five collisions (33%) were KSI collisions. All the pedestrian collisions (including most severe injury) occurred at intersections. Pedestrian violations were the cause of three (60%) KSI collisions in the City. The following collision data is based on only pedestrian collisions on the high injury network within the City of Patterson, followed by 5 E's strategies to address them. These strategies are summarized in **Table 9** below:

40%
Occurred along Sperry Avenue (KSI collisions)

80%
Occurred during Nighttime (KSI collisions)

60%
Caused by "Crossing not on Crosswalk" (KSI collisions)

Table 9. Emphasis Area 3 Strategies

Objective: Reduce the number of KSI collisions that improve pedestrain safety			
	Strategy	**Performance Measure**	**Agencies/ Organizations**
Education	Conduct pedestrian safety campaigns and outreach to raise their awareness of pedestrian safety needs through media outlets, social media, and public event.	Number of education campaigns	City/Police Department
Enforcement	Targeted enforcement at high-risk locations especially near schools and downtown area where pedestrians are more present. Continue to place a high priority on enforcement of motorist and pedestrian violations that most frequently cause injuries and fatalities among pedestrians.	Number of tickets issued	Police Department
Engineering	• S17PB, Install pedestrian countdown signal heads • S18PB, Install pedestrian crossing (S.I.) • S21PB, Modify signal phasing to implement a LPI • NS19PB, Install raised medians (refuge islands) • NS21PB/R35PB, Install/upgrade pedestrian crossing (with enhanced safety features) • NS22PB, Install RRFB • NS23PB, Install pedestrian signal (including Pedestrian Hybrid Beacon (HAWK)) • R34PB, Install sidewalk/pathway (to avoid walking along roadway) • R36PB, Install raised pedestrian crossing • R37PB, Install RRFB • High-visibility ladder crosswalks • Mid-block curb extension • In-road yield sign for pedestrian crossing at crosswalk • Intersection bulb-outs	Number of locations improved	City
EMS	Improve resource of deployment for emergency responses to collision sites. Ensure emergency routes are clear and well defined.	EMS vehicle response time	City/ Fire District and EMS Response Teams

EMPHASIS AREA 4 – ADDRESS NIGHTTIME COLLISIONS

For collisions of all severity on high injury networks, 10 (26%) collisions occurred at night, compared to KSI collisions where seven (47%) collisions occurred at nighttime. Five (71%) collisions out of the seven KSI collisions occurred at intersections due to unsafe speed and pedestrian violations. The following collision data is based on only nighttime collisions on the high injury network of Patterson, followed by 5 E's strategies to address them. These strategies are summarized in **Table 10** below:

29%
Caused due to Vehicle/ Pedestrian (KSI collisions)

43%
Occurred along Sperry Avenue (KSI collisions)

43%
Caused due to Unsafe Speed (KSI collisions)

Table 10. Emphasis Area 4 Strategies

Objective: Reduce the number of KSI collisions to address nighttime collisions			
	Strategy	**Performance Measure**	**Agencies/ Organizations**
Education	Develop awareness program to inform motorists of safe nighttime speed driving habits and the dangers of drunk driving, as well as high-risk collision locations and the most common violations/collision types occurring at night.	Number of education campaigns	City/CHP
Enforcement	Targeted enforcement at high-risk intersections and roadway locations where nighttime collisions are more common. Establish DUI check points at night where appropriate.	Number of tickets issued	Police Department
Engineering	• S01, Add intersection lighting • S02, Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number • S09, Install raised pavement markers and striping (Through Intersection) • S10, Install flashing beacons as advance warning (S.I.) • S11, Improve pavement friction (High Friction Surface Treatment) • NS01, Add intersection lighting (NS.I.) • NS07, Upgrade intersection pavement markings (NS.I.) • NS08, Install Flashing Beacons at Stop-Controlled Intersections • NS09, Install Flashing Beacons as advance warning (NS.I.) • NS12, Improve pavement friction (High Friction Surface Treatments) • NS22PB, Install RRFB • R01, Add Segment Lighting • R22, Install/Upgrade signs with new fluorescent sheeting (regulatory or warning) • R27, Install delineators, reflectors and/or object markers • R28, Install edge-lines and centerlines	Number of locations improved	City
EMS	Improve resource of deployment for emergency responses to collision sites. Ensure emergency routes are clear and well defined	EMS vehicle response time	City/Fire District and EMS Response Teams

EMPHASIS AREA 5 – ADDRESS BROADSIDE COLLISIONS

Three (8%) of the high injury network collisions were broadside collisions, including one (7%) KSI collisions. 100% (KSI collisions) of high injury network collisions were caused due to traffic signals and signs violation and involved another motor vehicle. The following collision data is based on only broadside injury collisions on the high injury network of Patterson, followed by 5 E's strategies to address them. These strategies are summarized in **Table 11** below:

100%
Occurred at Nighttime (KSI collisions)

100%
Involved another Motor Vehicle (KSI collisions)

100%
Occurred at Intersection (KSI collisions)

Table 11. Emphasis Area 5 Strategies

Objective: Reduce the number of KSI broadside collisions			
	Strategy	**Performance Measure**	**Agencies/ Organizations**
Education	Conduct public information and education campaign for intersection safety laws regarding traffic lights, stop signs, and turning left or right.	Number of education campaigns or residents reached	City/Police Department
Enforcement	Targeted enforcement at high-risk locations where automobile right of way and stop sign violations are more common.	Number of tickets issued	Police Department
Engineering	• S01, Add intersection lighting • S02, Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number • S03, Improve signal timing (coordination, phases, red, yellow, or operation) • S08, Convert signal to mast arm (from pedestal-mounted) • S09, Install raised pavement markers and striping (Through Intersection) • S16/NS04/NS05, Convert intersection to roundabout • NS02, Convert to all-way STOP control (from 2-way or Yield control) • NS03, Install signals • NS06, Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs • NS07, Upgrade intersection pavement markings (NS.I.) • NS08, Install flashing beacons at stop controlled intersections • NS09, Install flashing beacons as advance warning (NS.I.) • NS10, Install transverse rumble strips on approaches • NS11, Improve sight distance to intersection (Clear Sight Triangles) • NS13, add splitter-islands on the minor road approaches • S12/NS14, install raised median on approaches	Number of locations improved to mitigate broadside collisions	City
EMS	Improve resource of deployment for emergency responses to collision sites. Ensure emergency routes are clear and well defined.	EMS vehicle response time	Fire Districts and EMS Response Teams

EMPHASIS AREA 6 – IMPROVE SPERRY AVENUE (INTERSECTIONS)

A total of eight (21%) collisions on high injury network occurred along Sperry Avenue, including four (27%) KSI collisions. Unsafe speed violations were the major cause of two (50%) collisions of the four KSI collisions. The following collision data is based on only Sperry Avenue collisions on the high injury network of Patterson, followed by 5 E's strategies selected to address them. These strategies are summarized in **Table 12** below:

75%
Occurred at Nighttime (KSI collisions)

50%
Collisions Involved another Motor Vehicle (KSI collisions)

50%
Occurred at Intersection (KSI collisions)

Table 12. Emphasis Area 6 Strategies

Objective: Reduce the number of KSI collisions at Sperry Avenue			
	Strategy	**Performance Measure**	**Agencies/ Organizations**
Education	Conduct public information and education campaign for intersection safety laws regarding traffic lights, stop signs, and turning left or right.	Number of education campaigns or residents reached	City/Police Department
Enforcement	Targeted enforcement at high-risk intersections to monitor right-of-way violations, speed limit laws and other violations that occur at intersections.	Number of tickets issued	Police Department
Engineering	• S02, Improve signal hardware • S03, Improve signal timing • S09, Install raised pavement markers • S17PB, Install pedestrian countdown signal heads • S21PB, Modify signal phasing to implement a LPI • NS03, Install signals • NS06, Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs • NS07, Upgrade intersection pavement markings • NS08, Install Flashing Beacons at Stop-Controlled Intersections • S10/NS09, Install flashing beacons as advance warning • NS10, Install transverse rumble strips on approaches • NS11, Improve sight distance to intersection (Clear Sight Triangles) • NS13, Install splitter-islands on the minor road approaches • S12/NS14, Install raised median on approaches	Number of intersections improved	City
EMS	Improve resource of deployment for emergency responses to collision sites. Ensure emergency routes are clear and well defined.	EMS vehicle response time	Fire Districts and EMS Response Teams

6 | COUNTERMEASURE SELECTION

6 COUNTERMEASURE SELECTION

Identification of Countermeasures

Upon the identification of high-risk locations and Emphasis Areas, the next step was to identify appropriate safety countermeasures. The Caltrans LRSM provides 82 countermeasures, of which 21 are eligible in the current HSIP call for signalized intersections, 23 for un-signalized intersections, and 38 for roadway segments. The LRSM provides guidance on where to apply the countermeasures including the crash types each countermeasure would address, and a Crash Reduction Factor (CRF) for each countermeasure. The Federal Highway Administration (FHWA) CMF Clearinghouse and published research papers were reviewed by the project team to gain additional insight on CRFs and effectiveness of specific countermeasures.

The project team conducted a thorough review of the high-injury locations (intersections and roadway segments) using aerial photography, Google Maps Street View software, and in-person site visits. Crash characteristics of all collisions occurring on the High Injury Network were considered. After combining the physical and collision characteristics, the project team developed a table of preliminary countermeasures that address each of the seven identified Emphasis Areas. **Table 16** was refined by selecting up to four countermeasures for each high-risk location that were most commonly recommended among all Emphasis Areas. By doing this, the project team was able to identify countermeasures with the greatest opportunity for systemic implementation.

Countermeasure Toolbox

Engineering countermeasures were selected for each of the high-risk locations and for the emphasis areas. These were based off of approved countermeasures from the Caltrans LRSM used in HSIP grant calls for projects. The intention is to give the City potential countermeasures for each location that can be implemented either in future HSIP calls for projects, or using other funding sources, such as the City's Capital Improvement Program. Non-engineering countermeasures were also selected using the 5 E's strategies, and are included with the emphasis areas. The countermeasure toolbox in **Appendix D** details the draft countermeasures for each high-risk location and emphasis area, separated by intersections and roadway segments. While not all of these countermeasures will be included in the resulting safety projects, they are included to give the City a toolbox for implementing future safety improvements through other means, such as the City's Capital Improvement Program.

Table 13 provides a description of each countermeasure along with the CRF, federal funding eligibility, and opportunity for systemic implementation. An excerpt of the LRSM, detailing each available HSIP countermeasure referenced in the recommendations tables, are included as **Appendix E**.

Table 13. Countermeasures selected for the City of Patterson

Code	Countermeasure Name	Countermeasure Description	CRF	Federal Funding	Systemic Approach Opportunity
S02	Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number	Includes 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.	15%	90%	Very High
S03	Improve signal timing (coordination, phases, red, yellow, or operation)	Includes adding phases, lengthening clearance intervals, eliminating or restricting higher-risk movements, and coordinating signals at multiple locations.	15%	50%	Very High
S09	Install raised pavement markers and striping (Through Intersection)	Adding clear pavement markings can guide motorists through complex intersections. When drivers approach and traverse through complex intersections, drivers may be required to perform unusual or unexpected maneuvers.	10%	90%	Very High
S10	Install flashing beacons as advance warning (S.I.)	Increased driver awareness of an approaching signalized intersection and an increase in the driver's time to react. Driver awareness of both downstream intersections and traffic control devices is critical to intersection safety. Crashes often occur when the driver is unable to perceive an intersection, signal head or the back of a stopped queue in time to react. Advance flashing beacons can be used to supplement and call driver attention to intersection control signs. Most advance warning flashing beacons can be powered by solar, thus reducing the issues relating to power source.	30%	90%	Medium
S20PB	Install advance stop bar before crosswalk (Bicycle Box)	Signalized Intersections with a marked crossing, where significant bicycle and/or pedestrians volumes are known to occur.	15%	90%	Very High

Code	Countermeasure Name	Countermeasure Description	CRF	Federal Funding	Systemic Approach Opportunity
S21PB	Modify signal phasing to implement a LPI	Addition of LPI gives pedestrians the opportunity to enter an intersection 3-7 seconds before vehicles are given a green indication; only minor signal timing alteration is required.	60%	90%	Very High
NS01	Add intersection lighting (NS.I.)	Providing lighting at the intersection itself, or both at the intersection and on its approaches, improves the safety of an intersection during nighttime conditions by (1) making drivers more aware of the surroundings at an intersection, which improves drivers' perception-reaction times, (2) enhancing drivers' available sight distances, and (3) improving the visibility of non-motorists. Intersection lighting is of particular benefit to non-motorized users as lighting not only helps them navigate the intersection, but also helps drivers see them better.	40%	90%	Medium
NS06	Install/upgrade larger or additional stop signs or other intersection warning/ regulatory signs	Additional regulatory and warning signs at or prior to intersections will help enhance the ability of approaching drivers to perceive them.	15%	90%	Very High
NS07	Upgrade intersection pavement marking (NS.I)	The visibility of intersections and, thus, the ability of approaching drivers to perceive them can be enhanced by installing appropriate pavement delineation in advance of and at intersections will provide approaching motorists with additional information at these locations. Providing visible stop bars on minor road approaches to unsignalized intersections can help direct the attention of drivers to the presence of the intersection. Drivers should be more aware that the intersection is coming up, and therefore make safer decisions as they approach the intersection.	25%	90%	Very High

Code	Countermeasure Name	Countermeasure Description	CRF	Federal Funding	Systemic Approach Opportunity
NS08	Install Flashing Beacons at Stop-Controlled Intersections	Flashing beacons provide a visible signal to the presence of an intersection and can be very effective in rural areas where there may be long stretches between intersections as well as locations where night-time visibility of intersections is an issue.	15%	90%	High
NS09	Install flashing beacons as advance warning (NS.I)	Advance flashing beacons can be used to supplement and call driver attention to intersection control signs. Flashing beacons are intended to reinforce driver awareness of the stop or yield signs and to help mitigate patterns of crashes related to intersection regulatory sign violations. Most advance warning flashing beacons can be powered by solar, thus reducing the issues relating to power source.	30%	90%	High
NS10	Install transverse rumble strips on approaches	When motorists are traveling along the roadway, they are sometimes unaware they are approaching an intersection. This is especially true on rural roads, as there may be fewer clues indicating an intersection ahead. Transverse rumble strips warn motorists that something unexpected is ahead that they need to pay attention to.	20%	90%	High
NS11	Improve sight distance to intersection (Clear Sight Triangles)	Adequate sight distance for drivers at stop or yield-controlled approaches to intersections has long been recognized as among the most important factors contributing to overall safety at unsignalized intersections. By removing sight distance restrictions (e.g., vegetation, parked vehicles, signs, buildings) from the sight triangles at stop or yield-controlled intersection approaches, drivers will be able see approaching vehicles on the main line, without obstruction and therefore make better decisions about entering the intersection safely.	205	90%	High

Code	Countermeasure Name	Countermeasure Description	CRF	Federal Funding	Systemic Approach Opportunity
NS21PB	Install/upgrade pedestrian crossing at uncontrolled locations (with enhanced safety features)	Non-signalized intersections where pedestrians are known to be crossing intersections that involve significant vehicular traffic. They are especially important at school crossings and intersections with turn pockets. Flashing beacons, curb extensions, advanced "stop" or "yield" markings, and other safety features should be added to complement the standard crossing elements.	35%	90%	Medium
NS22PB	Install Rectangular Rapid Flashing Beacon (RRFB)	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.	35%	90%	Medium
R01	Add segment lighting	Providing roadway lighting improves the safety during nighttime conditions by (1) making drivers more aware of the surroundings, which improves drivers' perception-reaction times, (2) enhancing drivers' available sight distances to perceive roadway characteristic in advance of the change, and (3) improving non-motorist's visibility and navigation.	35%	90%	Medium
R02	Remove or relocate fixed objects outside of Clear Recovery Zone	While this strategy does not prevent the vehicle leaving the roadway, it does provide a mechanism to reduce the severity of a resulting crash. A clear zone is an unobstructed, traversable roadside area that allows a driver to stop safely or regain control of a vehicle that has left the roadway. Removing or moving fixed objects, flattening slopes, or providing recovery areas reduces the likelihood of a crash.	35%	90%	High
R22	Install/Upgrade signs with new fluorescent sheeting (regulatory or warning)	Additional or new signage can address crashes caused by lack of driver awareness or compliance of roadway signing.	15%	90%	Very High

Code	Countermeasure Name	Countermeasure Description	CRF	Federal Funding	Systemic Approach Opportunity
R26	Install dynamic/ variable speed warning signs	This strategy primarily addresses crashes caused by motorists traveling too fast around sharp curves. It is intended to get the drivers attention and give them a visual warning that they may be traveling over the recommended speed for the approaching curve. Care should be taken to limit the placement of these signs to help maintain their effectiveness.	30%	90%	High
R27	Install delineators, reflectors and/or object markers	Delineators, reflectors and/or object markers are intended to warn drivers of an approaching curve or fixed object that cannot easily be removed. They are intended to provide tracking information and guidance to the drivers. They are generally less costly than Chevron Signs as they don't require posts to place along the roadside, avoiding an additional object with which an errant vehicle can crash into.	15%	90%	Very High
R32PB	Install Bike Lanes	Most studies present evidence that bicycle lanes provide protection against bicycle/motor vehicle collisions. Bicycle lanes provide marked areas for bicyclist to travel along the roadway and provide for more predictable movements for both bicyclist and motorist. Evidence also shows that riding with the flow of vehicular traffic reduces bicyclists' chances of collision with a motor vehicle. Locations with bicycle lanes have lower rates of wrong-way riding. In combination with this CM, better guidance signs and markings for non-motorized and motorized roadway users should be considered, including: sign and markings directing cyclists on appropriate/legal travel paths and signs and markings warning motorists of non-motorized uses of the roadway that should be expected.	35%	90%	High

Code	Countermeasure Name	Countermeasure Description	CRF	Federal Funding	Systemic Approach Opportunity
R35PB	Install/Upgrade pedestrian crossing (with enhanced safety features)	Adding pedestrian crossings has the opportunity to greatly enhance pedestrian safety at locations noted as being problematic. The enhanced safety elements, which may include curb extensions, medians and pedestrian crossing islands, beacons, and lighting, combined with pavement markings delineating a portion of the roadway that is designated for pedestrian crossing. Care must be taken to warn drivers of the potential for pedestrians crossing the roadway and enhanced improvements added to the crossing increase the likelihood of pedestrians crossing in a safe manner. In combination with this CM, better guidance signs and markings for non-motorized and motorized roadway users should be considered, including: sign and markings directing pedestrians and cyclists on appropriate/legal travel paths and signs. When agencies opt to install aesthetic enhancement to crossing like stamped concrete/ asphalt, the project design and construction costs can significantly increase. For HSIP applications, these costs must be accounted for in the B/C calculation, but these costs (over standard crosswalk markings) must be tracked separately and are not federally reimbursable and will increase the agency's local-funding share for the project costs.	35%	90%	Medium

* Code: S - Signalized intersection improvements
NS - Non-signalized intersection improvements
R - Roadway segment improvements

7 | VIABLE SAFETY PROJECTS

7 VIABLE SAFETY PROJECTS

This chapter summarizes the process of selecting safety projects as part of the analysis for Patterson's LRSP. The next step after the identification of high-injury locations, emphasis areas and applicable countermeasures was to identify location specific safety improvements for all high-risk roadway segments and intersections.

Specific countermeasures and improvements were selected from the 2020 LRSM from Caltrans, where:

- S refers to improvements at signalized locations,
- NS refers to improvements at non-signalized locations, and
- R refers to improvements at roadway segments.

The corresponding number refers to the countermeasure number in the LRSM (2022). The countermeasures were grouped into safety projects for high-risk intersections and roadway segments. A total of six safety projects were developed. All countermeasures were identified based on the technical teams' assessment of viability that consisted of extensive analysis, observations, City staff input, and stakeholder/community input. The most applicable and appropriate countermeasures as identified have been grouped together to form projects that can help make high-risk locations safer.

Table 14 lists the viable safety projects for high-risk intersections and roadway segments. Additionally, based on community comments received from the survey portal, additional locations with traffic safety concerns were identified and countermeasure were recommended for locations. These safety projects were chosen based on the previously completed collisions analysis, which was used to identify main collision attributes that were found to be leading factors of KSI collisions in Patterson. These collision factors are shown below, as well as viable safety projects that can help address these factors.

Appendix F lists the detailed methodology to calculate Benefit/Cost (B/C) Ratio, as well as the complete cost, benefit, and B/C Ratio calculation spreadsheet.

These safety projects were chosen based on the previously completed collisions analysis, which was used to identify main collision attributes that were found to be leading factors of KSI in Patterson. These collision factors are shown below, as well as viable safety projects that can help address these factors.

Hit Object Collisions: This type of collision represented the higher proportion of KSI collisions, 33% of collisions were hit object collisions. This is much higher than its share of collisions of all severity (13%). Las Palmas Avenue have a higher concentration of hit object collisions, compared to other Patterson roads. These collisions can potentially be mitigated by installing edge line rumble strips, widen shoulders, installing delineators, reflectors, and object markers, installing curve warning signs, installing chevron signs at horizontal curves, and installing/upgrading signs with new fluorescent sheeting, and removing or relocating fixed objects outside of Clear Recovery Zone.

Unsafe Speed Violation: 39% of collisions occurred due to unsafe speed violation (compared to 23% of all collisions). 2nd Street has a higher concentration of unsafe speed collisions, compared to other Patterson roads. Countermeasures such as traffic calming, dynamic speed warning signs, road diet, upgrading intersection pavements markings, improving signal timings, and installing RRFB's can all help to address unsafe speed violation collisions.

Nighttime Collisions: 50% of collisions occurred in nighttime (dark with streetlights) compared to only 25% of collisions of all severities. Sperry Avenue has a higher concentration of nighttime collisions, compared to other Patterson roads. These collisions can potentially be mitigated with installing or upgrading street lighting with higher lumen, installing delineators, reflectors and object markers, installing high visibility pedestrian crossings, adding fluorescent sheeting to traffic signs, and installing rectangular rapid flashing beacons.

Pedestrian and Bicycle Collisions: For KSI collisions, 33% of collisions occurred due to involvement of pedestrians (compared to only 16% of collisions of all severities). 2nd Street has a higher concentration of pedestrian collisions, compared to other Patterson roads. Countermeasures such as traffic calming, high visibility crosswalks, RRFB's, sidewalk bulb outs, advanced flashing warning signs, can all help to address pedestrian collisions. The Bicycle collisions can potentially be mitigated with enhanced bicycle infrastructure, such as protected bike lanes, bicycle boxes at signalized intersections, green paint for enhanced visibility, additional lighting, or adding bike lanes/widening shoulders.

Broadside Collisions: For KSI collisions in the City of Patterson, 11% of collisions occurred due broadside collisions (compared to 34% of collisions of all severities). 2nd Street has a higher concentration of broadside collisions, compared to other Patterson roads. Broadside collisions can potentially be mitigated by increasing the visibility of an intersection through updated pavement markings, new or updated signage, lighting, flashing beacons, and improving sight distance.

Below is the list of identified projects for the City of Patterson, with a preliminary cost estimate for each location and the resulting B/C Ratio of the project (the title of each countermeasure is located in **Table 14** below). The next step in the process will be to finalize the list of safety projects and calculate the cost-estimates and benefit-cost ratios for each safety project. Below is the list of identified projects for the City of Patterson. The title of each countermeasure is located in **Table 16** below.

List of Safety Projects

- Project 1: Systemic Improvements at Signalized Intersections
- Project 2: Citywide Signal Hardware and Retiming
- Project 3: Systemic Improvements at Un-signalized Intersections
- Project 4: Systemic Improvements at Un-Signalized Intersections (review for mini-roundabouts)
- Project 5: Systemic Improvements at Roadway Segments (pedestrian and bicycle safety improvements)
- Project 6: Citywide Street Light Inventory

Table 14. List of Viable Safety Projects

Location	CM1	CM2	CM3	Cost per Location	Total	B/C Ratio
Project 1 – Signalized Intersection: Improve signal hardware; lenses, back-plates with retroreflective borders, mounting, size, and number, Install advance stop bar before crosswalk (Bicycle Box), Modify signal phasing to implement a LPI						
S 2nd Street and W Las Palmas Avenue	S02	S20PB	S21PB	$17,058	$17,058	356
Project 2 – Citywide Signal Hardware and Retiming						
Citywide Signalized Intersections	S02	S03	S21PB	$545,490	$545,490	1
Project 3 – Unsignalized Intersections: Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs, Upgrade intersection pavement markings, Install Flashing Beacons at Stop-Controlled Intersections						
S 2nd Street and S El Circulo		NS07		$2,204	$82,868	93.26
Keystone Pacific Parkway and Park Center Drive	NS06	NS07	NS08	$30,856		
Eucalyptus Avenue and Highway 33	NS06	NS07	NS08	$15,443		
Cornflower Avenue and American Eagle Avenue	NS06			$943		
Eucalyptus Avenue and Sycamore Avenue	NS06	NS07	NS08	$33,423		

Project 4 – Unsignalized Intersections: Convert Intersection to Mini-Roundabout (under City's review)						
Eucalyptus Avenue and Sycamore Avenue	NS05mr			$162,980	$590,730	4.0
S 7th Street and E Street	NS05mr			$103,385		
S 4th Street and E Street	NS05mr			$161,820		
S 3rd Street and E Street	NS05mr			$162,545		
Project 5 – Roadway Segments: Add Segment Lighting, Install bike lanes, Install/upgrade pedestrian crossing (with enhanced safety features)						
Las Palmas Avenue: East City limit to 2nd Street		R32PB	R35PB	$105,299	$988,941	26.9
Sperry Avenue: Del Puerto Avenue to Walker Ranch Parkway		R32PB	R35PB	$272,774		
2nd Street: North City limit to 0.2 miles South of Walnut Avenue	R01	R32PB	R35PB	-		
American Eagle Avenue: Creekside Middle School to Fawn Lily Drive		R32PB		$94,668		
Sperry Avenue: West City limit to Park Center Drive	R01	R32PB		$443,700		
Baldwin Road: Henley Parkway to Kohl's Driveway^			R35PB	$72,500		
Project 6 – Citywide Sign Upgrade						
Citywide Roadways	R22			$652,500	$652,500	21.4

Notes: CM – countermeasure. B/C ratio is the dollar amount of benefits divided by the cost of the countermeasure.

Roadway Segment Location and countermeasure is derived from the community comments received through the survey portal.

Project 3: The nature of the improvements for Project 3 (install signs, pavement markings, etc.) are inexpensive compared to other improvements so there isn't much ability to increase the costs.

Project 6: Assume 20 regulatory and warning signs per mile, 89 miles= 1780 (round to 1800).

Table 15. Additional Locations Identified from Public Comments

Location	CM1	CM2
S 2nd Street and Sperry Avenue	NS03	
S 9th Street and Sperry Avenue	NS23PB	NS11
Ivy Avenue and Olive Avenue	R22	
Heartland Ranch Avenue and Shearwater Drive	NS02	
American Eagle Avenue and Shearwater Dr	R35PB	
Shearwater Dr and Henley Pkwy	R35PB	
Ward Avenue and Heartland Ranch Avenue	NS03	
Ward Ave: M St to Highway 33	R26	
Highway 33 and Ward Avenue	NS11	
Calvinson Parkway: Baldwin Road and Ward Avenue	R26	Traffic Calming

Table 16. List of Countermeasures

Countermeasure Name
S02 - Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number
S03 - Improve signal timing (coordination, phases, red, yellow, or operation)
S20PB - Install advance stop bar before crosswalk (Bicycle Box)
S21PB - Modify signal phasing to implement a Leading Pedestrian Interval (LPI)
NS02 – Convert to all-way STOP control (from 2-way or Yield control)
NS03 – Install signals
NS05mr - Convert intersection to mini-roundabout
NS06 - Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs
NS07 – Upgrade intersection pavement markings (NS.I.)
NS08 – Install Flashing Beacons at Stop-Controlled Intersections
NS11 – Improve sight distance to intersection (Clear Sight Triangles)
NS23PB – Install Pedestrian Signal (including Pedestrian Hybrid Beacon (HAWK))
R01 – Add Segment Lighting
R22 - Install/Upgrades signs with new fluorescent sheeting (regulatory or warning)
R26 – Install dynamic/variable speed warning signs
R32PB - Install Bike lanes
R35PB - Install/upgrade pedestrian crossing (with enhances safety features)

8 | IMPLEMENTATION AND EVALUATION

8 IMPLEMENTATION AND EVALUATION

This chapter describes the steps the City may take to evaluate the success of this plan and steps needed to update the plan in the future. The LRSP is a guidance document and requires periodic updates to assess its efficacy and re-evaluate potential solutions. It is recommended to update the plan every two to five years in coordination with the identified safety partners. This document was developed based on community needs, stakeholder input, and collision analysis conducted to identify priority emphasis areas throughout the City. The implementation of strategies under each emphasis area would aim to reduce KSI collisions in the coming years.

Implementation

The LRSP is a guidance document that is recommended to be updated every two to five years in coordination with the safety partners. The LRSP document provides engineering, education, enforcement, and emergency medical service-related countermeasures that can be implemented throughout the City to reduce KSI collisions. It is recommended that the City of Patterson implement the selected projects in high-collision locations in coordination with other projects proposed for the City's infrastructure development in their future Capital Improvement Plans. After implementing countermeasures, the performance measures for each emphasis area should be evaluated annually. The most important measure of success of the LRSP should be reducing KSI collisions throughout the City. If the number of KSI collisions does not decrease over time, then the emphasis areas and countermeasures should be re-evaluated.

