CITY OF IRVINE

Local Roadway Safety Plan

DEPARTMENT OF PUBLIC WORKS AND TRANSPORTATION

PREPARED BY

FEHR PEERS

MAY 2022
DRAFT

ATTACHMENT 1

STATEMENT OF PROTECTION OF DATA FROM DISCOVERY AND ADMISSIONS

SECTION 148 OF TITLE 23, UNITED STATES CODE

REPORTS DISCOVERY AND ADMISSION INTO EVIDENCE OF CERTAIN REPORTS, SURVEYS, AND INFORMATION — Notwithstanding any other provisions of law, reports, surveys, schedules, lists, or data compiled or collected for any purpose relating to this section, shall not be subject to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at the location identified or addressed in the reports, surveys, schedules, lists, or other data.

This study applies a systemic safety approach that identifies certain features on particular roadways that are correlated with specific collision types and frequencies. This broad approach is necessitated by the inherent nature of covering an entire agency's facilities in one study and the limited scope/budget available to prepare LRSPs. Limited time is available to perform field observations throughout the study area to contextualize the data, and therefore, it is beyond the scope of work to perform in-depth "hot spot" evaluations at all locations.

Local Roadway Safety Plans are a Caltrans requirement for jurisdictions to be eligible for Highway Safety Improvement Program (HSIP) grant funding. The recommended countermeasures included in this LRSP were developed based on outcomes from a collision history analysis and present a "menu" of options for consideration. Each "Hot Spot" location may consider one, two, or a combination of improvements, all of which will require further analysis for consideration. The proposed countermeasures do not commit the City to employ them, but provide a number of options to further analyze for implementation.

The City of Irvine (City) Local Roadway Safety Plan was funded through a Local Roadway Safety Plan (LRSP) grant provided by the California Department of Transportation (Caltrans). Fehr & Peers assisted the City of Irvine in preparing the LRSP.

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PROJECT DEVELOPMENT TEAM

Cheryl Lea, Project Manager
Transportation Planning and Project Development

Jaimee Bourgeois
Interim Director of Public Works and Transportation

Melissa Dugan
Transportation Planning and Project Development

Eduardo Lopez
Neighborhood Traffic Engineering

Melissa Lutt
Traffic Management Center

FEHR & PEERS CONSULTANT TEAM

Matt Benjamin, RSP
Emily Finkel, RSP
Claude Strayer, PE
Natalie Chyba, EIT
Alex Melaragno, EIT
Sean Reseigh
Melody Wu

Glossary

AB Assembly Bill

ADT Average Daily Traffic

AHSC Affordable Housing and Sustainable Communities

ATP Active Transportation Program or Plan

BCIP Bicycle Corridor Improvement Program

BUILD Better Utilizing Investments to Leverage Development

CA MUTCD California Manual on Uniform Traffic Control Devices

CIP Capital Improvement Plan

CPUC California Public Utilities Commission

CRF Crash Reduction Factor

DUI Driving Under the Influence

FHWA Federal Highway Administration

HPS High Pressure Sodium Lamps

HSIP Highway Safety Improvement Program

ISATP International Symposium on Assembly and Task Planning

ITE Institute of Transportation Engineers

ITS Intelligent Transportation Systems

KSI Killed or Severely Injured

LED Light-emitting Diode

LPI Leading Pedestrian Interval

LPP Local Partnership Program

LRSM Local Roadway Safety Manual

LRSP Local Roadway Safety Plan

OCTA Orange County Transportation Authority

OTS Office of Traffic Safety

PCF Primary Collision Factor

RAISE Rebuilding American Infrastructure with Sustainability and Equity

ROW Right of Way

RRFB Rectangular Rapid Flashing Beacon

SB Senate Bill

SCAG Southern California Association of Governments

SCCP Solution for Congested Corridors Program

SCS Sustainable Communities Strategy

SGC Strategic Growth Council

STIP State Transportation Improvement Program

TCC Transportation Climate Communities

TIGER Transportation Investment Generating Economic Recovery

TNC Transportation Network Company

USDOT United States Department of Transportation

Table of Contents

CHAPTER 1

Introduction

The City of Irvine (City) is committed to advancing transportation safety on its streets. This Local Roadway Safety Plan (LRSP) builds upon existing and ongoing City safety efforts by proactively identifying and evaluating hot spots and systemic risk factors throughout the City. The LRSP identifies proven countermeasures that can be implemented through roadway design changes, as well as key programs and partnerships with safety stakeholders. This LRSP applies the Federal Highway Administration's (FHWA) Safe System approach, an international best practice framework that provides the foundation for this LRSP.

Caltrans Local Roadway Safety Plan Background

A Local Roadway Safety Plan is a means for providing the City an opportunity to address unique roadway safety needs while contributing to the success of the California Strategic Highway Safety Plan and statewide safety goals. The process of preparing an LRSP creates a framework to systemically identify and analyze safety problems and recommend improvements in coordination with local agency partners and stakeholders.

The LRSP offers a proactive approach to addressing safety needs and demonstrates the City's responsiveness to safety challenges. Cycle 11 of the Highway Safety Improvement Program (HSIP) in 2022 will require an LRSP for an agency to be eligible to apply for funds. For more information on Caltrans' LRSP approach, please refer to their website.

FHWA's Safe System Approach

Crashes can irreversibly change the course of human lives, touching victims, their families and loved ones, and society as a whole. Through collective action on the part of all roadway system stakeholders—from system operators and vehicle manufacturers, to law enforcement and everyday users—we can move to a Safe System approach that anticipates human mistakes, with the goal of reducing fatal and serious injuries for all road users.

The **Institute of Transportation Engineers (ITE)** and the **Road to Zero Coalition's Safe Systems Explanation and Framework** articulate that a Safe System seeks to anticipate human mistakes by:

- Separate users in a physical space (e.g., sidewalks, dedicated bicycle facilities)
- Separate users in time (e.g., pedestrian scramble, dedicated turn phases)
- Alert users to potential hazards
- Accommodate human injury tolerance through interventions that reduce speed or impact force

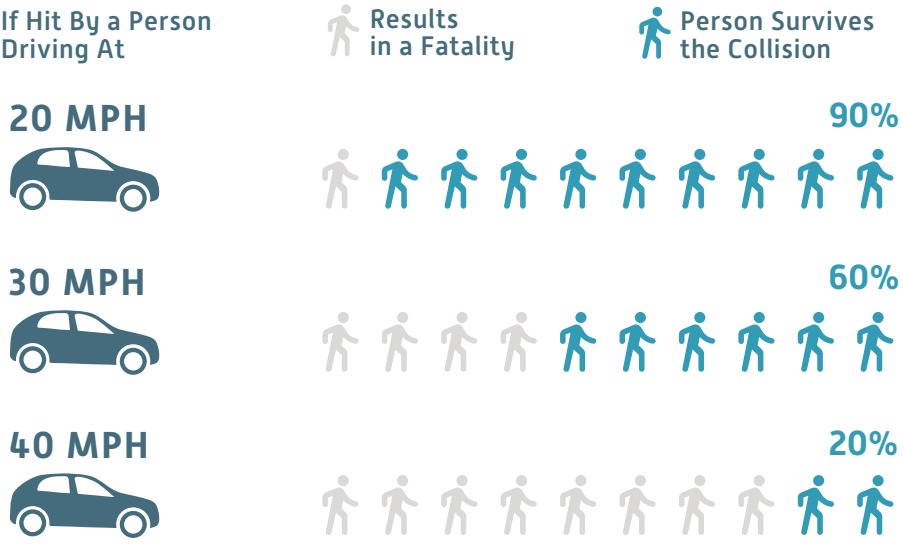
For more information on FHWA's Safe System Approach, please refer to their website. Caltrans has also adopted the Safe System Approach.

The Safe System Approach

The Safe System approach addresses the five elements of a safe transportation system—safe road users, safe vehicles, safe speeds, safe roads, and post-crash care—in an integrated manner, through a wide range of interventions.

Source: Fehr & Peers for FHWA

The Importance of Addressing Speed in a Safe System



Source: ITE Safe System Framework

City of Irvine LRSP Vision & Goals

The City of Irvine is advancing transportation safety for all who share our streets by reducing the number of fatal and severe injury collisions on City roadways.

Prioritize infrastructure and programmatic investments that address the City's most frequent and severe collision profiles.

Educate road users on the role they play in creating safer streets.

Support the mobility of the City's most vulnerable road users by reducing the number of collisions involving pedestrians, bicyclists, and children.

Establish safe and context-appropriate speeds on all City roadways.

CHAPTER 2

Safety Partners

The City sought insight from its safety and mobility partners on collision trends and perception of safety on City streets. The partners shared valuable input that helped shape both the findings and recommended countermeasures included in this LRSP.

The development of the LRSP involved three engagement meetings. These meetings brought together representatives from agencies and organizations throughout the City and County to discuss and share feedback on the vision for the LRSP, data analysis outcomes, and countermeasures.

September 2021

Internal City departments and external transportation agency partners (i.e., OCTA, Caltrans) met to discuss the vision of the LRSP and outcomes from the collision and contextual analyses.

October 2021

Community stakeholders met to discuss the outcomes from the collision and contextual analysis and provide insight on perception of safety.

March 2022

Internal City departments and external transportation agency partners met to discuss the final recommended countermeasures and next steps toward implementation.

For continued success of the LRSP and the implementation of recommended countermeasures herein, engagement with these groups should be ongoing.

Community Stakeholder Polling Exercise

At the October 2021 meeting, community stakeholders were asked a series of questions about their communities' experience traveling in the City.

The next page highlights key takeaways from that polling exercise. →

MY INITIAL PRIORITIES FOR IMPROVING SAFETY...

1. Near schools, childcare facilities and extracurricular organizations
2. At crosswalks and intersections
3. On major streets
4. On residential/local streets
5. Near parks, community centers, sports fields, and trail heads
6. Near businesses, restaurants, and shops

FAVORITE STREETS?

Alton Parkway
Barranca Parkway
Campus Drive
Harvard Avenue
Irvine Boulevard
Jeffrey Road
Ridge Valley
University Drive
Westport
Yale Loop

WHAT ARE THE BIGGEST SAFETY CONCERNS THAT YOU, YOUR COMMUNITY, AND YOUR CONSTITUENTS HAVE WHEN TRAVELING IN THE CITY OF IRVINE?

● # OF RESPONSES

Unsafe speeds ●●●●●●

RESPONSES INCLUDE:

- Unsafe speeds, especially as a pedestrian or bicyclist
- Inexperienced drivers near Irvine Valley College (IVC) campus
- Pedestrian safety at intersections due to unsafe speeds and red-light running

Distracted driver ●●●
Crossing at crosswalks as a pedestrian ●●
Distracted parents near schools ●●
Red light running ●●
Bike/vehicle conflicts ●
Not enough left-turn pocket storage ●
Auto violations of traffic signals and signs ●
Right-turning autos ●
Cars hitting kids on bikes ●

SAFETY PARTNERS

- Bicycle Club of Irvine
- Caltrans District 12
- City of Irvine Department of Public Works & Transportation
- City of Irvine Transportation Commission
- Concordia University
- FivePoint Communities
- Irvine Company
- Irvine Public Safety Department
- Irvine Unified School District
- Irvine Valley College
- Orange County Fire Authority
- Orange County Healthcare Agency
- Orange County Transportation Authority
- Spectrumotion
- University of California, Irvine

CHAPTER 3

Existing Safety Efforts

The City is continually making investments in roadway safety through project and program implementation and adoption of planning documents that identify transportation safety priorities and future projects.

PILOTING NEW COUNTERMEASURES

The City Public Works & Transportation staff are consistently monitoring emerging trends in roadway and signal design to stay on the cutting edge of industry best practices. The City is currently exploring the efficacy of high-friction surface treatments and green paint at auto/bicycle conflict zones throughout the City. More information on these countermeasures and their efficacy are provided in Chapter 7, Countermeasure Toolbox.

Grant-Funded Projects

In 2020, the City submitted a successful application to the Cycle 10 Highway Safety Improvement Program (HSIP). This awarded funding will fund pedestrian crossing enhancements with Rectangular Rapid Flashing Beacons (RRFBs) at the following seven locations across the City:

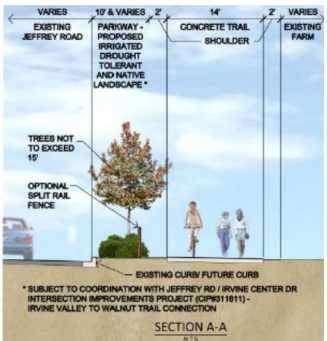
- **Venta Spur Trail & Amargosa**
- **Arborwood & Canyon View Elementary**
- **San Carlo & San Marino**
- **San Diego Creek Trail & Creek Road**
- **Dove Creek & Foxchase**
- **Shady Canyon Drive & Quail Hill (2 locations)**

SNAPSHOT

Recent Safety Efforts in the City

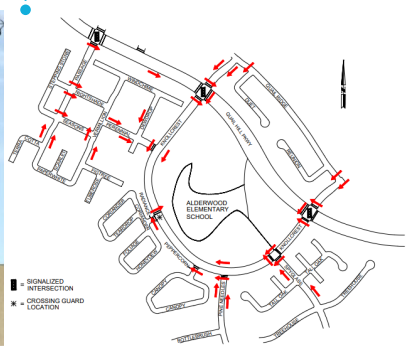
Jeffrey Open Space Trail

Expected Completion:
Trail: Spring 2024
Bridge: Fall 2024



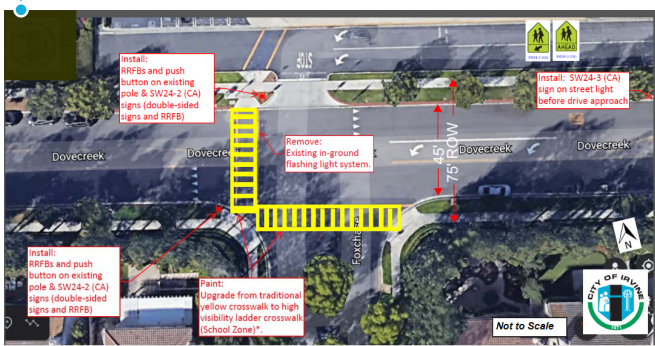
Suggested Routes to School Program

Releases route maps annually for 30+ elementary and K-8 schools throughout the city.



Successful HSIP Application

for Rectangular Rapid Flashing Beacons (RRFBs) at 7 locations



Transportation safety-related goals, policies, projects, and recommendations included in City planning documents are summarized here by the Safe System elements. Planning documents reviewed include:

- Irvine General Plan Circulation Element (2015)
- Irvine Strategic Active Transportation Plan (2021)
- Irvine Station First/Last Mile Strategic Plan (2020)
- City of Irvine Standard Plans

Safe Roads

ONGOING PROJECTS

The City maintains an interactive Capital Improvements Project Viewer where current capital improvements projects are mapped and documented. The improvements listed below were pulled from this resource in Winter 2021.

- **Vehicle and bicycle detection signal modifications** at the Culver Drive/Warner Avenue, Harvard Avenue/San Juan, and Main Street/MacArthur Boulevard intersections
  ESTIMATED COMPLETION DATE: DECEMBER 2021
- **Jeffrey Open Space Trail enhancements** including an extension of the Trail from Walnut Avenue to Barranca Parkway and a bicycle/pedestrian bridge over I-5 to connect gaps in the Jeffrey Open Space Trail.
  ESTIMATED COMPLETION DATE: SPRING 2024
- **Peters Canyon Trail Lighting Project** is under construction as of Summer 2021.
  COMPLETION DATE: WINTER 2021
- **Pedestrian infrastructure upgrades** including sidewalk improvements in the Irvine Business Complex, American with Disabilities Act (ADA) compliant access ramps on Barranca Parkway, and sidewalk and ramp improvements at the Jamboree/Barranca intersection.
  COMPLETION DATE: MARCH 2022
- **Paseo Westpark / San Remo Traffic Signal Modification:** Traffic signal modification adding a protected left-turn phase for northbound and southbound approaches to improve traffic flow, pedestrian flow, and traffic safety.
  ESTIMATED COMPLETION DATE: CURRENTLY IN DESIGN, CONSTRUCTION TO BE COMPLETED BY WINTER 2022
- **Trabuco Road / Remington Traffic Signal:** New traffic signal at the intersection to improve traffic and pedestrian flow, mobility and safety.
  ESTIMATED COMPLETION DATE: CURRENTLY IN DESIGN, CONSTRUCTION TO BE COMPLETED BY WINTER 2022

SAFETY SYSTEM ELEMENTS

The Safe System approach is built on five core elements and aims to eliminate fatal & serious injuries for all road users. For more information on the Safe System approach, check out FHWA's **factsheet**.

The Safe Roads Element includes the physical design of roadways, including the separation of users in time and space, and whether designs are accommodating to human mistakes and injury tolerance levels.

The Safe Speeds Element fine-tunes the idea of Safe Roads into infrastructure and policy changes that specifically target speed as a major factor in collisions and collision severity.

The Safe Road Users Element addresses safety from the behavioral perspective and focuses on education, engagement, and enforcement.

The Post-Crash Care Element focuses on addressing collision response, including emergency medical care response time, crash reporting and investigation, traffic incident management, and the justice system.

The Safe Vehicles Element calls for vehicles to be designed and regulated to minimize the occurrence and severity of collisions using safety measures that incorporate the latest technology.

CITYWIDE PLANS, POLICIES, AND GUIDELINES

- **Irvine General Plan Circulation Element (2015)** emphasizes roadway safety in its Roadway Design (B-2), Pedestrian Circulation (B-3), and Bicycle Circulation (B-4) objectives. The Circulation Element is available online.
- **Irvine Strategic Active Transportation Plan (ISATP, 2021)** guides development of existing and future pedestrian and bicycle facilities. The plan sets an existing conditions baseline for active transportation in the City through pedestrian and bicycle counts, collision analysis, traffic stress, comfort, and suitability analysis, existing infrastructure, and non-infrastructure programs. The ISATP presents a set of design guidelines for active transportation infrastructure. Tailored recommendations in the plan include:
  - **Active transportation toolbox** with bicycle, pedestrian, and operation improvement elements
  - **Network recommendations** including shared-use paths, bicycle facilities, and grade separation
  - **Corridor concept plans** with pedestrian and bicycle improvements for four corridors including North Yale Avenue, Yale Loop, Sunnyhill, South Yale Avenue and three intersections including Culver Drive and Walnut Avenue, Jeffrey Road and I-405, and the Sand Canyon Interchange.
  - **Local focus spot treatments** for pedestrian and bicycle improvements at 34 locations

  The ISATP also features an implementation plan with recommendations for project prioritization, phasing, cost estimates, funding opportunities, and performance measures. The ISATP is available online.
- **Irvine Station First/Last Mile Strategic Plan (2020)** funded and led by Southern California Association of Governments (SCAG) and guides improvements to pedestrian, bicycle, and transit access to the Irvine Amtrak/Metrolink Station. The plan establishes four goals for near- and long-term mobility improvements around the stations: 1) Prioritize improvements; 2) Plan for better connections; 3) Foster comfortable transportation; and 4) Encourage sustainability.

Safe Speeds

ONGOING PROJECTS

In 2020, the Irvine City Council approved an ordinance that updated posted speed limits on several City roadways. This ordinance reduced the speed limit on some roadways, including Business Center Drive, Newport Coast Drive, Park Place, Ridge Valley, Townsend, Tulip, East Yale Loop, and Campus Drive, and increased the speed limits on several other roads.

Safe Road Users

ONGOING PROGRAMS

The City currently operates various education and encouragement programs in alignment with the Safe Road Users Element:

- **Suggested Routes to School**, operated by the Irvine Public Safety Department, provides maps for the safest routes to each elementary and K-8 school with special notes and consideration for parents. More information on the program is available on the City's website.

- Various **workshops** are operated through the Public Safety Department and Neighborhood Traffic Engineering Division and engage parents and students on traffic and safety issues around schools.
- **Educational classes** operated by the City include the Traffic S.T.A.R.S Program, focused on elementary school students, as well as an online bicycle safety video.
- **Public messaging campaigns**, like the “Irvine Shares the Way” and “Move with Care” campaigns, include signage at bus shelters and on social media to educate on the proper rules of the road.
- **Bicycle and Pedestrian Safety Diversion Program** allows people aged 18 and under who receive bicycle or pedestrian citations to attend an education class instead of paying a fine or appearing in court.
- **Area Traffic Officer Program** appoints officers with strong community relations to address hyper-local traffic complaints with approaches tailored to the community’s needs.

CITYWIDE PLANS, POLICIES, AND GUIDELINES

- **Irvine General Plan Circulation Element (2015)** Policy J under the Bicycle Circulation Objective (B-4) calls to "Support programs to increase public awareness of bicycle safety and bicycling as an alternative mode of transportation.” The Circulation Element is available online.

Post-Crash Care

ONGOING PROGRAMS

The City Public Safety Department has a **Major Accident Investigation Team (MAIT)**, which investigates the causes of traffic collisions that result in severe injuries or collisions. Investigation of these severe collisions is an important piece of data gathering for improving roadway safety in the City.

CITYWIDE PLANS, POLICIES, AND GUIDELINES

- **City of Irvine Standard Plans** currently feature design guidelines for emergency vehicle median turn-arounds to allow for more rapid response to incidents.

Safe Vehicles

In 2019, an **autonomous vehicle (AV) ride-sharing pilot** began in the City. The pilot is known as BotRide and is operated by Hyundai using Pony.ai technology. This pilot operated in a specified zone near John Wayne Airport and the University of California, Irvine, presenting a glimpse into the potential future of Safe Vehicles in the City. Emerging vehicle technology, such as AVs, presents the opportunity to reduce the potential safety impacts of human error.

CHAPTER 4

Safety Analysis

This section summarizes the results of a broad collision analysis for the City, which informed the recommended emphasis areas and countermeasures identified for the City.

This analysis considers reported injury collisions on local roadways between 2015 and 2019, acquired from the Transportation Injury Mapping System (TIMS). To better understand systemic collision patterns in the City, several contextual factors were analyzed in conjunction with collision characteristics. Key contextual factors include:

- Roadway type and number of lanes
- Signalized & unsignalized intersections and midblock locations
- Proximity to schools, parks, civic centers, and bus stops
- Roadway speed

Appendix A of this report includes more details on the systemic analysis.

Key Takeaways

The share of pedestrians and cyclists in KSI collisions is almost 2x their share in all injury collisions.

Nearly 40% of bicyclist collisions are "right hook," involving a right-turning driver.

Unsafe speed is the top primary violation for all collisions, cited as the primary collision factor in 30% of all injury collisions.

Major 8-lane and 6-lane roadways make up just 9% of the total roadway miles in the City but over 50% of the total injury collisions.

About two-thirds of all pedestrian collisions and pedestrian KSI collisions involve a pedestrian crossing in a crosswalk at an intersection.

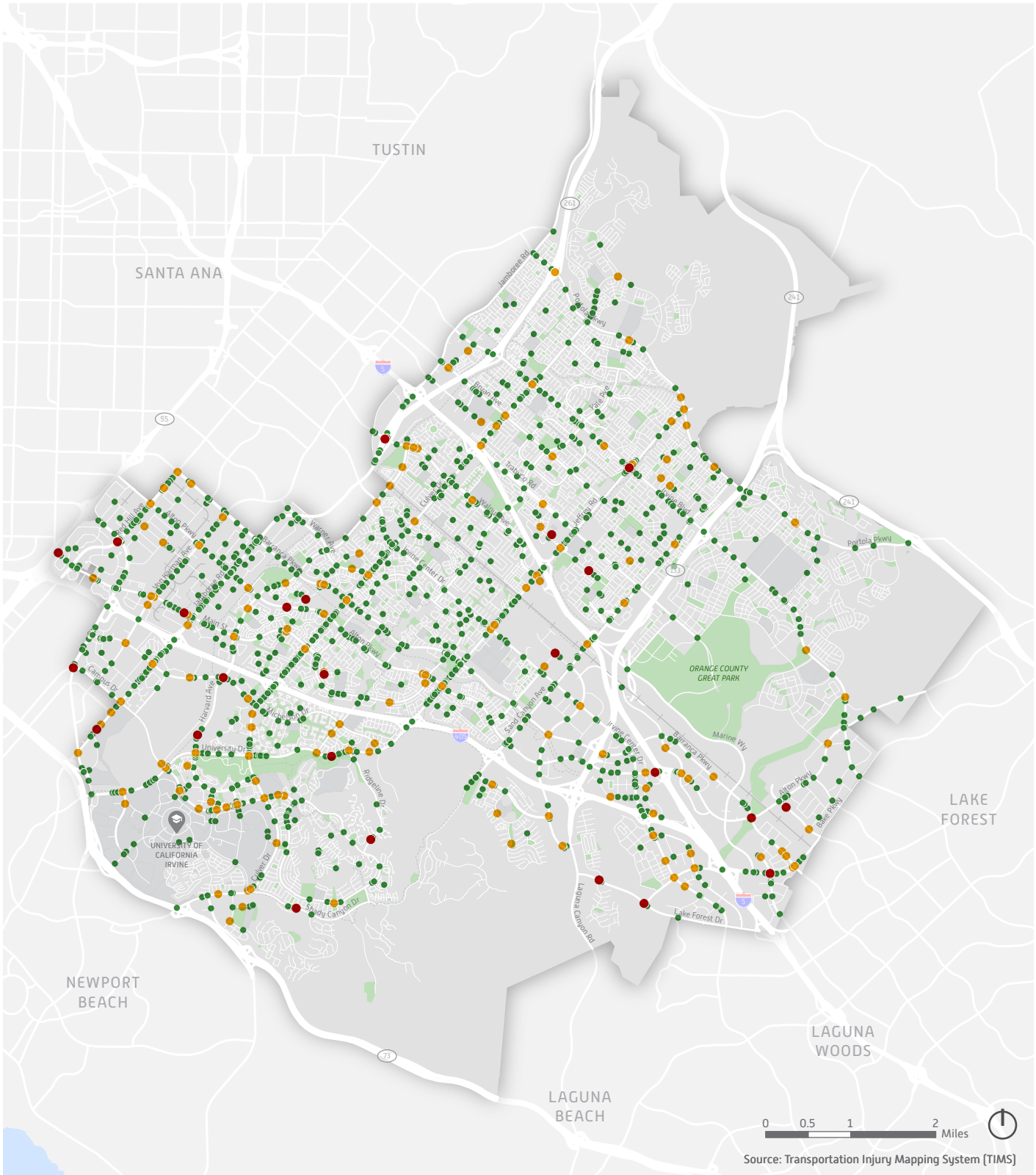
Roadway users 19 years old or younger are disproportionately involved in collisions compared to their share of the City's population.

KILLED OR SEVERELY INJURED (KSI)

Severe injuries resulting from a traffic collision can result in a number of catastrophic impacts, including permanent disability, lost productivity and wages, and ongoing healthcare costs. These injuries can include:

- Broken or fractured bones
- Dislocated or distorted limbs
- Severe lacerations
- Severe burns
- Skull, spinal, chest or abdominal injuries
- Unconsciousness at or when taken from the collision scene

Throughout this plan, the acronym KSI is used to denote collisions where someone was killed or severely injured.



CITY OF IRVINE

All Injury Locations

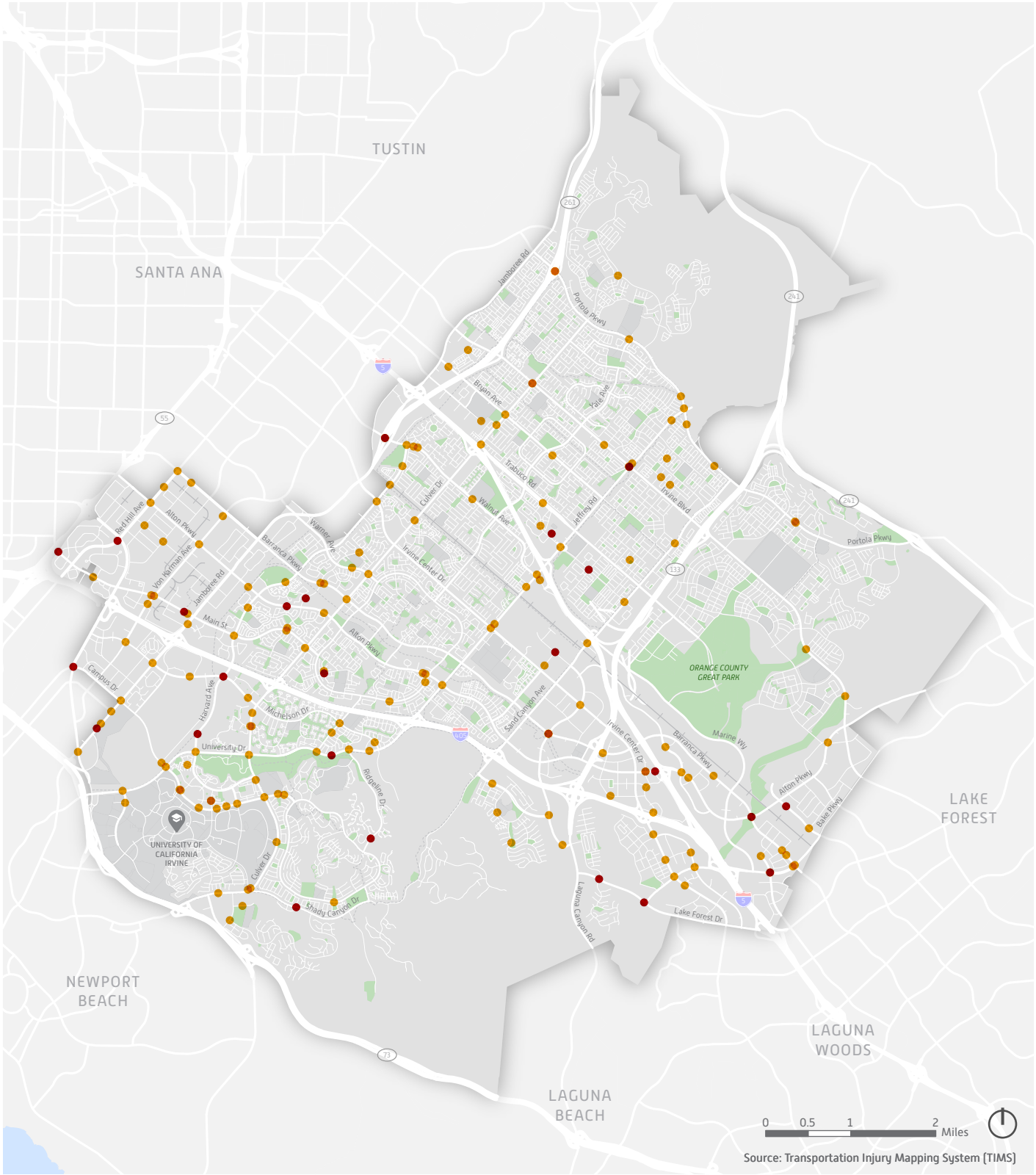
2015-2019

ALL INJURY COLLISIONS

- Fatal
- Severe Injury
- Other Injury

Parks

Schools



CITY OF IRVINE

KSI Collision Locations

2015-2019

KSI COLLISIONS

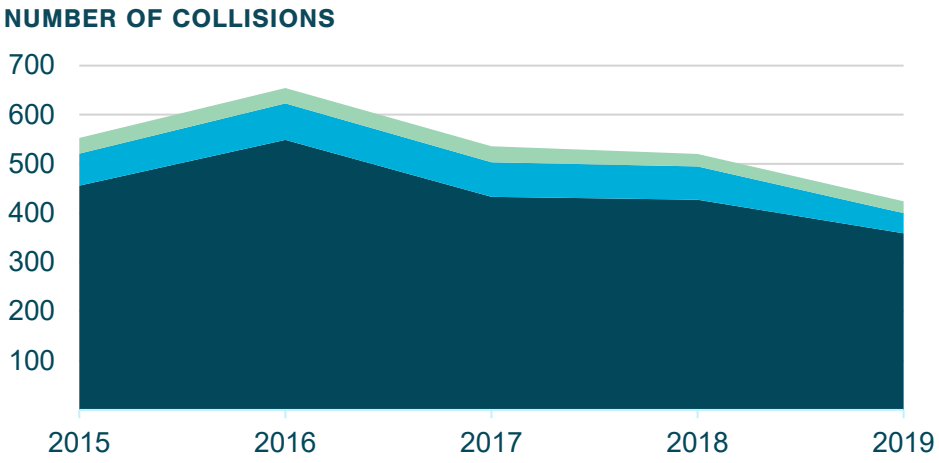
- Fatal
- Severe Injury

Parks Schools

All Collisions by Year

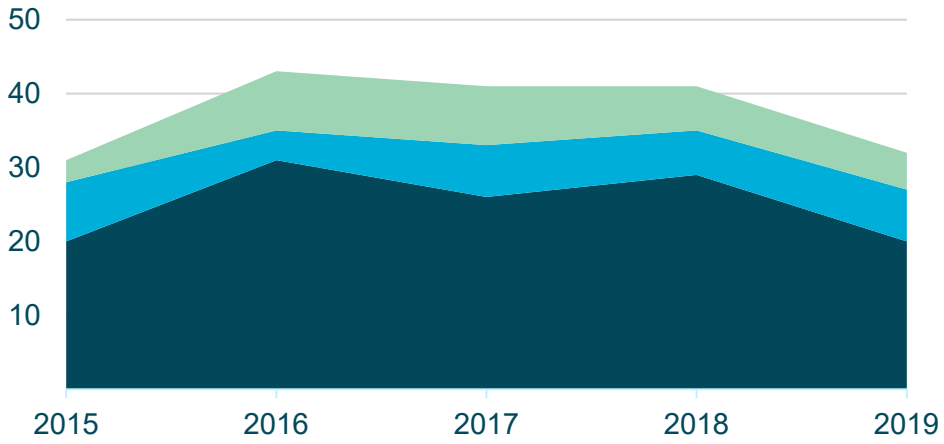
Between 2015 and 2019, **2,681** collisions occurred on local roadways in the City.

The total number of collisions per year has been on a decline since 2016.



KSI Collisions by Year

Over the 5-year period, there were **186** collisions where victims were killed or severely injured (KSI). **24** of these collisions were fatal.

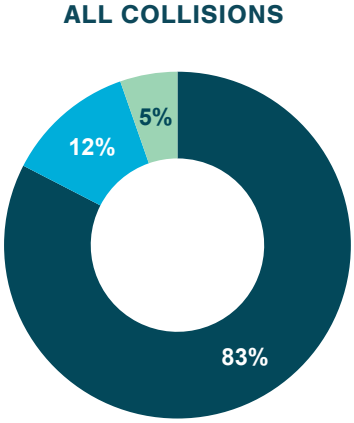


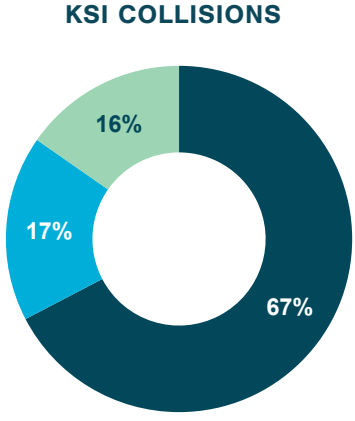
Collisions by Mode

Pedestrians and bicyclists make up a disproportionate share of KSI collisions compared to all collisions.

The share of pedestrians and cyclists in KSI collisions is almost **2x** their share in all injury collisions.

The share of pedestrians in KSI collisions is over **3x** their share in all injury collisions.

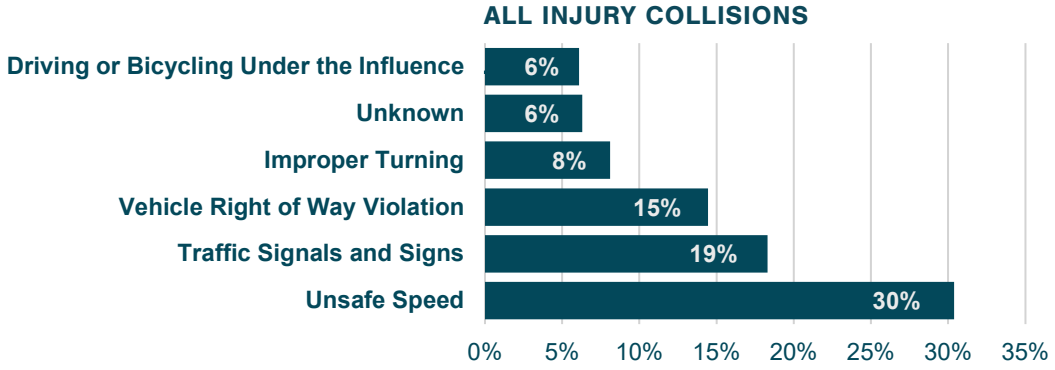


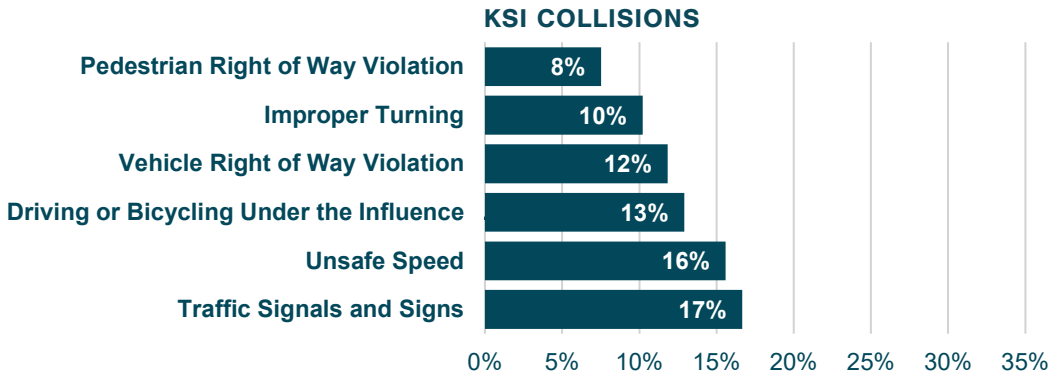


Primary Collision Factor (PCF)

Unsafe speed and **traffic signals and signs** violations accounted for the most collisions and most KSI collisions among all primary collision factors.

The **vehicle right of way violation** covers a party of any mode not yielding to the driver's right of way or the driver observing their right of way improperly, depending on which party is listed at fault.