Funding is a critical component of implementing any safety project. While the HSIP program is a common source of funding for safety projects, there are numerous other funding sources that could be pursued for such projects (see **Table 17**).

Table 17. List of Potential Funding Sources

Funding Source	Funding Agency	Amount Available	Next Estimated Call for Projects	Applicable E's	Notes
Active Transportation Program	Caltrans, California Transportation Commission, MTC	~$450 million per cycle (every two years)	2024	Engineering, Education	Can use used for most active transportation related safety projects as well as education programs? Funding available through Caltrans or MTC
Highway Safety Improvement Program	Caltrans	Varies	2024	Engineering	Most common grant source for safety projects
One Bay Area Grant (OBAG) Cycle 4	MTC (Combines various federal funds)	TBD	County & Local Program: TBD	Engineering	Distributes federal funding to cities and counties in MTC region
Office of Traffic Safety Grants	California Office of Traffic Safety	Varies by grant	Closes January 31st annually	Education, Enforcement, Emergency Response	10 grants available to address various components of traffic safety
Affordable Housing and Sustainable Communities Program	Strategic Growth Council and Dept. of Housing and Community Development	~$10-15 million per award	TBD; most recent in 2023	Engineering, Education	Must be connected to affordable housing projects; typically focuses on bike/pedestrian infrastructure/ programs
Urban Greening	California Natural Resources Agency	$28.5 million	TBD; most recent in 2022	Engineering	Focused on bike/pedestrian infrastructure and greening public spaces
Local Streets and Road Maintenance and Rehabilitation	CTC (distributed to local agencies)	$1.5 billion statewide	N/A; distributed by formula	Engineering	Typically pays for road maintenance type projects
RAISE Grant	USDOT	~$1.5 billion	2023	Engineering	Typically used for larger infrastructure projects

Sustainable Transportation Equity Project	California Air Resources Board	~$19.5 million	TBD; most recent call in 2023	Engineering, Education	Targets projects that will increase transportation equity in disadvantaged communities
Transformative Climate Communities	Strategic Growth Council	~$105 million	TBD; most recent call in 2022	Engineering	Funds community-led projects that achieve major reductions in greenhouse gas emissions in disadvantaged communities
Safe Streets and Roads for All (SS4A)	USDOT	$200k - $50 million	2023	Engineering	Two types of SS4A grants available: Action Plan Grants and Implementation Grants
Clean California Local Grant Program	Caltrans	$100 – 5 million per award	2023	Engineering	Funding for local communities to beautify and improve local streets and roads, tribal lands, parks, pathways, and transit centers

Monitoring and Evaluation

For the success of the LRSP, it is crucial to monitor and evaluate the 5 E's-strategies continuously. Monitoring and evaluation help provide accountability, ensures the effectiveness of the countermeasures for each emphasis area, and help making decisions on the need for new strategies. The process would help the City make informed decisions regarding the implementation plan's progress and accordingly, update the goals and objectives of the plan.

After implementing countermeasures, the strategies should be evaluated annually as per their performance measures. The evaluation should be recorded in a before-after study to validate the effectiveness of each countermeasure as per the following observations:

- Number of KSI collisions
- Number of police citations
- Number of public comments and concerns

Evaluation should be conducted during similar time periods and durations each year. The most important measure of success of the LRSP should be reduction in KSI collisions throughout the City. If the number of KSI collisions doesn't decrease initially, then the countermeasures should be evaluated as per the other observations, as mentioned above. The effectiveness of the countermeasures should be compared to the goals for each emphasis area.

LRSP Update

The LRSP is a guidance document and is recommended to be updated every two to five years after adoption. After monitoring performance measures focused on the status and progress of the 5 E's strategies in each emphasis area, the next LRSP update can be tailored to resolve any continuing safety problems. An annual stakeholder meeting with the safety partners is also recommended to discuss the progress for each emphasis area and oversee the implementation plan. The document should then be updated as per the latest collision data, emerging trends, and the 5 E's strategies' progress and implementation.

APPENDIX A:
SUMMARY OF PLANNING DOCUMENTS

Appendix A: Summary of Planning Documents

Document	Relevant Goals, Policies, and Projects
CITY OF PATTERSON GENERAL PLAN (2010)	**GOALS AND POLICIES** *Goal T-1: To create and maintain a roadway network that will ensure the safe and efficient movement of people and goods throughout the city.* • Policy T-1.1: Street design. Street design and access standards shall provide for safe and efficient movement of goods and people. Restrictive traffic control measures (such as channelization, street closures, and prohibition of some traffic movements) shall be used where appropriate to promote traffic safety and efficient traffic operation. • Policy T-1.5: Neighborhood streets. Neighborhood streets shall be designed, where feasible, to discourage unsafe traffic speeds. • Policy T-1.12: Traffic calming encouraged. Traffic calming techniques, including roundabouts, traffic circles, 'chokers' and chicanes, shall be considered as an alternative to traditional intersection controls. Where cul-de-sacs are employed, consideration should be given to establishing connections between the cul-de-sac and other streets, parks, bicycle paths and pedestrian trails. • Policy T-1.14: Protection of Neighborhoods. The City shall ensure to the extent feasible that pedestrian, bicycle, and automobile connections are maintained in existing neighborhoods affected by transportation and other development projects. *Goal T-7: To promote pedestrian, bicycle and rail travel as alternatives to automobile use.* • Policy T-7.1: Safe Pedestrian and Bike Pathways: The City shall create and maintain a safe and convenient system of pedestrian and bicycle pathways that encourages walking and bicycling as an alternative to driving. New development shall be required to pay its fair share of the costs for development of this pathway system. • Policy T-7.2: Pedestrian Access: All new development shall be reviewed to ensure safe pedestrian access is provided from the street, within parking areas and between new development and surrounding neighborhoods. • Policy T-7.3: Bike Routes: The City shall establish a safe and convenient network of identified bicycle routes connecting new

	residential areas by the shortest possible routes with recreation, shopping, and employment areas within the city. The City shall cooperate with surrounding jurisdictions in designing and implementing an area-wide bikeway system. • Policy T-7.4: Separation of Bike Routes from Motor Vehicles: Bicycle routes shall emphasize paths separated from vehicle traffic (Class I) to the maximum extent possible, but shall also include bicycle lanes within public streets (Class II and III). The City shall limit on-street bicycle routes to those streets where the available roadway width and traffic volumes permit safe coexistence of bicycle and motor vehicle traffic. • Policy T-7.7: Bicycle-Automobile Conflicts: The City shall promote the safe "sharing" of roads between automobiles and bicyclists. • Policy T-7.8: Bike Safety: Bicycle safety shall be considered when implementing improvements for automobile traffic operations • Policy T-7.9: Coordination with Schools: The City shall collaborate with the School District to promote bike use and shall actively pursue Safe Route to School grants to fund programs that facilitate safe bike routes. • Policy T-7.10: Coordination with Other Agencies: The City shall coordinate with Stanislaus County, the Stanislaus Council of Governments, Caltrans and other agencies to improve bicycle and pedestrian circulation region-wide.
CITY OF PATTERSON ACTIVE TRANSPORTATION PLAN (2021)	**GOALS AND POLICIES** *Goal 1: Promote Walking and Bicycling.* • Policy 1.1: Education: Provide an educational program for local residents explaining the benefits of active transportation. • Policy 1.3: Provision of Active Transportation Infrastructure: Identify and work to implement a complete and convenient active transportation network. • Policy 1.4: Conduct activities such as classroom/physical education lessons, mock cities and traffic gardens, bicycle rodeos, and field trips to promote bicycling and walking among students. *Goal 2: Safety* • Policy 2.1: Adopt a Vision Zero policy that eliminates all pedestrian and bicycle collisions by 2040. • Policy 2.2: Adopt a Local Roadway Safety Plan (LRSP) that focuses on the safety of pedestrians and bicyclists by using effective safety countermeasures. • Policy 2.3: Prioritize improvements that support walking and bicycling to school.

	• Policy 2.4: Evaluate the bicycle and pedestrian safety annually. • Policy 2.5: Promote safe roadway behavior through roadway design, education, and enforcement. *Goal 3: Connectivity* • Policy 3.1: Identify and fill existing gaps in the walking and biking network. • Policy 3.2: Design active transportation projects that are accessible and comfortable for people of all ages and abilities. *Goal 5: Equity* • Policy 5.1: Encourage the provision of comfortable walking, bicycling, and transit facilities in disadvantaged communities. *Goal 6: Accessibility* • Policy 6.1: Develop a walking and bicycling network that provides comfortable access to people of all ages and abilities.
CITY OF PATTERSON TRANSPORTATION INFRASTRUCTURE MASTER PLAN (TIMP) (2020)	**Relevant TIMP policies are listed below:** • Encourage future commercial development to provide bicycle access to surrounding residential areas. • Require future commercial development to place bike racks near entrances for employees and customers. • As appropriate require future development to construct bikeways included in the proposed system as a condition of development. • Meet the requirements of the Americans with Disabilities Act when constructing facilities contained in the proposed system, where applicable. • Encourage future development to consider schools as important destinations for bicyclists when designing circulation systems within new developments. • Establish and provide Complete Street policies for all future roadways. Adopt recommended bike facilities plan and provide future funding for its construction. Creation of more continuous bike lanes at key destinations would encourage more people to use bikes instead of autos. • Focus on redesign of downtown streets based walkable and livable principles.
STANCOG NON-MOTORIZED	**NMTMP GOALS AND POLICIES**

TRANSPORTATION MASTER PLAN (NMTMP), 2021	*Goal 1: Improve access to key destinations and services throughout the Stanislaus region by increasing access to walking and bicycling facilities that are comfortable for people of all ages and abilities.* • Objective: Develop a walking and bicycling network that connects people to key destinations such as schools, grocery stores, employment centers, and parks. • Objective: Identify and support walking and bicycling initiatives and programs that improve access to services and key destinations, such as Safe Routes to School. • Objective: Coordinate with the County, local jurisdictions, and transit agencies to install and maintain short-term and long-term bike parking facilities. *Goal 2: Develop a connected network of walking and bicycling facilities.* • Objective: Eliminate gaps/barriers in the walking and bicycling network to improve network connectivity within and between jurisdictions in the Stanislaus region. • Objective: Improve bicycle and pedestrian access to transit. *Goal 3: Ensure that all people living within the Stanislaus region have equitable access to walking and bicycling facilities.* • Objective: Identify barriers to walking and bicycling in disadvantaged communities. • Objective: Encourage the provision of comfortable walking and bicycling facilities in disadvantaged communities. • Objective: Assess and improve walking- and bicycling-related health and safety outcomes in historically underserved communities. *Goal 4: Improve safety for pedestrians and bicyclists in the Stanislaus region.* • Objective: Decrease the number of crashes involving pedestrians and bicyclists. • Objective: Decrease the number of fatal crashes involving pedestrians and bicyclists. • Objective: Encourage, through funding and technical assistance, the implementation of pedestrian and bicycle safety improvement projects in areas with a history of crashes, such as along high-crash corridors, and areas that do not have a history of crashes but have similar land use and roadway characteristics. • Objective: Promote safe roadway behavior through roadway design, education, and enforcement.

	Goal 5: Improve project development through strategic and collaborative efforts. • Objective: Improve and maintain communication and coordination among jurisdictions, regional agencies, and organizations. • Objective: Coordinate and track implementation of walking and bicycling facilities, programs, and policies. • Objective: Improve data collection of non-motorized transportation users and facilities. • Objective: Work collaboratively to secure grants and establish a dedicated funding source for walking and bicycling facilities and programs. • Objective: Prioritize transportation projects that improve access and safety for people walking and bicycling.
REGIONAL TRANSPORTATION PLAN, 2018	**Relevant regional goals include:** *Goal 1: Mobility & Accessibility* Improve the ability of people and goods to move between desired locations, and provide a variety of modal and mobility options. *Goal 6: Health & Safety* Operate and maintain the transportation system to ensure public safety and security; improve the health of residents by improving air quality, and provide more transportation options.

APPENDIX B:
CONSOLIDATED HIGH INJURY COLLISION DATABASE

Appendix B - Consolidated High Injury Collision Database

FID	CASE_ID	ACCIDENT_	PROC_DAT	JURIS	COLLISION_	COLLISION:	Hour	OFFICER_ID	REPORTING	DAY_OF_W	CHP_SHIFT	POPULATIC	CNTY_CITY	SPECIAL_CO	BEAT_TYPE	CHP_BEAT_	CITY_DIVIS	CHP_BEAT_	BEAT_NUM	PRIMARY_I
0	8421724	2017	########	5005	########	1530	15	S00030	PATTE	7	5	3	5005	0	0	0		0	PPS	SPERRY AV
1	9023579	2019	########	5005	########	730	7	S01320	WEST	2	5	3	5005	0	0	0		0	5	AMERICAN
2	8427178	2017	########	5005	########	1534	15	S01906	PATTE	4	5	3	5005	0	0	0		0	3L1	AMERICAN
3	8989734	2018	########	5005	########	1441	14	S02326	PATTE	2	5	3	5005	0	0	0		0		AMERICAN
4	9053925	2020	########	5005	########	1637	16	S01604		2	5	3	5005	0	0	0		0	312	W LAS PALI
5	9051154	2020	########	5005	########	1723	17	S02449	PATTE	1	5	3	5005	0	0	0		0	3L8	LAS PALMA
6	8077345	2016	########	5005	########	1850	18	S01347	PATTE	4	5	3	5005	0	0	0		0	3Q3	SPERRY AV
7	9169917	2020	########	5005	########	1639	16	SQ95	PSS	5	5	3	5005	0	0	0		0	3T4	HEARTLAN
8	9017688	2019	########	5005	########	845	8	S01320		4	5	3	5005	0	0	0		0	5	2ND ST
9	8686454	2018	########	5005	########	901	9	S01836	MODES	6	5	3	5005	0	0	0		0	RPD1	EAST LAS P
10	9184982	2020	########	5005	########	2042	20	SQ95	5005	4	5	3	5005	0	0	0		0	3T4	SPERRY AV
11	8465521	2017	########	5005	########	430	4	S01665	PPS	4	5	3	5005	0	0	0		0	6T33	SPERRY RD
12	8169176	2016	########	5005	########	1428	14	S01604	PATTE	6	5	3	5005	0	0	0		0	312	WARD
13	9033035	2020	########	5005	########	608	6	SQ95	PSS	2	5	3	5005	0	0	0		0	3T4	SPERRY AV
14	8989723	2018	########	5005	########	2320	23	S01733	PATTE	6	5	3	5005	0	0	0		0	1	W LAS PALI
15	9017696	2019	########	5005	########	1733	17	S02316	PPD	5	5	3	5005	0	0	0		0		W LAS PALI
16	9064746	2020	########	5005	########	1649	16	S03076	PATTE	5	5	3	5005	0	0	0		0		EAST LAS P
17	8989742	2018	########	5005	########	2141	21	S023216	MODES	7	5	3	5005	0	0	0		0		WARD AV
18	8543698	2017	########	5005	########	200	2	S01444	PATTE	4	5	3	5005	0	0	0		0	1	IVY AV
19	9211494	2020	########	5005	########	545	5	SQ95	PSS	3	5	3	5005	0	0	0		0	3T4	RT 33
20	9096859	2019	########	5005	########	2150	21	S02447	PPD	2	5	3	5005	0	0	0		0	3Q4	SPERRY AV
21	9199317	2020	########	5005	########	1600	16	S02809	PATTE	2	5	3	5005	0	0	0		0	3B1	LAS PALMA
0	9018069	2019	########	5005	########	2245	22	S02804	5005	2	5	3	5005	0	0	0		0	3Q5	SPERRY AV
8	9023583	2019	########	5005	########	2100	21	S02647	PPD	5	5	3	5005	0	0	0		0	3Q1	SPERRY AV
1	9042264	2019	########	5005	########	754	7	1320	WEST	5	5	3	5005	0	0	0		0	5	EAST LAS P
21	8989503	2018	########	5005	########	753	7	S01604		4	5	3	5005	0	0	0		0	312	EAST LAS P
6	9128356	2020	########	5005	########	1153	11	S02804	5005	6	5	3	5005	0	0	0		0	3L5	RT 33
14	9211493	2020	########	5005	########	358	3	S02649	PATTE	5	5	3	5005	0	0	0		0		RT 33
3	8503769	2017	########	5005	########	1154	11	S01639		6	5	3	5005	0	0	0		0	1	LAS PALMA
13	8989726	2018	########	5005	########	1710	17	S01906	PATTE	1	5	3	5005	0	0	0		0	3B5	LAS PALMA
4	9046020	2019	########	5005	########	1632	16	S02326	PPS	4	5	3	5005	0	0	0		0	5	AMERICAN
5	8989707	2018	########	5005	########	245	2	S987	MODES	7	5	3	5005	0	0	0		0		S SALADO
7	8465671	2018	########	5005	########	2107	21	S02447	PATTE	2	5	3	5005	0	0	0		0	3Q8	N 2ND ST
10	8989515	2018	########	5005	########	1810	18	S02034	5005	4	5	3	5005	0	0	0		0	3B3	WARD AV
11	9023599	2019	########	5005	########	1640	16	S02955	PPD	6	5	3	5005	0	0	0		0	3B3	S EL CIRCUI
12	8331250	2016	########	5005	########	300	3	GONZALEZ		7	5	3	5005	0	0	0		0	3Q7	SOUTH 1ST
15	8166801	2016	########	5005	########	1538	15	S987	MODES	1	5	3	5005	0	0	0		0		KEYSTONE
17	8174858	2016	########	5005	########	1700	17	S01906	5005	6	5	3	5005	0	0	0		0	3B3	PARK CENT
18	9030461	2019	########	5005	########	1830	18	S01337	5005	6	5	3	5005	0	0	0		0	3L5	W LAS PALI

SECONDAR	DISTANCE	DIRECTION	INTERSECT	Intersec_1	WEATHER_	WEATHER_	STATE_HW	CALTRANS_	CALTRANS_	STATE_ROI	ROUTE_SU	POSTMILE_	POSTMILE	LOCATION_	RAMP_INT	SIDE_OF_H	TOW_AWA	COLLISIO_1	NUMBER_I	NUMBER_I
CLOVER AV	70	E	N	Y	A	-	N		0	0			0				Y	4	0	2
GREBE LN	93	S	N	Y	A	-	N		0	0			0				N	3	0	1
SPERRY AV	26	N	N	Y	B	-	N		0	0			0				N	3	0	1
SPERRY AV	435	S	N	N	A	-	N		0	0			0				Y	3	0	1
NORTH 1ST	50	W	N	Y	A	-	N		0	0			0				N	4	0	2
WEBER AV	260	W	N	N	A	-	N		0	0			0				Y	3	0	1
CLOVER AV	21	E	N	Y	A	-	N		0	0			0				N	4	0	1
SHEARWAT	219	N	N	Y	A	-	N		0	0			0				N	3	0	1
IVY AV	963	N	N	N	A	-	Y	STA	10	33	-	-	14.37	H	-	N	Y	4	0	1
HARTLEY S	430	W	N	N	A	-	N		0	0			0				Y	2	0	2
LAS PALMA	176	E	N	Y	A	-	N		0	0			0				Y	2	0	1
SOUTH 9TH	185	E	N	Y	A	-	N		0	0			0				N	1	1	0
RT 33	15	S	N	Y	A	-	Y	STA	10	33	-	-	14.52	I		6	S	N	4	0	3
PARK CENT	936	W	N	N	C	-	N		0	0			0				Y	3	0	2
S HARTLEY	79	W	N	Y	A	-	N		0	0			0				Y	3	0	2
S HARTLEY	160	W	N	Y	A	-	N		0	0			0				Y	4	0	3
HARTLEY S	75	W	N	Y	A	-	N		0	0			0				Y	2	0	1
W LAS PALI	357	S	N	N	A	-	N		0	0			0				Y	2	0	1
RT 33	143	W	N	Y	A	-	Y	STA	10	33	-	-	14.185	I		6	S	Y	3	0	1
EUCALYPTU	196	S	N	Y	E	-	Y	STA	10	33	-	-	14.66	H	-	N		Y	1	1	0
AMERICAN	481	W	N	N	A	-	N		0	0			0				Y	2	0	2
HARTLEY A	545	E	N	N	A	-	N		0	0			0				Y	2	0	1
S 1ST AV	0		Y	Y	A	-	N		0	0			0				Y	4	0	1
SOUTH 1ST	0		Y	Y	A	-	N		0	0			0				N	2	0	1
HARTLEY A	0		Y	Y	A	-	N		0	0			0				N	3	0	1
HARTLEY	0		-	Y	A	-	N		0	0			0					4	0	1
EAST LAS P	0		Y	Y	A	-	Y	STA	10	33	-	-	13.18	I		5	S	Y	4	0	1
2ND ST	0		Y	Y	A	-	Y	STA	10	33	-	-	13.18	I		5	N	Y	1	1	1
N HARTLEY	0		Y	Y	A	-	N		0	0			0					N	4	0	1
SPERRY AV	0		Y	Y	A	-	N		0	0			0					Y	4	0	1
CORN FLO\	0		Y	Y	A	-	N		0	0			0					Y	2	0	1
RT 33	0		Y	Y	A	-	Y	STA	10	33	-	-	13.1	I		6	S	Y	2	0	1
W LAS PALI	0		Y	Y	A	-	Y	STA	10	33	-	-	13.18	I		5	S	N	1	1	0
9TH ST	0		Y	Y	A	-	N		0	0			0					N	2	0	2
RT 33	0		Y	Y	A	-	Y	STA	10	33	-	-	13.1	I		6	S	N	4	0	1
SPERRY AV	0		Y	Y	A	-	N		0	0			0					Y	3	0	1
PARK CENT	0	W	N	Y	A	-	N		0	0			0					Y	1	1	0
KEYSTON P	0		Y	Y	A	-	N		0	0			0					N	3	0	1
N 2ND ST	0		Y	Y	A	-	Y	STA	10	33	-	-	13.18	I		5	N	Y	4	0	1

PARTY_COI	PRIMARY_(	PCF_CODE_	PCF_VIOL_	PCF_VIOLA	PCF_VIOL_	HIT_AND_F	TYPE_OF_C	MVIW	PED_ACTIC	ROAD_SUR	ROAD_CON	ROAD_CON	LIGHTING	CONTROL_	CHP_ROAD	PEDESTRIA	BICYCLE_A	MOTORCY(	TRUCK_AC	NOT_PRIVA
2	A	-	3	22350		N	C	C	A	A	H	-	A	D	0					Y
2	A	-	17	21208	B	N	G	G	A	A	H	-	A	D	0		Y			Y
3	A	-	7	21658	A	N	B	C	A	A	H	-	A	A	0					Y
1	A	-	3	22350		N	E	I	A	A	H	-	A	D	0					Y
3	D	-	0	0		N	C	C	A	A	H	-	A	A	0					Y
2	A	-	8	21460	5	N	A	C	A	A	H	-	A	D	0					Y
2	A	-	3	22350		N	C	C	A	A	H	-	A	D	0					Y
2	A	-	3	22350		F	G	B	E	A	H	-	A	D	0	Y				Y
3	A	-	3	22350		N	C	C	A	A	H	-	A	D	0					Y
2	A	-	4	21703		N	C	D	A	A	H	-	A	D	0					Y
2	A	-	11	21955		N	G	B	D	A	H	-	C	D	0	Y				Y
2	A	-	0	20001	A	F	G	B	D	A	H	-	D	D	0	Y				Y
2	A	-	4	21703		N	C	C	A	A	H	-	A	A	0					Y
2	A	-	3	22350		N	A	C	A	B	H	-	C	D	0					Y
1	A	-	8	22107		N	E	I	A	A	H	-	C	D	0					Y
3	A	-	3	22350		N	C	C	A	A	H	-	A	A	0					Y
1	A	-	3	22350		N	E	I	A	A	H	-	A	A	0					Y
3	A	-	8	22107		N	C	C	A	A	H	-	C	D	0					Y
1	A	-	3	22350		N	E	I	A	A	H	-	D	A	0					Y
1	A	-	3	22350		N	F	J	A	B	H	-	D	D	0					Y
1	A	-	3	22350		N	E	I	A	A	H	-	C	A	0					Y
1	D	-	0	0		N	E	I	A	A	H	-	A	D	0					Y
1	A	-	3	22350		N	A	I	A	A	H	-	D	D	0					Y
1	A	-	3	22350		F	H	A	A	A	H	-	C	D	0					Y
2	A	-	10	21950	A	N	G	B	B	A	H	-	A	A	0	Y				Y
3	A	-	3	22350		N	C	C	A	A	H	-	A	A	0					Y
3	A	-	1	23152	A	N	D	C	A	A	H	-	A	A	0					Y
2	A	-	12	21453	A	N	D	C	A	A	H	-	C	A	0					Y
2	A	-	3	22350		N	C	C	A	A	H	-	A	A	0					Y
2	A	-	9	21801	A	N	A	C	A	A	H	-	C	A	0					Y
2	A	-	3	22350		N	B	J	A	A	H	-	A	D	0			Y		Y
2	A	-	11	21954	A	N	G	B	D	A	H	-	D	A	0	Y				Y
2	A	-	11	21456	B	N	G	B	B	A	H	-	C	A	0	Y				Y
3	A	-	10	21950	A	N	G	B	B	A	H	-	B	D	0	Y				Y
2	A	-	11	21955		N	G	B	D	A	H	-	A	A	0	Y				Y
1	A	-	8	22107		N	H	I	A	A	H	-	D	D	0					Y
1	A	-	3	22350		N	E	I	A	A	H	-	C	A	0			Y		Y
2	A	-	12	22450	A	N	D	C	A	-	-	-	A	A	0					Y
2	A	-	-	0		N	C	C	A	A	H	-	A	A	0					Y

ALCOHOL_	STWD_VEH	CHP_VEHT	COUNT_SE	COUNT_VI	COUNT_CC	COUNT_PE	COUNT_PE	COUNT_BI	COUNT_BI	COUNT_M	COUNT_M	PRIMARY_I	SECONDAR	LATITUDE	LONGITUD	COUNTY	CITY	POINT_X	POINT_Y	EPDO
	A	1	0	0	2	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.136	37.46433	6
	L	4	0	1	0	0	0	0	1	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.15	37.46743	11
	A	1	0	1	0	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.15	37.46455	11
	A	1	0	1	0	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.15	37.46344	11
	-	-	0	0	2	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.128	37.47268	6
	A	1	0	1	0	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.126	37.47337	11
	-		0	0	1	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.136	37.46434	6
	A	1	0	1	0	0	1	0	0	0	0	-	-	37.4702	-121.146	STANISLAU	PATTERSON	-121.147	37.47022	11
	A	7	0	0	1	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.14	37.48708	6
	D	22	2	0	0	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.123	37.47489	165
	N	60	1	0	0	0	1	0	0	0	0	-	-	37.46448	-121.144	STANISLAU	PATTERSON	-121.144	37.46445	165
Y	-		0	0	0	1	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.134	37.4643	165
	A	1	0	0	3	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.141	37.48899	6
	A	1	0	1	1	0	0	0	0	0	0	-	-	37.4646	-121.169	STANISLAU	PATTERSON	-121.169	37.46448	11
	A	1	0	2	0	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.122	37.47537	11
	I	11	0	0	3	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.122	37.47527	6
Y	A	1	1	0	0	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.122	37.47538	165
	A	1	1	0	0	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.141	37.46577	165
	A	1	0	1	0	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.138	37.48477	11
	A	7	0	0	0	0	0	0	0	0	0	-	-	37.491	-121.141	STANISLAU	PATTERSON	-121.142	37.4909	165
	-		1	1	0	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.151	37.46449	165
	-	-	1	0	0	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.12	37.47622	165
	A	1	0	0	1	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.122	37.46463	6
	A	1	1	0	0	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.122	37.46463	165
Y	I	11	0	1	0	0	1	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.122	37.47548	11
	-		0	0	1	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.122	37.47548	6
Y	A	1	0	0	1	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.129	37.47206	6
Y	A	1	0	0	1	0	0	0	0	0	0	-	-	37.472	-121.128	STANISLAU	PATTERSON	-121.129	37.47206	165
	A	1	0	0	1	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.122	37.47548	6
	A	1	0	0	1	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.145	37.46446	6
	C	2	1	0	0	0	0	0	0	0	1	-	-	0	0	STANISLAU	PATTERSON	-121.151	37.45894	165
Y	N	60	1	0	0	0	1	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.128	37.47107	165
Y	N	60	0	0	0	1	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.129	37.47206	165
	A	1	2	0	0	0	2	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.141	37.4726	165
	N	60	0	0	1	0	1	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.128	37.47107	6
	-		0	1	0	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.122	37.46463	11
	C	2	0	0	0	0	0	0	0	1	0	-	-	0	0	STANISLAU	PATTERSON	-121.165	37.4758	165
	D	23	0	1	0	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.165	37.4758	11
Y	A	1	0	0	1	0	0	0	0	0	0	-	-	0	0	STANISLAU	PATTERSON	-121.129	37.47206	6

Age	Gender	Move_Pre_
19	F	B
11	M	E
16	F	L
20	M	B
36	M	B
39	M	B
22	M	B
998	M	B
50	M	E
34	F	B
18	-	B
998	M	R
31	M	B
30	M	I
19	M	B
63	F	D
20	M	C
41	F	B
20	M	R
22	M	E
21	M	B
30	M	R
22	M	B
51	F	J
998	M	E
50	M	B
25	F	B
51	M	B
998	F	B
17	M	I
55	F	L
66	M	B
43	F	B
63	M	B
86	F	-
23	M	B
24	M	B
52	M	B
37	M	E