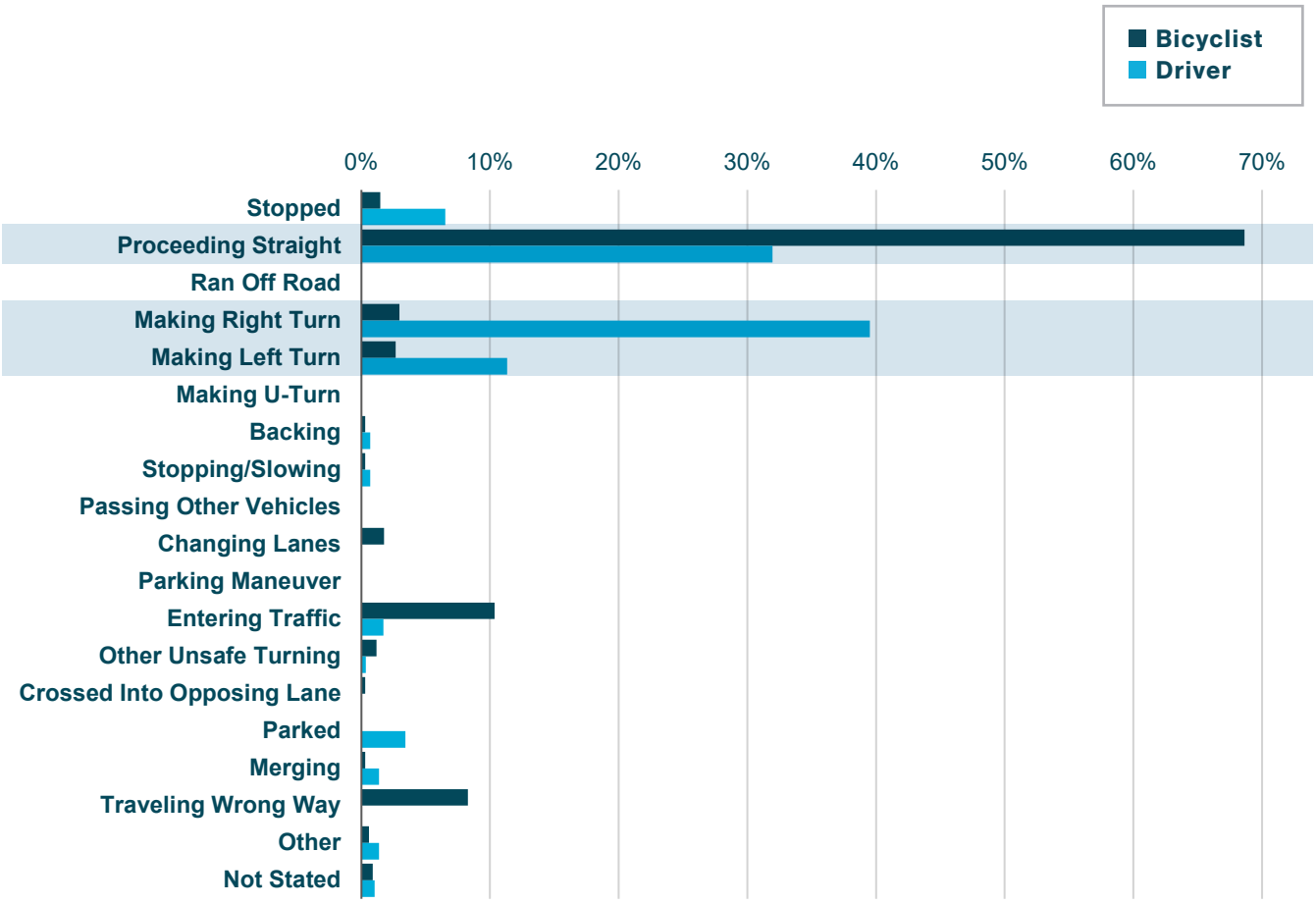




Action Before Bike Collisions

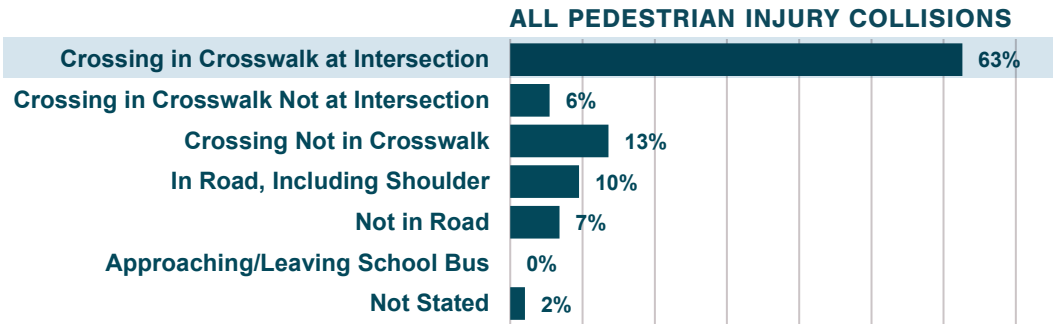
More than half of bicyclist collisions **involved a turning driver.**

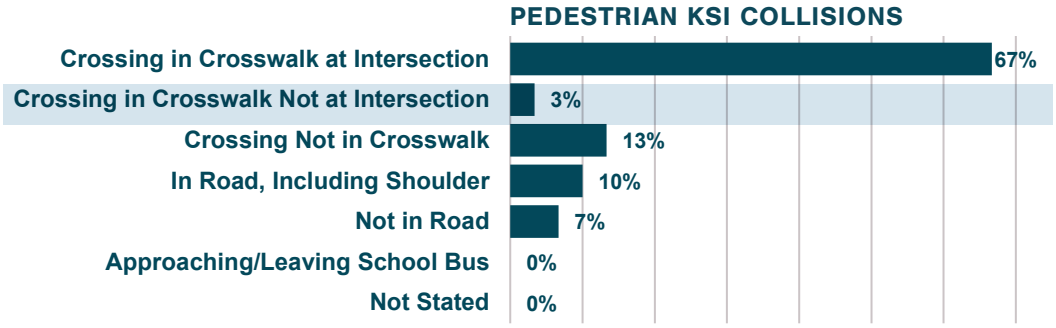
Nearly 40% of bicyclist collisions are **"right hook,"** involving a right-turning driver.



Pedestrian Action

About two-thirds of pedestrian collisions and pedestrian KSI collisions involved a pedestrian **crossing in a crosswalk at an intersection**.

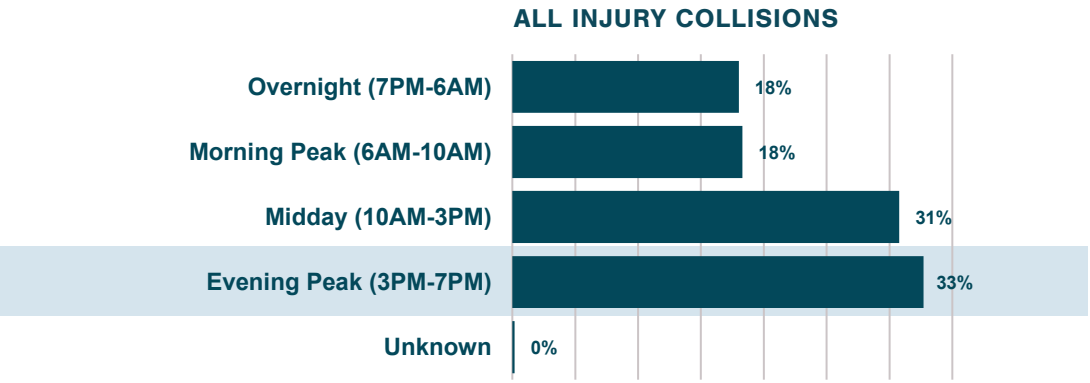


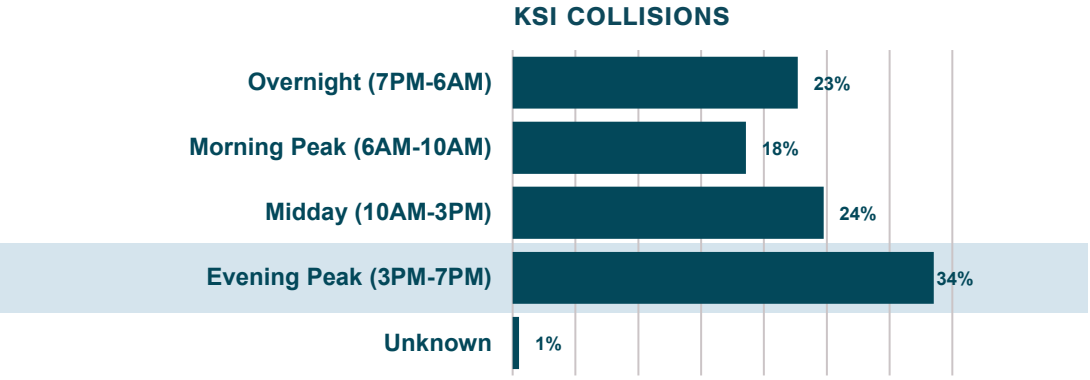


Time of Day

The most common time of day for a collision or KSI collision to occur was the **evening peak hours** of 3pm to 7pm.

The share of collisions occurring **overnight,** from 7pm to 6 am, is higher among KSI collisions than all collisions.



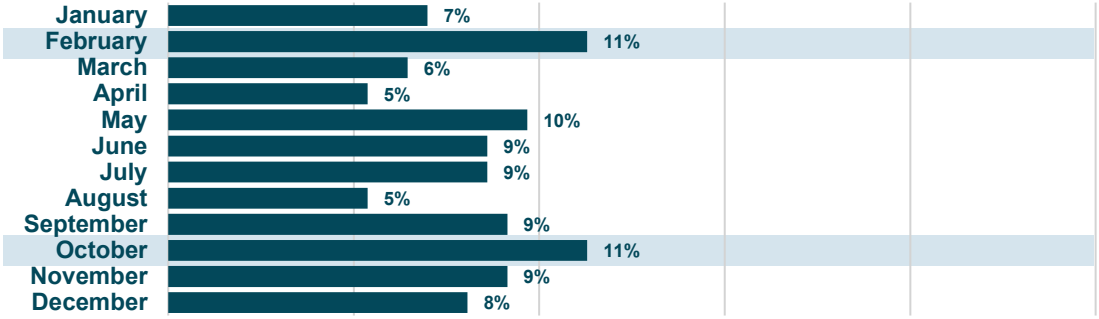


Time of Year

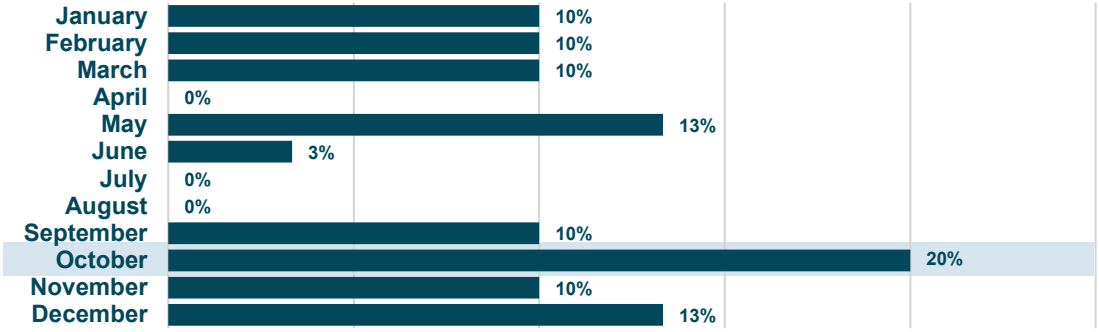
The rate of KSI collisions varies widely throughout the year, with February and October representing the highest share of collisions.

Pedestrian KSI collisions are disproportionately high in the month of **October**. **One-fifth** of all collisions occur during this month. Several factors may contribute to this, including the start of the new school year and less daylight approaching daylight savings.

ALL KSI COLLISIONS



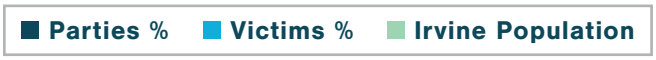
PEDESTRIAN KSI COLLISIONS



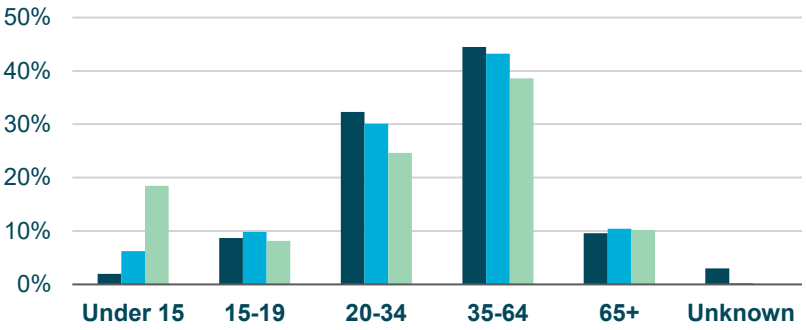
Collisions by Age

Road users who are **19 years** of age or **younger** have a disproportionately high rate of involvement in collisions in the City.

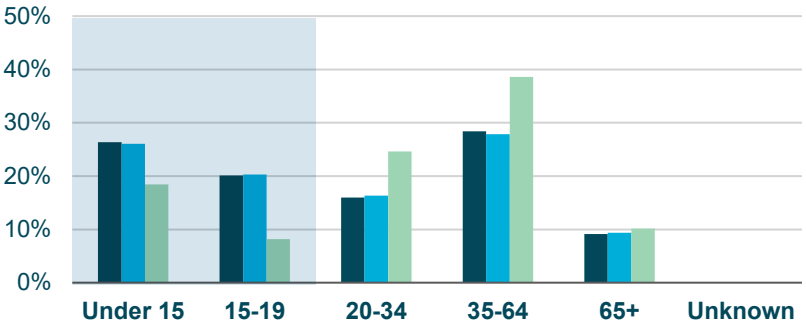
The share of collisions involving these younger users is **higher** than their share of the City's population.



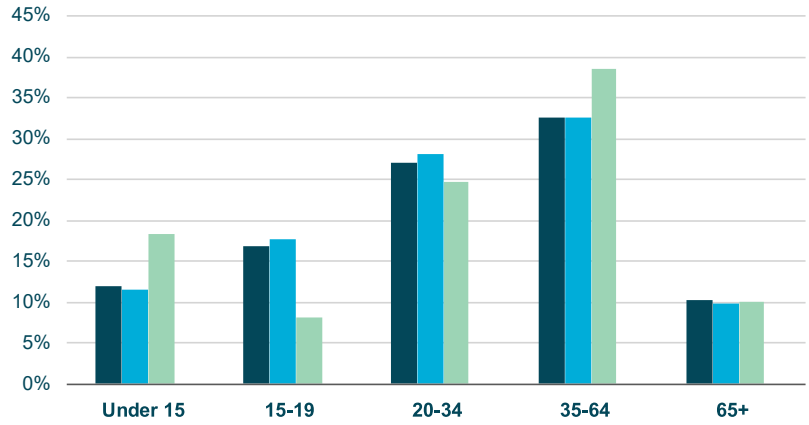
ALL INJURY COLLISIONS



ALL BICYCLE COLLISIONS



ALL PEDESTRIAN COLLISIONS

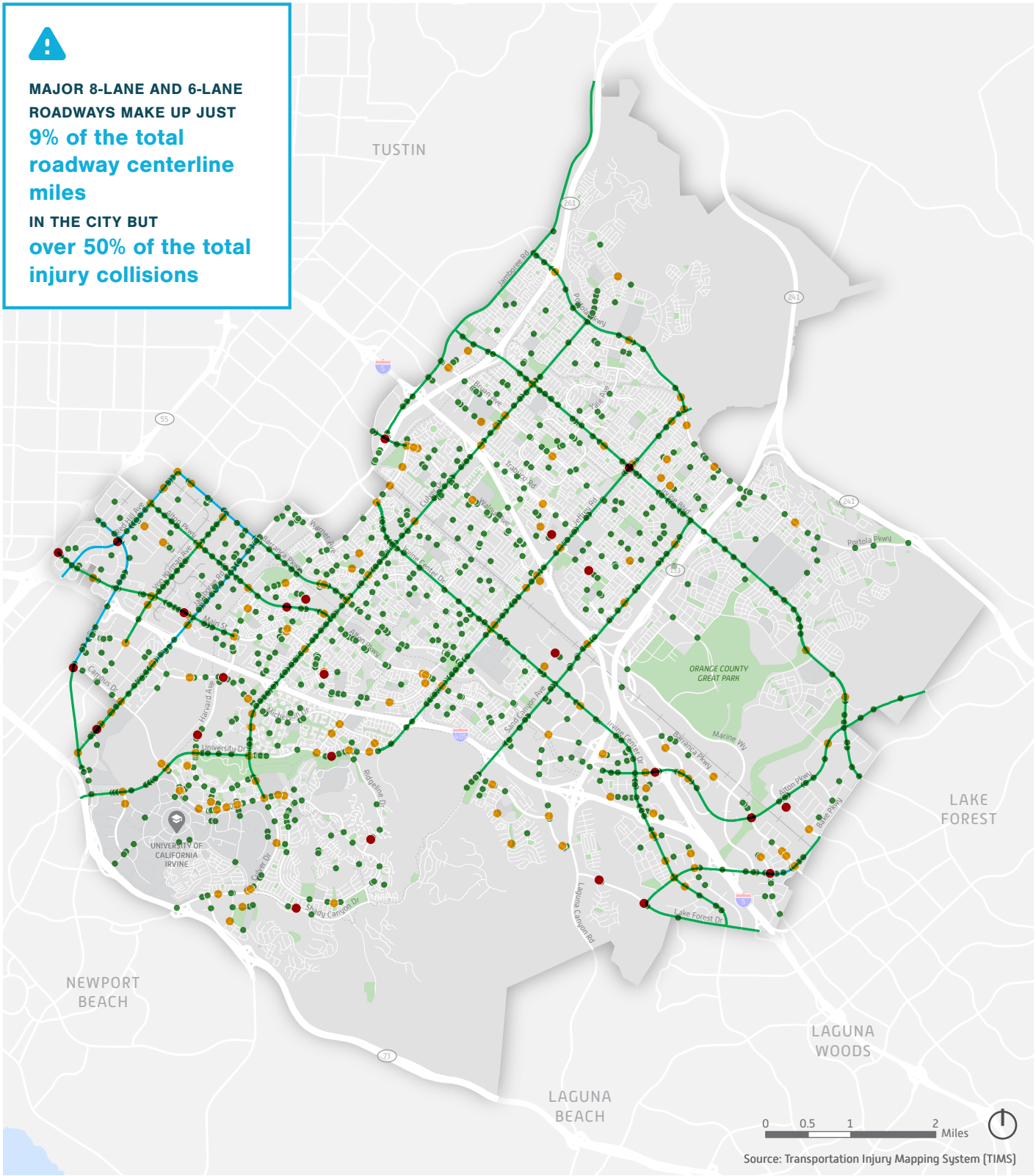


MAJOR 8-LANE AND 6-LANE ROADWAYS MAKE UP JUST

9% of the total roadway centerline miles

IN THE CITY BUT

over 50% of the total injury collisions



CITY OF IRVINE

All Injury Locations

2015-2019

ALL INJURY COLLISIONS

- Fatal
- Severe Injury
- Other Injury

Major 8-Lane
Major 6-Lane
Parks
Schools

Contextual Factors

Collision data was paired with geographic roadway characteristics including General Plan classification, posted speed, intersection control, bicycle facilities, and sensitive land uses. This pairing allowed for identification of the combinations of factors that contributed to a high number of all collisions, and combinations that led to a high number of fatal and severe collisions. Below are some significant takeaways. More details on the analysis can be found in Appendix A.

- Major 8-Lane and 6-Lane Roadways make up just 9% of the total roadway centerline miles in the City, but over 50% of the total injury collisions
- Streets with posted speeds 40 miles per hour (MPH) and above make up just over 30% of the total roadway miles, but over 85% of the total injury collisions
- 50% of injury collisions occur at signalized intersections
- 75% of all collisions involving victims 19 and under are occurring within a 1000' of a park, compared to 58% of all injury collisions

Data Considerations

TIMS reports injury collisions from the Statewide Integrated Traffic Records System (SWITRS). Collision databases have been found to have certain reporting biases, including:

- Collisions involving people walking, on bicycles, or on motorcycles are less likely to be reported than collisions with people driving
- Younger victims are less likely to report collisions
- Alcohol-involved collisions may be under-reported

Race, income, immigration status, and English proficiency may also impact reporting, but there is limited research on these factors.

CHAPTER 5

Emphasis Areas & Strategies

After identifying collision trends and systemic issues, the project team and City staff collaborated to identify a set of emphasis areas and associated countermeasures.

Emphasis Area Typologies

This LRSP includes two emphasis area typologies to comprehensively evaluate roadway safety in the City:

Collision Profile Emphasis Areas

directly stem from the collision and contextual analysis and represent combinations of collision and contextual factors that are seen throughout the City. Collision profiles allow for a proactive approach to improving safety, helping to identify higher-risk locations and suggested countermeasures before fatal and severe injury collisions occur.

Hot Spot Emphasis Areas

are based on a traditional location-based analysis to identify corridors or intersections where a high number of collisions occur, regardless of collision type or characteristics. Hot spots were selected based on the frequency and severity of crashes, and to demonstrate how countermeasures can be applied in a diversity of roadway types.

The countermeasures developed for each hot spot location present a data-driven menu of options for the City to further explore at each location. The proposed countermeasures do not commit the City to employ them, but provide a number of options to further analyze for implementation.

Emphasis Areas

Each emphasis area includes a set of recommended countermeasures aimed at reducing the number and severity of collisions. It is recommended that the City track progress against the goal of collision and severity reduction for each emphasis area, with particular focus on post-implementation evaluation. More information on evaluation strategies can be found in **Chapter 7**.

Collision Profiles

COLLISION PROFILE 1
Broadside Collisions at Signalized Intersections

COLLISION PROFILE 2
Overnight (9pm-6am) Collisions

COLLISION PROFILE 3
Bicycle Collisions Involving Victims 19 and Under

COLLISION PROFILE 4
Pedestrian Collisions in a Crosswalk at an Intersection

COLLISION PROFILE 5
Bicycle Right Hook Collisions

Hot Spots

HOTSPOT LOCATION 1
Harvard Avenue
Walnut Avenue to Irvine Center Drive

HOTSPOT LOCATION 2
Roosevelt
Huntington to Sand Canyon Avenue

HOTSPOT LOCATION 3
Campus Drive
University Drive to Turtle Rock Drive

HOTSPOT LOCATION 4
Jeffrey Road
Portola Parkway to Venta Spur Trail

HOTSPOT LOCATION 5
Alton Parkway/Gateway intersection

COLLISION PROFILE 1

Zoom In For Details

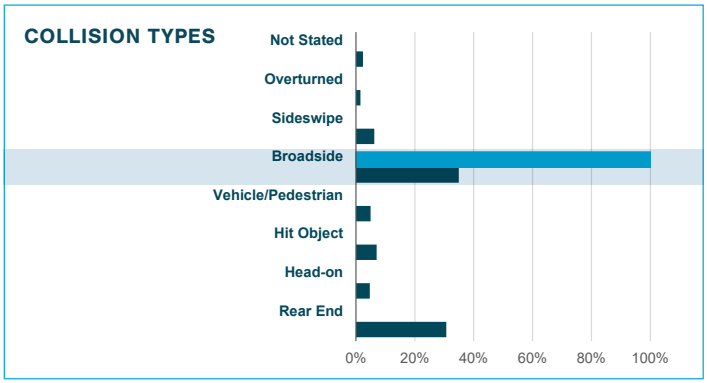
Broadside Collisions at Signalized Intersections

Collision Statistics & Roadway Context

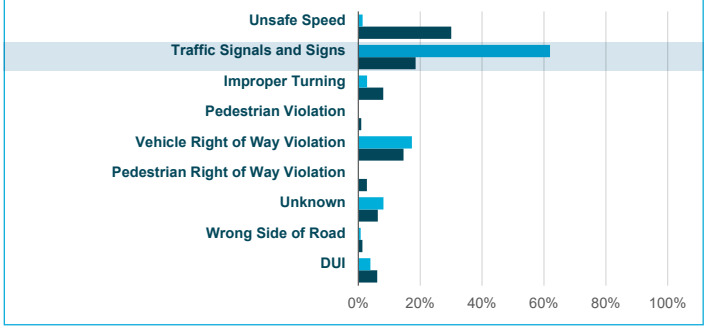
2015-2019 TIMS/SWITRS Historic Collision Data. The table below includes the number and percentage of collisions this profile represents by mode and severity.

	INJURY COLLISIONS		KSI COLLISIONS	
ALL MODES	641	**24%**	48	**26%**
BIKE COLLISIONS	33	**10%**	3	**9%**
PED COLLISIONS	1	**1%**	0	**0%**

COLLISION TYPES

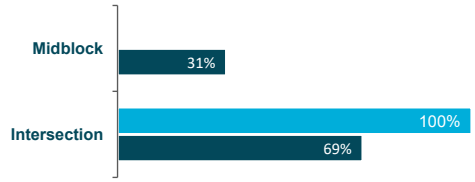


PRIMARY COLLISION FACTORS

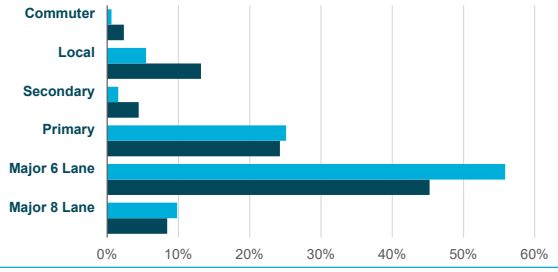


Broadside Collisions at Signalized Intersections
All City of Irvine Injury Collisions

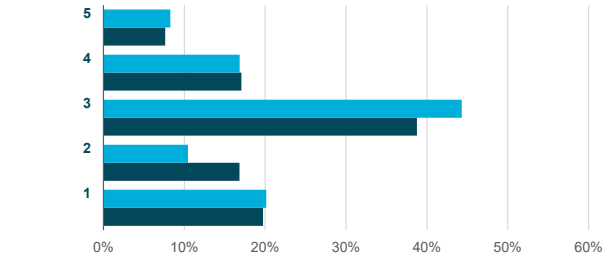
INTERSECTION VS. MIDBLOCK



GENERAL PLAN ROADWAY CLASSIFICATION



LRSP STUDY AREA



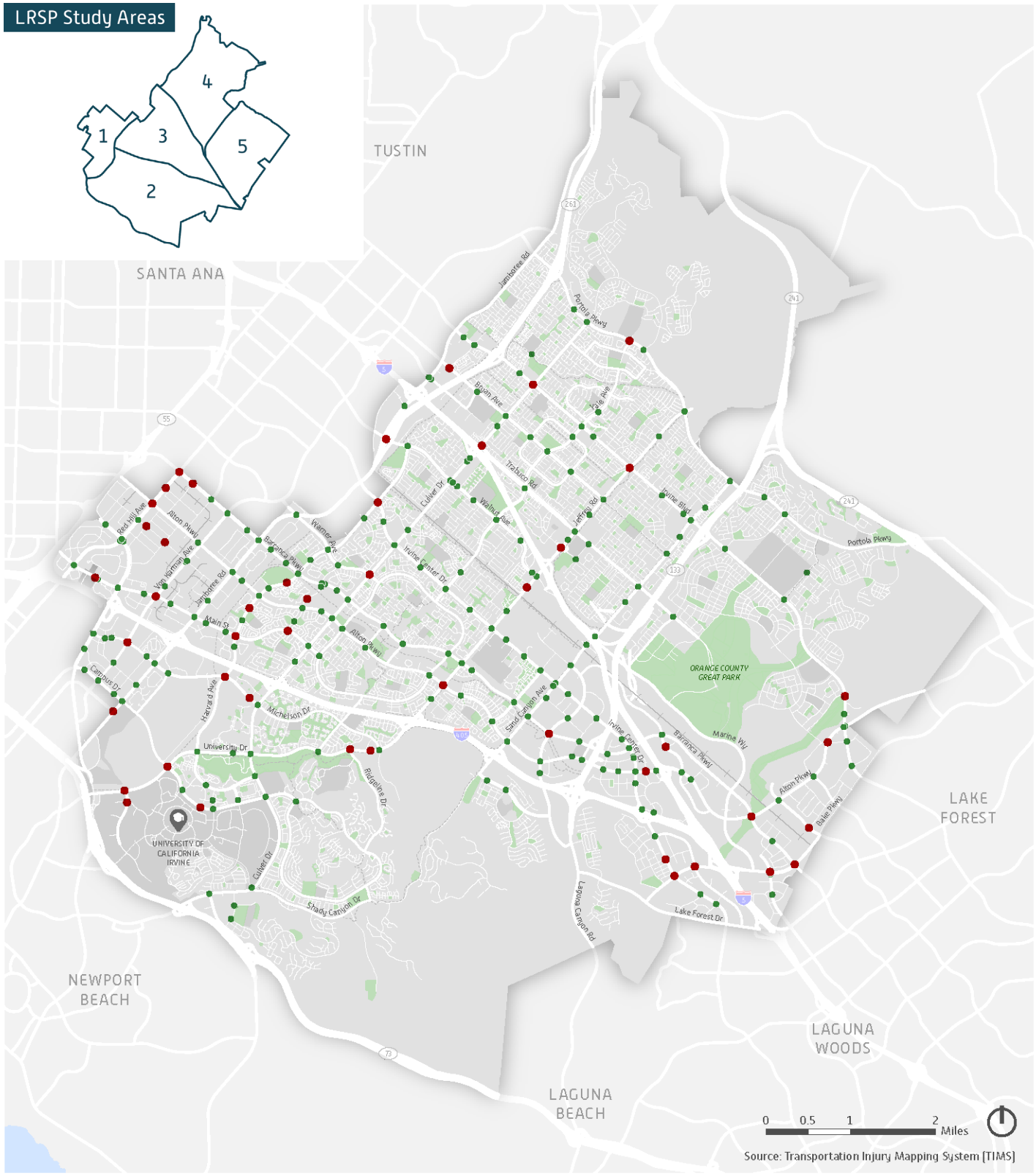
Recommended Engineering Countermeasures

Red-light running and **turn conflicts** were identified as the two major factors that contribute to broadside collisions in the City—over 60% of collisions in this profile have a PCF related to running red lights. Countermeasures for this collision profile were selected to address these two focus areas.

COUNTERMEASURE	CRF	FOCUS
Flashing Beacon As Advance Warning	30%	Red-light running
Intelligent Dilemma-Zone Detection	40%	Red-light running
Retroreflective Borders On Signals	15%	Red-light running
Shorten Cycle Length	15%	Red-light running
Signal Adaptive Speed Response	15%	Red-light running
Supplemental Signal Heads	15%	Red-light running

COUNTERMEASURE (CONTINUED)	CRF	FOCUS
Lane Reduction	30%	Red-light running
High Friction Surface Treatments	55%	Red-light running
Protected Left Turn	30%	Turn conflicts
Multimodal Roundabouts	12-78%	Turn conflicts
Upgrade Pavement Markings through the Intersection	10%	Turn conflicts

Note: CRFs listed are from Caltrans' Local Roadway Safety: A Manual for California's Local Road Users unless otherwise noted.



COLLISION PROFILE 1

Broadside Collisions at Signalized Intersections

2015-2019

ALL INJURY COLLISIONS

- KSI
- Other Injury

Parks

Schools

COLLISION PROFILE 2

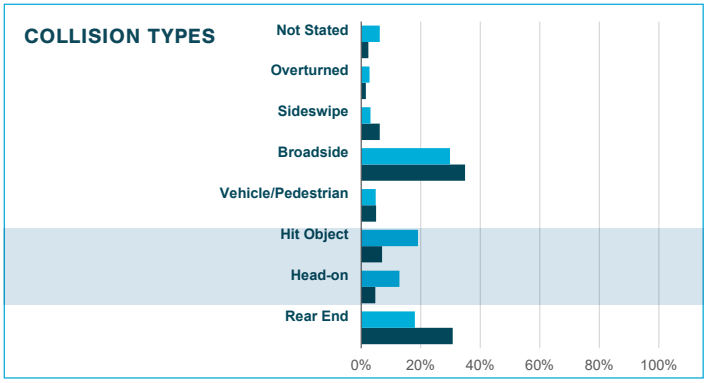
Overnight (9pm-6am) Collisions

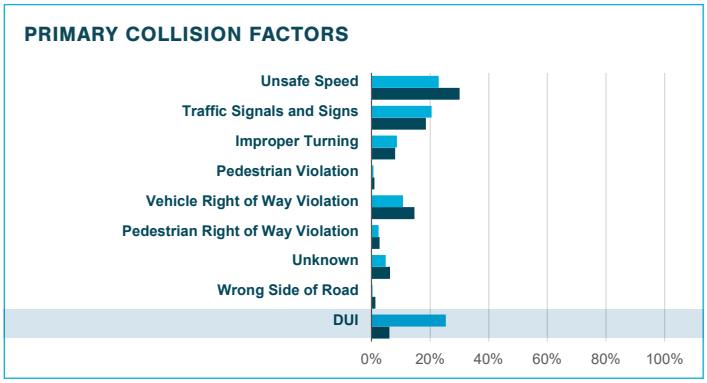
Zoom In For Details

Collision Statistics & Roadway Context

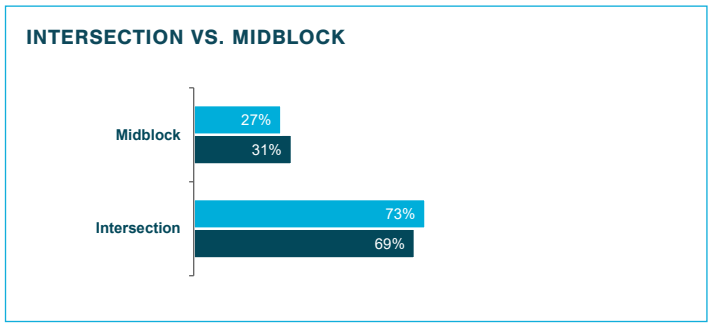
2015-2019 TIMS/SWITRS Historic Collision Data. The table below includes the number and percentage of collisions this profile represents by mode and severity.

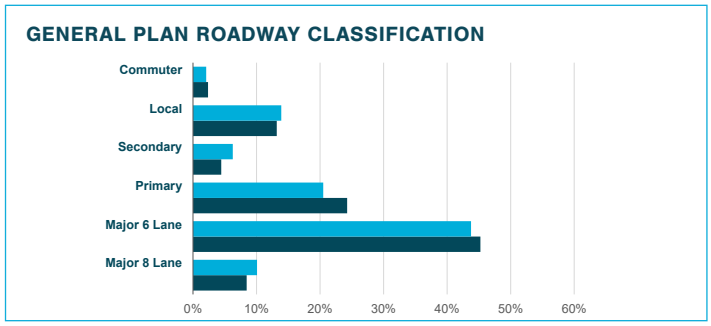
	INJURY COLLISIONS		KSI COLLISIONS	
ALL MODES	288	11%	31	16%
BIKE COLLISIONS	8	3%	0	0%
PED COLLISIONS	13	9%	6	20%

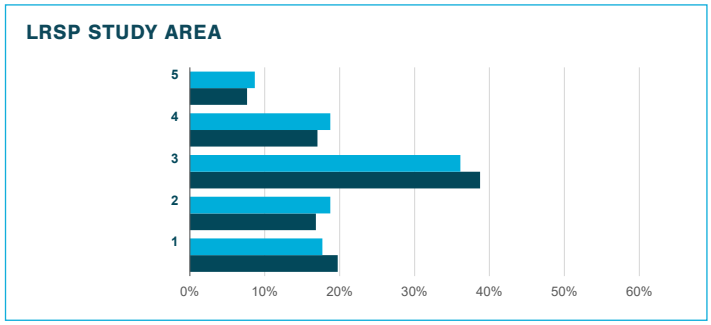




Overnight (9pm-6am) Collisions
All City of Irvine Injury Collisions





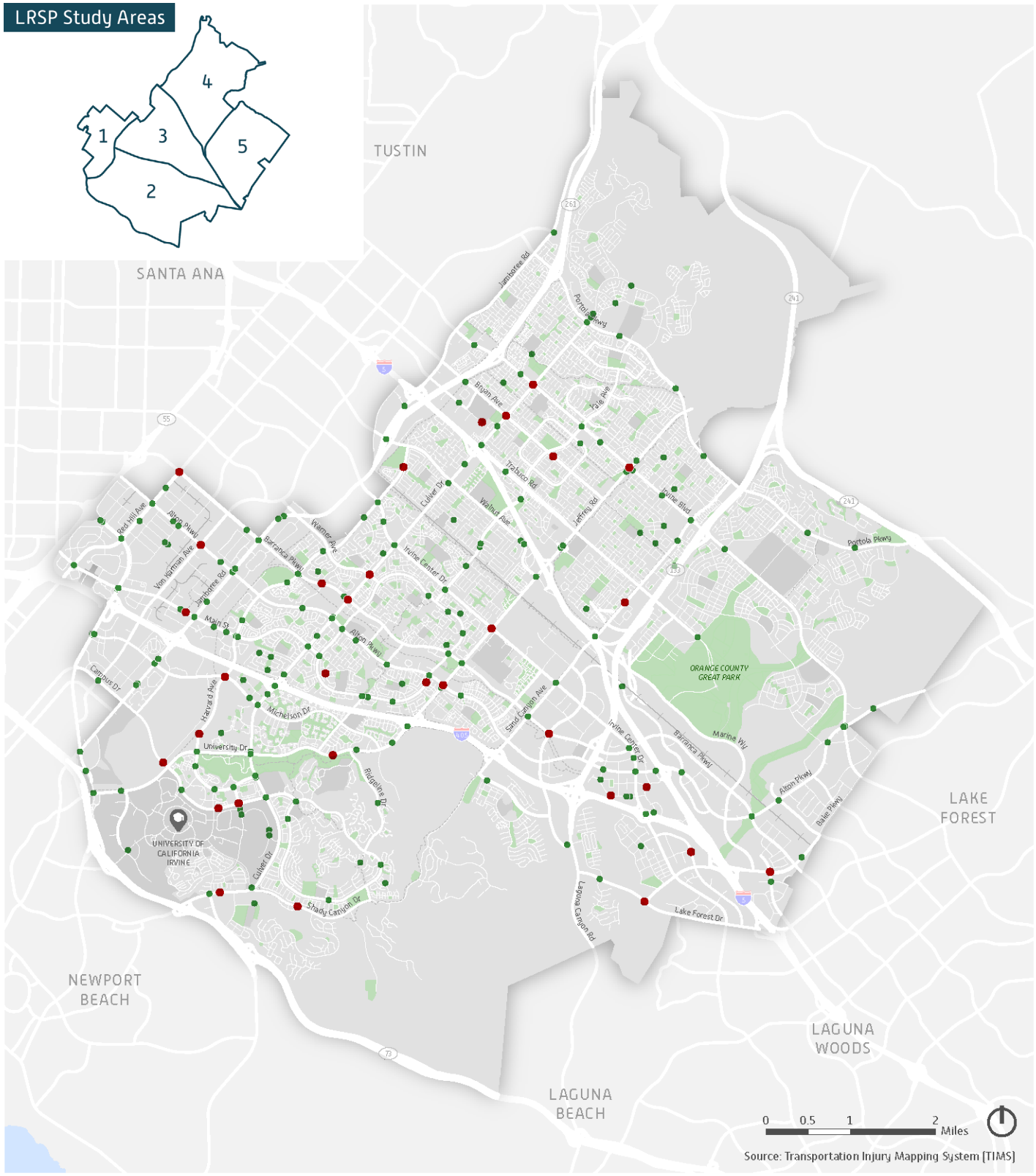


Recommended Engineering Countermeasures

Driving under the influence and **unsafe speeds** are the two top PCFs for overnight collisions in the City. **Broadside collisions** are the primary collision type, so all countermeasures listed for Collision Profile #1 are applicable to this profile as well. Countermeasures were developed with these focus areas in mind.