APPENDIX C:
PUBLIC COMMENTS WITH MAP INPUT TOOL

Appendix C - Public Comments with Map Input Data

Respondent ID	#	Long	Lat	Intersection	Location	Public Reported Concerns	Mode	Reported Issue
4hj4pu7edu46	1	-121.14	37.467032	Y	W Las Palmas Ave	High Traffic in am/pm school drop off/pick-up.	Motor Vehicle	Traffic conjestion
4hj4pu7edu46	2	-121.13	37.465572	Y	C St	Bad road conditions C Street (from Del Puerto - S. 6th Street)	Motor Vehicle	Roadway Improvement
4hj4pu7edu46	3	-121.14	37.471911	N	N 9th St	Bad road conditions on 9th Street all the way to Sperry Avenue.	Pedestrian	Pedestrian Safety
4cn37hhs3sg7	4	-121.135	37.464521	Y	S 9th St	Unsafe for walking and biking.	Bicycle	Bicycle Safety
7lsg8tuw4i7a	5	-121.14	37.464422	Y	Sperry Ave	Too much traffic on this road, needs to be widened, more lanes, turn lanes.	Motor Vehicle	Traffic conjestion
7lsg8tuw4i7a	6	-121.142	37.464439	Y	Sperry Ave	Palm trees, remove the palm trees from the dividers.	Motor Vehicle	Visibility
9lk64d9c9b44	7	-121.159	37.464365	Y	Sperry Ave	Sperry, Palmas, and Downtown are where the most economic activity exists, so often follows, traffic and collisions. There are no protected bike lanes in Patterson, and these areas would do well with some, especially Sperry.	Bicycle	Bicycle Safety
34aac9fjp6v9	8	-121.177	37.493373	Y	Zacharias Rd	Road widening, better maintenance of the surface of the roadway.	Motor Vehicle	Roadway Improvement
34aac9fjp6v9	9	-121.159	37.473585	Y	Baldwin Rd	Manhole openings need to be leveled with the road surface	Pedestrian	Pedestrian Safety
34aac9fjp6v9	10	-121.141	37.475644	Y	Ward Ave	Narrow lanes, school entrance near the intersection	Motor Vehicle	Narrow Roads
34aac9fjp6v9	11	-121.136	37.460652	Y	Clover Ave	Unsafe roadway surface, narrow road	Motor Vehicle	Narrow Roads
34aac9fjp6v9	12	-121.121	37.461721	Y	S 2nd St	Merging and turn lanes	Motor Vehicle	Roadway Safety
277vmp28hgc4	13	-121.171	37.464514	N	Sperry Ave	The road is horrible! They keep on filling in pot holes, but it doesn't last long.	Pedestrian	Pedestrian Safety
3la6aul3e9c7	14	-121.123	37.464094	Y	S 2nd St	Numerous collisions, busy with traffic, needs a signal or stop signs.	Motor Vehicle	Signage Improvement
2oe4ywt3jc38	15	-121.124	37.465644	Y	S 2nd St	Traffic only stops on speedy intersection has had multiple accidents could use some lights Speed bumps!	Motor Vehicle	Intersection Safety
9u3lah2dl7j6	17	-121.141	37.458619	Y	Ward Ave	Some way to force people to slow down and actually yells at the roundabouts	Motor Vehicle	Intersection Safety
3uk93a22wdu7	18	-121.12	37.48063,	N	Lorelei Ln	Too many pot holes on Morning Glory Dr. Dips also. We have had in front of our house the pipes replaced 2 times sewage backed up int our home.	Motor Vehicle	Speeding
7p8ffh4n6x87	19	-121.154	37.464497	Y	Sperry Ave	Within the last year there has been at least 4 accidents involving 11 Walker Ranch where a car is turning right from Sperry and loses control. 2 cars ended up on the property, 1 of those hit the house, a third totaled the car of the person living there, a fourth lost control, hit the garbage cans and hit a car on Walker Ranch. There's video. Also kids live on that property. I am requesting a barrier be placed on the sidewalk in front of 11 Walker Ranch, maybe some metal or cement poles or big boulders. Also maybe speed bumps on Walker Ranch.	Pedestrian	Pedestrian Safety

						SPEEDING at all hours of the day and night. Cards do not yield or slow down at the roundabouts! More often than not they speed through them.		
8vn4bnu4cci3	21	-121.154	37.460989	Y	Calvinson Pkwy	SPEED HUMPS ARE NEEDED ALONG CALVINSON to slow cars down in the neighborhood where kids play, people walk and ride their bikes.	Motor Vehicle	Speeding
7nv9z2wra9za	22	-121.141	37.476121	Y	Ward Ave	Traffic congestion during morning/afternoon school schedule	Motor Vehicle	Unsafe turning
2ygv4txl3cz8	23	-121.088	37.492457	N	Old Las Palmas Av	Again the whole road needs to be repaired due to many many potholes damages to car rims and tires. Popular photo stop please let's make it more appealing and safe to walk and drive	Motor Vehicle	Speeding
3wbb8sla4be6	24	-121.14	37.479431	Y	Ward Ave	Increase speed limit to 35mph	Motor Vehicle	Traffic conjestion
						This roadway segment is unsafe for walking/biking/running.		
92f2ktp6yip4	25	-121.159	37.468098	Y	Baldwin Rd	Cars don't stop at this stop-controlled intersection, painted crosswalks.	Pedestrian	Pedestrian Safety
3vm2hp66ijp9	26	-121.141	37.47224,	Y	Ward Ave	We need a signal or 4 way stop. Morning traffic is crazy and they don’t have crossing guards for the students attending at the HIGH SCHOOL.In the afternoon same problem.	Motor Vehicle	Speeding
3vm2hp66ijp9	27	-121.123	37.464219	Y	Sperry Ave	Traffic needs a forced stop. To many people speed and the traffic that stops doesn’t always stop	Motor Vehicle	Sign Violation
67whr227k82a	28	-121.123	37.464281	Y	Sperry Ave	Too many accidents or near accident, need a 4 way traffic light	Pedestrian	Pedestrian Safety
4eb7use8o3v6	29	-121.123	37.464299	Y	Sperry Ave	It needs a Light to many people get in accidents here and we just Recently had someone pass away here on February 9	Bicycle	Bicycle Safety
7lef243ooi98	1	37.47148	-121.14	N	N 9th St	Crossing of students in the future	Motor Vehicle	Intersection Safety
94wfy88dkv34	2	37.47549	-121.122	Y	E Las Palmas Ave		Motor Vehicle	Signage Improvement
4hj4pu7edu46	3	37.46438	-121.123	Y	S 2nd St	Traffic collisions occurring at this location, including fatalities. Also, very difficult to cross safely as that intersection is busy.	Motor Vehicle	Signage Improvement
4hj4pu7edu46	4	37.46456	-121.15	Y	Sperry Ave	Busy intersection due to commercial shopping area being busy. Not safe for pedestrians or vehicle traffic on Las Palmas both ways as there is no turn arrow lights like there is on Sperry. I almost got ran over a couple of times and witnessed many incidents of vehicles almost getting hit there. This is highly used by children and is very dangerous.	Motor Vehicle	Speeding
4hj4pu7edu46	5	37.46446	-121.145	Y	Sperry Ave	Busy intersection due to commercial shopping area being busy. Not safe for pedestrians or vehicle traffic on Las Palmas both ways as there is no turn arrow lights like there is on Sperry. I almost got ran over a couple of times and witnessed many incidents of vehicles almost getting hit there.	Motor Vehicle	Signage Improvement
4hj4pu7edu46	6	37.46985	-121.141	Y	Ward Ave	Lots of traffic back-up in the morning when children are being dropped off to High School. Very hard to cross to get onto Ward Avenue.	Motor Vehicle	Lighting

4hj4pu7edu46	7	37.47226	-121.141	Y	N 9th St	Very busy during school hours. Can be dangerous for traffic and pedestrians, especially students getting to/from school.	Pedestrian	Pedestrian Safety
4hj4pu7edu46	7	37.47226	-121.141	Y	N 9th St	Very busy during school hours. Can be dangerous for traffic and pedestrians, especially students getting to/from school.	Bicycle	Bicycle Safety
4hj4pu7edu46	8	37.47467	-121.141	Y	Ward Ave	This street back-up after school. Traffic delays for almost 30 minutes. Hard to also get on to Ward heading west on Salado Avenue.	Motor Vehicle	Slow Moving Traffic
4hj4pu7edu46	9	37.46466	-121.141	Y	Sperry Ave	High traffic back-up on Sperry and 9th Street after school and in the morning.	Motor Vehicle	Slow Moving Traffic
4hj4pu7edu46	10	37.46838	-121.138	Y	N 9th St	Very backed up on Las Palmas Avenue, 9th Street during school pick-up/drop off.	Motor Vehicle	Slow Moving Traffic
4hj4pu7edu46	11	37.47204	-121.129	Y	N 2nd St	Traffic Back-up on Las Palmas all the way around circle in the afternoon between 3pm-3:30pm	Motor Vehicle	Slow Moving Traffic
4hj4pu7edu46	12	37.47584	-121.141	Y	Ward Ave	traffic back-up around schools during afternoon and morning, worse in the pm.	Motor Vehicle	Slow Moving Traffic
3oy9bc9nx6ma	13	37.46434	-121.123	Y	S 2nd St	Intersection is not safe	Motor Vehicle	Unsafe Intersection
9hb4lx8pft73	14	37.46585	-121.124	N	S 2nd St		Motor Vehicle	Unsafe Roadway Segment
4hk3axs7bgm8	15	37.46433	-121.123	Y	S 2nd St	This is a well-known accident spot. This area must be addressed ASAP.	Motor Vehicle	Unsafe Intersection
4hk3axs7bgm8	16	37.45948	-121.12	N	S 2nd St	Make a turning lane for those entering the dispensary.	Motor Vehicle	Unsafe Turning
8st2m3z7j43v	17	37.47207	-121.129	Y	S 2nd St	traffic signals and signs violations	Motor Vehicle	Traffic Signals
8st2m3z7j43v	17	37.47207	-121.129	Y	S 2nd St	traffic signals and signs violations	Motor Vehicle	Sign Violation
7lsg8tuw4i7a	18	37.48485	-121.141	N	Ward Ave	Cars drive too fast through this section of road.	Motor Vehicle	Speeding
3vm6o7glj8v8	19	37.46431	-121.123	Y	S 2nd St	there needs to be a 4 way stop sign. There has been so many accidents because to the left there is a blind spot.	Motor Vehicle	Unsafe Intersection
9lk64d9c9b44	20	37.4713	-121.13	Y	Plaza Cir	City should do more to promote biking and walking in Downtown Patterson.	Pedestrian	Pedestrian Safety
9lk64d9c9b44	20	37.4713	-121.13	Y	Plaza Cir	City should do more to promote biking and walking in Downtown Patterson.	Bicycle	Bicycle Safety
34aac9fjp6v9	21	37.47124	-121.152	Y	Shearwater Dr	Pedestrians crossing Shearwater in heavy traffic during school year.	Pedestrian	Pedestrian Safety
34aac9fjp6v9	21	37.47124	-121.152	Y	Shearwater Dr	Pedestrians crossing Shearwater in heavy traffic during school year.	Bicycle	Bicycle Safety
34aac9fjp6v9	22	37.471	-121.154	Y	Henley Pkwy	Pedestrians crossing Henley in heavy traffic during school year.	Pedestrian	Pedestrian Safety
34aac9fjp6v9	22	37.471	-121.154	Y	Henley Pkwy	Pedestrians crossing Henley in heavy traffic during school year.	Bicycle	Bicycle Safety
34aac9fjp6v9	23	37.46436	-121.135	Y	Sperry Ave	Pedestrians crossing uncontrolled lanes of traffic on Sperry.	Pedestrian	Pedestrian Safety
34aac9fjp6v9	23	37.46436	-121.135	Y	Sperry Ave	Pedestrians crossing uncontrolled lanes of traffic on Sperry.	Bicycle	Bicycle Safety
34aac9fjp6v9	24	37.45438	-121.141	N	Ward Ave	Traffic turning into the park and leaving the park, crossing traffic. Turn/merge lanes would be a nice addition.	Motor Vehicle	Unsafe Turning
34aac9fjp6v9	25	37.46983	-121.141	Y	Ward Ave	Pedestrians crossing uncontrolled Ward Ave	Pedestrian	Pedestrian Safety
34aac9fjp6v9	25	37.46983	-121.141	Y	Ward Ave	Pedestrians crossing uncontrolled Ward Ave	Bicycle	Bicycle Safety
34aac9fjp6v9	26	37.48927	-121.141	Y	Ward Ave	From Ward, turning left onto Hwy 33 - the corner is difficult to see fully	Motor Vehicle	Visibility

34aac9fjp6v9	27	37.46044	-121.151	Y	Calvinson Pkwy	Oncoming westbound traffic on Calvinson Pkwy is difficult to see from southbound American Eagle due to the bushes and/or angle of the wall.	Motor Vehicle	Visibility
34aac9fjp6v9	28	37.46431	-121.123	Y	S 2nd St	The intersection needs to be a four-way controlled intersection with turn lanes from each direction.	Motor Vehicle	Unsafe Intersection
7obp2g88gxs7	29	37.46461	-121.175	Y	Sperry Ave	Drivers run this red light using the right turn only lane. They use it to illegally drive straight to beat the drivers in the adjacent lane. I have seen this multiple times and never seen any law enforcement. A red light camera or patrols are needed to correct this.	Motor Vehicle	Sign Violation
7obp2g88gxs7	29	37.46461	-121.175	Y	Sperry Ave	Drivers run this red light using the right turn only lane. They use it to illegally drive straight to beat the drivers in the adjacent lane. I have seen this multiple times and never seen any law enforcement. A red light camera or patrols are needed to correct this.	Motor Vehicle	Traffic Signals
9ly93i7w32m4	30	37.46981	-121.147	Y	Shearwater Dr	4 way stop	Motor Vehicle	Unsafe Intersection
2px99jkc4e66	31	37.46486	-121.13	N	Sperry Ave	Need a light at the corner of sorry and 33 near Thompson dealership.	Motor Vehicle	Visibility
3u9hww76n6s4	32	37.46435	-121.123	Y	S 2nd St	Needs to have stop light for the many pedestrians walking across Sperry.	Pedestrian	Pedestrian Safety
3u9hww76n6s4	32	37.46435	-121.123	Y	S 2nd St	Needs to have stop light for the many pedestrians walking across Sperry.	Bicycle	Bicycle Safety
9u3lah2dl7j6	33	37.48871	-121.141	Y	Ward Ave	Needs a light	Motor Vehicle	Visibility
9u3lah2dl7j6	34	37.46429	-121.123	Y	S 2nd St	Needs a light	Motor Vehicle	Visibility
3pnw6pc76lb8	35	37.4643	-121.136	Y	Sperry Ave	Heavy traffic area. Drivers coming out of Clover Ave need to cross the walking path to view drivers in both directions on Sperry road. Making a left or right turn in peak hours can cause the driver to gun it almost causing an accident. Morning rush hours is the worse. Several accidents have happened in the intersection.	Motor Vehicle	Unsafe Turning
3pnw6pc76lb8	36	37.4643	-121.134	Y	Sperry Ave	Light is needed here. Drivers to not respect the flashing lights when students cross. I have see students from local schools running across and almost getting hit. Fog season is the worst. Several times the cross walk flashers do not work.	Motor Vehicle	Sign Violation
3pnw6pc76lb8	36	37.4643	-121.134	Y	Sperry Ave	Light is needed here. Drivers to not respect the flashing lights when students cross. I have see students from local schools running across and almost getting hit. Fog season is the worst. Several times the cross walk flashers do not work.	Motor Vehicle	Traffic Signals
3pnw6pc76lb8	37	37.46441	-121.123	Y	S 2nd St	Needs a light. Unsafe area when turning left or right. Many accidents at this location. Sperry Ave overall needs lights due to high usage especially from larger semi.	Motor Vehicle	Visibility

3kp4jsf7bag4	38	37.46431	-121.135	Y	Sperry Ave	Intersection of Sperry and 9th st.; No working crosswalk and speeding drivers go around those turning on 9th street either way and do not see pedestrians crossing.	Motor Vehicle	Speeding
8ehr4kaa4tnl	39	37.49848	-121.126	Y	Eucalyptus Ave	People run the stop sign at eucalyptus and sycamore all the time. I have wittnessed it many times on my way to work. Last week 2 cars ran the stop sign right in front of me its extremely dangerous. We need a 4 way stop there.	Motor Vehicle	Traffic Signals
8ehr4kaa4tnl	39	37.49848	-121.126	Y	Eucalyptus Ave	People run the stop sign at eucalyptus and sycamore all the time. I have wittnessed it many times on my way to work. Last week 2 cars ran the stop sign right in front of me its extremely dangerous. We need a 4 way stop there.	Motor Vehicle	Traffic Signals
99s9jbd337z3	40	37.46426	-121.123	Y	S 2nd St		Motor Vehicle	Unsafe Intersection
4v4y988kam46	41	37.46386	-121.123	Y	S 2nd St	Dangerous intersection! Many cars don't stop here properly.. almost got crashed into 4 times here!	Motor Vehicle	Traffic Signals
4v4y988kam46	41	37.46386	-121.123	Y	S 2nd St	Dangerous intersection! Many cars don't stop here properly.. almost got crashed into 4 times here!	Motor Vehicle	Sign Violation
2xas3od279xa	42	37.4643	-121.123	Y	S 2nd St	Unsafe crossing, traffic light needed	Motor Vehicle	Unsafe Intersection
2xas3od279xa	43	37.47227	-121.141	Y	S 2nd St	Unsafe crossing, traffic light needed.	Motor Vehicle	Unsafe Intersection
3uk93a22wdu7	44	37.46424	-121.123	Y	S 2nd St	Too hard to see traffic coming in all directions. Many accidents there. It was agreed when Walmart went in a traffic light would be put there. Sperry Ave and Hwy 33 intersection. We need traffic light there.	Motor Vehicle	Unsafe Intersection
7u3pi4rj9xj7	45	37.46427	-121.123	Y	S 2nd St	We need a stop light here ! It is so dangerous with so many incidents	Motor Vehicle	Unsafe Intersection
7u3pi4rj9xj7	46	37.47464	-121.141	Y	Ward Ave	We need a stop light here. It backs up very badly around school times	Motor Vehicle	Slow Moving Traffic
9v4z6xs3ufx3	47	37.46432	-121.123	Y	S 2nd St	Need a traffic light	Motor Vehicle	Unsafe Intersection
9v4z6xs3ufx3	48	37.46445	-121.154	Y	Sperry Ave	Street sign lights have been out for several years	Motor Vehicle	Visibility
4tdl6noi46a4	49	37.47678	-121.147	Y	Roadrunner Dr	Roadrunner and Flicker. I have had my car totaled by a driver that came speeding off Cliffswallow to Roadrunner. She plowed into the back of my envoy. In the last year. My next door neighbor had their truck totaled. The neighbors on the corner of Roadrunner and Cliffswallow had 2 cars totalled. My neighbor across the street had her car plowed into during Apricot fiesta also on Roadrunner. 2 weeks ago 3 cars were totaled at Roadrunner and Flicker. We need speed bumps on Roadrunner and Cliffswallow. And a stop sign at Roadrunner and Flicker. PLEASE.	Motor Vehicle	Speeding
4um37j92z7p4	50	37.46432	-121.123	Y	S 2nd St	this location needs a traffic light so many accidents have occurred here at this location it is unsafe and not okay for this intersection to not have a traffic light	Motor Vehicle	Unsafe Intersection

8arj96gkk2c9	51	37.46396	-121.122	Y	S 2nd St	Highway 33 and Sperry are heavily traveled roadways. Many cars speeding above the posted speed limit makes it unsafe to cross over 33.	Motor Vehicle	Speeding
8oz7atk6kck4	52	37.48892	-121.141	Y	Ward Ave	Speeding. There's nothing to slow people down coming off of highway 33 onto ward Avenue and they sustain the highway speed making it impossible to pull out of the neighborhoods We need stop signs	Motor Vehicle	Speeding
69xcf39dfd79	53	37.46424	-121.123	Y	S 2nd St	Need a traffic Light or a roundabout. Way to many accidents at this intersection.	Motor Vehicle	Unsafe Intersection
69xcf39dfd79	54	37.46998	-121.127	Y	E St	Needs warrning lights and train crossing guards. Hard to see if a train is approaching. Building obstruct the view of on coming trains.	Motor Vehicle	Unsafe Rail Crossing
8r67wdz8btg6	55	37.47226	-121.141	Y	N 9th St		Motor Vehicle	Unsafe Intersection
8r67wdz8btg6	56	37.47228	-121.141	Y	N 9th St	It needs a 4 way stop or lights it's impossible to get through that intersection in the morning	Motor Vehicle	Unsafe Intersection
8r67wdz8btg6	57	37.47229	-121.141	Y	Ward Ave		Motor Vehicle	Unsafe Intersection
2a78bz9dxi36	58	37.46424	-121.123	Y	Sperry Ave	A traffic light would be essential for this location	Motor Vehicle	Unsafe Intersection
3wfw6aya2so9	59	37.46444	-121.123	Y	Sperry Ave	This intersection is a nightmare!	Motor Vehicle	Unsafe Intersection
9yc7cwj6fgc6	60	37.4643	-121.123	Y	Sperry Ave		Motor Vehicle	Unsafe Intersection
6h6bju69wp73	61	37.46424	-121.123	Y	Sperry Ave	This area NEEDS a traffic light. There has been too many close calls and huge accidents.	Motor Vehicle	Unsafe Intersection
27jdl7lxx2s9	62	37.46427	-121.135	Y	Sperry Ave	Needs a stop light or better visibility of pedestrians crossing. Currently, there's a yellow flashing light which is on constantly so it seems as if no one pays attention to it when there's an actual person crossing.	Pedestrian	Pedestrian Safety
27jdl7lxx2s9	62	37.46427	-121.135	Y	Sperry Ave	Needs a stop light or better visibility of pedestrians crossing. Currently, there's a yellow flashing light which is on constantly so it seems as if no one pays attention to it when there's an actual person crossing.	Bicycle	Bicycle Safety
6yz4tc6akd38	63	37.46441	-121.123	Y	Sperry Ave	Unsafe turning conditions	Motor Vehicle	Unsafe Turning
8sw7inc2gd3n	64	37.46427	-121.123	Y	Sperry Ave	Multiple intersections that are uncontrolled. High speed drivers and awkward sight lines make this a dead intersection	Motor Vehicle	Unsafe Intersection
8sw7inc2gd3n	64	37.46427	-121.123	Y	Sperry Ave	Multiple intersections that are uncontrolled. High speed drivers and awkward sight lines make this a dead intersection	Motor Vehicle	Speeding
8sw7inc2gd3n	65	37.47069	-121.132	Y	W Las Palmas Ave	Multiple emergency vehicles coming and going near a school zone. Heavy traffic area during school season. Danger to pedestrians and cross traffic. Needs warning lights or additional stop signs.	Motor Vehicle	Slow Moving Traffic
8sw7inc2gd3n	65	37.47069	-121.132	Y	W Las Palmas Ave	Multiple emergency vehicles coming and going near a school zone. Heavy traffic area during school season. Danger to pedestrians and cross traffic. Needs warning lights or additional stop signs.	Motor Vehicle	Unsafe Crossing

9ob3lpd4o786	66	37.46876	-121.133	Y	S 6th St	Cars speed through this intersection and run these stop signs every day. This is a school area. Speed bumps would help stop the speeding. I have so many ppl caught on my camera running these stops. Scares me.	Motor Vehicle	Sign Violation
9ob3lpd4o786	66	37.46876	-121.133	Y	S 6th St	Cars speed through this intersection and run these stop signs every day. This is a school area. Speed bumps would help stop the speeding. I have so many ppl caught on my camera running these stops. Scares me.	Motor Vehicle	Traffic Signals
79old9jd77em	67	37.47212	-121.129	Y	N 2nd St	33 and Sperry. It's hard to see on the right. It's needed badly. Too many accidents	Motor Vehicle	Visibility
79old9jd77em	68	37.47297	-121.128	Y	N 1st St	Accidents, big rigs going fast	Motor Vehicle	Speeding
9op7hl88jd47	69	37.46438	-121.123	Y	Sperry Ave	Traffic light needed at Sperry & Ward	Motor Vehicle	Unsafe Intersection
4kx4cuc9u4i3	70	37.46435	-121.123	Y	Sperry Ave	Needs a traffic light	Motor Vehicle	Unsafe Intersection
9iw8hhb83ta3	71	37.46429	-121.123	Y	Sperry Ave	It's extremely dangerous and time consuming!	Motor Vehicle	Unsafe Intersection
9iw8hhb83ta3	72	37.48465	-121.138	Y	N 2nd St	The stop sign is placed in a ridiculous location!! When the sun is blinding the sign is hard to see! I've seen that sign get hit multiple times!	Motor Vehicle	Visibility
9iw8hhb83ta3	73	37.48877	-121.141	Y	N 2nd St	This area needs to be removed! It's horribly planned !	Motor Vehicle	Unsafe Intersection
3c4yiv69ldg8	74	37.46386	-121.123	Y	Sperry Ave		Motor Vehicle	Unsafe Intersection
3c4yiv69ldg8	75	37.46488	-121.124	Y	Sperry Ave		Motor Vehicle	Unsafe Intersection
96ev7ph8o4s9	76	37.46438	-121.123	Y	Sperry Ave	There needs to be a stoplight here at sperry and 33.	Motor Vehicle	Unsafe Intersection
7nv9z2wra9za	77	37.47801	-121.159	N	Baldwin Rd	Excessive Speeds above 35mph.	Motor Vehicle	Speeding
7nv9z2wra9za	78	37.46434	-121.123	Y	Sperry Ave	Unsafe due to speed of North and South bound traffic. Stop light at this locations is a must!	Motor Vehicle	Speeding
7fn7ij22cg77	79	37.46429	-121.123	Y	Sperry Ave		Motor Vehicle	Speeding
8ft4xyd8zfw8	80	37.46429	-121.123	Y	Sperry Ave	Traffic lights needed	Motor Vehicle	Unsafe Intersection
2ygv4txl3cz8	81	37.46424	-121.123	Y	Sperry Ave	Too many accidents due to lack of signal lights. Traffic cant always be seen or cars comíng too fast from Newman. Light badly needed!!!	Motor Vehicle	Unsafe Intersection
2ygv4txl3cz8	82	37.49238	-121.087	N	Old Las Palmas Ave	This road needs to get repaved badly I have fallen a few times there there are many many potholes also car rims and tires are badly damaged. This is a HUGE photo spot for many people needs to be repaired!!!	Motor Vehicle	Bad Pavement Condition
3wbb8sla4be6	83	37.46394	-121.123	Y	Sperry Ave	A traffic light is needed!	Motor Vehicle	Unsafe Intersection
98u7u3p9t2b8	84	37.47224	-121.141	Y	Ward Ave	Stop light, no concern for cross traffic or pedestrian crossing at school. Turning cars cause traffic to be backed up in either direction	Motor Vehicle	Unsafe Intersection
3ema3rtt3ap4	85	37.46468	-121.124	Y	Sperry Ave	Stop light or a 4 way stop	Motor Vehicle	Unsafe Intersection

4879xdg6z9k6	86	37.47095	-121.145	Y	Heartland Ranch Ave	This area desperately needs 3 way stop signs and crosswalk. My kid started school on 9/11 and nearly everyday since, I have been witness to near misses. People speed and do not stop for the kids! I walk my son across that section every day and do my best to make sure I am seen. I have had cars respectfully aliw down and stop just to have the car behind them go around them on the left! There should be speed bumps also along Heartland Ranch and James Burke. Why were no crosswalks planned along those streets to begin with??	Motor Vehicle	Unsafe Intersection
2e8rcz7vb42a	87	37.48314	-121.123	Y	Walnut Ave	People speed into this neighborhood turning in from both directions on Walnut. There is only a stop sign leaving the neighborhood on Headley but 3 way stop would be better. A solar power digital read speed limit/ speed check like the one on Ward would be good there also.	Motor Vehicle	Speeding
2e8rcz7vb42a	88	37.46429	-121.123	Y	Sperry Ave	To many accidents here. Need signal lights	Motor Vehicle	Unsafe Intersection
49a3znn3dae7	89	37.47038	-121.15	Y	American Eagle Ave	We need a stop sign on the corner of sheer water and heartland ranch we need. A 4 way stop sign that is a blind spot specially because the house on 1176 sheewater have an auto repair out of their home there is always lots of cars in that corner ! I've seen few accidents in that corner my husband was hit several years ago ! Please put stop signs this is a disaster waiting to happen… thank you	Motor Vehicle	Unsafe Intersection
7dbs7g8uto44	90	37.46428	-121.123	Y	Sperry Ave	Safety for All. A stop light NEEDS TO BE HERE, WAY TOO MANY ACCIDENTS HAVE OCCURRED HERE.	Motor Vehicle	Unsafe Intersection
67whr227k82a	91	37.47402	-121.138	Y	N Salado Ave	No side walk for kids to walk on, they have to walk on the street. Very dangerous specially after school when traffic is crazy.	Pedestrian	Pedestrian Safety
67whr227k82a	91	37.47402	-121.138	Y	N Salado Ave	No side walk for kids to walk on, they have to walk on the street. Very dangerous specially after school when traffic is crazy.	Bicycle	Bicycle Safety
7yn7xmp8h8l8	92	37.46438	-121.123	Y	Sperry Ave	A stop light is needed on 33 and Sperry.	Motor Vehicle	Unsafe Intersection
99bfs7lax7u9	93	37.46421	-121.123	Y	Sperry Ave	Need lights up so people can stop	Motor Vehicle	Unsafe Intersection
3kv7sde48iuk	94	37.48477	-121.118	Y	Barnby Ln	Speeding happens day and night. Speed limit signs need to be posted.	Motor Vehicle	Speeding
3kv7sde48iuk	95	37.46484	-121.124	Y	Sperry Ave	Traffic light needs to be installed. Multiple accidents have happened and left turns are sometimes fatal.	Motor Vehicle	Unsafe Intersection

6tu3elr9lgw6	96	37.46432	-121.124	Y	Sperry Ave	As a school bus driver and resident of Patterson this intersection is dangerous and accidents happen there weekly. With there being a trucking company and truck parking lot just south of this intersection there are many trucks that unintentionally block the view of traffic when stopped at Sperry and 2nd street/ hwy 33 facing east. By simply putting in a traffic light we can reduce the numbers of accidents and hopefully avoid what is an inevitable death	Motor Vehicle	Unsafe Intersection
23cdy3gbb483	97	37.46663	-121.136	N	S 9th St	This section of road hasn't been fixed in 30+ years, it's ridiculously ridged, patched and horrible to drive	Motor Vehicle	Bad Pavement Condition
23cdy3gbb483	98	37.46431	-121.123	Y	Sperry Ave	There needs to be a light or a four way stop at this intersection. There is an awkward angle with a short visibility to oncoming traffic south on 33	Motor Vehicle	Unsafe Intersection
4y8p9rmt8sr7	99	37.47204	-121.129	Y	N 2nd St	This traffic light and curb needs to be moved further back to give more room for trucks to make a right turn safely. It's a designated truck route but semi trucks cannot make this turn safely without encroaching into the oncoming traffic lanes making it unsafe for cars and the semi trucks.	Motor Vehicle	Unsafe Intersection
3k7ayd3k6u27	100	37.46422	-121.123	Y	Sperry Ave	need a stop light and turn lanes at hwy 33 and Sperry	Motor Vehicle	Unsafe Intersection
4cul8j8bdx48	101	37.46455	-121.123	Y	Sperry Ave	Sperry and 33 needs traffic light. Traffic	Motor Vehicle	Unsafe Intersection
7zk3x7vdn3z7	102	37.46422	-121.123	Y	Sperry Ave	Dangerous Intersection needs a stop light. Several accidents at this location. Proposed light was included in Walmart build but never installed.	Motor Vehicle	Unsafe Intersection
7zk3x7vdn3z7	103	37.4694	-121.159	N	Baldwin Rd	People act like Baldwin Road is a speedway. Speed bumps would greatly reduce the speed of cars on this stretch of street.	Motor Vehicle	Speeding
9pm4xwo869wa	104	37.46431	-121.123	Y	Sperry Ave	Unsafe intersection - so many accidents. Blocked views d/t cars parked in front of auto dealership.	Motor Vehicle	Unsafe Intersection
9pm4xwo869wa	105	37.46427	-121.135	Y	Sperry Ave	Unsafe intersection - people pass on the right of someone trying to turn left. Have almost been hit numerous times. Plus children crossing to head to Las Palmas & PHS - people do not always stop for crosswalk. Needs a light!	Motor Vehicle	Unsafe Intersection
2r8bo2xnz8c9	106	37.46435	-121.123	Y	Sperry Ave	This area needs a stop light, cars do not yield or stop completely. There have been too many accidents at this intersection, too many people hurt. There needs to be action taken now so there are no future accidents or people injured. Stop light at Sperry & Hwy 33 needs to happen!	Motor Vehicle	Unsafe Intersection
7g36ge48y8b7	107	37.46426	-121.123	Y	Sperry Ave	The amount of accidents that happen in this intersection. We need lights or a 4 way stop to make the area safer.	Motor Vehicle	Unsafe Intersection
7g36ge48y8b7	108	37.46483	-121.123	Y	Sperry Ave	The number of accidents that happen at this intersection. We need lights or a 4 way stop	Motor Vehicle	Unsafe Intersection
4iw8ngs4kic4	109	37.46436	-121.123	Y	Sperry Ave	Needs a traffic light it get a little dangerous to cross during traffic hrs	Motor Vehicle	Unsafe Intersection
4cs6eti9oms8	110	37.4644	-121.124	Y	Sperry Ave	Too many accidents	Motor Vehicle	Unsafe Intersection

4yw7b7t4rh23	111	37.46467	-121.176	Y	Sperry Ave	Congestion, cars going straight forward on the right only lane. Big rigs in the city. The city growth needs expansion, an additional entrace/exit to the I5 freeway is a must to meet the traffic demand that comes with city growth.	Motor Vehicle	Slow Moving Traffic
6ig9fsg2y47a	112	37.48242	-121.121	N	Ashwood Ln	Speeding vehicles coming into Ashwood lane right in front of park where kids cross.	Motor Vehicle	Speeding
4d9k9xyh6tha	113	37.47225	-121.141	Y	Ward Ave	Unsafe speeds on Ward with no stop signs. Unsafe for pedestrians to cross from the high school into the neighborhoods. Need to consider higher visibility crosswalk signals and a mechanism to STOP the traffic on Ward between the two existing stoplights. Crossing by car or foot is extremely dangerous.	Motor Vehicle	Speeding
399bbm2bwc64	114	37.46439	-121.123	Y	Sperry Ave	This intersection needs a stop light. My cousin lost his life in February due to someone cutting him off turning left here. The town is growing and there is increased traffic here and it's not going to slow done. With the growth of patterson it just going to get worse. Too many accidents have happened here.	Motor Vehicle	Unsafe Intersection
9xs37zkw8lma	115	37.46431	-121.123	Y	Sperry Ave	We have a rapid growing community and safety concerns for this interaction need to be addressed… there been to many accidents and casualties here… Just recently my Family member passed away at this Intersection and this could of been prevented if there was a traffic light here.	Motor Vehicle	Unsafe Intersection
8dh3zsk2vf33	116	37.46424	-121.123	Y	Sperry Ave	To many accidents at this location including one that took my brother's life. People need to slow down pulling into town off that highway	Motor Vehicle	Unsafe Intersection
89wtm6wgf3ga	117	37.46425	-121.124	Y	Sperry Ave	Traffic on 33 is fast, people don't stop	Motor Vehicle	Unsafe Intersection
73pjz3hry9kh	118	37.4644	-121.123	Y	Sperry Ave		Motor Vehicle	Unsafe Intersection
73pjz3hry9kh	119	37.46458	-121.123	Y	Sperry Ave	Need a stop light at the intersection of Hwy. 33 and Sperry. To many fatal accidents at this intersection over years, isn't time something is done about this?	Motor Vehicle	Unsafe Intersection
3rw499i76awa	120	37.46428	-121.123	Y	Sperry Ave	This intersection is notoriously dangerous to get across. It is hard to see around the dealership and the cross traffic is usually going over the speed limit so that makes it even worse. The recent death related accident is enough to tell me that a stop lotus absolutely necessary.	Motor Vehicle	Unsafe Intersection
7a8rtt67umh6	121	37.46433	-121.124	Y	Sperry Ave	My cousin was killed here. It's dangerous. Save a life.	Motor Vehicle	Unsafe Intersection
7mio4ah6ypi8	122	37.46431	-121.123	Y	Sperry Ave	Cars don't make complete stops. Very hard to see when your turning onto 33 off of sperry.	Motor Vehicle	Unsafe Intersection
424hpw8639x8	123	37.47469	-121.144	Y	Sperry Ave	People run the stope sign all day and all night. Kids have been run over at that corner. A car has even ended up in the park where kids play.	Motor Vehicle	Unsafe Intersection

93uxp8igb247	124	37.46422	-121.123	Y	Sperry Ave	Needs a traffic light people coming in to town come in way to fast makes it hard for the cross traffic to pull out as you can't see down the road because of the angle and curve	Motor Vehicle	Unsafe Intersection
93uxp8igb247	125	37.46382	-121.18	Y	Sperry Ave		Motor Vehicle	Unsafe Intersection
6cp9gsz3vyu6	126	37.46508	-121.123	Y	Sperry Ave		Motor Vehicle	Unsafe Intersection
2jay4nof2ula	127	37.4784	-121.135	Y	N 2nd St	Need s a stop sign ● both directions hard to see any cars coming from rail road tracks and drivers heading toward railroad tracks always speeding!	Motor Vehicle	Signage Improvement
2jay4nof2ula	127	37.4784	-121.135	Y	N 2nd St	Need s a stop sign ● both directions hard to see any cars coming from rail road tracks and drivers heading toward railroad tracks always speeding!	Motor Vehicle	Speeding
9e2b2hoz6mk9	128	37.46962	-121.147	Y	Shearwater Dr	Speed and visibility-there are no stop signs but it is very well traveled. Traffic comes form and to the schools, kids are walking there, and the road curves so visibility is limited	Motor Vehicle	Speeding
9e2b2hoz6mk9	128	37.46962	-121.147	Y	Shearwater Dr	Speed and visibility-there are no stop signs but it is very well traveled. Traffic comes form and to the schools, kids are walking there, and the road curves so visibility is limited	Motor Vehicle	Visibility
9e2b2hoz6mk9	129	37.46414	-121.123	Y	S 2nd St	Speed and the mix of highway and town traffic with no signal light.	Motor Vehicle	Speeding
9e2b2hoz6mk9	129	37.46414	-121.123	Y	S 2nd St	Speed and the mix of highway and town traffic with no signal light.	Motor Vehicle	Intersection Safety

APPENDIX D:
COUNTERMEASURE TOOLBOX

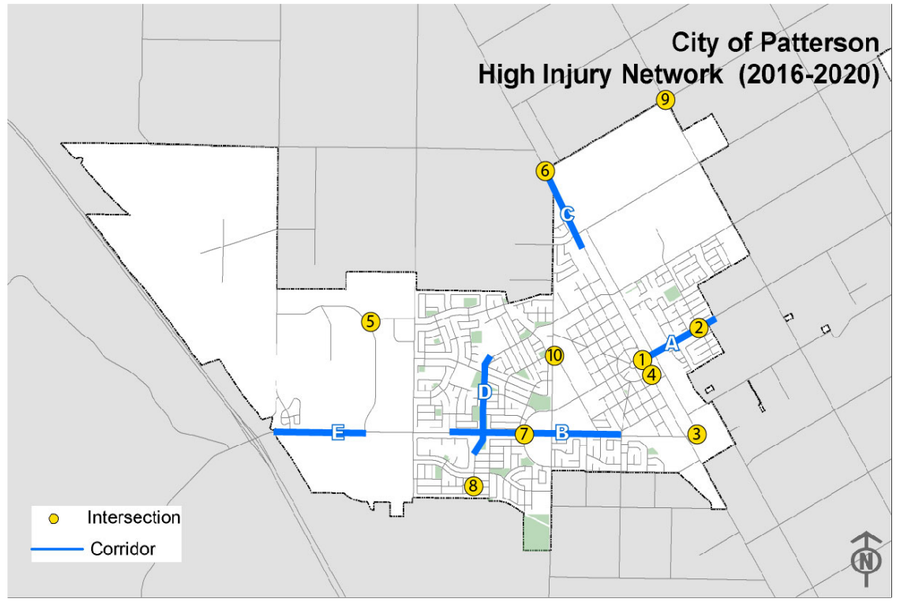
Appendix D - Countermeasure Toolbox

High-risk Intersections

ID	Intersection	Control	Consolidated CMs (HSIP-Eligible - Refer to LRSM* 2020)						Additional CM (non-HSIP)**	EA - 1 Reduce Hit Object Collisions			EA - 2 Reduce Unsafe Speed			EA - 3 Improve Pedestrian Safety			EA - 4 Reduce Nighttime Collisions			EA - 5 Reduce Broadside Collisions			EA - 6 Improve Intersection Safety (Sperry Ave)		
			CM1	CM2	CM3	CM4	CM5	CM6		CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3
1	2nd St and Las Palmas Ave	Signalized	S09	S02	S21PB	S20PB			Upgrade Crosswalk Markings (Include Stripe)							S20PB	S09	S21PB	S02	S09							
2	Las Palmas Ave and Hartley St	Signalized	S10	S09	S02	S03	S21PB	S20PB	Increase Curb Radius to avoid hit object collisions/ Zip Zac Lane Stripes can reduce speed	S10			S10	S03	S09	S20PB	S09	S21PB	S02	S09	S10	S02	S03				
3	1st St and Sperry Ave	Stop Controlled	NS06	NS07	NS01	NS08	NS10	NS14	Upgrade Pavement Markings	NS06	NS07		NS06	NS07					NS01	NS06	NS08				NS06	NS10	NS14
4	2nd St and El Circulo	Stop Controlled	NS07	NS21PB	NS22PB				Improve Pavement Markings/ Install signals							NS07	NS21PB	NS22PB									
5	Keystone Pacific Parkway and Park Center Drive	Stop Controlled	NS06	NS07	NS09	NS01	NS08		Increase Curb Radius	NS06	NS07	NS09	NS06	NS07					NS01	NS06	NS08						
6	Eucalyptus Ave and Highway 33	Stop Controlled	NS06	NS07	NS11	NS01	NS08		Intersection warning needed for through traffic to slow down	NS06	NS07	NS11	NS06	NS07					NS01	NS06	NS08						
7	Sperry Ave and Las Palmas Ave	Signalized	S02	S10	S09				Improve Pavemment Condition										S02	S09	S10				S02	S10	S09
8	Cornflower Ave and American Eagle Ave	Stop Controlled	NS06	NS07	NS09				Increase Curb Radius	NS06	NS07	NS09	NS06	NS07													
9	Eucalyptus Ave and Sycamore Ave	Stop Controlled	NS06	NS07	NS09	NS01	NS08		Increase Curb Radius	NS06	NS07	NS09	NS06	NS07					NS01	NS06	NS08						
10	9th St and Ward Ave	Stop Controlled	NS07	NS22PB	NS21PB				Mark Yield Signs							NS07	NS21PB	NS22PB									
11	RT33 and 2nd St								Cannot find intersection (exact location) - Check with Ruta																		

Code	Countermeasure Name
HSIP/Non-HSIP Code	
S01	Add intersection lighting
S02	Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size
S03	Improve signal timing (coordination, phases, red, yellow, or operation)
S05	Install emergency vehicle pre-emption systems
S06	Install left-turn lane and add turn phase (signal has no left-turn lane or phase before)
S07	Provide protected left turn phase (left turn lane already exists)
S08	Convert signal to mast arm (from pedestal-mounted)
S09	Install raised pavement markers and striping (Through Intersection)
S10	Install flashing beacons as advance warning (S.I.)
S11	Improve pavement friction (High Friction Surface Treatments)
S12	Install raised median on approaches (S.I.)
S13PB	Install pedestrian median fencing on approaches
S14	Create directional median openings to allow (and restrict) left-turns and U-turns (S.I.)
S15	Reduced Left-Turn Conflict Intersections (S.I.)
S16	Convert intersection to roundabout (from signal)
S17PB	Install pedestrian countdown signal heads
S18PB	Install pedestrian crossing (S.I.)
S19PB	Pedestrian Scramble
S20PB	Install advance stop bar before crosswalk (Bicycle Box)
S21PB	Modify signal phasing to implement a Leading Pedestrian Interval (LPI)

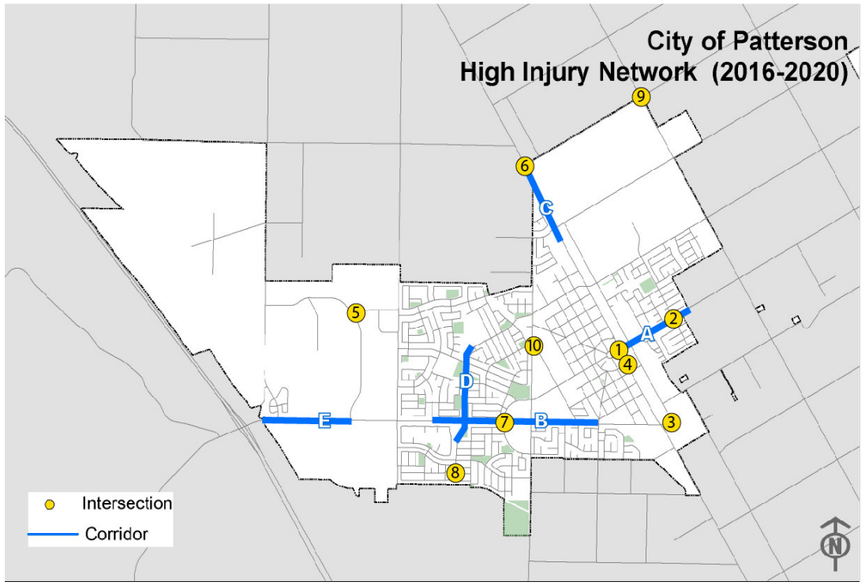
Code	Countermeasure Name
NS01	Add intersection lighting (NS.I.)
NS02	Convert to all-way STOP control (from 2-way or Yield control)
NS03	Install Signals
NS04	Convert intersection to roundabout (from all way stop)
NS05	Convert intersection to roundabout (from 2-way stop or Yield control)
NS05mi	Convert intersection to mini-roundabout
NS06	Install/upgrade larger or additional stop signs or other intersection warning/regulatorysigns
NS07	Upgrade intersection pavement markings (NS.I.)
NS08	Install Flashing Beacons at Stop-Controlled Intersections
NS09	Install flashing beacons as advance warning (NS.I.)
NS10	Install transverse rumble strips on approaches
NS11	Improve sight distance to intersection (Clear Sight Triangles)
NS12	Improve pavement friction (High Friction Surface Treatments)
NS13	Install splitter-islands on the minor road approaches
NS14	Install raised median on approaches (NS.I.)
NS15	Create directional median openings to allow (and restrict) left-turns and u-turns (NS.I.)
NS16	Reduced Left-Turn Conflict Intersections (NS.I.)
NS17	Install right-turn lane (NS.I.)
NS18	Install left-turn lane (where no left-turn lane exists)
NS19PB	Install raised medians (refuge islands)
NS20PB	Install pedestrian crossing at uncontrolled locations (signs and markings only)
NS21PB	Install/upgrade pedestrian crossing at uncontrolled locations (with enhanced safety features)
NS22PB	Install Rectangular Rapid Flashing Beacon (RRFB)
NS23PB	Install Pedestrian Signal (including Pedestrian Hybrid Beacon (HAWK))



High-risk Roadway Segments

ID	Roadway Segment	Consolidated CMs (HSIP-Eligible - Refer to LRSM* 2020)						Additional CM (non-HSIP)**	EA - 1 Reduce Hit Object Collisions			EA - 2 Reduce Unsafe Speed			EA - 3 Improve Pedestrian Safety			EA - 4 Reduce Nighttime Collisions			EA - 5 Reduce Broadside Collisions			EA - 6 Improve Intersection Safety (Sperry Ave)		
		CM1	CM2	CM3	CM4	CM5	CM6		CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3	CM1	CM2	CM3
A	Las Palmas Ave: City Boundary to 2nd St	R01	R32PB	R35PB	R02	R27	R22	Upgrade Parking Lane	R01	R02					R32PB	R35PB		R01	R22	R27						
B	Sperry Ave: Del Puerto Ave to Walker Ranch Parkway	R32PB	R35PB					Too Many Trees can be a distraction							R32PB	R35PB										
C	2nd St: City Coundary to 0.2 miles south of Walnut Ave	R01	R32PB	R35PB	R02			Improve Pavement Condition	R01	R02					R32PB	R35PB										
D	American Eagle Ave: Creekside Middle School to Fawn Lily Dr	R01	R32PB	R35PB	R02				R01	R02					R32PB	R35PB										
E	Sperry Ave: City Boundary to Park Center Dr	R01	R32PB	R35PB	R02	R26		Improve Pavement Condition	R01	R02	R26				R32PB	R35PB										

Code	Countermeasure Name
R01	Add Segment Lighting
R02	Remove or relocate fixed objects outside of Clear Recovery Zone
R03	Install Median Barrier
R04	Install Guardrail
R05	Install impact attenuators
R06	Flatten side slopes
R07	Flatten side slopes and remove guardrail
R08	Install raised median
R09	Install median (flush)
R10PB	Install pedestrian median fencing
R11	Install acceleration/ deceleration lanes
R12	Widen lane (initially less than 10 ft)
R13	Add two-way left-turn lane (without reducing travel lanes)
R14	Road Diet (Reduce travel lanes from 4 to 3 and add a two way left-turn and bike lanes)
R15	Widen shoulder
R16	Curve Shoulder widening (Outside Only)
R17	Improve horizontal alignment (flatten curves)
R18	Flatten crest vertical curve
R19	Improve curve superelevation
R20	Convert from two-way to one-way traffic
R21	Improve pavement friction (High Friction Surface Treatments)
R22	Install/Upgrade signs with new fluorescent sheeting (regulatory or warning)
R23	Install chevron signs on horizontal curves
R24	Install curve advance warning signs
R25	Install curve advance warning signs (flashing beacon)
R26	Install dynamic/variable speed warning signs
R27	Install delineators, reflectors and/or object markers
R28	Install edge-lines and centerlines
R29	Install no-passing line
R30	Install centerline rumble strips/stripes
R31	Install edgeline rumble strips/stripes
R32PB	Install bike lanes
R33PB	Install Separated Bike Lanes
R34PB	Install sidewalk/pathway (to avoid walking along roadway)
R35PB	Install/upgrade pedestrian crossing (with enhanced safety features)
R36PB	Install raised pedestrian crossing
R37PB	Install Rectangular Rapid Flashing Beacon (RRFB)
R38	Install Animal Fencing



APPENDIX E:
LOCAL ROADWAY SAFETY MANUAL (LRSM) EXCERPT

Local Roadway Safety

A Manual for California's Local Road Owners

Version 1.6
April 2022

Created by Caltrans in conjunction with FHWA and SafeTREC
for the express benefit of California Local Agencies.

Caltrans

U. S. Department of Transportation
Federal Highway Administration

Safe Transportation
Research & Education Center
SafeTREC

Document History

Version 1.0: 4/20/2012

The California Department of Transportation - Division of Local Assistance developed the first version of the Local Roadway Safety Manual (Version 1.0) in 2012 to support the Cycle 5 HSIP call-for-projects.

Version 1.1: 4/26/2013

Based on feedback and lessons learned from Cycle 5, Caltrans updated Appendix B: "Table of Countermeasures and Crash Reduction Factors" to better clarify text in "Where to use", "Why it works", and "General Qualities" for several of the countermeasures included in the original manual.

No other changes were made to the Local Roadway Safety Manual as part of Version 1.1

Version 1.2: 03/10/2015

Based on feedback and lessons learned from Cycle 6, Caltrans made minor updates to the text of the document as needed for achieving consistency with overall Caltrans local HSIP guidance documents. The following sections were updated: 1.2, 4.2, 5.1, 6.2, and Appendix B, E, F & G.

Version 1.3: 04/29/2016

Caltrans made updates to the text of the document as needed in the following sections: 4.2, 5.1 and Appendix B.

Version 1.4: 06/08/2018

3/30/18 - Caltrans made updates to the crash costs in Appendix D, some of the website links in Appendix G, and some other texts of the document.
6/8/18 - Countermeasure S22 ("Modify signal phasing to implement a Leading Pedestrian Interval (LPI)") is added.

Version 1.5: April 2020

Caltrans added a few more countermeasures (e.g. Pedestrian Scramble, Install Separated Bike Lanes, Reduced Left-Turn Conflict Intersections, and Curve Shoulder widening), renumbered the countermeasures and updated the crash costs in Appendix D.

Version 1.6: April 2022

For Cycle 11 Call-for-projects, Countermeasure S04 (Provide Advanced Dilemma Zone Detection for high-speed approaches) was deleted and Countermeasure NS05mr (Convert intersection to mini-roundabout) added. The HSIP Funding Eligibility was changed to 90% except for S03, of which the HSIP Funding Eligibility stays at 50%. The crash costs in Appendix D were updated.

Future Updates:

In the future, Caltrans anticipates that additional changes will be needed to keep the Local Roadway Safety Manual consistent with future Calls-for-Projects' Guidelines and Application Instructions. In addition, new local HSIP programs, improvements to California data on local roadways, data analysis tools, and the latest safety research and methodologies may give rise to the need to make more significant changes to this manual.

Table of Contents

B.1 Intersection Countermeasures – Signalized

S01, Add intersection lighting (Signalized Intersection => S.I.)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	"night" crashes	40%	20 years
Notes:	This CM only applies to "night" crashes (all types) occurring within limits of the proposed roadway lighting 'engineered' area.		

General information				
Where to use:				
Signalized intersections that have a disproportionate number of night-time 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).				
Why it works:				
Providing lighting at the intersection itself, or both at the intersection and on its approaches, improves the safety of an intersection during nighttime conditions by (1) making drivers more aware of the surroundings at an intersection, which improves drivers' perception-reaction times, (2) enhancing drivers' available sight distances, and (3) improving the visibility of non-motorists. 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.				
General Qualities (Time, Cost and Effectiveness):				
A lighting project can usually be completed relatively quickly, but generally requires at least 1 year to implement because the lighting system must be designed and the provision of electrical power must be arranged. The provision of lighting involves both a fixed cost for lighting installation and an ongoing maintenance and power cost which results in a moderate to high cost. Some locations can result in high B/C ratios, but due to higher costs, these projects often result in medium to low B/C ratios.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Night, All	CRF:	20-74%

S02, Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	15%	10 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the upgraded signals. This CM does not apply to improvements like "battery backup systems", which do not provide better intersection/signal visibility or help drivers negotiate the intersection (unless applying past crashes that occurred when the signal lost power). If new signal mast arms are part of the proposed project, CM "S2" should not be used and the signal improvements would be included under CM "S7".		

General information				
Where to use:				
Signalized intersections with a high frequency of right-angle and rear-end crashes occurring because drivers are unable to see traffic signals sufficiently in advance to safely negotiate the intersection being approached. Signal 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.				
Why it works:				
Providing better visibility of intersection signals aids the drivers' advance perception of the upcoming intersection. Visibility and clarity of the signal should be improved without creating additional confusion for drivers.				
General Qualities (Time, Cost and Effectiveness):				
Installation costs and time should be minimal as these type strategies are classified as low cost and implementation does not typically require the approval process normally associated with more complex projects. When considered at a single location, these low cost improvements are usually funded through local funding by local maintenance crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in low to moderate cost projects that are more appropriate to seek state or federal funding.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Rear-End, Angle	CRF:	0-46%

S03, Improve signal timing (coordination, phases, red, yellow, or operation)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
50%	All	15%	10 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new signal timing. For projects coordination signals along a corridor, the crashes related to side-street movements should not be applied. This CM does not apply to projects that only 'study' the signal network and do not make physical timing changes, including corridor operational studies and improvements to Traffic Operation Centers (TOCs). In Caltrans calls for projects, this CM has a HSIP reimbursement ratio of 50%, considering that it will improve the signal operation rather than merely the safety.		

General information				
Where to use:				
Locations that have a crash history at multiple signalized intersections. Signalization improvements may include adding phases, lengthening clearance intervals, eliminating or restricting higher-risk movements, and coordinating signals at multiple locations. Understanding the corridor or roadway's crash history can provide insight into the most appropriate strategy for improving safety.				
Why it works:				
Certain timing, phasing, and control strategies can produce multiple safety benefits. Sometimes capacity improvements come along with the safety improvements and other times adverse effects on delay or capacity occur. Corridor improvements often have the highest benefit but may take longer to implement. Projects focused on capacity improvements (without a separate focus on signal timing safety needs) may not result in a reduction in future crashes.				
General Qualities (Time, Cost and Effectiveness):				
In general, these low-cost improvements to multiple signalized intersections can be implemented in a short time. Typically these low cost improvements are funded through local funding by local maintenance crews. However, some projects requiring new interconnect infrastructure can have moderate to high costs making them more appropriate to seek state or federal funding. The expected effectiveness of this CM must be assessed for each individual project.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	0 - 41%

~~S04, Provide Advanced Dilemma-Zone Detection for high speed approaches~~

~~For HSIP Cycle 11 Call-for-projects~~			
~~Funding Eligibility~~	~~Crash Types Addressed~~	~~CRF~~	~~Expected Life~~
~~90%~~	~~All~~	~~40%~~	~~10 years~~
~~Notes:~~	~~This CM only applies to crashes occurring on the approaches / influence area of the new detection and signal timing.~~		

~~General information~~				
~~**Where to use:**~~				
~~More rural/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.~~				
~~**Why it works:**~~				
~~Clearance times provide safe, orderly transitions in ROW assignment between conflicting streams of traffic. An Advanced Dilemma Zone Detection system has several benefits relative to traditional multiple detector systems, which have upstream detection for vehicles in the dilemma zone but do not take the speed or size of individual vehicles into account. These benefits include: Reducing the frequency of red-light violations; Reducing the frequency of crashes associated with the traffic signal phase change (for example, rear-end and angle crashes); Reducing delay and stop frequency on the major road and a reduction in overall intersection delay.~~				
~~**General Qualities (Time, Cost and Effectiveness):**~~				
~~Installation costs should be low and the time to implement short. Additional modifications to the traffic signal controller may also necessary. In general, This CM can be very effective and can be considered on a systematic approach. Video detection equipment is now available for this purpose, making installation and maintenance more efficient.~~				
~~**FHWA CMF Clearinghouse:**~~	~~Crash Types Addressed:~~	~~All~~	~~CRF:~~	~~39%~~

S05, Install emergency vehicle pre-emption systems

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Emergency Vehicle - only	70%	10 years
Notes:	This CM only applies to "E.V." crashes occurring on the approaches / influence area of the new pre-emption system.		