COUNTERMEASURE	CRF	FOCUS
Centerline Rumble Strips	20%	Driving under the influence/ Drowsy driving
Signal Rest in Red	15%	Speeding
Speed Feedback Sign		Speeding
Intersection lighting	40%	Visibility
Segment lighting	35%	Visibility

Note: CRFs listed are from Caltrans' Local Roadway Safety: A Manual for California's Local Road Users unless otherwise noted.



COLLISION PROFILE 2

Overnight (9pm-6am) Collisions

2015-2019

ALL INJURY COLLISIONS

- KSI
- Other Injury

- Parks
- Schools

COLLISION PROFILE 3

Zoom In For Details

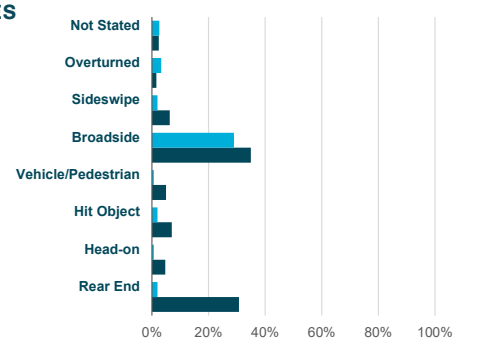
Bicycle Collisions Involving Victims 19 and Under

Collision Statistics & Roadway Context

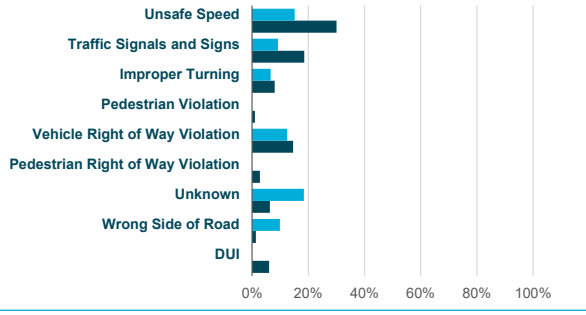
2015-2019 TIMS/SWITRS Historic Collision Data. The table below includes the number and percentage of collisions this profile represents by mode and severity.

	INJURY COLLISIONS		KSI COLLISIONS	
ALL MODES	-	-	-	-
BIKE COLLISIONS	152	**48%**	9	**28%**
PED COLLISIONS	-	-	-	-

COLLISION TYPES

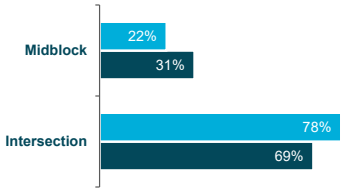


PRIMARY COLLISION FACTORS

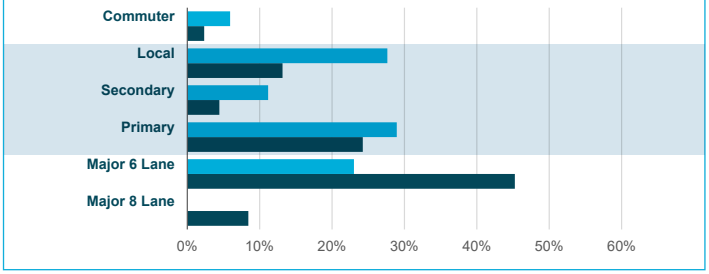


Bike Collisions Involving Victims 19 and Under
All City of Irvine Injury Collisions

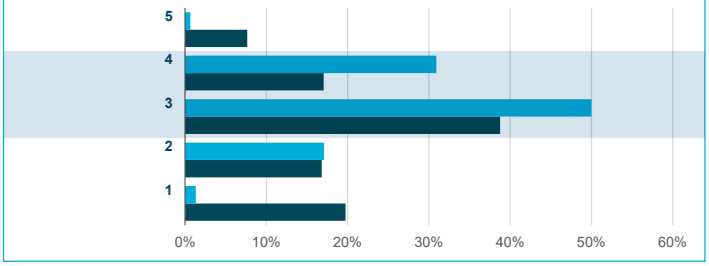
INTERSECTION VS. MIDBLOCK



GENERAL PLAN ROADWAY CLASSIFICATION



LRSP STUDY AREA



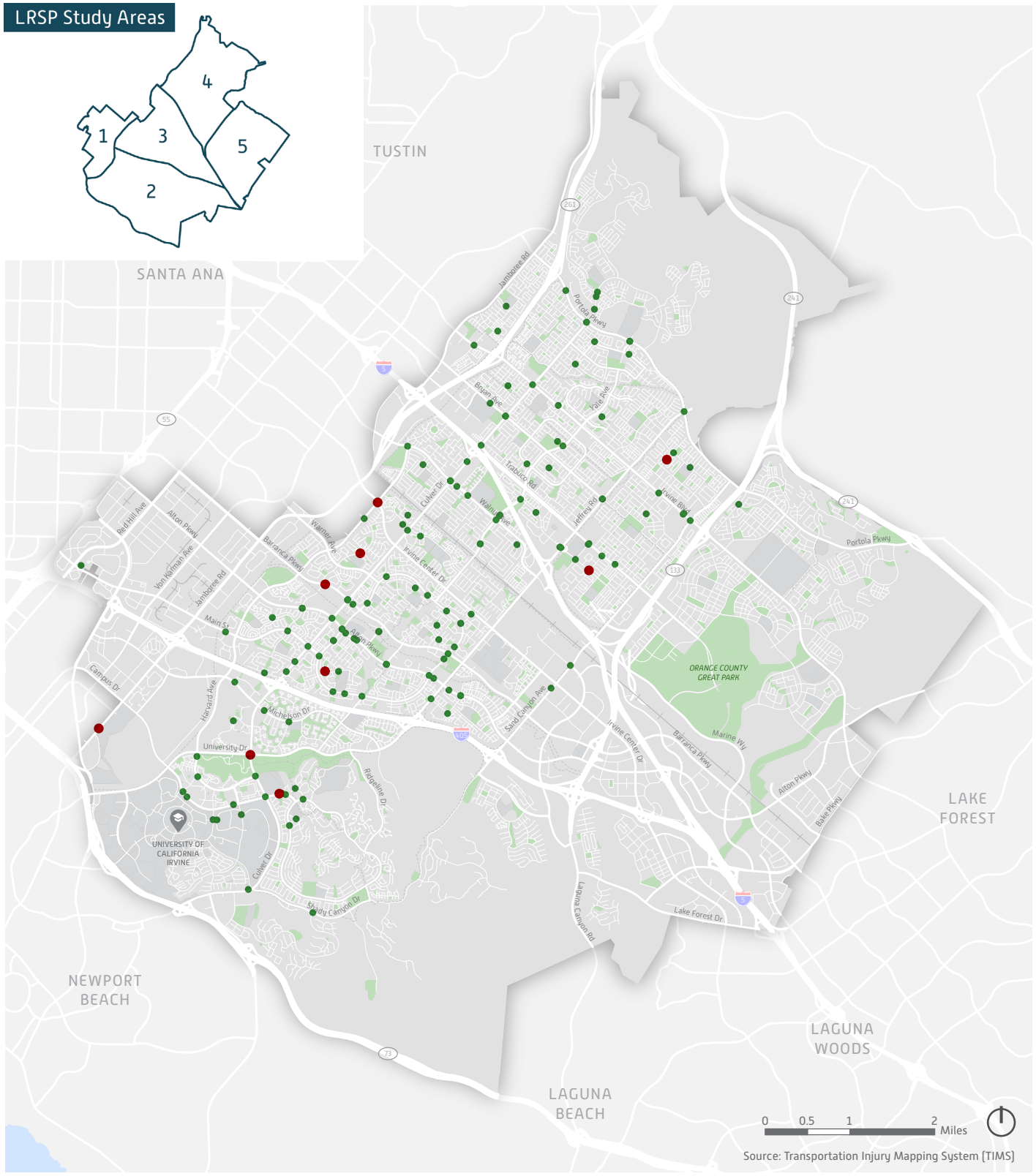
Recommended Engineering Countermeasures

Countermeasure development for this collision profile was focused on addressing and minimizing auto/bicycle conflicts by **separating users in time**, **separating users in space**, and **elevating awareness of the conflict zone**.

COUNTERMEASURE	CRF	FOCUS
Bike Conflict Striping/Mixing Zone		Elevating awareness of the conflict zone
Modified Sign R10-15 “Turning Vehicles Yield to Ped” to include bicycles	15%	Elevating awareness of the conflict zone
Pedestrian Hybrid Beacons	55%	Elevating awareness of the conflict zone
LED-Enhanced Stop Signs	15%	Elevating awareness of the conflict zone
Multimodal Roundabouts	12-78%	Separating users in space
Protected Intersections/Corners	45%	Separating users in space
Bicycle Crossings		Separating users in space
Bike Box	15%	Separating users in space

COUNTERMEASURE (CONTINUED)	CRF	FOCUS
Buffered Bike Lane		Separating users in space
Separated Bike Lanes	45%	Separating users in space
Bicycle signals	15%	Separating users in time
Leading Pedestrian Intervals paired with Sign R9-5 "Bikes Use Ped Signal"	60%	Separating users in time
Restrict Right-Turn-on-Red	15%	Separating users in time
All-Way Stop Control	50%	Separating users in time
Protected Left Turn	30%	Separating users in time
Lane Reduction	30%	Slowing speeds

Note: CRFs listed are from Caltrans' Local Roadway Safety: A Manual for California's Local Road Users unless otherwise noted.



COLLISION PROFILE 3

Bicycle Collisions Involving Victims 19 and Under

2015-2019

ALL INJURY COLLISIONS

- KSI
- Other Injury

- Parks
- Schools

COLLISION PROFILE 4

Zoom In For Details

Pedestrian Collisions in a Crosswalk at an Intersection

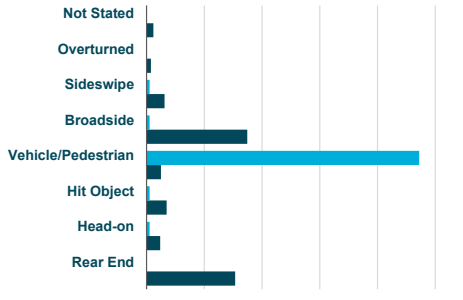
Collision Statistics & Roadway Context

2015-2019 TIMS/SWITRS Historic Collision Data. The table below includes the number and percentage of collisions this profile represents by mode and severity.

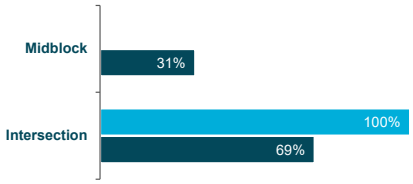
	INJURY COLLISIONS		KSI COLLISIONS	
ALL MODES	–	–	–	–
BIKE COLLISIONS	–	–	–	–
PED COLLISIONS	90	**62%**	19	**63%**

■ Pedestrian Collisions in a Crosswalk at an Intersection
■ All City of Irvine Injury Collisions

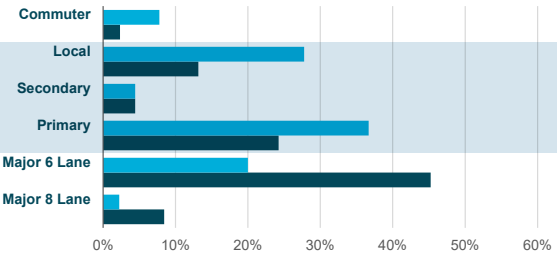
COLLISION TYPES



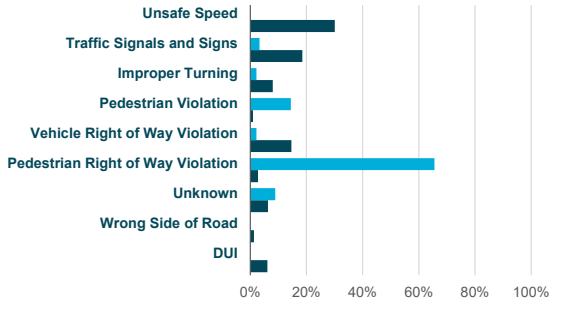
INTERSECTION VS. MIDBLOCK



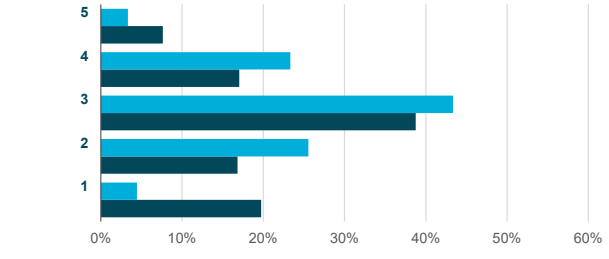
GENERAL PLAN ROADWAY CLASSIFICATION



PRIMARY COLLISION FACTORS



LRSP STUDY AREA



Recommended Engineering Countermeasures

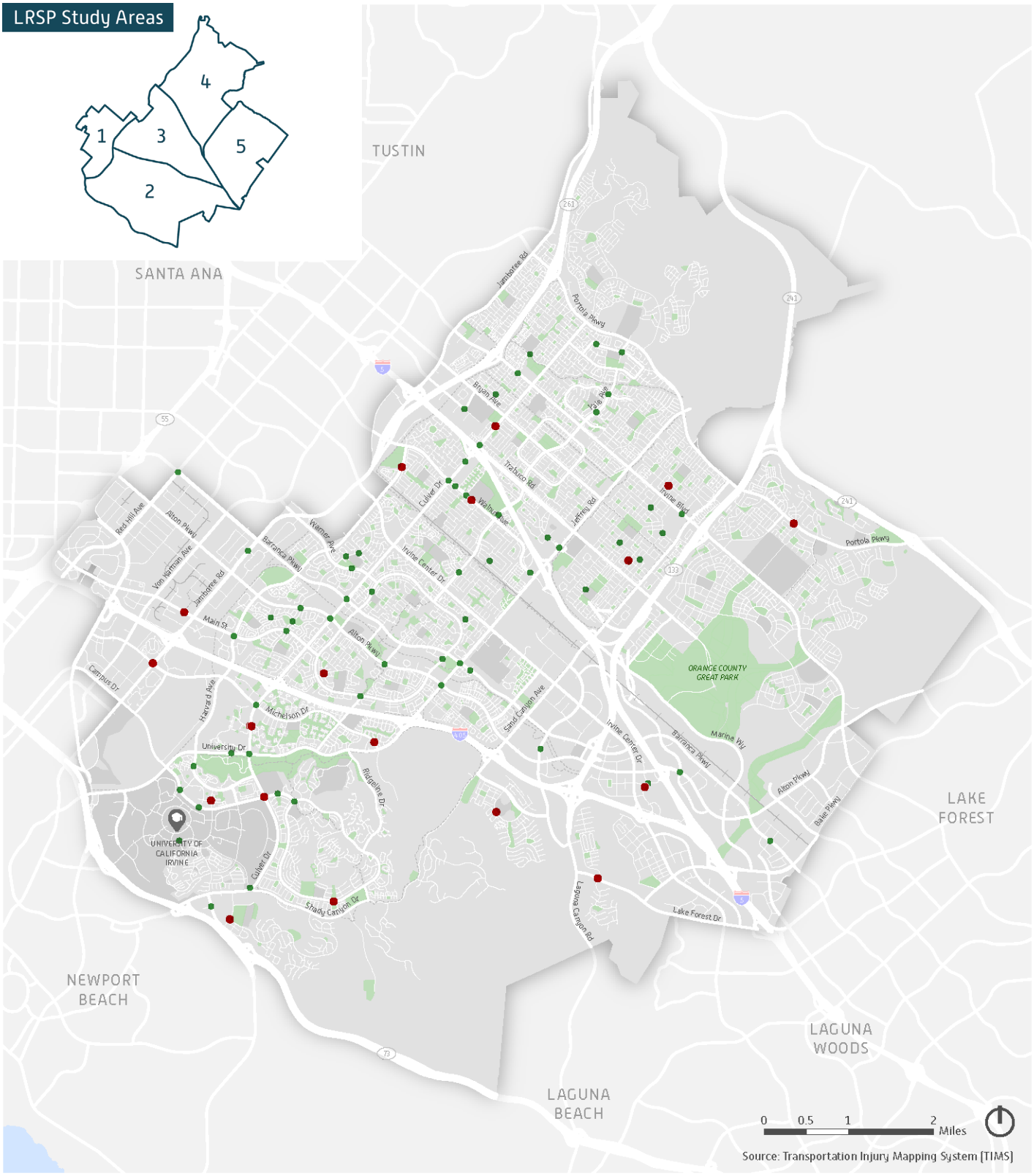
In addition to addressing and minimizing pedestrian/auto conflicts by **separating users in time**, **separating users in space**, and **elevating driver awareness** of the conflict zone (i.e., crosswalks and other crossing locations), countermeasures were also identified to address pedestrian collisions due to **red-light running**.

COUNTERMEASURE	CRF	FOCUS
Pedestrian Countdown Signal Heads	25%	Elevating awareness of the conflict zone
All-Way Stop Control	50%	Elevating awareness of the conflict zone
LED-Enhanced Stop Signs	15%	Elevating awareness of the conflict zone
Advanced Stop Bar	15%	Elevating awareness of the conflict zone
Stripe New Crosswalk	25%	Elevating awareness of the conflict zone
Upgrade to High-Visibility Crosswalk Striping	40%*	Elevating awareness of the conflict zone
Flashing Beacon as Advance Warning	30%	Red-light running
Intelligent Dilemma-Zone Detection	40%	Red-light running
Retroreflective Borders on Signals	15%	Red-light running
Lane Reduction	30%	Red-light running
High Friction Surface Treatments	55%	Red-light running

COUNTERMEASURE (CONTINUED)	CRF	FOCUS
Curb Extensions/Bulbouts	45%	Separating users in space
Raised Median/Refuge Island	45%	Separating users in space
Leading Pedestrian Intervals	60%	Separating users in time
Restrict Right-Turn-on-Red	15%	Separating users in time
Extended Pedestrian Interval	15%	Separating users in time
Passive Pedestrian Detection	15%	Separating users in time
Pedestrian Scramble Phase/All Pedestrian Phase	40%	Separating users in time
Protected Left Turn	30%	Separating users in time
Multimodal Roundabouts	12-78%	Slowing speeds
Protected Intersections/Corners	45%	Slowing speeds (turning movements)

**FHWA Proven Safety Countermeasure*

Note: CRFs listed are from Caltrans' Local Roadway Safety: A Manual for California's Local Road Users unless otherwise noted.