General information
Where to use:
Corridors that have a history of crashes involving emergency response vehicles. 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
Why it works:
Providing emergency vehicle preemption capability at a signal or along a corridor can be a highly effective strategy in two ways; any type of crash could occur as emergency vehicles try to navigate through intersections and as other vehicles try to maneuver out of the path of the emergency vehicles. In addition, a signal preemption system can decrease emergency vehicle response times therefore decreasing the time in receiving emergency medical attention, which is critical in the outcome of any crash. When data is not available for past crashes with emergency vehicles, an agency may consider combining the E.V. pre-emption improvements into a comprehensive project that also makes significant signal hardware and/or signal timing improvements.
General Qualities (Time, Cost and Effectiveness):
Costs for installation of a signal preemption system will vary from medium to high, based upon the number of signalized intersections at which preemption will be installed and the number of emergency vehicles to be outfitted with the technology. The number of detectors, a requirement for new signal controllers, and the intricacy of the preemption system could increase costs. This CM is considered systemic as it is usually implemented on a corridor-basis.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Emergency Vehicle - only	CRF:	70%

S06, Install left-turn lane and add turn phase (signal has no left-turn lane or phase before)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	55%	20 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new left turn lanes. This CM does NOT apply to converting a single-left into double-left turn.		

General information
Where to use:
Intersections that do not currently have a left turn lane or a related left-turn phase that are experiencing a large number of crashes. Many intersection safety problems can be traced to difficulties in 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, rear-end, sideswipe) is to provide exclusive left-turn lanes and the appropriate signal phasing, particularly on high-volume and high-speed major-road approaches. Agencies need to document their consideration of the MUTCD, Section 4D.19 guidelines; the section on implementing protected left-turn phases.
Why it works:
Left-turn lanes allow separation of left-turn and through-traffic streams, thus reducing the potential for rear-end collisions. Left-turn phasing also provides a safer opportunity for drivers to make a left-turn. The combination of left-turn storage and a left turn signal has the potential to reduce many collisions between left-turning vehicles and through vehicles and/or non-motorized road users.
General Qualities (Time, Cost and Effectiveness):
Implementation time may vary from months to years. At some locations, left-turn lanes can be quickly installed simply by restriping the roadway. At other locations, widening of the roadway, acquisition of additional right-of-way, and extensive environmental processes may be needed. Such projects require a substantial time for development and construction. Costs are highly variable and range from very low to high. Installing a protected left turn lane and phase where none exists results in a high Crash Reduction Factor and is often highly effective.

FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	17 - 58 %

S07, Provide protected left turn phase (left turn lane already exists)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	20 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new left turn phases. This CM does NOT apply to converting a single-left into double-left turn (unless the single left is unprotected and the proposed double left will be protected).		

General information				
Where to use:				
Signalized intersections (with existing left turns pockets) that currently have a permissive left-turn or no left-turn protection that 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. Protected left-turn phases are warranted based on such factors as turning volumes, delay, visibility, opposing vehicle speed, distance to travel through the intersection, presence of non-motorized road users, and safety experience of the intersections. Agencies need to document their consideration of the MUTCD, Section 4D.19 guidelines; the section on implementing protected left-turn phases.				
Why it works:				
Left turns are widely recognized as the highest-risk movements at signalized intersections. Providing Protected left-turn phases (i.e., the provision for a specific phase for a turning movement) for signalized intersections with existing left turn pockets significantly improve the safety for left-turn maneuvers by removing the need for the drivers to navigate through gaps in oncoming/opposing through vehicles. Where left turn pockets are not protected, the pedestrian and bicyclist crossing phase often conflicts with these left turn maneuvers. Drivers focused on navigating the gaps of oncoming cars may not anticipate and/or perceive the non-motorized road users.				
General Qualities (Time, Cost and Effectiveness):				
If the existing traffic signal only requires a minor modification to allow for a protected left-turn phase, then the cost would also be low. The time to implement this countermeasure is short because there is no actual construction that has to take place. In-house signal maintainers can perform this operation once the proper signal phasing is determined so the cost is low. In addition, the countermeasure is tried and proven to be effective. Has the potential of being applied on a systemic/systematic approach.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Rear-End, Sideswipe, Broadside	CRF:	16 - 99%

S08, Convert signal to mast arm (from pedestal-mounted)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	20 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the converted signal heads that are relocated from median and/or outside shoulder pedestals to signal heads on master arms over the travel-lanes. Projects using CM "S7" should not also apply "S2" in the B/C calc.		

General information				
Where to use:				
Intersections currently controlled by pedestal mounted traffic signals (in medians and/or on outside shoulder) that have a high frequency of right-angle and rear-end crashes occurring because drivers are unable to see traffic signals 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. Care should be taken to place the new signal heads (with back plates) as close to directly over the center of the travel lanes as possible.				
Why it works:				
Providing better visibility of intersection signs and signals aids the drivers' advance perception of the upcoming intersection. Visibility and clarity of the signal should be improved without creating additional confusion or distraction for drivers.				
General Qualities (Time, Cost and Effectiveness):				
Dependent on the scope of the project. Costs are generally moderate for this type of project. There is usually no right-of-way costs, minimal roadway reconstruction costs, and a shorter project development timeline. At the same time, new mast arms can be expensive. Some locations can result in high B/C ratios, but due to moderate costs, some locations may result in medium to low B/C ratios.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Rear-End, Angle	CRF:	12 - 74%

S09, Install raised pavement markers and striping (Through Intersection)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	10%	10 years
Notes:	This CM only applies to crashes occurring in the intersection and influence areas of the new pavement markers and/or markings.		

General information				
Where to use:				
Intersections where the lane designations are not clearly visible to approaching motorists and/or intersections noted as being complex and experiencing crashes that could be attributed to a driver's unsuccessful attempt to navigate the intersection. Driver confusion can exist in regard to choosing the proper turn path or where through-lanes do not line up. This is especially relevant at intersections where the overall pavement area of the intersection is large, and multiple turning lanes are involved or other unfamiliar elements are presented to the driver.				
Why it works:				
Adding clear pavement markings can guide motorists through complex intersections. When drivers approach and traverse through complex intersections, drivers may be required to perform unusual or unexpected maneuvers. Providing more effective guidance through an intersection will minimize the likelihood of a vehicle leaving its appropriate lane and encroaching upon an adjacent lane.				
General Qualities (Time, Cost and Effectiveness):				
Costs of implementing this strategy will vary based on the scope and number of applications. Applying raised pavement markers is relatively low cost but can be variable and determined largely by the material used for pavement markings (paint, thermoplastic, epoxy, RPMs etc.). When using this type delineators, an issue of concern is the cost-to-service-life of the material. (Note: When HSIP safety funding is used for these installations in high-wear-locations, the local agency is expected to maintain the improvement for a minimum of 10 years.) When considered at a single location, these low cost improvements are usually funded through local funding by local maintenance crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Wet, Night, All	CRF:	10 - 33%

S10, Install flashing beacons as advance warning (S.I.)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	10 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new flashing beacons.		

General information				
Where to use:				
At signalized intersections with crashes that are a result of drivers being unaware of the intersection or are unable to see the traffic control device in time to comply.				
Why it works:				
Increased driver awareness of an approaching signalized intersection and an increase in the driver's time to react. Driver awareness of both downstream intersections and traffic control devices is critical to intersection safety. Crashes often occur when the driver is unable to perceive an intersection, signal head or the back of a stopped queue in time to react. Advance flashing beacons can be used to supplement and call driver attention to intersection control signs. Most advance warning flashing beacons can be powered by solar, thus reducing the issues relating to power source.				
General Qualities (Time, Cost and Effectiveness):				
Before choosing this CM, the agency needs to confirm the ability to provide power to the site (solar may be an option). Flashing beacons can be constructed with minimal design, environmental and right-of-way issues and have relatively low costs. This combined with a relatively high CRF, can result in high B/Cs for locations with a history of crashes and lead to a high effectiveness.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Rear End, Angle	CRF:	36 - 62%

S11, Improve pavement friction (High Friction Surface Treatments)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	55%	10 years
Notes:	This CM only applies to crashes occurring within the limits of the improved friction overlay. This CM is not intended to apply to standard chip-seal or open-graded maintenance projects for long segments of corridors or structure repaving projects intended to fix failed pavement.		

General information				
Where to use:				
Nationally, this countermeasure is referred to as "High Friction Surface Treatments" or HFST. 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 is determined to be a problem in wet or dry conditions and the target vehicle is unable to stop due to insufficient skid resistance.				
Why it works:				
Improving the skid resistance at locations with high frequencies of wet-road crashes and/or failure to stop crashes can result in reductions of 50 percent for wet-road crashes and 20 percent for total crashes. Applying HFST can double friction numbers, e.g. low 40s to high 80s. This CM represents a special focus area for both FHWA and Caltrans, which means there are extra resources available for agencies interested in more details on High Friction Surface Treatment projects.				
General Qualities (Time, Cost and Effectiveness):				
This strategy can be relatively inexpensive and implemented in a short timeframe. The installation would be done by either agency personnel or contractors and can be done by hand or machine. In general, This CM can be very effective and can be considered on a systematic approach.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Wet, Night, ALL	CRF:	10 - 62 %

S12, Install raised median on approaches (S.I.)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	20 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new raised median. All new raised medians funded with HSIP funding should not include the removal of the existing roadway structural section and should be doweled into the existing roadway surface. This requirement is being implemented to maximize the safety-effectiveness of the limited HSIP funding and to minimize project impacts. Landscaping, if included in the project, is considered non-participating.		

General information				
Where to use:				
Intersections noted as having turning movement crashes near the intersection as a result of insufficient access control. Application of this CM should be based on current crash data and a clearly defined need to restrict or accommodate the movement.				
Why it works:				
Raised medians next to left-turn lanes at intersections offer a cost-effective means for reducing crashes and improving operations at higher volume intersections. The raised medians prohibit left turns into and out of driveways that may be located too close to the functional area of the intersection.				
General Qualities (Time, Cost and Effectiveness):				
Raised medians at intersections may be most effective in retrofit situations where high volumes of turning vehicles have degraded operations and safety, and where more extensive CMs would be too expensive because of limited right-of-way and the constraints of the built environment. The result is This CM can be very effective and can be considered on a systematic approach. Raised medians can often be installed directly over the existing pavement. When agencies opt to install landscaping in conjunction with new raised medians, the portion of the cost for landscaping and other non-safety related items that exceeds 10% of the project total cost is not federally participated and must be funded by the applicant.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Angle	CRF:	21 -55 %

S13PB, Install pedestrian median fencing on approaches

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	35%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring on the approaches/influence area of the new pedestrian median fencing.		

General information				
Where to use:				
Signalized Intersections with high pedestrian-generators nearby (e.g. transit stops) may experience a high volumes of pedestrians J-walking 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, then installing a continuous pedestrian barrier in the median may be a viable solution.				
Why it works:				
Adding pedestrian median fencing has the opportunity to enhance pedestrian safety at locations noted as being problematic involving pedestrians running/darting across the roadway outside the intersection crossings. Pedestrian median fencing can significantly reduce this safety issue by creating a positive barrier, forcing pedestrians to the designated pedestrian crossing.				
General Qualities (Time, Cost and Effectiveness):				
Costs associated with this strategy will vary widely depending on the type and placement of the median fencing. Impacts to transit and other land uses may need to be considered and controversy can delay the implementation. In general, this CM can be effective as a spot-location approach.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	25- 40%

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

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	50%	20 years
Notes:	This CM only applies to crashes occurring in the intersection / influence area of the new directional openings.		

General information				
Where to use:				
Crashes related to turning maneuvers include angle, rear-end, pedestrian, and sideswipe (involving opposing left turns) type 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.				
Why it works:				
Restricting turning movement into and out of an intersection can help reduce conflicts between through and turning traffic. The number of access points, coupled with the speed differential between vehicles traveling along the roadway, contributes to crashes. Affecting turning movements by either allowing them or restricting them, based on the application, can ensure safe movement of traffic.				
General Qualities (Time, Cost and Effectiveness):				
Turn prohibitions that are implemented by closing a median opening can be implemented quickly. The cost of this strategy will depend on the treatment. Impacts to businesses and other land uses must be considered and controversy can delay the implementation. In general, This CM can be very effective and can be considered on a systematic approach.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	51%

S15, Reduced Left-Turn Conflict Intersections (S.I.)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	50%	20 years
Notes:	This CM only applies to crashes occurring in the intersection / influence area of the new Reduced Left-Turn Conflict.		

General information

Where to use and Why it works:

Reduced left-turn conflict intersections are geometric designs that alter how left-turn movements occur in order 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 (RCUT) and the median U-turn (MUT).

Restricted Crossing U-turn (RCUT):

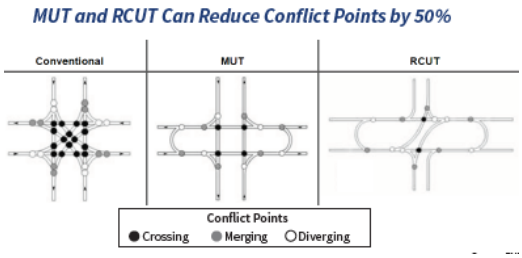
The RCUT intersection modifies the direct left-turn and through movements from cross-street approaches. Minor road traffic makes a right turn followed by a U-turn at a designated location (either signalized or unsignalized) to continue in the desired direction.

The RCUT is suitable for a variety of circumstances, including along rural, high-speed, four-lane, divided highways or signalized routes. It also can be used as an alternative to signalization or constructing an interchange. RCUTs work well when consistently used along a corridor, but also can be used effectively at individual intersections.

Median U-turn (MUT)

The MUT intersection modifies direct left turns from the major approaches. Vehicles proceed through the main intersection, make a U-turn a short distance downstream, followed by a right turn at the main intersection. The U-turns can also be used for modifying the cross-street left turns.

The MUT is an excellent choice for heavily traveled intersections with moderate left-turn volumes. When implemented at multiple intersections along a corridor, the efficient two-phase signal operation of the MUT can reduce delay, improve travel times, and create more crossing opportunities for pedestrians and bicyclists.



General Qualities (Time, Cost and Effectiveness):

Implementing this strategy may take from months to years, depending on whether additional R/W is required. Such projects require a substantial time for development and construction. Costs are highly variable and range from very low to high. The expected effectiveness of this CM must be assessed for each individual location.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Angle/Left-turn/Rear-End/All	CRF:	34.8-100%

S16, Convert intersection to roundabout (from signal)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	Varies	20 years
Notes:	This CM only applies to crashes occurring in influence area of the new roundabout. This CM is not intended for mini-roundabouts. The benefit of this CM is calculated using Caltrans procedure. The CRF is dependent on the ADT, project location (Rural/Urban) and the roundabout type (1 lane or 2 lanes). The benefit comes from both the reduction in the number and the severity of the crashes.		

General information				
Where to use:				
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 geometry and intersections with frequent left-turn movements.				
Why it works:				
The types of conflicts that occur at roundabouts are different from those occurring at conventional intersections; namely, conflicts from crossing and left-turn movements are not present in a roundabout. The geometry of a roundabout forces drivers to reduce speeds as they proceed through the intersection. This helps keep the range of vehicle speed narrow, which helps reduce the severity of crashes when they do occur. Pedestrians only have to cross one direction of traffic at a time at roundabouts, thus reducing their potential for conflicts.				
General Qualities (Time, Cost and Effectiveness):				
Provision of a roundabout requires substantial project development. The need to acquire right-of-way is likely and will vary from site to site and depends upon the geometric design. These activities may require up to 4 years or longer to implement. Costs are variable, but construction of a roundabout to replace an existing signalized intersection are relatively high. The result is this CM may have reduced relative-effectiveness compared to other CMs.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	35 - 67%

S17PB, Install pedestrian countdown signal heads

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	25%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the intersection/crossing with the new countdown heads.		

General information				
Where to use:				
Signals that have signalized pedestrian crossing with walk/don't walk indicators and where there have been pedestrian vs. vehicle crashes.				
Why it works:				
A pedestrian countdown signal contains a timer display and counts down the number of seconds left to finish crossing the street. 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. Countdown signals begin counting down either when the "WALK" or when the flashing "DON'T WALK" interval appears and stop at the beginning of the steady "DON'T WALK" interval. These signals also have been shown to encourage more pedestrians to use the pushbutton rather than jaywalk.				
General Qualities (Time, Cost and Effectiveness):				
Costs and time of installation will vary based on the number of intersections included in this strategy and if it requires new signal controllers capable of accommodating the enhancement. When considered at a single location, these low cost improvements are usually funded through local funding by local crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	25%

S18PB, Install pedestrian crossing (S.I.)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	25%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the intersection/crossing with the new crossing. This CM is not intended to be used for high-cost aesthetic enhancements to intersection crosswalks (i.e. stamped concrete or stamped asphalt).		

General information				
Where to use:				
Signalized Intersections with no marked crossing and pedestrian signal heads, where pedestrians are known to be crossing intersections that involve significant turning movements. They are especially important at intersections with (1) multiphase traffic signals, such as left-turn arrows and split phases, (2) school crossings, and (3) double-right or double-left turns. At signalized intersections, pedestrian crossings are often safer when the left turns have protected phases that do not overlap the pedestrian walk phase.				
Why it works:				
Adding pedestrian crossings has the opportunity to enhance pedestrian safety at locations noted as being problematic. Nearly one-third of all pedestrian-related crashes occur at or within 50 feet of an intersection. Of these, 30 percent may involve a turning vehicle. Another 22 percent of pedestrian crashes involve a pedestrian either running across the intersection or darting out in front of a vehicle whose view was blocked just prior to the impact. Finally, 16 percent of these intersection-related crashes occur because of a driver violation (e.g., failure to yield right-of-way). When agencies opt to install aesthetic enhancement to intersection crosswalks like stamped concrete/asphalt, the project design and construction costs can significantly increase. For HSIP applications, these costs must be accounted for in the B/C calculation, but these costs (over standard crosswalk markings) must be tracked separately and are not federally reimbursable and will increase the agency's local-funding share for the project costs.				
General Qualities (Time, Cost and Effectiveness):				
Costs associated with this strategy will vary widely, depending if curb ramps and sidewalk modifications are required with the crossing. When considered at a single location, these low cost improvements may be funded through local funding by local crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate to high cost projects that are appropriate to seek state or federal funding.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	25%

S19PB, Pedestrian Scramble

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	40%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the intersection with the new pedestrian crossing.		

General information				
Where to use:				
Pedestrian Scramble is a form of pedestrian "WALK" phase at a signalized intersection in which all vehicular traffic is required to stop, allowing pedestrians/bicyclists to safely cross through the intersection in any direction, including diagonally. Pedestrian Scramble may be considered at signalized intersections with very high pedestrian/bicycle volumes, e.g. in an urban business district.				
Why it works:				
Pedestrian Scramble has been shown to reduce injury risk and increase bicycle ridership due to its perceived safety and comfort.				
General Qualities (Time, Cost and Effectiveness):				
Not involving any additional R/W, Pedestrian Scramble should not require a long development process and should be implemented reasonably soon. A systemic approach may be used in implementing this CM, resulting in cost efficiency with low to moderate cost.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	-10% to 51%

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

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	15%	10 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the intersection-crossing with the new advanced stop bars.		

General information				
Where to use:				
Signalized Intersections with a marked crossing, where significant bicycle and/or pedestrians volumes are known to occur.				
Why it works:				
Adding 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 (This dedicated space is often referred to as a bike-box.)				
General Qualities (Time, Cost and Effectiveness):				
Costs and time of installation will vary based on the number of intersections included in this strategy and if it requires new signal controllers capable of accommodating the enhancement. When considered at a single location, these low cost improvements are usually funded through local funding by local crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	35%

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

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	60%	10 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the intersections with signalized pedestrian crossing with the newly implemented Leading Pedestrian Interval (LPI).		

General information				
Where to use:				
Intersections with signalized pedestrian crossing that have high turning vehicles volumes and have had pedestrian vs. vehicle crashes.				
Why it works:				
A leading pedestrian interval (LPI) gives pedestrians the opportunity to enter an intersection 3-7 seconds before vehicles are given a green indication. With this head start, pedestrians can better establish their presence in the crosswalk before vehicles have priority to turn left. LPIs provide (1) increased visibility of crossing pedestrians; (2) reduced conflicts between pedestrians and vehicles; (3) Increased likelihood of motorists yielding to pedestrians; and (4) enhanced safety for pedestrians who may be slower to start into the intersection.				
General Qualities (Time, Cost and Effectiveness):				
Costs for implementing LPIs are very low, since only minor signal timing alteration is required. This makes it an easy and inexpensive countermeasure that can be incorporated into pedestrian safety action plans or policies and can become routine agency practice. When considered at a single location, the LPI is usually local-funded. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	59%

B.2 Intersection Countermeasures – Non-signalized

NS01, Add intersection lighting (NS.I.)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Night	40%	20 years
Notes:	This CM only applies to "night" crashes (all types) occurring within limits of the proposed roadway lighting 'engineered' area.		

General information				
Where to use:				
Non-signalized intersections that have a disproportionate number of night-time 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).				
Why it works:				
Providing lighting at the intersection itself, or both at the intersection and on its approaches, improves the safety of an intersection during nighttime conditions by (1) making drivers more aware of the surroundings at an intersection, which improves drivers' perception-reaction times, (2) enhancing drivers' available sight distances, and (3) improving the visibility of non-motorists. Intersection lighting is of particular benefit to non-motorized users as lighting not only helps them navigate the intersection, but also helps drivers see them better.				
General Qualities (Time, Cost and Effectiveness):				
A lighting project can usually be completed relatively quickly, but generally requires at least 1 year to implement because the lighting system must be designed and the provision of electrical power must be arranged. The provision of lighting involves both a fixed cost for lighting installation and an ongoing maintenance and power cost. For rural intersections, studies have shown the installation of streetlights reduced nighttime crashes at unlit intersections and can be more effective in reducing nighttime crashes than either rumble strips or overhead flashing beacons. Some locations can result in high B/C ratios, but due to higher costs, these projects often result in medium to low B/C ratios.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Night, All	CRF:	25- 50%

NS02, Convert to all-way STOP control (from 2-way or Yield control)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	50%	10 years
Notes:	This CM only applies to crashes occurring in the intersection and/or influence area of the new control. CA-MUTCD warrant must be met.		

General information				
Where to use:				
Unsignalized intersection locations that have a crash history and have no controls on the major roadway approaches. However, all-way stop 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. MUTCD warrants should always be followed.				
Why it works:				
All-way stop control can reduce right-angle and turning collisions at unsignalized intersections by providing more orderly movement at an intersection, reducing through and turning speeds, and minimizing the safety effect of any sight distance restrictions that may be present. Advance public notification of the change is critical in assuring compliance and reducing crashes.				
General Qualities (Time, Cost and Effectiveness):				
The costs involved in converting to all-way stop control are relatively low. All-way stop control can normally be implemented at multiple intersections with just a change in signing on intersection approaches, and typically are very quick to implement. When considered at a single location, these low cost improvements are usually funded through local funding by local maintenance crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Left-turn, Angle	CRF:	6 - 80%

NS03, Install signals

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	20 years
Notes:	This CM only applies to crashes occurring in the intersection and/or influence area of the new signals. **All new signals must meet MUTCD "safety" warrants: 4, 5 or 7.** Given the over-arching operational changes that occur when an intersection is signalized, no other intersection CMs can be applied to the intersection crashes in conjunction with this CM.		

General information				
Where to use:				
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. Refer to the CA MUTCD, Section 4C.01, Studies and Factors for Justifying Traffic Control Signals.				
Why it works:				
Traffic signals have the potential to reduce the most severe type crashes but will likely cause an increase in rear-end collisions. A reduction in overall injury severity is likely the largest benefit of traffic signal installation.				
General Qualities (Time, Cost and Effectiveness):				
Typical traffic signal costs fall in the medium to high category and are affected by application, type of signal and right-of-away considerations. Projects of this magnitude should only be considered after alternate and lesser means of correction have been evaluated. Some locations can result in high B/C ratios, but due to higher costs, these projects often result in medium to low B/C ratios.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	0 - 74%

NS04, Convert intersection to roundabout (from all way stop)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	Varies	20 years
Notes:	This CM only applies to crashes occurring in the intersection and/or influence area of the new control. The benefit of this CM is calculated using Caltrans procedure. The CRF is dependent on the ADT, project location (Rural/Urban) and the roundabout type (1 lane or 2 lanes). The benefit comes from both the reduction in the number and the severity of the crashes.		

General information				
Where to use:				
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 many suburban and urban settings where right-of-way is limited.				
Why it works:				
Roundabouts provide an important alternative to signalized and all-way stop-controlled intersections. Modern roundabouts differ from traditional traffic circles in that they operate in such a manner that traffic entering the roundabout must yield the right-of-way to traffic already in it. Roundabouts can serve moderate traffic volumes with less delay than all-way stop-controlled intersections and provide fewer conflict points. Crashes at roundabouts tend to be less severe because of the speed constraints and elimination of left-turn and right-angle movements.				
General Qualities (Time, Cost and Effectiveness):				
Construction of roundabouts are usually relatively costly and major projects, requiring the environmental process, right-of-way acquisition, and implementation under an agency's long-term capital improvement program. (For this reason, roundabouts may not be appropriate for California's Federal Safety Programs that have relatively short delivery requirements.) Even with roundabouts higher costs, they still can have a relatively high effectiveness.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Left-turn, Angle	CRF:	12 - 78 %

NS05, Convert intersection to roundabout (from 2-way stop or Yield control)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	Varies	20 years
Notes:	This CM only applies to crashes occurring in the intersection and/or influence area of the new control. The benefit of this CM is calculated using Caltrans procedure. The CRF is dependent on the ADT, project location (Rural/Urban) and the roundabout type (1 lane or 2 lanes). The benefit comes from both the reduction in the number and the severity of the crashes.		

General information				
Where to use:				
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 many suburban and urban settings where right-of-way is limited.				
Why it works:				
Roundabouts provide an important alternative to signalized and all-way stop-controlled intersections. Modern roundabouts differ from traditional traffic circles in that they operate in such a manner that traffic entering the roundabout must yield the right-of-way to traffic already in it. Roundabouts can serve moderate traffic volumes with less delay than all-way stop-controlled intersections and provide fewer conflict points. Crashes at roundabouts tend to be less severe because of the speed constraints and elimination of left-turn and right-angle movements.				
General Qualities (Time, Cost and Effectiveness):				
Construction of roundabouts are usually relatively costly and major projects, requiring the environmental process, right-of-way acquisition, and implementation under an agency's long-term capital improvement program. (For this reason, roundabouts may not be appropriate for California's Federal Safety Programs that have relatively short delivery requirements.) Even with roundabouts higher costs, they still can have a relatively high effectiveness.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Left-turn, Angle	CRF:	12 - 78 %

NS05mr, Convert intersection to mini-roundabout

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	20 years
Notes:	This CM only applies to crashes occurring in the intersection and/or influence area of the new control.		

General information				
Where to use:				
Mini-roundabouts are characterized by a small diameter (45-90 ft) and traversable islands (central island and splitter islands). Mini-roundabouts offer most of the benefits of regular roundabouts with the added benefit of a smaller footprint. They are best suited to environments where speeds are already low and environmental constraints would preclude the use of a larger roundabout. Mini-roundabouts are most effective in lower speed environments in which all approaching roadways have posted speed of 30 mph or less and an 85th-percentile speed of less than 35 mph near the proposed yield and/or entrance line. For any location with an 85th-percentile speed above 35 mph, the mini-roundabout can be included as part of a broader system of traffic calming measures to achieve an appropriate speed environment.				
Why it works:				
Mini-roundabouts may be an optimal solution for a safety or operational issue at an existing intersection where there is insufficient right-of-way for a standard roundabout installation. The benefits of mini-roundabouts are the Compact size, operational efficiency, traffic safety improvement and traffic Calming.				
General Qualities (Time, Cost and Effectiveness):				
Construction costs for mini-roundabouts vary widely depending upon the extent of sidewalk modifications or other geometric improvements and the types of materials used. In most cases, mini-roundabouts have been installed with little or no pavement widening and with only minor changes to curbs and sidewalks. Construction costs can be minimum for an installation consisting entirely of pavement markings and signage or moderate for mini-roundabouts that include raised islands and pedestrian improvements.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	NA	CRF:	NA

NS06, Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	15%	10 years
Notes:	This CM only applies to crashes occurring in the influence area of the new signs. The influence area must be determined on a location by location basis.		

General information				
Where to use:				
The target for this strategy should be approaches to unsignalized intersections with patterns of rear-end, right-angle, or turning collisions related to lack of driver awareness of the presence of the intersection.				
Why it works:				
The visibility of intersections and, thus, the ability of approaching drivers to perceive them can be enhanced by installing larger regulatory and warning signs at or prior to intersections. A key to success in applying this strategy is to select a combination of regulatory and warning sign techniques appropriate for the conditions on a particular unsignalized intersection approach.				
General Qualities (Time, Cost and Effectiveness):				
Signing improvements do not require a long development process and can typically be implemented quickly. Costs for implementing this strategy are nominal and depend on the number of signs. When considered at a single location, these low cost improvements are usually funded through local funding by local maintenance crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	11 - 55%

NS07, Upgrade intersection pavement markings (NS.I.)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	10 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new pavement markings. This CM is not intended to be used for general maintenance activities (i.e. the replacement of existing pavement markings in-kind) and must include upgraded safety features over the existing pavement markings and striping.		

General information				
Where to use:				
Unsignalized intersections that are not clearly visible to approaching motorists, particularly approaching motorists on the major road. The strategy is particularly 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.				
Why it works:				
The visibility of intersections and, thus, the ability of approaching drivers to perceive them can be enhanced by installing appropriate pavement delineation in advance of and at intersections will provide approaching motorists with additional information at these locations. Providing visible stop bars on minor road approaches to unsignalized intersections can help direct the attention of drivers to the presence of the intersection. Drivers should be more aware that the intersection is coming up, and therefore make safer decisions as they approach the intersection.				
General Qualities (Time, Cost and Effectiveness):				
Pavement marking improvements do not require a long development process and can typically be implemented quickly. Costs for implementing this strategy are nominal and depend on the number of markings. When considered at a single location, these low cost improvements are usually funded through local funding by local maintenance crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding. Note: When federal safety funding is used for these installations in high-wear-locations, the local agency is expected to maintain the improvement for a minimum of 10 years.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	13 - 60%

NS08, Install Flashing Beacons at Stop-Controlled Intersections

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	15%	10 years
Notes:	This CM only applies to crashes occurring on the stop-controlled approaches / influence area of the new beacons.		

General information				
Where to use:				
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.				
Why it works:				
Flashing beacons provide a visible signal to the presence of an intersection and can be very effective in rural areas where there may be long stretches between intersections as well as locations where night-time visibility of intersections is an issue.				
General Qualities (Time, Cost and Effectiveness):				
Flashing beacons can be constructed with minimal design, environmental and right-of-way issues and have relatively low costs. Before choosing this CM, the agency needs to confirm the ability to provide power to the site (solar may be an option). In general, This CM can be very effective and can be considered on a systematic approach.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Angle, Rear-End	CRF:	5-34%

NS09, Install flashing beacons as advance warning (NS.I.)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	10 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new beacons placed in advance of the intersection.		

General information				
Where to use:				
Non-Signalized Intersections with patterns of crashes that could be related to lack of a driver's awareness of approaching intersection or controls at a downstream intersection.				
Why it works:				
Advance flashing beacons can be used to supplement and call driver attention to intersection control signs. Flashing beacons are intended to reinforce driver awareness of the stop or yield signs and to help mitigate patterns of crashes related to intersection regulatory sign violations. Most advance warning flashing beacons can be powered by solar, thus reducing the issues relating to power source.				
General Qualities (Time, Cost and Effectiveness):				
Use of flashing beacons requires minimal development process, allowing flashing beacons to be installed within a short time period. Before choosing this CM, the agency needs to confirm the ability to provide power to the site (solar may be an option). In general, This CM can be very effective and can be considered on a systematic approach.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Angle, Rear-End	CRF:	36 - 62%

NS10, Install transverse rumble strips on approaches

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	20%	10 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new rumble strips.		

General information				
Where to use:				
Transverse rumble strips are installed in the travel lane for the purposes of providing 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.				
Why it works:				
When motorists are traveling along the roadway, they are sometimes unaware they are approaching an intersection. This is especially true on rural roads, as there may be fewer clues indicating an intersection ahead. Transverse rumble strips warn motorists that something unexpected is ahead that they need to pay attention to.				
General Qualities (Time, Cost and Effectiveness):				
Use of transverse rumble strips requires minimal development process, allowing transverse rumble strips to be installed within a short time period. In general, This CM can be very effective and can be considered on a systematic approach, although care should be taken to not over-use this CM. Note: When federal safety funding is used for these installations in high-wear-locations, the local agency is expected to maintain the improvement for a minimum of 10 years.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	0 - 35%

NS11, Improve sight distance to intersection (Clear Sight Triangles)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	20%	10 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the significantly improved new sight distance. Minor/incidental improvements to sight distance would not likely result in the CRF shown below.		

General information				
Where to use:				
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.				
Why it works:				
Adequate sight distance for drivers at stop or yield-controlled approaches to intersections has long been recognized as among the most important factors contributing to overall safety at unsignalized intersections. By removing sight distance restrictions (e.g., vegetation, parked vehicles, signs, buildings) from the sight triangles at stop or yield-controlled intersection approaches, drivers will be able see approaching vehicles on the main line, without obstruction and therefore make better decisions about entering the intersection safely.				
General Qualities (Time, Cost and Effectiveness):				
Projects involving clearing sight obstructions on the highway right-of-way can typically be accomplished quickly, assuming the objects are readily moveable. Clearing sight obstructions on private property requires more time for discussions with the property owner. Costs will generally be low, assuming that in most cases the objects to be removed are within the right-of-way. In general, this CMs can be very effective and can be implemented by agencies' maintenance staff and/or implemented on a systematic approach. Usually only high-cost removals would be good candidates for Caltrans Federal Safety Funding. Note: When federal safety funding is used to remove vegetation that has the potential to grow back, the local agency is expected to maintain the improvement for a minimum of 10 years.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	11 - 56%

NS12, Improve pavement friction (High Friction Surface Treatments)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	55%	10 years
Notes:	This CM only applies to crashes occurring within the limits of the improved friction overlay. This CM is not intended to apply to standard chip-seal or open-graded maintenance projects for long segments of corridors or structure repaving projects intended to fix failed pavement.		

General information				
Where to use:				
Nationally, this countermeasure is referred to as "High Friction Surface Treatments" or HFST. 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 is determined to be a problem in wet or dry conditions and the target vehicle is unable to stop due to insufficient skid resistance.				
Why it works:				
Improving the skid resistance at locations with high frequencies of wet-road crashes and/or failure to stop crashes can result in reductions of 50 percent for wet-road crashes and 20 percent for total crashes. Applying HFST can double friction numbers, e.g. low 40s to high 80s. This CM represents a special focus area for both FHWA and Caltrans, which means there are extra resources available for agencies interested in more details on High Friction Surface Treatment projects.				
General Qualities (Time, Cost and Effectiveness):				
This strategy can be relatively inexpensive and implemented in a short timeframe. The installation would be done by either agency personnel or contractors and can be done by hand or machine. In general, This CM can be very effective and can be considered on a systematic approach.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Wet, Night, ALL	CRF:	10 - 62 %

NS13, Install splitter-islands on the minor road approaches

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	40%	20 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of **the new splitter island on the minor road approaches.**		

General information				
Where to use:				
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. In creation of a splitter island allows for an additional stop sign to be placed in the median for the minor approach.				
Why it works:				
The installation of splitter islands allows for the addition of a stop sign in the median to make the intersection more conspicuous. Additionally, the splitter island on the minor-road provides for a positive separation between turning vehicles on the through road and vehicles stopped on the minor road approach.				
General Qualities (Time, Cost and Effectiveness):				
Splitter islands at non-signalized intersections can usually be installed with minimal roadway reconstruction and relatively quickly. In general, This CM can be very effective and can be considered on a systematic approach.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Angle, Rear-End	CRF:	35 - 100 %

NS14, Install raised median on approaches (NS.I.)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	20 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new raised median. All new raised medians funded with federal HSIP funding should not include the removal of the existing roadway structural section and should be doweled into the existing roadway surface. This requirement is being implemented to maximize the safety-effectiveness of the limited HSIP funding and to minimize project impacts. Landscaping, if included in the project, is considered non-participating.		

General information				
Where to use:				
Where related or nearby turning movements affect the safety and operation of an intersection. Effective access management is key to improving safety at, and adjacent to, intersections. The number of intersection access points coupled with the speed differential between vehicles traveling along the roadway often contributes to crashes. Any access points within 250 feet upstream and downstream of an intersection are generally undesirable.				
Why it works:				
Raised medians with left-turn lanes at intersections offer a cost-effective means for reducing crashes and improving operations at higher volume intersections. The raised medians also prohibit left turns into and out of driveways that may be located too close to the functional area of the intersection.				
General Qualities (Time, Cost and Effectiveness):				
Raised medians at intersections may be most effective in retrofit situations where high volumes of turning vehicles have degraded operations and safety, and where more extensive approaches would be too expensive because of limited right-of-way and the constraints of the built environment. Because raised medians limit property access to right turns only, the need for providing alternative access ways should be considered. In general, This CM can be very effective and can be considered on a systematic approach. When agencies opt to install landscaping in conjunction with new raised medians, the portion of the cost for landscaping and other non-safety related items that exceeds 10% of the project total cost is not federally participated and must be funded by the applicant.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	20 - 39 %

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

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	50%	20 years
Notes:	This CM only applies to crashes occurring in the intersection / influence area of the new directional openings.		

General information				
Where to use:				
Crashes related to turning maneuvers include angle, rear-end, pedestrian, and sideswipe (involving opposing left turns) type 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. Because raised medians limit property access to right turns only, they should be used in conjunction with efforts to provide alternative access ways and promote driveway spacing objectives.				
Why it works:				
Agencies are increasingly using access management techniques on urban and suburban arterials to manage the number of conflicts experienced at an intersection. A key element of access management is to restrict certain movements, create directional median openings, or close median openings that are deemed too close to an intersection.				
General Qualities (Time, Cost and Effectiveness):				
Turn prohibitions that are implemented by closing a median opening can usually be implemented quickly. Costs are highly variable but in many cases could be considered low. In some cases this strategy may involve acquiring access or constructing replacement access; those actions will significantly increase the cost of the project. Impacts to businesses and other land uses must be considered and controversy can delay the implementation. In general, This CM can be very effective and can be considered on a systematic approach.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	51%

NS16, Reduced Left-Turn Conflict Intersections (NS.I.)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	50%	20 years
Notes:	This CM only applies to crashes occurring in the intersection / influence area of the new Reduced Left-Turn Conflict.		

General information

Where to use and Why it works:

Reduced left-turn conflict intersections are geometric designs that alter how left-turn movements occur in order 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 (RCUT) and the median U-turn (MUT).

Restricted Crossing U-turn (RCUT):

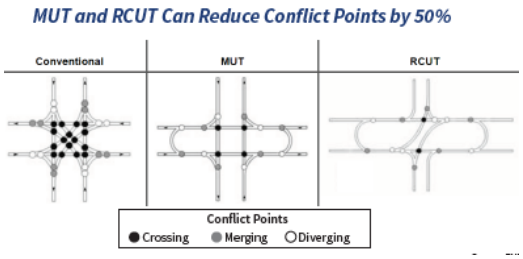
The RCUT intersection modifies the direct left-turn and through movements from cross-street approaches. Minor road traffic makes a right turn followed by a U-turn at a designated location (either signalized or unsignalized) to continue in the desired direction.

The RCUT is suitable for a variety of circumstances, including along rural, high-speed, four-lane, divided highways or signalized routes. It also can be used as an alternative to signalization or constructing an interchange. RCUTs work well when consistently used along a corridor, but also can be used effectively at individual intersections.

Median U-turn (MUT)

The MUT intersection modifies direct left turns from the major approaches. Vehicles proceed through the main intersection, make a U-turn a short distance downstream, followed by a right turn at the main intersection. The U-turns can also be used for modifying the cross-street left turns.

The MUT is an excellent choice for heavily traveled intersections with moderate left-turn volumes. When implemented at multiple intersections along a corridor, the efficient two-phase signal operation of the MUT can reduce delay, improve travel times, and create more crossing opportunities for pedestrians and bicyclists.



General Qualities (Time, Cost and Effectiveness):

Implementing this strategy may take from months to years, depending on whether additional R/W is required. Such projects require a substantial time for development and construction. Costs are highly variable and range from very low to high. The expected effectiveness of this CM must be assessed for each individual location.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Angle/Left-turn/Rear-End/All	CRF:	34.8-100%

NS17, Install right-turn lane (NS.I.)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	20%	20 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new right-turn lanes. This CM is not eligible for use at existing all-way stop intersections.		

General information				
Where to use:				
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. When considering new right-turn lanes, potential impacts to non-motorized users should be considered and mitigated as appropriate.				
Why it works:				
The strategy is targeted to reduce the frequency of rear-end collisions resulting from conflicts between vehicles turning right and following vehicles and vehicles turning right and through vehicles coming from the left on the cross street. Right-turn lanes also remove slow vehicles that are decelerating to turn right from the through-traffic stream, thus reducing the potential for rear-end collisions. Right-turn lanes can increase the length of the intersection crossing and create an additional potential conflict point for non-motorized users.				
General Qualities (Time, Cost and Effectiveness):				
Implementing this strategy may take from months to years. At some locations, right-turn lanes can be quickly and simply installed by restriping the roadway. At other locations, widening of the roadway, acquisition of additional right-of-way, and extensive environmental processes may be needed. Such projects require a substantial time for development and construction. Costs are highly variable and range from very low to high. The expected effectiveness of this CM must be assessed for each individual location.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	14 - 26 %

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

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	35%	20 years
Notes:	This CM only applies to crashes occurring on the approaches / influence area of the new left-turn lanes. This CM does NOT apply to converting a single-left into double-left turn. This CM is not eligible for use at existing all-way stop intersections.		

General information				
Where to use:				
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 appropriate.				
Why it works:				
Adding left-turn lanes remove vehicles waiting to turn left from the through-traffic stream, thus reducing the potential for rear-end collisions. Because they provide a sheltered location for drivers to wait for a gap in opposing traffic, left-turn lanes may encourage drivers to be more selective in choosing a gap to complete the left-turn maneuver. This strategy may reduce the potential for collisions between left-turn and opposing through vehicles.				
General Qualities (Time, Cost and Effectiveness):				
Implementing this strategy may take from months to years. At some locations, left-turn lanes can be quickly and simply installed by restriping the roadway. At other locations, widening of the roadway, acquisition of additional right-of-way, and extensive environmental processes may be needed. Such projects require a substantial time for development and construction. Costs are highly variable and range from very low to high. The expected effectiveness of this CM must be assessed for each individual location.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	9 -55 %

NS19PB, Install raised medians (refuge islands)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	45%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the crossing with the new islands. All new raised medians funded with federal HSIP funding should not include the removal of the existing roadway structural section and should be doweled into the existing roadway surface. This requirement is being implemented to maximize the safety-effectiveness of the limited HSIP funding and to minimize project impacts. Landscaping, if included in the project, is considered non-participating.		

General information				
Where to use:				
Intersections that have a long pedestrian crossing distance, a higher 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.				
Why it works:				
Raised pedestrian refuge islands, or medians at crossing locations along roadways, are another strategy to reduce exposure between pedestrians and motor vehicles. Refuge islands and medians that are raised (i.e., not just painted) provide pedestrians more secure places of refuge during the street crossing. They can stop partway across the street and wait for an adequate gap in traffic before completing their crossing.				
General Qualities (Time, Cost and Effectiveness):				
Median and pedestrian refuge areas are a low-cost countermeasure to implement. This cost can be applied to retrofit improvements or if it is a new construction project, implementing this countermeasure is even more cost-effective. In general, This CM can be very effective and can be considered on a systematic approach. When agencies opt to install landscaping in conjunction with new raised medians, the portion of the cost for landscaping and other non-safety related items that exceeds 10% of the project total cost is not federally participated and must be funded by the applicant.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian and Bicycle	CRF:	30 - 56 %

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

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	25%	10 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the intersection/crossing with the new crossing. This CM is not intended to be used for high-cost aesthetic enhancements to intersection crosswalks (i.e. stamped concrete or stamped asphalt).		

General information				
Where to use:				
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. See Zegeer study (Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations) for additional guidance regarding when to install a marked crosswalk.				
Why it works:				
Adding pedestrian crossings has the opportunity to enhance pedestrian safety at locations noted as being problematic. Pavement markings delineate a portion of the roadway that is designated for pedestrian crossing. These markings will often be different for controlled verses uncontrolled locations. The use of "ladder", "zebra" or other enhanced markings at uncontrolled crossings can increase both pedestrian and driver awareness to the increased exposure at the crossing. Incorporating advanced "stop" or "yield" markings provides an extra safety buffer and can be effective in reducing the 'multiple-threat' danger to pedestrians. Nearly one-third of all pedestrian-related crashes occur at or within 50 feet of an intersection. Of these, 30 percent may involve a turning vehicle. There are several types of pedestrian crosswalks, including: continental, ladder, zebra, and standard. When agencies opt to install aesthetic enhancement to intersection crosswalks like stamped concrete/asphalt, the project design and construction costs can significantly increase. For HSIP applications, these costs must be accounted for in the B/C calculation, but these costs (over standard crosswalk markings) must be tracked separately and are not federally reimbursable and will increase the agency's local-funding share for the project costs.				
General Qualities (Time, Cost and Effectiveness):				
Costs associated with this strategy will vary widely, depending upon if curb ramps and sidewalk modifications are required with the crossing. When considered at a single location, these low cost improvements are usually funded through local funding by local crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian and Bicycle	CRF:	25 %

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

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	35%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the new crossing (influence area) with enhanced safety features. This CM is not intended to be used for high-cost aesthetic enhancements to intersection crosswalks (i.e. stamped concrete or stamped asphalt).		

General information				
Where to use:				
Non-signalized intersections where pedestrians are known to be crossing intersections that involve significant vehicular traffic. They are especially important at school crossings and intersections with turn pockets. Based on the Zegeer study (Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations) at many locations, a marked crosswalk alone may not be sufficient to adequately protect non-motorized users. In these cases, **flashing beacons, curb extensions, advanced "stop" or "yield" markings, and other safety features** should be added to complement the standard crossing elements.				
Why it works:				
Adding pedestrian crossings that include enhances safety features has the opportunity to enhance pedestrian safety at locations noted as being especially problematic. The enhanced safety elements help delineate a portion of the roadway that is designated for pedestrian crossing. Incorporating advanced "yield" markings provide an extra safety buffer and can be effective in reducing the 'multiple-threat' danger to pedestrians. Nearly one-third of all pedestrian-related crashes occur at or within 50 feet of an intersection. When agencies opt to install aesthetic enhancement to intersection crosswalks like stamped concrete/asphalt, the project design and construction costs can significantly increase. For HSIP applications, these costs must be accounted for in the B/C calculation, but these costs (over standard crosswalk markings) must be tracked separately and are not federally reimbursable and will increase the agency's local-funding share for the project costs.				
General Qualities (Time, Cost and Effectiveness):				
Costs associated with this strategy will vary widely, depending upon the types of enhanced features that will be combined with the standard crossing improvements. The need for new curb ramps and sidewalk modifications will also be a factor. This CM may be effectively and efficiently implemented using a systematic approach with more than one location and can have relatively high B/C ratios based on past non-motorized crash history.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian and Bicycle	CRF:	37%

NS22PB, Install Rectangular Rapid Flashing Beacon (RRFB)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	35%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the influence area (expected to be a maximum of within 250') of the crossing which includes the RRFB.		

General information				
Where to use:				
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.				
Why it works:				
RRFBs can enhance safety by increasing driver awareness of potential pedestrian conflicts and reducing crashes between vehicles and pedestrians at unsignalized intersections and mid-block pedestrian crossings. The addition of RRFB may also increase the safety effectiveness of other treatments, such as crossing warning signs and markings.				
General Qualities (Time, Cost and Effectiveness):				
RRFBs are a lower cost alternative to traffic signals and hybrid signals. This CM can often be effectively and efficiently implemented using a systematic approach with numerous locations.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	7 – 47.4%

NS23PB, Install Pedestrian Signal (including Pedestrian Hybrid Beacon (HAWK))

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	55%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the intersection/crossing with the new signal. For HAWK or other pedestrian signals, the justification may be Warrant 4, 5 and/or 7, or passing the test in Figure 4F-1/4F-2 in Chapter 4F of CA MUTCD. Please refer to Chapter 4F of CA MUTCD for more details		

General information				
Where to use:				
Intersections noted as having a history of pedestrian vs. vehicle crashes and in areas where the likelihood of the pedestrian presence is high. Corridors should also be assessed to determine if there are adequate safe opportunities for non-motorists to cross and if a pedestrian signal, or a Pedestrian Hybrid Beacon (PHB) (also called High-Intensity Activated crossWalK beacon (HAWK)) are needed to provide an active warning to motorists when a pedestrian is in the crosswalk.				
Why it works:				
Adding a pedestrian signal has the opportunity to greatly enhance pedestrian safety at locations noted as being problematic. Nearly one-third of all pedestrian-related crashes occur at or within 50 feet of an intersection. In combination with this CM, better guidance signs and markings for non-motorized and motorized roadway users should be considered, including: sign and markings directing pedestrians and cyclists on appropriate/legal travel paths and signs and markings warning motorists of non-motorized uses of the roadway that should be expected.				
General Qualities (Time, Cost and Effectiveness):				
The cost of improvements are generally high, but can vary dependent on the type of signal and overall scope of the project. In most cases the project duration can be short. The expected effectiveness of this CM must be assessed for each individual location.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian and Bicycle	CRF:	15 - 69%

B.3 Roadway Countermeasures

R01, Add Segment Lighting

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Night	35%	20 years
Notes:	This CM only applies to "night" crashes (all types) occurring within limits of the proposed roadway lighting 'engineered' area.		

General information				
Where to use:				
Where to use: 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.				
Why it works:				
Providing roadway lighting improves the safety during nighttime conditions by (1) making drivers more aware of the surroundings, which improves drivers' perception-reaction times, (2) enhancing drivers' available sight distances to perceive roadway characteristic in advance of the change, and (3) improving non-motorist's visibility and navigation.				
General Qualities (Time, Cost and Effectiveness):				
It expected that projects of this type may be constructed in a year or two and are relatively costly. There are several types of costs associated with providing lighting, including the cost of providing a permanent source of power to the location, the cost for the luminaire supports (i.e., poles), and the cost for routinely replacing the bulbs and maintenance of the luminaire supports. Some locations can result in high B/C ratios, but due to higher costs, these projects often result in medium to low B/C ratios.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Night, All	CRF:	18 - 69 %

R02, Remove or relocate fixed objects outside of Clear Recovery Zone

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	35%	20 years
Notes:	This CM only applies to crashes occurring within the limits of the new clear recovery zone (per Caltrans' HDM).		

General information				
Where to use:				
Known 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.				
Why it works:				
While this strategy does not prevent the vehicle leaving the roadway, it does provide a mechanism to reduce the severity of a resulting crash. A clear zone is an unobstructed, traversable roadside area that allows a driver to stop safely or regain control of a vehicle that has left the roadway. Removing or moving fixed objects, flattening slopes, or providing recovery areas reduces the likelihood of a crash.				
General Qualities (Time, Cost and Effectiveness):				
Projects involving removing fixed objects from highway right-of-way can typically be accomplished quickly, assuming the objects are readily moveable. Clearing objects on private property requires more time for discussions with the property owner. Costs will generally be low, assuming that in most cases the objects to be removed are within the right-of-way. This CMs can be very effective and can be implemented by agencies' maintenance staff and/or implemented on a systematic approach. High-cost removals or removals implemented using a systematic approach would be good candidates for Caltrans Federal Safety Funding.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Fixed Object	CRF:	17 - 100 %

R03, Install Median Barrier

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	20 years
Notes:	Note: For Caltrans' statewide Calls-for-Projects, this CM only applies to crashes occurring within the limits of the new barrier.		

General information
Where to use:
Areas where crash history indicates drivers are unintentionally crossing the median and the cross-overs are resulting in high severity crashes. The installation of median barriers can increase the number of PDO and non-severe injuries. The net result in safety from this countermeasure is connected more to reducing the severity of crashes not the number of crashes. It is recommended to review the warrants as outlined in Chapter 7 of the Caltrans Traffic Manual when considering whether to install median barriers.
Why it works:
This strategy is designed to prevent head-on collisions by providing a barrier between opposing lanes of traffic. The variety of median barriers available makes it easier to choose a site-specific solution. The main advantage is the reduction of the severity of the crashes. The key to success would be in selecting an appropriate barrier based on the site, previous crash history, maintenance needs, and median width.
General Qualities (Time, Cost and Effectiveness):
This strategy would in many cases be possible to implement within a short period after site selection. Costs will vary depending on the type of median barrier selected and whether the strategy is implemented as a stand-alone project or incorporated as part of a reconstruction or resurfacing effort. Maintenance costs and worker exposure will also vary depending on the type of barrier selected. The expected effectiveness of this CM must be assessed for each individual location.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Head-on	CRF:	0 - 94 %

R04, Install Guardrail

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	20 years
Notes:	This CM only applies to crashes occurring within the limits of the new guardrail. This CM is not intended to be used for general maintenance activities (i.e. the replacement of existing damaged rail). For projects proposing to upgrade existing guardrail to current standards, this CM and corresponding CRF should only be applied to locations where past crash data or engineering judgment applied to the existing rail conditions suggests the upgraded guardrail may result in fewer or less severe crashes (justifying the use of the 25% CRF for this CM).		

General information
Where to use:
Guardrail is installed to reduce the severity of lane departure crashes. However, guardrail 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. Guardrail 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 crashes. New and upgraded guardrail and end-treatments must meet current safety standards; see Method for Assessing Safety Hardware (MASH) for more information. Caltrans (or other national accepted guidance) slope/height criteria need to be considered and documented.
Why it works:
Guardrail redirects a vehicle away from embankment slopes or fixed objects and dissipates the energy of an errant vehicle.
General Qualities (Time, Cost and Effectiveness):
Strategies range from relatively inexpensive too costly. Costly projects may include those that upgrade existing guardrail applications to more semi-rigid and rigid barrier systems over extended distances. In general, this CMs can be effective and can be implemented by agencies' maintenance staff and/or implemented on a systematic approach.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Fixed Object, Run-off Road	CRF:	11 - 78 %

R05, Install impact attenuators

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	10 years
Notes:	This CM only applies to crashes occurring within the limits of the new attenuators. This CM is not intended to be used for general maintenance activities (i.e. the replacement of existing damaged attenuators). For projects proposing to upgrade existing attenuators to current standards, this CM and corresponding CRF should only be applied to locations where past crash data or engineering judgment applied to the existing attenuator conditions suggests the upgraded attenuators may result in fewer or less severe crashes (justifying the use of the 25% CRF for this CM).		

General information				
Where to use:				
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. New and upgraded barrier end-treatments must meet current safety standards; see MASH for more information.				
Why it works:				
Attenuators bring an errant vehicle to a more-controlled stop or redirect the vehicle away from a rigid object. Attenuators are effective at absorbing impact energy and increasing occupant safety. They also tend to draw attention to the fixed object, which helps drivers steer clear of the fixed objects.				
General Qualities (Time, Cost and Effectiveness):				
Costs depending on the scope of the project, type(s) used, and associated ongoing maintenance costs. Time to install is fairly quick once site is identified.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Fixed Object, Run-off Road	CRF:	5 - 50 %

R06, Flatten side slopes

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	20 years
Notes:	This CM only applies to crashes occurring within the limits of the new side slopes. Minor/incidental flattening of side slopes would not likely result in the CRF shown below and may not be appropriate for use in Caltrans B/C calculations.		

General information				
Where to use:				
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. 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.				
Why it works:				
Flattened slopes provide a greater area for a driver to regain control of a vehicle. Steep slopes, ditches or unprotected hazardous drops-offs adjacent to a travel lane offer little opportunities to correct an inappropriate action by a driver and can result in sever crashes.				
General Qualities (Time, Cost and Effectiveness):				
Roadside modifications range from relatively inexpensive to very costly. Strategies that include creating safer side slopes where none exists can be moderately expensive based on the scope of the project and the associated clearing, grading, etc. The potential for high environmental and right-of-way impacts is high which can take several years to clear. In other cases This CM can be effective and can be implemented by agencies' maintenance staff and/or implemented on a systematic approach.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Fixed Object, Run-off Road	CRF:	5 - 62 %

R07, Flatten side slopes and remove guardrail

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	40%	20 years
Notes:	This CM only applies to crashes occurring within the limits of both the removed guardrail and the new side slopes.		

General information				
Where to use:				
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.				
Why it works:				
Flattened side slopes and an unobstructed clear zone provide a greater area for a driver to regain control of a vehicle. The existing guardrail may help protect the steep slopes, fixed objects, or unprotected hazardous drops-offs adjacent to a travel lane, but removing all of these obstacles generally improves safety.				
General Qualities (Time, Cost and Effectiveness):				
Roadside modifications range from relatively inexpensive to very costly. Strategies that include creating safer side slopes where none exists can be moderately expensive based on the scope of the project and the associated clearing, grading, etc. The potential for high environmental and right-of-way impacts is high which can take several years to clear.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Roll Over, Fixed Object	CRF:	42%

R08, Install raised median

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	20 years
Notes:	This CM only applies to crashes occurring within the limits of the new raised median. All new raised medians funded with federal HSIP funding should not include the removal of the existing roadway structural section and should be doweled into the existing roadway surface. This requirement is being implemented to maximize the safety-effectiveness of the limited HSIP funding and to minimize project impacts. Landscaping, if included in the project, is considered non-participating.		