COLLISION PROFILE 4

Pedestrian Collisions in a Crosswalk at an Intersection

2015-2019

ALL INJURY COLLISIONS

- KSI
- Other Injury

Parks

Schools

COLLISION PROFILE 5

Bicycle Right Hook Collisions

Zoom In For Details

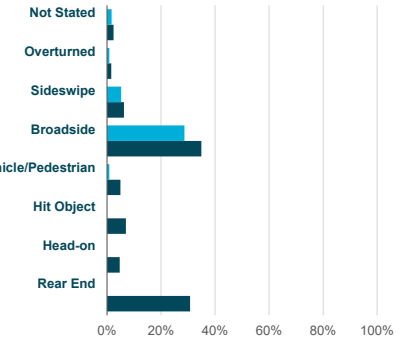
Collision Statistics & Roadway Context

2015-2019 TIMS/SWITRS Historic Collision Data. The table below includes the number and percentage of collisions this profile represents by mode and severity.

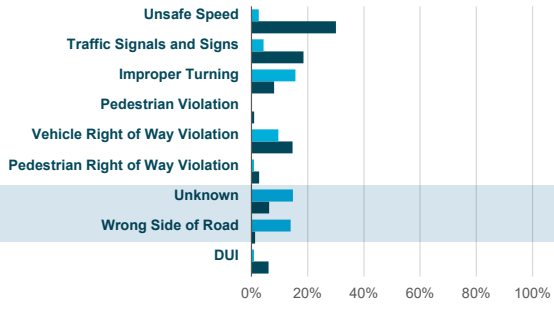
	INJURY COLLISIONS		KSI COLLISIONS	
ALL MODES	–	–	–	–
BIKE COLLISIONS	115	**36%**	3	**9%**
PED COLLISIONS	–	–	–	–

■ Bicycle Right Hook Collisions
■ All City of Irvine Injury Collisions

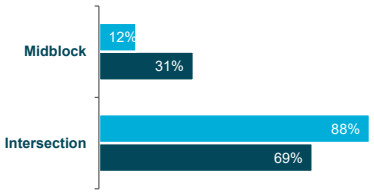
COLLISION TYPES



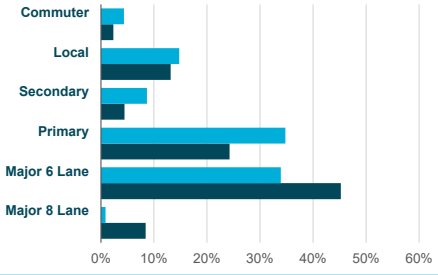
PRIMARY COLLISION FACTORS



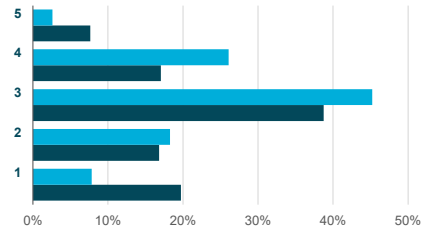
INTERSECTION VS. MIDBLOCK



GENERAL PLAN ROADWAY CLASSIFICATION



LRSP STUDY AREA



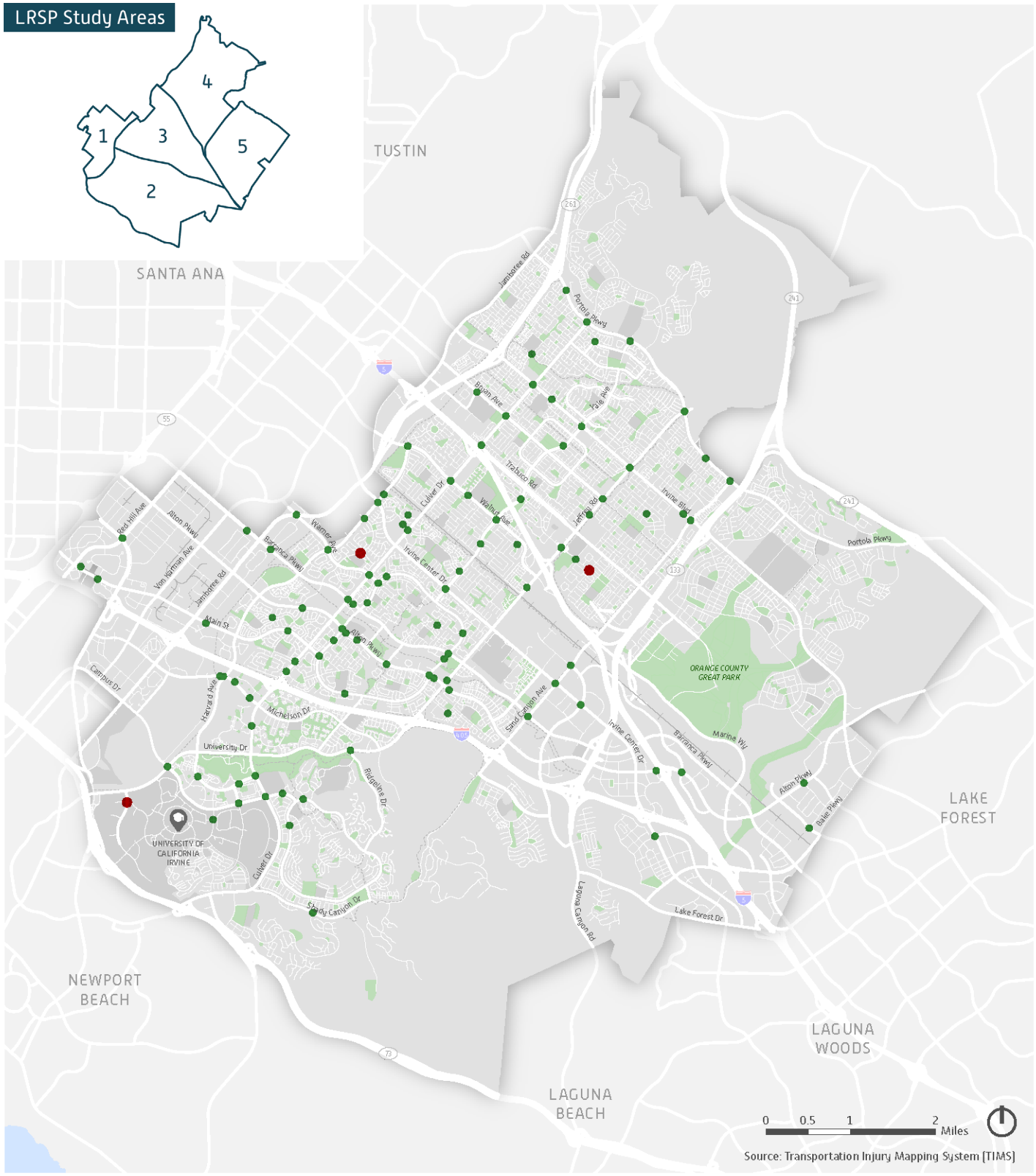
Recommended Engineering Countermeasures

Countermeasure development for this collision profile was focused on addressing and minimizing auto/bicycle conflicts by **separating users in time**, **separating users in space**, and **elevating awareness of the conflict zone**.

COUNTERMEASURE	CRF	FOCUS
Bike Conflict Striping/Mixing Zone		Elevating awareness of the conflict zone
Modified Sign R10-15 "Turning Vehicles Yield to Ped" to include bicycles	15%	Elevating awareness of the conflict zone
Multimodal Roundabouts	12-78%	Separating users in space
Protected Intersections/Corners	45%	Separating users in space
Bicycle Crossings		Separating users in space

COUNTERMEASURE (CONTINUED)	CRF	FOCUS
Bike Box	15%	Separating users in space
Bicycle signals	15%	Separating users in time
Leading Pedestrian Intervals paired with Sign R9-5 "Bikes Use Ped Signal"	60%	Separating users in time
Restrict Right-Turn-on-Red	15%	Separating users in time

Note: CRFs listed are from Caltrans' Local Roadway Safety: A Manual for California's Local Road Users unless otherwise noted.



COLLISION PROFILE 5

Bicycle Right Hook Collisions

2015-2019

ALL INJURY COLLISIONS

- KSI
- Other Injury

Parks

Schools

HOTSPOT LOCATION 1

Harvard Avenue Walnut Avenue to Irvine Center Drive

Corridor Vision

Develop a comfortable corridor for bicyclists and pedestrians accessing trails and parks off Harvard Avenue.

Special attention should be paid at the at-grade railroad crossing, where the Como Channel Trail and Walnut Trail intersect with Harvard Avenue and up to 70 trains cross daily.

The City of Tustin, Orange County Transportation Authority (OCTA), and the California Public Utilities Commission (CPUC) will be major stakeholders along this corridor due to shared right of way and the railroad crossing.

PRECEDENT

The Sonoma Marin Area Rail Transit (SMART) corridor includes several examples of signalized pedestrian crossings for a parallel trail through Rohnert Park, California that can serve as precedent for this location.

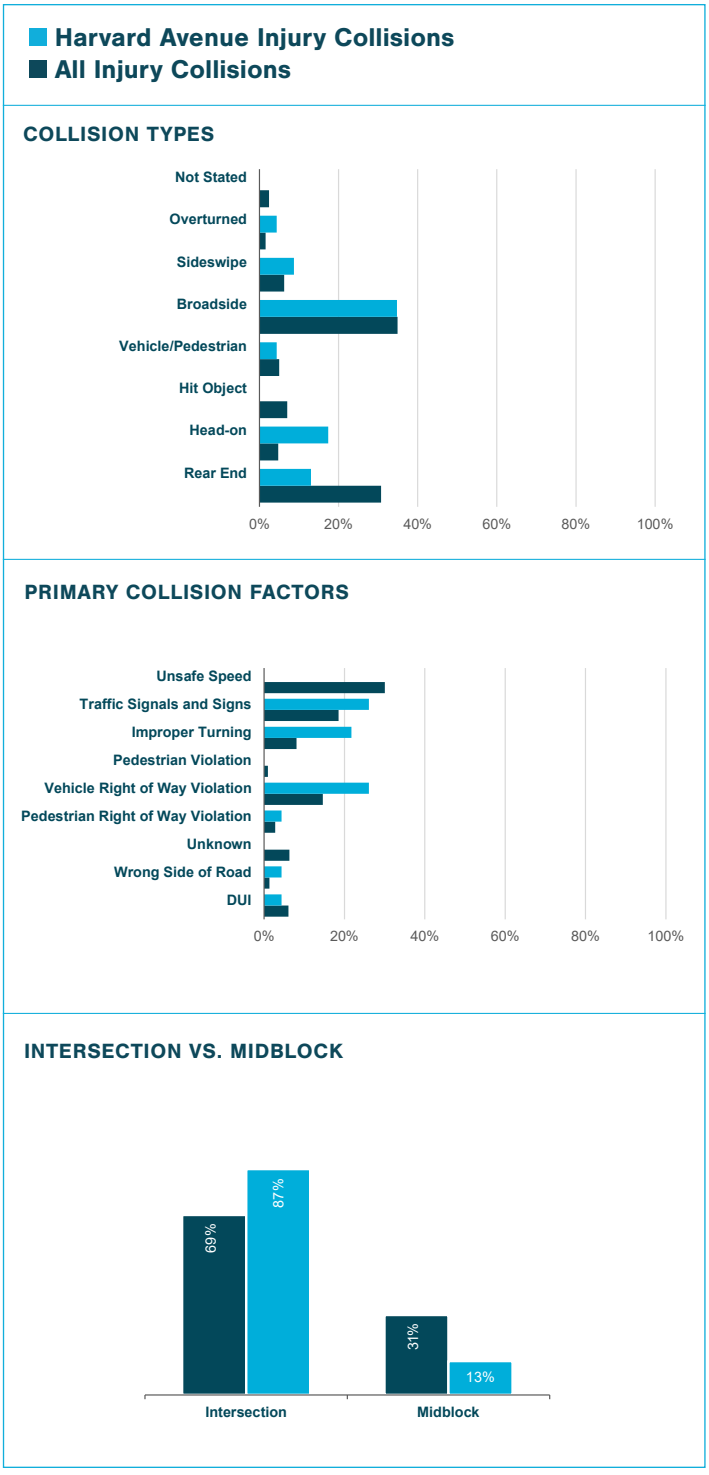
Contextual Data

CORRIDOR LENGTH (MILES)	**0.8**
LRSP STUDY AREA	**3**
GENERAL PLAN CLASSIFICATION	**Primary**
NUMBER OF LANES	**2**
POSTED SPEED (MPH)	**45**
AVERAGE DAILY TRAFFIC (2019)	**8,700**

Collision Statistics

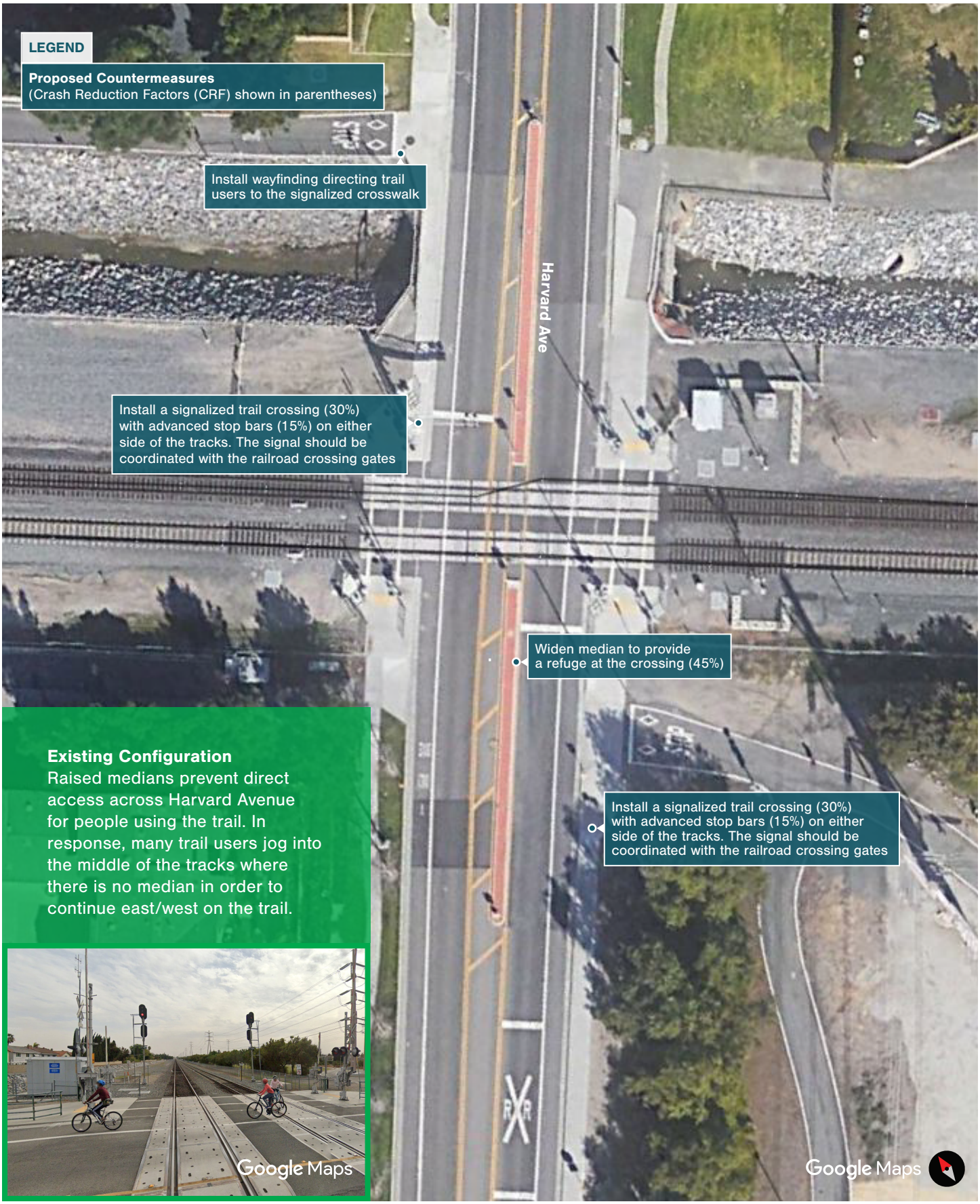
2015-2019 TIMS/SWITRS Historic Collision Data. The table below includes the number and percentage of collisions this profile represents by mode and severity.

	INJURY COLLISIONS		KSI COLLISIONS	
ALL MODES	23	**1%**	5	**3%**
BIKE COLLISIONS	9	**3%**	4	**13%**
PED COLLISIONS	1	**1%**	1	**3%**



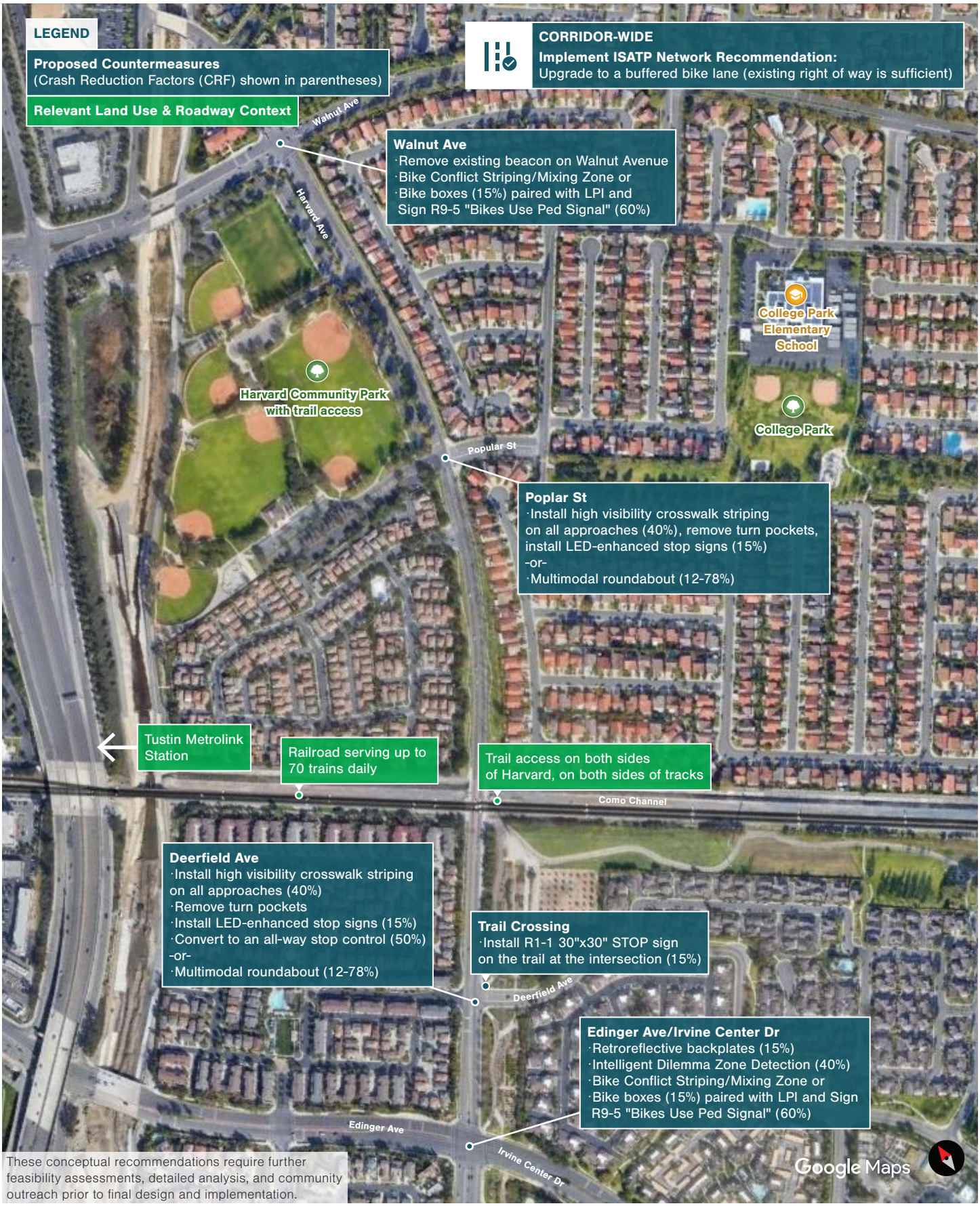
HOTSPOT LOCATION 1

Harvard Avenue Trail Crossing



HOTSPOT LOCATION 1

Harvard Avenue, Walnut Avenue to Irvine Center Drive



These conceptual recommendations require further feasibility assessments, detailed analysis, and community outreach prior to final design and implementation.