General information				
Where to use:				
Areas 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. Application of raised medians on roadways with higher speeds is not advised - instead a median barrier should be considered. Including landscaping in new raised medians can be counterproductive to the HSIP safety goals and should only be done in ways that do not increase drivers' exposure to fixed objects and that will maintain driver's sight distance needs throughout the life of the proposed landscaping. **Agencies need to consider and document impacts of additional turning movements at nearby intersections.**				
Why it works:				
Adding raised medians is a particularly effective strategy as it adds to or reallocates the existing cross section to incorporate a buffer between the opposing travel lanes and reinforces the limits of the travel lane. Raised median may also be used to limit unsafe turning movements along a roadway.				
General Qualities (Time, Cost and Effectiveness):				
In some cases this strategy may be a retrofit into the existing roadway by utilizing a portion of the existing paved shoulder. These raised medians can be installed directly over the existing pavement. Cost and time to implement could significantly increase if the paved area is not sufficient to include a median. The surface treatment of the raised median also significantly affects their cost-effectiveness: standard concrete or other hardscape surfaces are usually more cost effective than landscaped medians. When agencies opt to install landscaping in conjunction with new raised medians, the project design and construction costs can significantly increase due to excavation, backfill/top-soil, water-connection, irrigation, planting, maintenance needed for the landscaping. When agencies opt to install landscaping in conjunction with new raised medians, the portion of the cost for landscaping and other non-safety related items that exceeds 10% of the project total cost is not federally participated and must be funded by the applicant.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Head-on	CRF:	20 - 75 %

R09, Install median (flush)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	15%	20 years
Notes:	This CM only applies to crashes occurring within the limits of the new flush median. The new median must be a minimum of 4 feet wide (or "wider" if a narrow median exists before the proposed project).		

General information
Where to use:
Areas 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.
Why it works:
Adding medians is a particularly effective strategy as it adds to or reallocates the existing cross section to incorporate a narrow buffer median between opposing flows, thereby providing a greater opportunity to correct an errant maneuver and further reinforce the limits of the travel lane. Application widths can vary based on the available cross section and intended application. Additional safety can be provided by combining this CM with rumble strips.
General Qualities (Time, Cost and Effectiveness):
In some cases this strategy may be retrofitted into the existing roadway by utilizing a portion of the existing paved shoulder and can ultimately be as simple as restriping the roadway. Costs and time to implement could significantly increase if the paved area is not sufficient to include a median.

FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	15 - 78 %

R10PB, Install pedestrian median fencing

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	35%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring on the approaches/influence area of the new pedestrian median fencing.		

General information
Where to use:
Roadway segments with high pedestrian-generators and pedestrian-destinations nearby (e.g. transit stops) may experience a high volume of pedestrians J-walking 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.
Why it works:
Adding pedestrian median fencing has the opportunity to enhance pedestrian safety at locations noted as being problematic involving pedestrians running/darting across the roadway outside designated pedestrian crossings. Pedestrian median fencing can significantly reduce this safety issue by creating a positive barrier, forcing pedestrians to the designated pedestrian crossing.
General Qualities (Time, Cost and Effectiveness):
Costs associated with this strategy will vary widely depending on the type and placement of the median fencing. Impacts to transit and other land uses may need to be considered and controversy can delay the implementation. In general, this CM can be effective as a spot-location approach.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	25 - 40%

R11, Install acceleration/ deceleration lanes

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	20 years
Notes:	This CM only applies to crashes occurring within the limits of the new accel/decel lanes on high speed roadways. Significant improvements to the merge length for lane-drop locations is also an acceptable use of this CM.		

General information				
Where to use:				
Areas 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 CM can also be used to improve the safety of merging vehicles at a lane-drop location.				
Why it works:				
A lane that does not provide enough deceleration length and storage space for turning traffic may cause the turn queue to back up into the adjacent through lane. This can contribute to rear-end and sideswipe crashes. An acceleration lane is an auxiliary or speed-change lane that allows vehicles to accelerate to highway speeds (high speed roadways) before entering the through-traffic lanes of a highway. Additionally, if acceleration by entering traffic takes place directly on the traveled way, it may disrupt the flow of through-traffic and cause rear-end and sideswipe collisions.				
General Qualities (Time, Cost and Effectiveness):				
Costs are highly variable. Where sufficient median or shoulder space exists it may be possible to provide acceleration/deceleration lanes at a moderate cost. Where the roadway must be widened and additional right-of-way must be acquired, higher costs and a lengthy time-to-construct are likely. The expected effectiveness of this CM must be assessed for each individual location.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Sideswipe, Rear-End	CRF:	10 - 75 %

R12, Widen lane (initially less than 10 ft)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	20 years
Notes:	Note: For Caltrans' statewide Calls-for-Projects, this CM only applies to crashes occurring within the limits of the widened lanes. Widening must a minimum of 1 foot.		

General information				
Where to use:				
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 pavement width less than 10 feet.				
Why it works:				
Increasing pavement width can affect almost all crash types. A common practice is to widen the traveled way on horizontal curves to make operating conditions on curves comparable to those on tangents. Speed is a primary consideration when evaluating potential adverse impacts of lane width on safety. On high-speed, rural two-lane highways, an increased risk of cross-centerline head-on or cross-centerline sideswipe crashes is a concern because drivers may have more difficulty staying within the travel lane.				
General Qualities (Time, Cost and Effectiveness):				
Costs will depend on the amount of reconstruction necessary and on whether additional right-of-way is required. In general, this is one of the higher-cost strategies recommended, but it can also be very beneficial. Since this is a relatively expensive treatment, one of the keys to creating a cost effective project with at least a medium B/C ratio is targeting higher-hazard roadways.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	5 - 70 %

R13, Add two-way left-turn lane

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	20 years
Notes:	This CM only applies to crashes occurring within the limits of the new lane, where an existing median did not already exist.		

General information
Where to use:
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 crossing the centerline of an undivided multilane roadway inadvertently.
Why it works:
Two-way left-turn lanes provide a buffer between opposing directions of travel and separate left turning traffic from through traffic. They can also help to allow vehicles to begin to accelerate before entering the through-traffic lanes. They reduce the disruption of flow of through-traffic and reducing rear-end and sideswipe collisions. For some roadways the option of converting a four-lane undivided arterials to two-vehicle-lane roadways with a center left-turn lane and bike lanes should be considered (see "Road Diet" CM.)
General Qualities (Time, Cost and Effectiveness):
In some cases this strategy may be retrofitted into the existing roadway by utilizing a portion of the existing paved shoulder and can ultimately be as simple as restriping the roadway. Costs and time to implement could significantly increase if the paved area is not sufficient to include a median, requiring new right-of-way, and having significant environmental impacts. The expected effectiveness of this CM must be assessed for each individual location as the B/C ratios will vary from low to high.

FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	8 - 50 %

R14, Road Diet (Reduce travel lanes and add a two way left-turn and bike lanes)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	35%	20 years
Notes:	This CM only applies to crashes occurring within the limits of the new lane striping. "Intersection" crashes can only be applied when they resulted from turning movements that had no designated turn lanes/phases in the existing condition and the Road Diet will provide turn lanes/phases for these movements. This CM does not apply to roadway sections that already included left turn lanes or two way left turn lanes before the lane reductions. New bike lanes are also expected to be part of these projects. if any pavement is planned to be removed for the purpose of adding landscaping, planter-boxes, or other non-roadway user features, the cost should be non-participating.		

General information
Where to use:
Areas noted as having a higher frequency of head-on, left-turn, and rear-end crashes with traffic volumes that can be handled by only 2 free flowing lanes. Using this strategy in locations with traffic volumes that are too high could result in diversion of traffic to routes less safe than the original four-lane design. It may also result in congestion levels that contribute to other crashes.
Why it works:
The application of this strategy usually reduces the roadway segment speeds and serious head-on crashes. In many cases the extra pavement width can be used for the installation of bike lanes. In addition to increasing bicycle safety, these bike lanes can improve the safety of on-street parking.
General Qualities (Time, Cost and Effectiveness):
Implementation would require more time than in other low-cost treatments to complete environmental analyses, traffic studies and public input. Projects that only require new lane markings and minor signalization modifications will have relatively low cost and can be very effective and can be considered on a systematic approach. These striping and signal modification costs should be considered part of this CM and not an additional CM. (If additional signal hardware improvements are being made, over what is needed for the road diet, then the Improve Signal Hardware CM may also be used.) Often road diet projects need a seal-coat placed on the roadway to fully remove the old striping. These seal coats are considered part of the proper installation of this CM. In contrast, structural-overlays should not be considered part of this CM and are not considered eligible for funding in the California Local HSIP.

FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	26 - 43 %

R15, Widen shoulder

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	20 years
Notes:	This CM only applies to crashes occurring within the limits of the new paved shoulder. A minimum of 2 feet width must be added and the new/resulting shoulders must be a minimum of 4 feet wide. This CM is not eligible unless it is done as the last step of an "incremental approach", for which the agency documents that: 1) they have already pursued and installed lower cost and lower impact CMs (i.e. signing/striping upgrades to MUTCD standards/recommendations, rumble strips, etc.), 2) they have already monitored the crash occurrences after these improvements were installed, and 3) the 'after' crash rate is still unacceptably high. This 'incremental approach' (or a special exception from the HSIP program manager) must be documented in the Narrative Questions in the application and a summary of the 'before' and 'after' crash analysis must be attached to the application.		

General information				
Where to use:				
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.				
Why it works:				
Based on the best available research, adding shoulder or widening an existing shoulder provides a greater area to regain control of a vehicle, as well as lateral clearance to roadside objects such as guardrail, signs and poles. They may also provide space for disabled vehicles to stop or drive slowly, provide increased sight distance for through vehicles and for vehicles entering the roadway, and in some cases reduce passing conflicts between motor vehicles and bicyclists and pedestrians. The likely safety benefits for adding or widening an existing shoulder generally increase as the widening width increases - practitioners should refer to NCHRP Report 500 Series, the CMF Clearinghouse or other references for more details.				
General Qualities (Time, Cost and Effectiveness):				
Shoulder widening costs would depend on whether new right-of-way is required and whether extensive roadside modification is needed. Since shoulder widening can be a relatively expensive treatment, one of the keys to creating a cost effective project with at least a medium B/C ratio is targeting higher-hazard roadways.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Fixed Object, Run-off Road, Sideswipe	CRF:	15 - 75 %

R16, Curve Shoulder widening (Outside Only)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	45%	20 years
Notes:	This CM only applies to crashes occurring within the limits (or influence area) of the new shoulder widening at curves. A minimum of 2-4 feet width must be added to the outside of horizontal curves and the new traversable shoulder must be a minimum of 4 feet wide.		

General information		
Where to use:		
Roadway curves noted as having frequent lane departure crashes due to inadequate or no shoulders, resulting in an unsuccessful attempt to reenter the roadway.		
Why it works:		
Adding shoulders (outside only) creates a recovery area in which a driver can regain control of a vehicle, as well as lateral clearance to roadside objects.		
General Qualities (Time, Cost and Effectiveness):		
To minimize the R/W needs and the cost, only outside shoulder at curves is to be widened. This CM can be implemented in a relatively short timeframe.		
FHWA CMF Clearinghouse:	NA	

R17, Improve horizontal alignment (flatten curves)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	50%	20 years
Notes:	This CM only applies to crashes occurring within the limits (or influence area) of the improved alignment. **This CM is not eligible unless** it is done as the last step of an "incremental approach", including: the agency documents that: 1) they have already pursued and installed lower cost and lower impact CMs (i.e. signing/striping upgrades to MUTCD standards/recommendations, rumble strips, etc.), 2) they have already monitored the crash occurrences after these improvements were installed, and 3) the 'after' crash rate is still unacceptably high. This 'incremental approach' (or a special exception from the HSIP program manager) must be documented in the Narrative Questions in the application and a summary of the agency's 'before' and 'after' crash analysis must be attached to the application.		

General information				
Where to use:				
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.				
Why it works:				
Increasing the radius of a horizontal curve can be very effective in improving the safety performance of the curve. Curve modification reduces the likelihood of a vehicle leaving its lane, crossing the roadway centerline, or leaving the roadway at a horizontal curve; and minimizes the adverse consequences of leaving the roadway. Horizontal alignment improvement projects are expected to include standard/improved superelevation elements, which should be considered part of this CM and not an additional CM.				
General Qualities (Time, Cost and Effectiveness):				
This strategy is a long-term, higher-cost alternative for improving the safety of a horizontal curve because it usually involves total reconstruction of the roadway. It may also require acquisition of additional right-of-way and an environmental review. This strategy, albeit costly, has shown that increasing the radius of curvature can significantly reduce total curve-related crashes by up to 80 percent. The expected effectiveness of this CM must be assessed for each individual location.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	24 - 90%

R18, Flatten crest vertical curve

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	20 years
Notes:	This CM only applies to crashes occurring within the limits (or influence area) of the improved alignment. This CM is not eligible unless it is done as the last step of an "incremental approach", including: the agency documents that: 1) they have already pursued and installed lower cost and lower impact CMs (i.e. signing/striping upgrades to MUTCD standards/recommendations, rumble strips, etc.), 2) they have already monitored the crash occurrences after these improvements were installed, and 3) the 'after' crash rate is still unacceptably high. This 'incremental approach' (or a special exception from the HSIP program manager) must be documented in the Narrative Questions in the application and a summary of the agency's 'before' and 'after' crash analysis must be attached to the application.		

General information				
Where to use:				
The target for this strategy is usually unsignalized intersections with restricted 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.				
Why it works:				
Adequate sight distance for drivers at stopped approaches to intersections has long been recognized as among the most important factors contributing to overall intersection safety. Vertical alignment improvement projects are expected to include standard/improved superelevation elements, which should be considered part of this CM and not an additional CM.				
General Qualities (Time, Cost and Effectiveness):				
Projects involving changing the horizontal and/or vertical alignment to provide more sight distance are quite extensive and usually take several years to accomplish. If additional right-of-way is required or environmental impacts are expected, these projects will require a substantial period of time. Since this is usually an expensive treatment, one of the keys to creating a cost effective project with at least a medium B/C ratio is targeting higher-hazard locations.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	20 - 51 %

R19, Improve curve superelevation

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	45%	20 years
Notes:	This CM only applies to crashes occurring within the limits (or influence area) of the improved superelevation. This CM does not apply to sections of roadways where the horizontal or vertical alignments are changing via another CM.		

General information				
Where to use:				
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.				
Why it works:				
Superelevation works with friction between the tires and pavement to counteract the forces on the vehicle associated with cornering. Many curves may have inadequate superelevation because of vehicles traveling at higher speeds than were originally designed for, because of loss of effective superelevation after resurfacing, or because of changes in design policy after the curve was originally constructed.				
General Qualities (Time, Cost and Effectiveness):				
This strategy can be a higher-cost alternative for improving the safety of a curve because it involves reconstruction to some degree. Other projects may be able to be constructed by simple overlays and minimal reconstruction of roadways features. When simple overlay fixes are pursued, a systematic installation approach may be appropriate. The expected effectiveness of this CM must be assessed for each individual location.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Run-off Road, All	CRF:	40 - 50 %

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

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	35%	20 years
Notes:	This CM only applies to crashes occurring within the limits of the new one-way sections.		

General information				
Where to use:				
One-way streets can offer improved signal timing and accommodate odd-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 which creates new problems. Care must be taken not to create conditions that cause driver confusion and erratic maneuvers.				
Why it works:				
Studies have shown a 10 to 50-percent reduction in total crashes after conversion of a two-way street to one-way operation. While studies have shown that con-version of two-way streets to one-way generally reduces pedestrian crashes, one-way streets tend to have higher speeds which creates new problems. At the same time, this strategy (1) increases capacity significantly and (2) can have safety-related drawbacks including pedestrian confusion and minor sideswipe crashes.				
General Qualities (Time, Cost and Effectiveness):				
The costs will vary depending on length of treatment and if the conversion requires modification to signals. Conversion costs can be high to build "crossovers" where the one-way streets convert back to two-way streets and to rebuild traffic signals. It's also likely that these types of modifications will require public involvement and could significantly add to the time it takes to complete the project. The expected effectiveness of this CM must be assessed for each individual location.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	26 - 43 %

R21, Improve pavement friction (High Friction Surface Treatments)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	55%	10 years
Notes:	This CM only applies to crashes occurring within the limits of the improved friction overlay. This CM is not intended to apply to standard chip-seal or open-graded **maintenance** projects for long segments of corridors or structure repaving projects intended to fix failed pavement.		

General information				
Where to use:				
Nationally, this countermeasure is referred to as "High Friction Surface Treatments" or HFST. Areas as noted having crashes on wet pavements or under dry conditions when the pavement friction available is significantly less than actual roadway speeds; including but not limited to curves, loop ramps, intersections, and areas with short stopping or weaving distances. This treatment is intended to target locations where skidding is determined to be a problem, in wet or dry conditions and the target vehicle is one that runs (skids) off the road or is unable to stop due to insufficient skid resistance.				
Why it works:				
Improving the skid resistance at locations with high frequencies of wet-road crashes and/or failure to stop crashes can result in a reduction of 50 percent for wet-road crashes and 20 percent for total crashes. Applying HFST can double friction numbers, e.g. low 40s to high 80s. This CM represents a special focus area for both FHWA and Caltrans, which means there are extra resources available for agencies interested in more details on High Friction Surface Treatment projects.				
General Qualities (Time, Cost and Effectiveness):				
This strategy can be relatively inexpensive and implemented in a short timeframe. The installation would be done by either agency personnel or contractors and can be done by hand or machine. In general, This CM can be very effective and can be considered on a systematic approach.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Wet, Rear-End, All	CRF:	17 - 68 %

R22, Install/Upgrade signs with new fluorescent sheeting (regulatory or warning)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	15%	10 years
Notes:	This CM only applies to crashes occurring within the influence area of the new/upgraded signs. This CM is not intended for maintenance upgrades of street-name, parking, guide, or any other signs without a primary focus on roadway safety. **This CM 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. The overall sign audit scope (or a special exception from the HSIP program manager) must be documented in the Narrative Questions in the application. Based on the scope of the project/audit, it may be appropriate to combine other CMs in the B/C calculation.		

General information				
Where to use:				
The target for this strategy should be on roadway segments with patterns of head on, nighttime, non-intersection, run-off road, and sideswipe crashes related to lack of driver awareness of the presence of a specific roadway feature or regulatory requirement. Ideally this type of safety CM would be combined with other sign evaluations and upgrades (install chevrons, warning signs, delineators, markers, beacons, and relocation of existing signs per MUTCD standards.)				
Why it works:				
This strategy primarily addresses crashes caused by lack of driver awareness (or compliance) roadway signing. It is intended to get the drivers attention and give them a visual warning by using fluorescent yellow sheeting (or other retroreflective material).				
General Qualities (Time, Cost and Effectiveness):				
Signing improvements do not require a long development process and can typically be implemented quickly. Costs for implementing this strategy are nominal and depend on the number of signs. When considered at a single location, these low cost improvements are usually funded through local funding by local maintenance crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding. When considering any type of federally funded sign upgrade project, California local agencies are encouraged to consider "Roadway Safety Signing Audit (RSSA) and Upgrade Projects". Including RSSAs in the development phase of sign projects are expected to identify non-standard (per MUTCD) sign features and missing signs that may otherwise go unnoticed. More information on RSSA is available on the Local Assistance HSIP webpage.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Head on, Run-off road, Sideswipe, Night	CRF:	18 - 35%

R23, Install chevron signs on horizontal curves

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	40%	10 years
Notes:	This CM only applies to crashes occurring within the influence area of the new signs. (i.e. only through the curve).		

General information				
Where to use:				
Roadways that have an unacceptable level of crashes on relatively sharp curves during periods of light and darkness. Ideally this type of safety CM would be combined with other sign evaluations and upgrades (install warning signs, delineators, markers, beacons, and relocation of existing signs per MUTCD standards.)				
Why it works:				
Post-mounted chevrons are intended to warn drivers of an approaching curve and provide tracking information and guidance to the drivers. While they are intended to act as a warning, it should also be remembered that the posts, placed along the roadside, represent a possible object with which an errant vehicle can crash into. Design of posts to minimize damage and injury is an important part of the considerations to be made when selecting these treatments.				
General Qualities (Time, Cost and Effectiveness):				
Signing improvements do not require a long development process and can typically be implemented quickly. Costs for implementing this strategy are nominal and depend on the number of signs. When considered at a single location, these low cost improvements are usually funded through local funding by local maintenance crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding. When considering any type of federally funded sign upgrade project, California local agencies are encouraged to consider "Roadway Safety Signing Audit (RSSA) and Upgrade Projects". Including RSSAs in the development phase of sign projects are expected to identify non-standard (per MUTCD) sign features and missing signs that may otherwise go unnoticed. More information on RSSA is available on the Local Assistance HSIP webpage.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Run-off Road, All	CRF:	6 - 64 %

R24, Install curve advance warning signs

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	10 years
Notes:	This CM only applies to crashes occurring within the influence area of the new signs. (i.e. only through the curve)		

General information				
Where to use:				
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 CM would be combined with other sign evaluations and upgrades (install warning signs, chevrons, delineators, markers, beacons, and relocation of existing signs per MUTCD standards.)				
Why it works:				
This strategy primarily addresses problem curves, and serves as an advance warning of an unexpected or sharp curve. It provides advance information and gives drivers a visual warning that their added attention is needed.				
General Qualities (Time, Cost and Effectiveness):				
Signing improvements do not require a long development process and can typically be implemented quickly. Costs for implementing this strategy are nominal and depend on the number of signs. When considered at a single location, these low cost improvements are usually funded through local funding by local maintenance crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding. When considering any type of federally funded sign upgrade project, California local agencies are encouraged to consider "Roadway Safety Signing Audit (RSSA) and Upgrade Projects". Including RSSAs in the development phase of sign projects are expected to identify non-standard (per MUTCD) sign features and missing signs that may otherwise go unnoticed. More information on RSSA is available on the Local Assistance HSIP webpage.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Run-off Road, All	CRF:	20 - 30 %

R25, Install curve advance warning signs (flashing beacon)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	10 years
Notes:	This CM only applies to crashes occurring within the influence area of the new signs. (i.e. only through the curve)		

General information				
Where to use:				
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.				
Why it works:				
This strategy primarily addresses problem curves, and serves as an enhanced advance warning of an unexpected or sharp curve. It provides advance information and gives drivers a visual warning that their added attention is needed. Flashing beacons are an added indication that a curve may be particularly challenging.				
General Qualities (Time, Cost and Effectiveness):				
Use of flashing beacons requires minimal development process, allowing flashing beacons to be installed within a short time period. Before choosing this CM, the agency needs to confirm the ability to provide power to the site (solar may be an option). In general, This CM can be very effective and can be considered on a systematic approach.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	30 %

R26, Install dynamic/variable speed warning signs

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	30%	10 years
Notes:	This CM only applies to crashes occurring within the influence area of the new signs. (i.e. through the curve) {**<u>This CM does not apply to dynamic regulatory speed warning signs.</u>** There are currently no nationally accepted CRFs for dynamic regulatory signs (also known as Radar Speed Feedback Signs). CRFs are being developed and Caltrans hopes to include these CMs and CRFs in future calls for projects.}		

General information				
Where to use:				
Curvilinear roadways that have an unacceptable level of crashes due to excessive speeds on relatively sharp curves.				
Why it works:				
This strategy primarily addresses crashes caused by motorists traveling too fast around sharp curves. It is intended to get the drivers attention and give them a visual warning that they may be traveling over the recommended speed for the approaching curve. Care should be taken to limit the placement of these signs to help maintain their effectiveness.				
General Qualities (Time, Cost and Effectiveness):				
Use of dynamic speed warning signs requires minimal development process, allowing them to be installed within a short time period. Before choosing this CM, the agency needs to confirm the ability to provide power to the site (solar may be an option). In general, This CM can be very effective and can be considered on a systematic approach.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	0 - 41 %

R27, Install delineators, reflectors and/or object markers

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	15%	10 years
Notes:	This CM only applies to crashes occurring within the limits / influence area of the new features. {**This is not a striping-related CM**}		

General information				
Where to use:				
Roadways that have an unacceptable level of crashes on curves (relatively flat to sharp) during periods of light and darkness. Any road with a history of fixed object crashes is a candidate for this treatment, as are roadways with similar fixed objects along the roadside that have yet to experience crashes. If a fixed object cannot be relocated or made break-away, placing an object marker can provide additional information to motorists. Ideally this type of safety CM would be combined with other sign evaluations and upgrades (install warning signs, chevrons, beacons, and relocation of existing signs per MUTCD standards.)				
Why it works:				
Delineators, reflectors and/or object markers are intended to warn drivers of an approaching curve or fixed object that cannot easily be removed. They are intended to provide tracking information and guidance to the drivers. They are generally less costly than Chevron Signs as they don't require posts to place along the roadside, avoiding an additional object with which an errant vehicle can crash into.				
General Qualities (Time, Cost and Effectiveness):				
These improvements do not require a long development process and can typically be implemented quickly. Costs for implementing this strategy are nominal and depend on the number of locations. When considered at a single location, these low cost improvements are usually funded through local funding by local maintenance crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in low to moderate cost projects that are more appropriate to seek state or federal funding. When considering any type of federally funded sign upgrade project, California local agencies are encouraged to consider "Roadway Safety Signing Audit (RSSA) and Upgrade Projects". Including RSSAs in the development phase of sign projects are expected to identify non-standard (per MUTCD) sign features and missing signs that may otherwise go unnoticed. More information on RSSA is available on the Local Assistance HSIP webpage.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	All	CRF:	0 - 30 %

R28, Install edge-lines and centerlines

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	25%	10 years
Notes:	This CM only applies to crashes occurring within the limits of the new centerlines and/or edge-lines. This CM is not intended to be used for general maintenance activities (i.e. the replacement of existing striping and RPMs in-kind) and must include upgraded safety features over the existing striping. For two lane roadways allowing passing, a striping audit must be done to ensure the passing limits meeting the MUTCD standards. Both the centerline and edge-lines are expected to be upgraded, unless prior approval is granted by Caltrans staff in writing and attached to application.		

General information				
Where to use:				
Any road with a history of run-off-road right, head-on, opposite-direction-sideswipe, or run-off-road-left crashes is a candidate for this treatment - install where the existing lane delineation is not sufficient to assist the motorist in understanding the existing limits of the roadway. Depending on the width of the roadway, various combinations of edge line and/or center line pavement markings may be the most appropriate. Incorporating raised/reflective pavement markers (RPMs) into centerlines (and edge-lines) should be considered as it has been shown to improve safety.				
Why it works:				
Installing edge-lines and centerlines where none exists or making significant upgrades to existing lines (paint to thermoplastic, adding audible disks/bumps in the thermoplastic stripes, or adding RPMs) are intended/designed to help drivers who might leave the roadway because of their inability to see the edge of the roadway along the horizontal edge of the pavement or cross-over the centerline of the roadway into oncoming traffic. New pavement marking products tend to be more durable, are all-weather, more visible, and have a higher retroreflectivity than traditional pavement markings.				
General Qualities (Time, Cost and Effectiveness):				
These improvements do not require a long development process and can typically be implemented quickly. Costs for implementing this strategy are nominal and depend on the number and length of locations. This CM can be effectively and efficiently implemented using a systematic approach with numerous and long locations, resulting in low to moderate cost projects that are more appropriate to seek state or federal funding. When considering any type of federally funded striping upgrade project, California local agencies are encouraged to consider "Roadway Safety Striping Audit and Upgrade Projects". Including wide-scale striping audits in the development phase of striping projects are expected to identify non-standard (per MUTCD) striping/marking features, no-passing zone limits needing adjustment, and missing striping/markings that may otherwise go unnoticed. More information on this concepts is available on the Local Assistance HSIP webpage under an RSSA example document. Note: When federal safety funding is used for these installations in high-wear-locations, the local agency is expected to maintain the improvement for a minimum of 10 years.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Head-on, Run-off Road, All	CRF:	0 - 44 %

R29, Install no-passing line

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	45%	10 years
Notes:	This CM only applies to crashes occurring within the limits of the new or extended no-passing zones.		

General information
Where to use:
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. General restriping projects can be good opportunities to reevaluate and incorporate new no-passing zones limits. The incorporation 'No Passing Zone' pennants should also be considered when reevaluating the limits of no-passing zones. Installing no-passing limits in areas that are not warranted may reduce the overall safety of the corridor as drivers may become frustrated and attempt passing maneuvers at other locations without the necessary sight distance.
Why it works:
When the centerline markings do not differentiate between passing and no-passing areas, drivers may have difficulty determining where passing maneuvers can be completed safely. Providing clear and engineered passing and no-passing areas can encourage drivers to wait patiently for safe passing areas and avoid aggressively looking for passing opportunities.
General Qualities (Time, Cost and Effectiveness):
These improvements do not require a long development process and can typically be implemented quickly. Costs for implementing this strategy are nominal and depend on the number and length of locations. When considered at a single location, these low cost improvements are usually funded through local funding by local maintenance crews. However, This CM can be effectively and efficiently implemented using a systematic approach with numerous and long locations, resulting in low to moderate cost projects that are more appropriate to seek state or federal funding.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Head-on, Side-swipe	CRF:	40 - 53%

R30, Install centerline rumble strips/stripes

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	20%	10 years
Notes:	This CM only applies to crashes occurring within the limits of the new rumble strips/stripes.		