HOTSPOT LOCATION 2

Roosevelt Huntington to Sand Canyon Avenue

Corridor Vision

Create a bike-friendly street that provides access to the parks, schools, community centers, and after-school programs located along Roosevelt.

Facilities should include buffered bike lanes and enhanced intersection design to encourage bicyclists to transition off the sidewalk and onto the on-street facility to increase their visibility at intersections.

Contextual Data

CORRIDOR LENGTH (MILES)	1.4
LRSP STUDY AREA	4
GENERAL PLAN CLASSIFICATION	Local
NUMBER OF LANES	2-4
POSTED SPEED	35-40
AVERAGE DAILY TRAFFIC (2019)	5,500-13,300
2-DAY PEAK PERIOD BIKE VOLUMES*	41-80

*Source: Irvine Strategic Active Transportation Plan (2021)

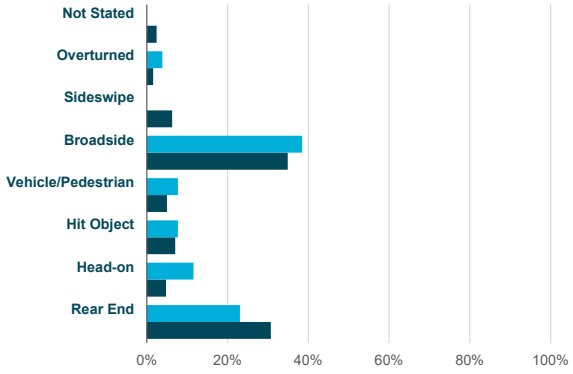
Collision Statistics

2015-2019 TIMS/SWITRS Historic Collision Data. The table below includes the number and percentage of collisions this profile represents by mode and severity.

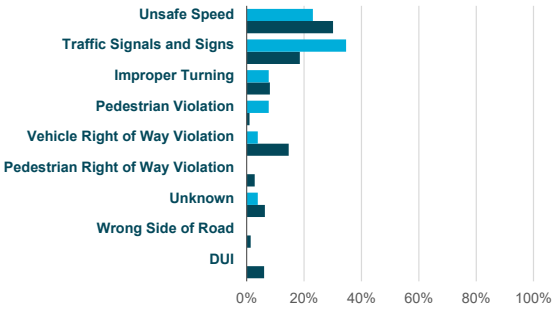
	INJURY COLLISIONS		KSI COLLISIONS	
ALL MODES	26	1%	4	2%
BIKE COLLISIONS	4	1%	1	3%
PED COLLISIONS	2	1%	0	0%

Roosevelt Injury Collisions
All Injury Collisions

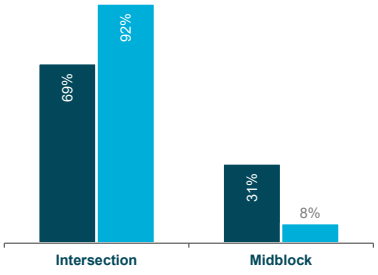
COLLISION TYPES



PRIMARY COLLISION FACTORS



INTERSECTION VS. MIDBLOCK



HOTSPOT LOCATION 2

Roosevelt, Huntington to Sand Canyon Avenue


Recommended Countermeasures at Stop-Controlled Locations
·Install high visibility crosswalk striping on all approaches (40%),
·Remove turn pockets,
·Install LED-enhanced stop signs (15%),
·At Huntington, convert to an all-way stop control (50%)
-or-
Convert stop-controlled intersections to roundabouts (12-78%)
traffic calming/safety and operations benefits
Recommended Countermeasures at Signalized Locations
Maintain the signal and enhance with Bike Conflict Striping/Mixing Zone paired with LPI and Sign R9-5 "Bikes Use Ped Signal" (60%)
-or-
Convert signal to roundabout (35-67%) to provide a consistent intersection control treatment along the corridor and for the traffic calming, safety, and operational co-benefits
Lane Reduction (30%)
Evaluate the feasibility of implementing one continuous cross section throughout the corridor by reducing the number of lanes in highlighted areas. Repurpose the right of way for bicycle facility buffers, or widened sidewalks. Paired with roundabouts, limited operational impacts are expected.
Bay Tree
Scented Violet
Rush Lily
Tulip
Sand Canyon Ave
Convert to Roundabout
Convert to Roundabout
Convert to Roundabout
Convert to Roundabout
Sand Canyon Ave
·Retroreflective backplates (15%)
·Install additional signal heads in NB/SB direction (15%)
·Intelligent Dilemma Zone Detection (40%)
Cypress Grove Park
Floral Park
Cypress Village Elementary School
Google Maps

HOTSPOT LOCATION 3

Campus Drive University Drive to Turtle Rock Drive

Corridor Vision

Create a multimodal gateway to University of California, Irvine and University High School, with a focus on reducing speeds and creating a comfortable environment to encourage bicyclists to move off the sidewalk and onto the on-street bicycle facility.

This corridor vision includes:

- **Providing enhanced bicycle facilities and address speeding on long block lengths**
- **Elevating awareness of bike/ped/auto conflict zones at midblock driveways**
- **Addressing rear-end, broadside, pedestrian, and bicycle collisions at intersections**

This segment of Campus Drive has one of the highest collision densities in the City—over 5 KSIs per mile

Contextual Data

CORRIDOR LENGTH (MILES)	1.8
LRSP STUDY AREA	1/2
GENERAL PLAN CLASSIFICATION	Primary
NUMBER OF LANES	4
POSTED SPEED (MPH)	45
AVERAGE DAILY TRAFFIC (2019)	13,500-20,500
2-DAY PEAK PERIOD BIKE VOLUMES*	>800

*Source: Irvine Strategic Active Transportation Plan (2021)

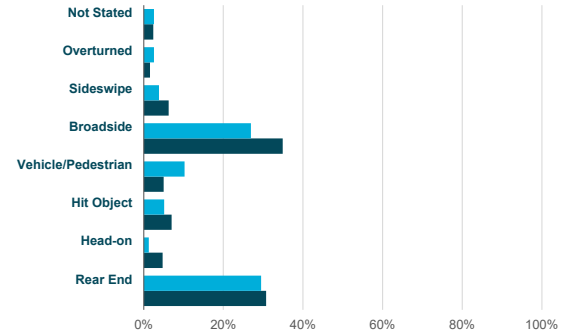
Collision Statistics

2015-2019 TIMS/SWITRS Historic Collision Data. The table below includes the number and percentage of collisions this profile represents by mode and severity.

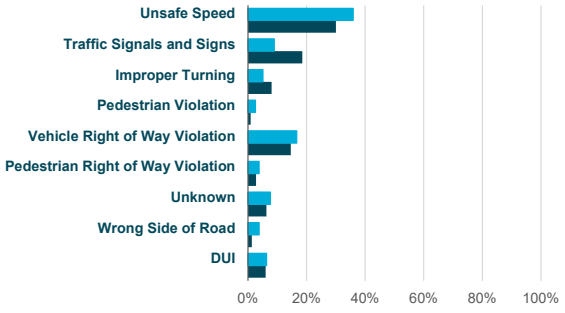
	INJURY COLLISIONS		KSI COLLISIONS	
ALL MODES	78	3%	11	6%
BIKE COLLISIONS	18	6%	4	13%
PED COLLISIONS	8	6%	2	7%

Campus Drive Injury Collisions
All Injury Collisions

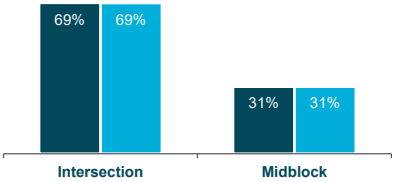
COLLISION TYPES



PRIMARY COLLISION FACTORS



INTERSECTION VS. MIDBLOCK



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HOTSPOT LOCATION 3

Campus Drive, University Drive to Berkeley Avenue

Campus Drive, Berkeley Avenue to Turtle Rock Drive


Berkeley Ave
Peltason Dr
Stanford
Driveway
·Bike Conflict Striping/Mixing Zone
·Modified Sign R10-15 “Turning Vehicles Yield to Ped” to include bicycles
Berkeley Ave
·High-visibility crosswalk striping (40%) with advanced stop bars (15%)
·Intelligent Dilemma Zone Detection (40%)
Stanford
·High-visibility crosswalk striping (40%) with advanced stop bars (15%)
·Retroreflective Borders on Signals (15%)
·LPI and Sign R9-5 "Bikes Use Ped Signal" (60%)
·Add crosswalk to east leg (25%) (provides direct access between student housing and parking garage)
These conceptual recommendations require further feasibility assessments, detailed analysis, and community outreach prior to final design and implementation.


Paseo Montoya
·Install signal (30%) with co-benefit of likely providing access improvements at Cobblestone
·Consider addingcrosswalk to west leg (25%)
Cobblestone
Consider prohibiting lefts out of Cobblestone either via signage and/or closing the median. People traveling to/from the south have existing access on Turtle Rock
Culver Dr
Paseo Montoya
Culver Dr
·LPI and Sign R9-5 "Bikes Use Ped Signal" (60%)
·High-visibility crosswalk striping (40%) with advanced stop bars (15%)
·Bike Conflict Striping/Mixing Zone
·Retroreflective Borders on Signals (15%)
·Intelligent Dilemma Zone Detection (40%)
Turtle Rock Dr
·Remove the pavement markings that currently create de-facto southbound right slip lane and stripe an advanced stop bar (15%)
·Add crosswalk to the south leg to provide direct trail access (25%)
These conceptual recommendations require further feasibility assessments, detailed analysis, and community outreach prior to final design and implementation.

HOTSPOT LOCATION 4

Jeffrey Road Portola Parkway to Venta Spur Trail (just south of Irvine Boulevard)

Corridor Vision

Manage speeds on longer block lengths and address broadside and rear-end collisions at major intersections. The roadway typology and associated collisions along this hot spot are typical in the broader City context. Consider applying this set of countermeasures along other major 6- and 8-lane roadways throughout the City.

Optional/exploratory safety enhancements beyond what is currently identified include:

- **Break up longer block lengths with midblock crossings/signals to provide traffic calming and speed management benefits. Midblock crossings could provide a co-benefit of increasing ped/bike access at residential cul-de-sacs.**
- **Low ADT along this segment is supportive of a lane reduction (30%). Right of way could be reallocated toward providing a widened trail on west side or widened median**
- **The City could explore designating this segment a "safety corridor" (California Assembly Bill 43) to allow for flexibility in speed setting due to the adjacent recreational land uses.**

Contextual Data

CORRIDOR LENGTH (MILES)	1.2
LRSP STUDY AREA	4
GENERAL PLAN CLASSIFICATION	Major 6-Lane
NUMBER OF LANES	6
POSTED SPEED (MPH)	50-55
AVERAGE DAILY TRAFFIC (2019)	15,700
TYPICAL MIDBLOCK CONDITIONS	Median and long block lengths with limited curb cuts/access points

*Source: Irvine Strategic Active Transportation Plan (2021)

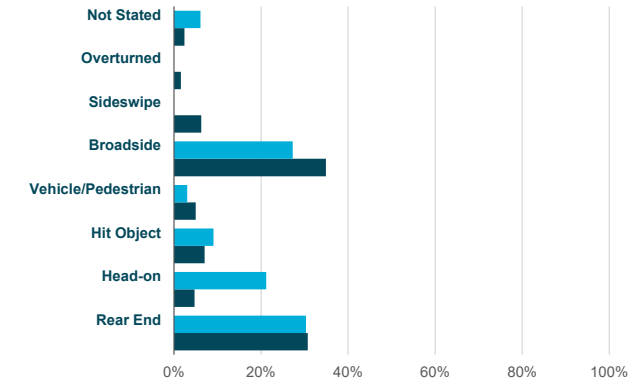
Collision Statistics

2015-2019 TIMS/SWITRS Historic Collision Data. The table below includes the number and percentage of collisions this profile represents by mode and severity.

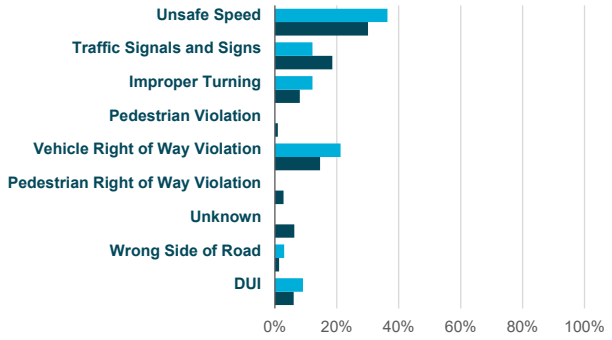
	INJURY COLLISIONS		KSI COLLISIONS	
ALL MODES	33	1%	6	3%
BIKE COLLISIONS	3	1%	1	3%
PED COLLISIONS	1	1%	1	3%

Jeffrey Road Injury Collisions
All Injury Collisions

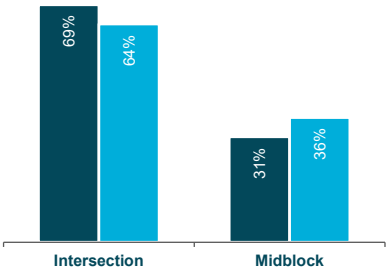
COLLISION TYPES



PRIMARY COLLISION FACTORS



INTERSECTION VS. MIDBLOCK



HOTSPOT LOCATION 4

Jeffrey Road, Portola Parkway to Venta Spur Trail

HOTSPOT LOCATION 5

Highest rate of collisions of any intersection in the City of Irvine

Alton Parkway/Gateway Intersection

Intersection Vision & Context

Increase visibility of the intersection to oncoming motorists, especially those traveling in the westbound direction. The high frequency of red-light running (>90% of collisions) and of collisions caused by motorists traveling in the westbound direction, paired with the downhill grade in the westbound direction, suggests that motorists are missing the intersection in their line of sight.

Contextual Data

CORRIDOR LENGTH (MILES)	--
LRSP STUDY AREA	3
GENERAL PLAN CLASSIFICATION	Major 6-Lane
NUMBER OF LANES	6
POSTED SPEED (MPH)	45
AVERAGE DAILY TRAFFIC (2019)	26,800 on Alton Parkway

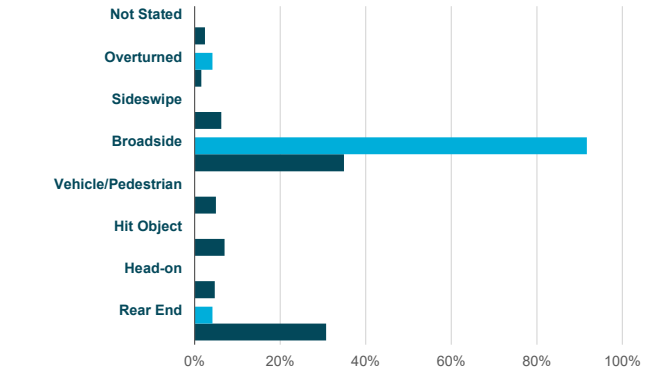
Collision Statistics

2015-2019 TIMS/SWITRS Historic Collision Data. The table below includes the number and percentage of collisions this profile represents by mode and severity.

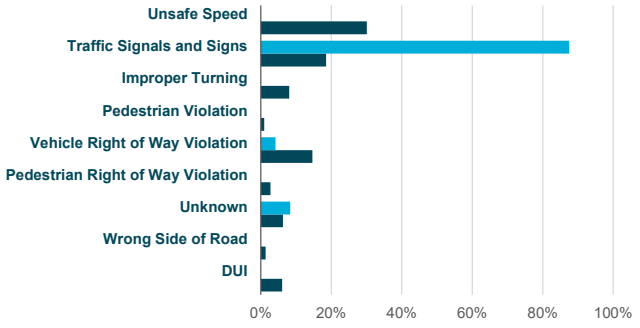
	INJURY COLLISIONS		KSI COLLISIONS	
ALL MODES	24	1%	2	1%
BIKE COLLISIONS	1	0%	0	0%
PED COLLISIONS	0	0%	0	0%