General information
Where to use:
Center Line rumble strips/stripes can be used on virtually any roadway – 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.
Why it works:
Rumble strips provide an auditory indication and tactile rumble when driven on, alerting drivers that they are drifting out of their travel lane, giving them time to recover before they depart the roadway or cross the center line. Additionally, rumble stripes (pavement marking in the rumble itself) provide an enhanced marking, especially in wet dark conditions.
General Qualities (Time, Cost and Effectiveness):
These improvements do not require a long development process and can typically be implemented quickly. Costs for implementing this strategy are nominal and depend on the number and length of locations. This CM can be effectively and efficiently implemented using a systematic approach with numerous and long locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding.

FHWA CMF Clearinghouse:	Crash Types Addressed:	Head-on, Side-swipe, All	CRF:	15 - 68%

R31, Install edgeline rumble strips/stripes

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	All	15%	10 years
Notes:	This CM only applies to crashes occurring within the limits of the new rumble strips/stripes.		

General information				
Where to use:				
Shoulder and edge line 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.				
Why it works:				
Rumble strips provide an auditory indication and tactile rumble when driven on, alerting drivers that they are drifting out of their travel lane, giving them time to recover before they depart the roadway or cross the center line. Additionally, rumble stripes (pavement marking in the rumble itself) provide an enhanced marking, especially in wet dark conditions.				
General Qualities (Time, Cost and Effectiveness):				
These improvements do not require a long development process and can typically be implemented quickly. Costs for implementing this strategy are nominal and depend on the number and length of locations. This CM can be effectively and efficiently implemented using a systematic approach with numerous and long locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Run-off Road	CRF:	10 - 41%

R32PB, Install bike lanes

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	35%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring within the limits of the Class II (not Class III) bike lanes. When an off-street bike-path is proposed that is not adjacent to the roadway, the applicant must document the engineering judgment used to determine which "Ped & Bike" crashes to apply.		

General information				
Where to use:				
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 bike lanes can be incorporated into a roadway when is desirable to delineate which available road space is for exclusive or preferential use by bicyclists.				
Why it works:				
Most studies present evidence that bicycle lanes provide protection against bicycle/motor vehicle collisions. Bicycle lanes provide marked areas for bicyclist to travel along the roadway and provide for more predictable movements for both bicyclist and motorist. Evidence also shows that riding with the flow of vehicular traffic reduces bicyclists' chances of collision with a motor vehicle. Locations with bicycle lanes have lower rates of wrong-way riding. In combination with this CM, better guidance signs and markings for non-motorized and motorized roadway users should be considered, including: sign and markings directing cyclists on appropriate/legal travel paths and signs and markings warning motorists of non-motorized uses of the roadway that should be expected.				
General Qualities (Time, Cost and Effectiveness):				
Adding striped bicycle lanes can range from the simply restriping the roadway and minor signing to projects that require roadway widening, right-of-way, and environmental impacts. It is most cost efficient to create bike lanes during street reconstruction, street resurfacing, or at the time of original construction. The expected effectiveness of this CM must be assessed for each individual location. For simple installation scenarios, This CM can be very effective and can be considered on a systematic approach.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	0 - 53 %

R33PB, Install Separated Bike Lanes

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	45%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring within the limits of the separated bike lanes. When an off-street bike-path is proposed that is not adjacent to the roadway, the applicant must document the engineering judgment used to determine which "Ped & Bike" crashes to apply.		

General information				
Where to use:				
Separated bikeways are most appropriate on streets with high volumes of bike traffic and/or high bike-vehicle collisions, presumably in an urban or suburban area. 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. In some cases, it may be possible to provide additional space in areas where pedestrian and bicyclists may interact, such as the parking buffer, or loading zones, or extra bike lane width for cyclists to pass one another.				
Why it works:				
Separated bike lanes provide increased safety and comfort for bicyclists beyond conventional bicycle lanes. By separating bicyclists from motor traffic, "protected" or physically separated bike lanes can offer a higher level of comfort and are attractive to a wider spectrum of the public. Intersections and approaches must be carefully designed to promote safety and facilitate left-turns for bicyclists from the primary corridor to cross street. In combination with this CM, better guidance signs and markings for non-motorized and motorized roadway users should be considered, including: sign and markings directing cyclists on appropriate/legal travel paths and signs and markings warning motorists of non-motorized uses of the roadway that should be expected.				
General Qualities (Time, Cost and Effectiveness):				
The cost of Installing separated bike lanes can be low to medium or high, depending on whether roadway widening, right-of-way and environmental impacts are involved. It is most cost efficient to create bike lanes during street reconstruction, street resurfacing, or at the time of original construction. The expected effectiveness of this CM must be assessed for each individual location.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	3.7 - 100 %

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

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	80%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring within the limits of the new walkway. This CM is not intended to be used where an existing sidewalk is being replaced with a wider one, unless prior Caltrans approval is included in the application. When an off-street multi-use path is proposed that is not adjacent to the roadway, the applicant must document the engineering judgment used to determine which "Ped & Bike" crashes to apply.		

General information
Where to use:
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.
Why it works:
Sidewalks and walkways provide people with space to travel within the public right-of-way that is separated from roadway vehicles. The presence of sidewalks on both sides of the street has been found to be related to significant reductions in the "walking along roadway" pedestrian crash risk compared to locations where no sidewalks or walkways exist. Reductions of 50 to 90 percent of these types of pedestrian crashes. In combination with this CM, better guidance signs and markings for non-motorized and motorized roadway users should be considered, including: sign and markings directing pedestrians and cyclists on appropriate/legal travel paths and signs and markings warning motorists of non-motorized uses of the roadway that should be expected.
General Qualities (Time, Cost and Effectiveness):

Costs for sidewalks will vary, depending upon factors such as width, materials, and existing of curb, gutter and drainage. Asphalt curbs and walkways are less expensive, but require more maintenance. The expected effectiveness of this CM must be assessed for each individual location. These projects can be very effective in areas of high-pedestrian volumes with a past history of crashes involving pedestrians.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	65 - 89 %

R35PB, Install/upgrade pedestrian crossing (with enhanced safety features)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	35%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the influence area (expected to be a maximum of within 250') of the new crossing which includes new enhanced safety features. Note: This CM is not intended to be combined with the "Install raised pedestrian crossing" when calculating the improvement's B/C ratio. This CM is not intended to be used for high-cost aesthetic enhancements (i.e. stamped concrete or stamped asphalt).		

General information				
Where to use:				
Roadway segments with no controlled crossing for a significant distance in high-use midblock crossing areas and/or multilane roads locations. Based on the Zegeer study (Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations) at many locations, a marked crosswalk alone may not be sufficient to adequately protect non-motorized users. In these cases, flashing beacons, curb extensions, medians and pedestrian crossing islands and/or other safety features should be added to complement the standard crossing elements. For multi-lane roadways, advance "yield" markings can be effective in reducing the 'multiple-threat' danger to pedestrians.				
Why it works:				
Adding pedestrian crossings has the opportunity to greatly enhance pedestrian safety at locations noted as being problematic. The enhanced safety elements, which may include curb extensions, medians and pedestrian crossing islands, beacons, and lighting, combined with pavement markings delineating a portion of the roadway that is designated for pedestrian crossing. Care must be taken to warn drivers of the potential for pedestrians crossing the roadway and enhanced improvements added to the crossing increase the likelihood of pedestrians crossing in a safe manner. In combination with this CM, better guidance signs and markings for non-motorized and motorized roadway users should be considered, including: sign and markings directing pedestrians and cyclists on appropriate/legal travel paths and signs. When agencies opt to install aesthetic enhancement to crossing like stamped concrete/asphalt, the project design and construction costs can significantly increase. For HSIP applications, these costs must be accounted for in the B/C calculation, but these costs (over standard crosswalk markings) must be tracked separately and are not federally reimbursable and will increase the agency's local-funding share for the project costs.				
General Qualities (Time, Cost and Effectiveness):				
Costs associated with this strategy will vary widely, depending on the extent of the curb extensions, raised medians, flashing beacons, and other pedestrian safety elements that are needed with the crossing. When considered at a single location, these improvements can sometimes be low cost and funded through local funding by local crews. This CM can often be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate to high cost projects that are appropriate to seek state or federal funding.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	8 - 56%

R36PB, Install raised pedestrian crossing

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	35%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the area with the new raised crossing. Note: This CM is not intended to be combined with the "Install pedestrian crossing (with enhanced safety features)" when calculating the improvement's B/C ratio.		

General information				
Where to use:				
On lower-speed roadways, where pedestrians are known to be crossing roadways that involve significant vehicular traffic. Based on the Zegeer study (Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations) at many locations, a marked crosswalk alone, may not be sufficient to adequately protect non-motorized users. 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.				
Why it works:				
Adding a raised pedestrian crossing has the opportunity to enhance pedestrian safety at locations noted as being especially problematic. The raised crossing encourages motorists to reduce their speed and provides improved delineation for the portion of the roadway that is designated for pedestrian crossing. In combination with this CM, better guidance signs and markings for non-motorized and motorized roadway users should be considered, including: sign and markings directing pedestrians and cyclists on appropriate/legal travel paths.				
General Qualities (Time, Cost and Effectiveness):				
Costs associated with this strategy will vary widely, depending upon the elements of the raised crossing and the need for new curb ramps and sidewalk modifications. This CM may be effectively and efficiently implemented using a systematic approach with more than one location and can have medium to high B/C ratios based on past non-motorized crash history.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	30 - 46%

R37PB, Install Rectangular Rapid Flashing Beacon (RRFB)

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Pedestrian and Bicycle	35%	20 years
Notes:	This CM only applies to "Ped & Bike" crashes occurring in the influence area (expected to be a maximum of within 250') of the crossing which includes the RRFB.		

General information				
Where to use:				
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.				
Why it works:				
RRFBs can enhance safety by increasing driver awareness of potential pedestrian conflicts and reducing crashes between vehicles and pedestrians at unsignalized intersections and mid-block pedestrian crossings. The addition of RRFB may also increase the safety effectiveness of other treatments, such as crossing warning signs and markings.				
General Qualities (Time, Cost and Effectiveness):				
RRFBs are a lower cost alternative to traffic signals and hybrid signals. This CM can often be effectively and efficiently implemented using a systematic approach with numerous locations.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Pedestrian, Bicycle	CRF:	7 – 47.4%

R38, Install Animal Fencing

For HSIP Cycle 11 Call-for-projects			
Funding Eligibility	Crash Types Addressed	CRF	Expected Life
90%	Animal	80%	20 years
Notes:	This CM only applies to "animal" crashes occurring within the limits of the new fencing.		

General information				
Where to use:				
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).				
Why it works:				
Animal fencing helps to channelize the identified animals to a natural or man-made crossing, eliminating the conflict between vehicles and animals on the same place. Animal fencing is typically installed at a bridge location with its "run of need" dependent on the surrounding terrain.				
General Qualities (Time, Cost and Effectiveness):				
Time to install fencing can be moderate to lengthy depending on the environmental commitments and agreed upon solution to mitigating project impacts. Costs will be fairly low and depend on the "run of need" length. There will be minimal reoccurring maintenance costs on keeping the fence intact. The expected effectiveness of this CM must be assessed for each individual location.				
FHWA CMF Clearinghouse:	Crash Types Addressed:	Animal	CRF:	70 - 90 %

APPENDIX F:
B/C RATIO CALCULATION

Cost, Benefit and B/C Ratio Calculation Table

FID	Location	CM 1	CM 2	CM 3	CM1_CRF	CM2_CRF	CM3_CRF	CM1_Life (Year)	CM2_Life (Year)	CM3_Life (Year)	Unused & Desired CM	CM Cost	Contingency Cost	Environmental Cost	PS&E Cost	Right of Way Engineering Cost	Appraisals, Acqusitions & Utilities Cost
	Project 1: Signlaized Intersections: Install raised pavement markers and striping (Through Intersection), Install advance stop bar before crosswalk (Bicycle Box)																
1	S 2nd St & W Las Palmas Ave	S09	S20PB	S02/S21PB	0.1	0.15	0.6	10	10	10		$ 11,764.00	$ 1,176	$ 588	$ 1,765		
	Project 2: Citywide Signal Hardware and Retiming																
1	Sperry Ave & Rogers Rd	S02	S03	S21PB	0.15	0.15	0.6	10	10	10		$ 22,500.00	$ 2,250	$ 1,125	$ 3,375		
2	Sperry Ave & Park Center Dr	S02	S03	S21PB	0.15	0.15	0.6	10	10	10		$ 21,000.00	$ 2,100	$ 1,050	$ 3,150		
3	Sperry Ave & Baldwin Rd	S02	S03	S21PB	0.15	0.15	0.6	10	10	10		$ 22,500.00	$ 2,250	$ 1,125	$ 3,375		
4	Sperry Ave & Walker Ranch Pkwy	S02	S03	S21PB	0.15	0.15	0.6	10	10	10		$ 18,500.00	$ 1,850	$ 925	$ 2,775		
5	Sperry Ave & American Eagle Ave	S02	S03	S21PB	0.15	0.15	0.6	10	10	10		$ 38,000.00	$ 3,800	$ 1,900	$ 5,700		
6	Sperry Ave & W Las Palmas Ave	S02	S03	S21PB	0.15	0.15	0.6	10	10	10		$ 23,300.00	$ 2,330	$ 1,165	$ 3,495		
7	Sperry Ave & Ward Ave	S02	S03	S21PB	0.15	0.15	0.6	10	10	10		$ 27,000.00	$ 2,700	$ 1,350	$ 4,050		
9	Sperry Ave & S Del Puerto Ave	S02	S03	S21PB	0.15	0.15	0.6	10	10	10		$ 21,500.00	$ 2,150	$ 1,075	$ 3,225		
10	E Las Palmas Ave & N Harley St	S02	S03	S21PB	0.15	0.15	0.6	10	10	10		$ 19,300.00	$ 1,930	$ 965	$ 2,895		
11	E Las Palmas Ave & N 1st St	S02	S03	S21PB	0.15	0.15	0.6	10	10	10		$ 32,500.00	$ 3,250	$ 1,625	$ 4,875		
12	W Las Palmas Ave & N 2nd St	S02	S03	S21PB	0.15	0.15	0.6	10	10	10		$ 18,600.00	$ 1,860	$ 930	$ 2,790		
13	W Las Palmas Ave & Ward Ave	S02	S03	S21PB	0.15	0.15	0.6	10	10	10		$ 22,000.00	$ 2,200	$ 1,100	$ 3,300		
14	Walnut Ave & N Hartley St	S02	S03	S21PB	0.15	0.15	0.6	10	10	10		$ 22,500.00	$ 2,250	$ 1,125	$ 3,375		
15	Walnut Ave & N 1st St	S02	S03	S21PB	0.15	0.15	0.6	10	10	10		$ 22,000.00	$ 2,200	$ 1,100	$ 3,300		
16	M St & N 2nd St	S02	S03	S21PB	0.15	0.15	0.6	10	10	10		$ 22,500.00	$ 2,250	$ 1,125	$ 3,375		
17	American Eagle Ave & Ward Ave	S02	S03	S21PB	0.15	0.15	0.6	10	10	10		$ 22,500.00	$ 2,250	$ 1,125	$ 3,375		
	Project 3: Unsignalized intersections: Install/upgrade larger or additional stop signs or other intersection warning/regulartory signs, Upgrade intersection pavement markings, Install Flashing Beacons at Stop-Controlled Intersections																
1	S 2nd St & S El Circulo		NS07			0.25			10			$ 1,520	$ 152	$ 76	$ 228		
2	Keystone Pacific Parkway & Park Cneter Drive	NS06	NS07	NS08	0.15	0.25	0.15	10	10	10		$ 21,280	$ 2,128	$ 1,064	$ 3,192		
3	Eucalyptus Ave & Highway 33	NS06	NS07	NS08	0.15	0.25	0.15	10	10	10		$ 10,650	$ 1,065	$ 533	$ 1,598		
4	Cornflower Ave & American Eagle Ave	NS06			0.15			10				$ 650	$ 65	$ 33	$ 98		
5	Eucalyptus Ave & Sycamore Ave	NS06	NS07	NS08	0.15	0.25	0.15	10	10	10		$ 23,050	$ 2,305	$ 1,153	$ 3,458		
	Project 4: Unsignalized Intersections: Convert Intersection to mini-roundabout (under City's review)																
1	Eucalyptus Ave & Sycamore Ave	NS05mr			0.3			20				$ 112,400	$ 11,240	$ 5,620	$ 16,860		
2	S 7th St & E St	NS05mr			0.3			20				$ 71,300	$ 7,130	$ 3,565	$ 10,695		
3	S 4th St & E St	NS05mr			0.3			20				$ 111,600	$ 11,160	$ 5,580	$ 16,740		
4	S 3rd St & E St	NS05mr			0.3			20				$ 112,100	$ 11,210	$ 5,605	$ 16,815		
	No Collisions found in the data																
	Project 5: Roadway Segments: Add Segment Lighting, Install bike lanes, Install/upgrade pedestrian crossing (with enhanced safety features)																
1	Las Palmas Ave: East City Limit to 2nd St		R32PB	R35	0.35	0.35	0.35	20	20	20		$ 72,620.00	$ 7,262	$ 3,631	$ 10,893		
2	Sperry Ave: Del Puerto Ave to Walker Ranch Parkway		R32PB	R35		0.35	0.35		20	20		$ 188,120.00	$ 18,812	$ 9,406	$ 28,218		
3	2nd St: North City Limit to 0.2 miles south of Walnut Ave	R01	R32PB	R35	0.35	0.35	0.35	20	20	20			$ -	$ -	$ -		
4	American Eagle Ave: Creekside Middle School to Fawn Lily Dr		R32PB		0.35	0.35	0.35	20	20	20		$ 65,288.00	$ 6,529	$ 3,264	$ 9,793		
5	Sperry Ave: West City Limit to Park Center Dr	R01	R32PB		0.35	0.35	0.35	20	20	20		$ 306,000.00	$ 30,600	$ 15,300	$ 45,900		
6	Baldwin Rd: Henley Pkway to Kohl's Driveway			R35			0.35			20		$ 50,000.00	$ 5,000	$ 2,500	$ 7,500		
	Project 6: Citywide Sign Upgrade																
1	Citywide Roadways	R22			0.15			10				$ 450,000	$ 45,000	$ 22,500	$ 67,500		

			Collisions (2016-2020)					Crash Costs						CM Annual Benefit	
Construction Engineering (CE) Cost	Cost Per Location	All Locations (Cost 2022)	Total #Collisions	Fatal	Severe Injury	Other Visible Injury	Compliant of Pain	Fatal	Severe Injury	Other Visible Injury	Compliant of Pain	Crash Costs	Total Crash Cost	CM1_Benefit (Annual)	CM2_Benefit (Annual)
$ 1,765	$ 17,058	$ 17,058	2	1	1	0	0	$ 1,787,000.00	$ 1,787,000.00	$ -	$ -	$ 3,574,000.00	$ 3,574,000.00	$ 71,480.00	$ 107,220.00
$ 3,375	$ 32,625	$ 545,490	5	0	0	0	5	$ -	$ -	$ -	$ 454,500.00	$ 454,500.00	$ 454,500.00	$ 13,635.00	$ 13,635.00
$ 3,150	$ 30,450		3	0	0	1	2	$ -	$ -	$ 159,900	$ 181,800.00	$ 341,700.00	$ 341,700.00	$ 10,251.00	$ 10,251.00
$ 3,375	$ 32,625		2	0	0	0	2	$ -	$ -	$ -	$ 181,800.00	$ 181,800.00	$ 181,800.00	$ 5,454.00	$ 5,454.00
$ 2,775	$ 26,825		1	0	0	0	1	$ -	$ -	$ -	$ 90,900.00	$ 90,900.00	$ 90,900.00	$ 2,727.00	$ 2,727.00
$ 5,700	$ 55,100		5	0	1	2	2	$ -	$ 1,787,000.00	$ 319,800	$ 181,800.00	$ 2,288,600.00	$ 2,288,600.00	$ 68,658.00	$ 68,658.00
$ 3,495	$ 33,785		2	0	1	0	1	$ -	$ 1,787,000.00	$ -	$ 90,900.00	$ 1,877,900.00	$ 1,877,900.00	$ 56,337.00	$ 56,337.00
$ 4,050	$ 39,150		1	0	0	0	1	$ -	$ -	$ -	$ 90,900.00	$ 90,900.00	$ 90,900.00	$ 2,727.00	$ 2,727.00
$ 3,225	$ 31,175		1	0	0	0	1	$ -	$ -	$ -	$ 90,900.00	$ 90,900.00	$ 90,900.00	$ 2,727.00	$ 2,727.00
$ 2,895	$ 27,985		4	0	2	1	1	$ -	$ 3,574,000.00	$ 159,900	$ 90,900.00	$ 3,824,800.00	$ 3,824,800.00	$ 114,744.00	$ 114,744.00
$ 4,875	$ 47,125		1	0	0	1	0	$ -	$ -	$ 159,900	$ -	$ 159,900.00	$ 159,900.00	$ 4,797.00	$ 4,797.00
$ 2,790	$ 26,970		1	0	0	0	1	$ -	$ -	$ -	$ 90,900.00	$ 90,900.00	$ 90,900.00	$ 2,727.00	$ 2,727.00
$ 3,300	$ 31,900		2	0	1	1	0	$ -	$ 1,787,000.00	$ 159,900	$ -	$ 1,946,900.00	$ 1,946,900.00	$ 58,407.00	$ 58,407.00
$ 3,375	$ 32,625		0	0	0	0	0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 3,300	$ 31,900		1	0	0	0	1	$ -	$ -	$ -	$ 90,900.00	$ 90,900.00	$ 90,900.00	$ 2,727.00	$ 2,727.00
$ 3,375	$ 32,625		0	0	0	0	0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 3,375	$ 32,625		1	0	0	0	1	$ -	$ -	$ -	$ 90,900.00	$ 90,900.00	$ 90,900.00	$ 2,727.00	$ 2,727.00
$ 228	$ 2,204	$ 82,868	3	0	1	1	1	$ -	$ 1,787,000.00	$ 159,900	$ 90,900.00	$ 2,037,800.00	$ 9,436,600.00	$ -	$ 101,890.00
$ 3,192	$ 30,856		2	1	0	1	0	$ 1,787,000.00	$ -	$ 159,900	$ -	$ 1,946,900.00		$ 58,407.00	$ 97,345.00
$ 1,598	$ 15,443		2	1	0	0	1	$ 1,787,000.00	$ -	$ -	$ 90,900.00	$ 1,877,900.00		$ 56,337.00	$ 93,895.00
$ 98	$ 943		1	0	1	0	0	$ -	$ 1,787,000.00	$ -	$ -	$ 1,787,000.00		$ 53,610.00	$ -
$ 3,458	$ 33,423		1	1	0	0	0	$ 1,787,000.00	$ -	$ -	$ -	$ 1,787,000.00		$ 53,610.00	$ 89,350.00
$ 16,860	$ 162,980	$ 590,730	1	1	0	0	0	$ 1,787,000.00	$ -	$ -	$ -	$ 1,787,000.00	$ 1,968,800.00	$ 107,220.00	$ -
$ 10,695	$ 103,385		0	0	0	0	0	$ -	$ -	$ -	$ -	$ -		$ -	$ -
$ 16,740	$ 161,820		2	0	0	0	2	$ -	$ -	$ -	$ 181,800.00	$ 181,800.00		$ 10,908.00	$ -
$ 16,815	$ 162,545		0	0	0	0	0	$ -	$ -	$ -	$ -	$ -		$ -	$ -
$ 10,893	$ 105,299	$ 988,941	3	1	0	1	1	$ 1,787,000.00	$ -	$ 159,900	$ 90,900.00	$ 2,037,800.00	$ 7,912,800.00	$ 142,646.00	$ 142,646.00
$ 28,218	$ 272,774		8	0	2	1	5	$ -	$ 3,574,000.00	$ 159,900	$ 454,500.00	$ 4,188,400.00		$ -	$ 293,188.00
$ -	$ -		5	0	0	2	3	$ -	$ -	$ 319,800	$ 272,700.00	$ 592,500.00		$ 41,475.00	$ 41,475.00
$ 9,793	$ 94,668		4	0	0	3	1	$ -	$ -	$ 479,700	$ 90,900.00	$ 570,600.00		$ 39,942.00	$ 39,942.00
$ 45,900	$ 443,700		2	0	0	1	1	$ -	$ -	$ 159,900	$ 90,900.00	$ 250,800.00		$ 17,556.00	$ 17,556.00
$ 7,500	$ 72,500		3	0	0	0	3	$ -	$ -	$ -	$ 272,700.00	$ 272,700.00		$ -	$ -
$ 67,500	$ 652,500	$ 652,500	143	6	12	45	80	$ 10,722,000.00	$ 21,444,000.00	$ 7,195,500	$ 7,272,000.00	$ 46,633,500.00	$ 46,633,500.00	$ 1,399,005.00	$ -

	CM Life Benefit			Benefit	Total Benefit		
CM3_Benefit (Annual)	CM1_Benefit (Life)	CM2_Benefit (Life)	CM3_Benefit (Life)	Benefit per Location (Life)	Total_Benefit (Life)		
$ 428,880.00	$ 714,800.00	$ 1,072,200.00	$ 4,288,800.00	$ 6,075,800.00	$ 6,075,800.00	Combined Benefit	$ 6,075,800.00
						Combined Cost	$ 17,057.80
						B/C	$ 356
$ 54,540.00	$ 136,350.00	$ 136,350.00	$ 545,400.00	$ 818,100.00	$ 818,100.00	Combined Benefit	$ 818,100.00
$ 41,004.00	$ 102,510.00	$ 102,510.00	$ 410,040.00	$ 615,060.00	$ 615,060.00	Combined Cost	$ 545,490.00
$ 21,816.00	$ 54,540.00	$ 54,540.00	$ 218,160.00	$ 327,240.00	$ 327,240.00	B/C	$ 1
$ 10,908.00	$ 27,270.00	$ 27,270.00	$ 109,080.00	$ 163,620.00	$ 163,620.00		
$ 274,632.00	$ 686,580.00	$ 686,580.00	$ 2,746,320.00	$ 4,119,480.00	$ 4,119,480.00		
$ 225,348.00	$ 563,370.00	$ 563,370.00	$ 2,253,480.00	$ 3,380,220.00	$ 3,380,220.00		
$ 10,908.00	$ 27,270.00	$ 27,270.00	$ 109,080.00	$ 163,620.00	$ 163,620.00		
$ 10,908.00	$ 27,270.00	$ 27,270.00	$ 109,080.00	$ 163,620.00	$ 163,620.00		
$ 458,976.00	$ 1,147,440.00	$ 1,147,440.00	$ 4,589,760.00	$ 6,884,640.00	$ 6,884,640.00		
$ 19,188.00	$ 47,970.00	$ 47,970.00	$ 191,880.00	$ 287,820.00	$ 287,820.00		
$ 10,908.00	$ 27,270.00	$ 27,270.00	$ 109,080.00	$ 163,620.00	$ 163,620.00		
$ 233,628.00	$ 584,070.00	$ 584,070.00	$ 2,336,280.00	$ 3,504,420.00	$ 3,504,420.00		
$ -	$ -	$ -	$ -	$ -	$ -		
$ 10,908.00	$ 27,270.00	$ 27,270.00	$ 109,080.00	$ 163,620.00	$ 163,620.00		
$ -	$ -	$ -	$ -	$ -	$ -		
$ 10,908.00	$ 27,270.00	$ 27,270.00	$ 109,080.00	$ 163,620.00	$ 163,620.00		
$ -	$ -	$ 1,018,900.00	$ -	$ 1,018,900.00		Combined Benefit	$ 7,727,980.00
$ 58,407.00	$ 584,070.00	$ 973,450.00	$ 584,070.00	$ 2,141,590.00		Combined Cost	$ 82,867.50
$ 56,337.00	$ 563,370.00	$ 938,950.00	$ 563,370.00	$ 2,065,690.00	$ 7,727,980.00	B/C	$ 93.26
$ -	$ 536,100.00	$ -	$ -	$ 536,100.00			
$ 53,610.00	$ 536,100.00	$ 893,500.00	$ 536,100.00	$ 1,965,700.00			
$ -	$ 2,144,400.00	$ -	$ -	$ 2,144,400.00		Combined Benefit	$ 2,362,560.00
$ -	$ -	$ -	$ -	$ -	$ 2,362,560.00	Combined Cost	$ 590,730
$ -	$ 218,160.00	$ -	$ -	$ 218,160.00		B/C	$ 4.0
$ -	$ -	$ -	$ -	$ -			
$ 142,646.00	$ 2,852,920.00	$ 2,852,920.00	$ 2,852,920.00	$ 8,558,760.00		Combined Benefit	$ 26,606,440.00
$ 293,188.00	$ -	$ 5,863,760.00	$ 5,863,760.00	$ 11,727,520.00		Combined Cost	$ 988,941
$ 41,475.00	$ 829,500.00	$ 829,500.00	$ 829,500.00	$ 2,488,500.00	$ 26,606,440.00	B/C	$ 26.9
$ 39,942.00	$ 798,840.00	$ 798,840.00	$ 798,840.00	$ 2,396,520.00			
$ 17,556.00	$ 351,120.00	$ 351,120.00	$ 351,120.00	$ 1,053,360.00			
$ 19,089.00	$ -	$ -	$ 381,780.00	$ 381,780.00			
$ -	$ 13,990,050.00	$ -	$ -	$ 13,990,050.00	$ 13,990,050.00	Combined Benefit	$ 13,990,050.00
						Combined Cost	$ 652,500
						B/C	$ 21.4