Alton Parkway/Gateway Intersection Injury Collisions
All Injury Collisions

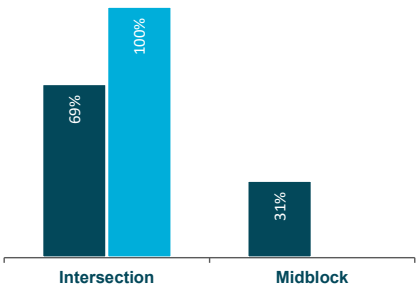
COLLISION TYPES



PRIMARY COLLISION FACTORS



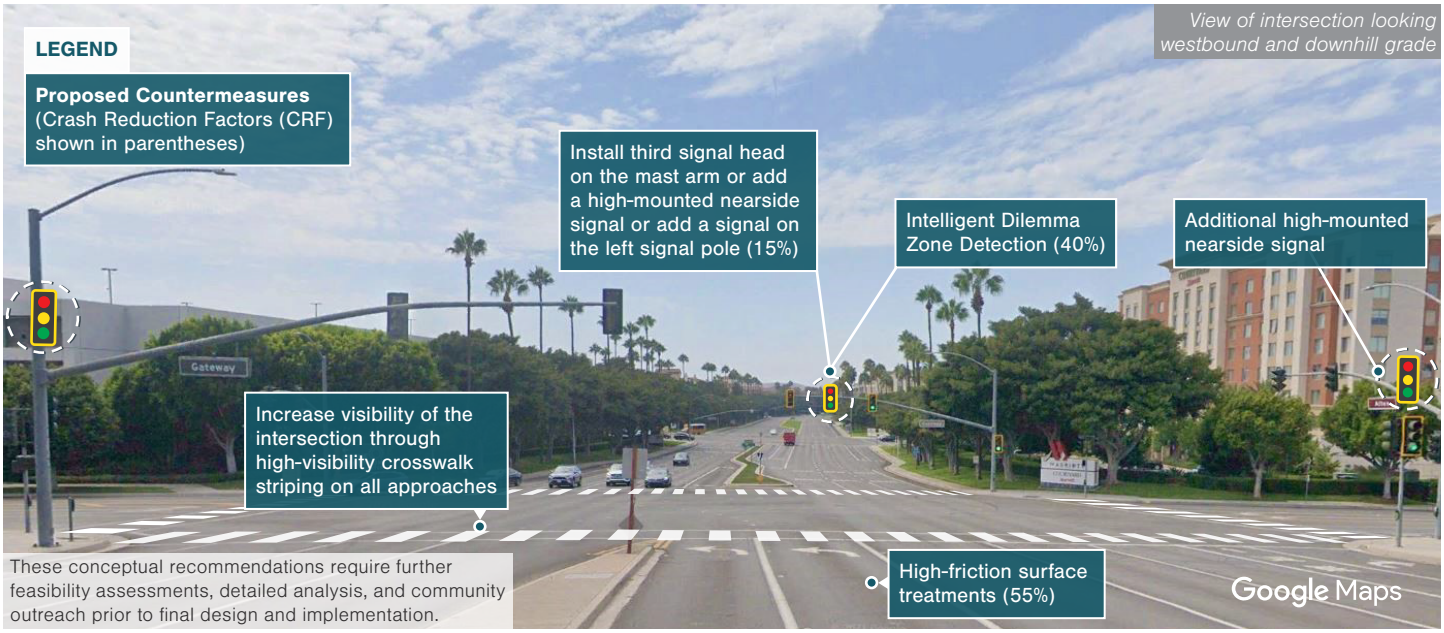
INTERSECTION VS. MIDBLOCK



HOTSPOT LOCATION 5

Alton Parkway/Gateway Intersection Context

Alton Parkway/Gateway Intersection Recommended Countermeasures



CHAPTER 6

Countermeasure Toolbox

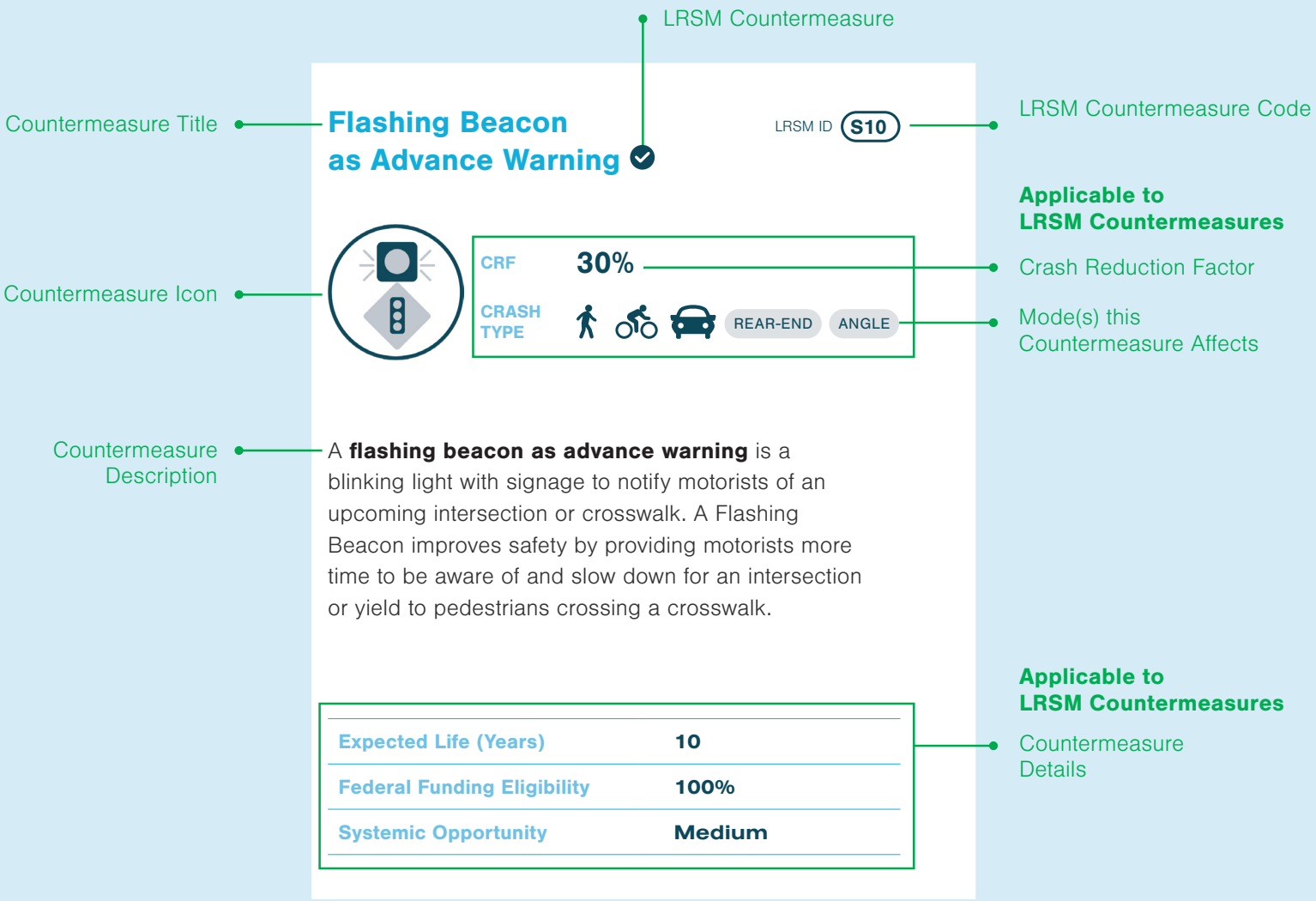
This toolbox presents safety countermeasures addressing the collision trends identified through the historical collision analysis.

Countermeasures are organized into the following:

- **Signal Modifications & ITS**
- **Intersection Control**
- **Geometric Modifications**
- **Operation/Warning**
- **Lighting**
- **Programmatic**

These countermeasures include those recommended for the Emphasis Areas identified in this plan, as well as additional countermeasures that are applicable to the City of Irvine context.

What You'll See in This Toolbox



TYPE	COUNTERMEASURE	Caltrans LRSM CRF	Broadside Collisions at Signalized Intersections
SIGNAL MODIFICATIONS & ITS	Bicycle Signals	15%	
	Extended Pedestrian Interval	15%	
	Flashing Beacon As Advance Warning	30%	✓
	Intelligent Dilemma-Zone Detection	40%	✓
	Leading Pedestrian Intervals	60%	
	Passive Pedestrian Detection	15%	
	Pedestrian Countdown Signal Heads	25%	
	Pedestrian Hybrid Beacons	55%	
	Pedestrian Scramble Phase/All Pedestrian Phase	40%	
	Protected Left Turn	30%	✓
	Restrict Right-Turn-On-Red	15%	
	Retroreflective Borders On Signals	15%	✓
	Shorten Cycle Length	15%	✓
	Signal Adaptive Speed Response	15%	✓
	Signal Rest In Red	15%	
	Supplemental Signal Heads	15%	✓
INTERSECTION CONTROL	Convert From Side-Street To All-Way Stop Control	50%	
	Led-Enhanced Stop Signs	15%	
	Multimodal Roundabouts	12-78%	✓
GEOMETRIC MODIFICATIONS	Buffered Bike Lanes		
	Curb Extensions/Bulbouts	45%	
	Lane Reduction	30%	✓
	Lane Narrowing		
	Raised Median/Refuge Island	45%	
	Separated Bike Lanes	45%	
OPERATION/ WARNING	Advanced Stop Bar	15%	
	Bicycle Crossings		
	Bike Box	15%	
	Bike Conflict Striping/Mixing Zone		
	Centerline Rumble Strips	20%	
	High Friction Surface Treatments	55%	✓
	Stripe New Crosswalk	25%	
	Modified Sign R10-15 “Turning Vehicles Yield to Ped” to include bicycles	15%	
	Rectangular Rapid Flashing Beacon	35%	
	Sign R9-5 "Bikes Use Ped Signal"		
	Speed Feedback Sign		
	Upgrade Intersection Pavement Markings	10%	✓
	Upgrade to High-Visibility Crosswalk Striping		
LIGHTING	Intersection lighting	40%	
	Segment lighting	35%	
PROGRAMMATIC	Advanced Bicycle Light Distribution Program		
	Driver Education Campaign (e.g., Safe Speeds, Safe Turns)		✓
	DUI Prevention Campaign		
	High-Visibility DUI Patrols		
	Safe Ride Home Program		
	Suggested Routes to School Program		

Overnight (9pm-6am) Collisions	Bicycle Collisions Involving Victims 19 and Under	Pedestrian Collisions In a Crosswalk at an Intersection	Bicycle Collisions Involving Drivers Making Right Turns
	✓		✓
		✓	
✓		✓	
✓		✓	
	✓	✓	✓
		✓	
		✓	
	✓		
		✓	
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Signal Modifications & ITS

Bicycle Signals

LRSM ID S02

CRF 15%

CRASH TYPE

Bicycle signals are used to clearly communicate bicycle right of way, especially at locations where bicyclists needs may be different for other road users, for example at trail crossings. Bicycle signals should be paired with existing conventional traffic signals and timed to separate bicycle movements from conflicting motor vehicle, transit, or pedestrian movements.

Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Opportunity	Medium

Extended Pedestrian Interval

LRSM ID S03

CRF 15%

CRASH TYPE

An **extended pedestrian interval** extends the clearance time for pedestrians crossing the street to accommodate for longer crossing distances and more vulnerable road users, such as children and older adults.

Expected Life (Years)	10
Federal Funding Eligibility	50%
Systemic Opportunity	Very High

Flashing Beacon as Advance Warning

LRSM ID S10

CRF 30%

CRASH TYPE

A **flashing beacon as advance warning** is a blinking light with signage to notify motorists of an upcoming intersection or crosswalk. A Flashing Beacon improves safety by providing motorists more time to be aware of and slow down for an intersection or yield to pedestrians crossing a crosswalk.

Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Opportunity	Medium

Intelligent Dilemma-Zone Detection

LRSM ID S04

CRF 40%

CRASH TYPE

An **intelligent dilemma-zone detection** system minimizes the number of vehicles the intersection traffic control signal system exposes to an intersection-approach dilemma zone. This is accomplished by adjusting the start time of the yellow-signal phase either earlier or later, based on observed vehicle locations and speeds.

Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Opportunity	High

Signal Modifications & ITS

LRSM Countermeasure

Leading Pedestrian Intervals

LRSM ID S21PB

CRF 60%

CRASH TYPE

At intersection locations that have a high volume of turning vehicle and have high pedestrian vs. vehicle crashes, a **leading pedestrian interval** 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 or right.

Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Opportunity	High

Passive Pedestrian Detection

LRSM ID S03

CRF 15%

CRASH TYPE

Passive pedestrian detection involves video sensors installed on poles and configured with detection zones within the crosswalk. Upon detection of a pedestrian in the crosswalk, the pedestrian interval is extended to allow more time for the pedestrian to cross.

Expected Life (Years)	10
Federal Funding Eligibility	50%
Systemic Opportunity	Very High

Pedestrian Countdown Signal Heads

LRSM ID S17PB

CRF 25%

CRASH TYPE

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.

Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Opportunity	Medium

Pedestrian Hybrid Beacons

LRSM ID NS23PB

CRF 30%

CRASH TYPE

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.

Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Opportunity	Medium

Signal Modifications & ITS

Pedestrian Scramble Phase/ All Pedestrian Phase

LRSM ID S19PB

CRF 40%

CRASH TYPE

An **all pedestrian phase** is a form of pedestrian "WALK" phase at a signalized intersection in which all vehicular traffic is required to stop, allowing pedestrians to safely cross through the intersection in any direction. In a **pedestrian scramble phase**, this includes diagonally.

Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Opportunity	Very High

Protected Left Turn

LRSM ID S07

CRF 30%

CRASH TYPE

A **protected left turn** can be implemented at signalized intersections (with existing left turns pockets) that currently have a permissive left-turn or no left-turn protection and have a high frequency of angle crashes involving left turning, opposing through vehicles, and non-motorized road users. Left turns are widely recognized as the highest-risk movements at signalized intersections. Providing protected left-turn phases for signalized intersections significantly improves the safety for left-turn maneuvers by removing the need for the drivers to navigate through gaps in oncoming/opposing through vehicles.

Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Opportunity	High

Restrict Right-Turn-on-Red

LRSM ID S03

CRF 15%

CRASH TYPE

Restricting right-turn-on-red movements should be considered where exclusive pedestrian “WALK” phases, Leading Pedestrian Intervals (LPIs), sight distance issues, or high pedestrian or bike volumes are present. They can help prevent crashes between vehicles turning right on red from one street and through vehicles on the cross street, and crashes involving pedestrians and bicyclists.

Expected Life (Years)	10
Federal Funding Eligibility	50%
Systemic Opportunity	Very High

Retroreflective Borders on Signals

LRSM ID S02

CRF 15%

CRASH TYPE

Retroreflective borders enhance the visibility of traffic signals for aging and color vision impaired drivers enabling them to understand which signal indication is illuminated. Retroreflective borders may also alert drivers to signalized intersections during periods of power outages when the signals would otherwise be dark, and non–reflective signal heads and backplates would not be visible.

Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Opportunity	Very High

Signal Modifications & ITS

LRSM Countermeasure

Shorten Cycle Length

LRSM ID S03

CRF 15%

CRASH TYPE

Traffic signal cycle lengths have a significant impact on the quality of the urban realm and consequently, the opportunities for bicyclists, pedestrians, and transit vehicles to operate safely along a corridor. Long signal cycles, compounded over multiple intersections, can make crossing a street or walking even a short distance prohibitive and frustrating. Short cycle lengths of 60–90 seconds are ideal but must be balanced with the time it takes for a pedestrian to cross the street, especially at wide intersections.

Expected Life (Years)	10
Federal Funding Eligibility	50%
Systemic Opportunity	Very High

Signal Adaptive Speed Response

LRSM ID S03

CRF 15%

CRASH TYPE

If speeds are observed to exceed specified thresholds, traffic signal timing is modified to a **lower progression speed** or a **speed-sensitive rest-in-red**. By modifying the progression speed, signal adaptive speed response can result in fewer collisions related to unsafe speed and decrease overall collision severity. This strategy can be accompanied by dynamic roadside signage that displays the recommended speed or vehicle-to-infrastructure (V2I) messaging.

Expected Life (Years)	10
Federal Funding Eligibility	50%
Systemic Opportunity	Very High

Signal Rest in Red

LRSM ID S03

CRF 15%

CRASH TYPE

With **rest-in-red**, signals with no volume detected will remain red instead of green, which requires drivers to slow down or stop when approaching the intersection. This can lower intersection departure speeds and reduce the frequency or severity of speed-related collisions.

Rest-in-red is intended to be implemented during low-volume conditions, such as nighttime.

Expected Life (Years)	10
Federal Funding Eligibility	50%
Systemic Opportunity	Very High

Supplemental Signal Heads

LRSM ID S02

CRF 15%

CRASH TYPE

Additional signal heads allow drivers to anticipate signal changes farther away from intersections. Supplemental traffic signals may be placed on the near side of an intersection, far-left, far-right, or very high.

Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Opportunity	Medium

Intersection Control

Convert from Side-Street to All-Way Stop Control

LRSM ID NS02

CRF 50%

CRASH TYPE

An **all-way stop-controlled intersection** requires all vehicles to stop before crossing the intersection. An all-way stop-controlled intersection improves safety by removing the need for motorists, bicyclists, and pedestrians on a side-street stop-controlled intersection to cross free-flowing lanes of traffic, which reduces the risk of collision. An "All-Way Stop" sign should be placed under stop signs at all-way stop-controlled intersections as required by the California Manual on Uniform Traffic Control Devices (MUTCD).

Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Opportunity	High

LED-Enhanced Stop Signs

LRSM ID NS08

CRF 15%

CRASH TYPE

An **LED-Enhanced Stop Sign** has LED lights embedded in the sign to outline the sign itself or the words and symbols on the sign. The LEDs may be set to flash or operate in a steady mode. An LED-enhanced sign improves safety by improving the visibility of signs at locations with visibility limitations or with a documented history of drivers failing to see or obey the stop sign.

Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Opportunity	Very High

Multimodal Roundabouts

LRSM ID S10/NS04/NS05

CRF VARIES

CRASH TYPE

A **roundabout** is a type of circular intersection in which road traffic is permitted to flow in one direction around a central island, and priority is typically given to traffic already in the junction. 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 keeps 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. See CA MUTCD Chapter 3C for details.

Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Opportunity	Low

Geometric Modifications

LRSM Countermeasure

Buffered Bike Lanes

Countermeasure not currently listed in the Caltrans LRSM

In addition to the paint stripe used for a typical bicycle lane, a lateral offset with a **painted buffer** can help to further separate bicyclists from vehicle traffic, creating a more comfortable facility for bicyclists. The buffer can be used either adjacent to the auto lane, or adjacent to the parking lane to provide a buffer for the "door zone."

Expected Life (Years)	20
Federal Funding Eligibility	N/A
Systemic Opportunity	High

Curb Extensions/ Bulbouts

LRSM ID NS19PB

CRF 35%

CRASH TYPE

A **curb extension** is a traffic calming measure which widens the sidewalk for a short distance to enhance the pedestrian crossing. This reduces the crossing distance and allowing pedestrians and drivers to see each other when parked vehicles would otherwise block visibility.

Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Opportunity	Medium

Lane Reduction

LRSM ID R14

CRF 30%

CRASH TYPE

A **lane reduction** reduces roadway space dedicated to vehicle travel lanes to create room for bicycle facilities, wider sidewalks, center turn lanes, or on-street parking.. A lane reduction improves safety by reducing vehicle speeds and creating designated space for all road users. FHWA advises that streets with 20,000 ADT or less may be good candidates for road diets, though road diets have been implemented successfully on roadways with higher traffic volumes in urban settings.

Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Opportunity	Low

Lane Narrowing

Countermeasure not currently listed in the Caltrans LRSM

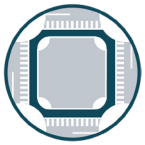
Lane narrowing reduces lane widths to encourage motorists to travel at slower speeds. Lane Narrowing improves safety by lowering the risk or severity of collisions among bicyclists, pedestrians, and other motorists.

Expected Life (Years)	20
Federal Funding Eligibility	N/A
Systemic Opportunity	High

Geometric Modifications

Protected Intersections/ Corners

LRSM ID NS19PB



CRF 45%

CRASH TYPE

Protected intersections use corner islands, curb extensions, and colored paint to delineate bicycle and pedestrian movements across an intersection. Slower driving speeds and shorter crossing distance increase safety for pedestrians.

Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Opportunity	Medium

Raised Median/ Refuge Island

LRSM ID NS19PB

CRF 45%

CRASH TYPE

A **raised median/refuge island**, is raised curb in the center of the roadway that can restrict certain turning movements and provide a place for pedestrians to wait if they are unable to finish crossing the intersection. A raised median can improve safety by reducing the number of potential conflict points with designated zones for vehicles to turn, and a pedestrian refuge island improves safety by reducing the exposure time for pedestrians crossing the intersection.

Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Opportunity	Medium

Separated Bike Lanes

LRSM ID R33PB

CRF 45%

CRASH TYPE

A **separated bike lane** provides dedicated street space, typically adjacent to outer vehicle travel lanes, with separation from vehicle traffic, designated lane markings, pavement legends, and signage. Bike lanes improve safety by reducing conflicts between bicycles and vehicles on the road and by creating a road-narrowing effect with buffers or vertical barriers, which may reduce vehicle speeds.

Expected Life (Years)	20
Federal Funding Eligibility	90%
Systemic Opportunity	High

Operations/Warning

LRSM Countermeasure

Advanced Stop Bar

LRSM ID S20PB

CRF 15%

CRASH TYPE

An **advance stop bar** is a horizontal stripe painted ahead of the crosswalk at stop signs and signals to indicate where drivers should stop. An advanced stop bar improves safety by reducing instances of vehicles encroaching on the crosswalk. Creating a wider stop bar or setting the stop bar further back may be appropriate for locations with known crosswalk encroachment issues. See CA MUTCD Section 3B.16 for more information.

Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Opportunity	Very High

Bicycle Crossings

Countermeasure not currently listed in the Caltrans LRSM

Bicycle crossings are markings through the intersection or across driveways that indicate the intended path of bicyclists, separated from the through movements of autos and pedestrians. Their use is intended to raise awareness of potential conflict areas, reduce bicyclist stress by delineating the bicycling zone, and increase visibility of bicyclists.

Bike Box

LRSM ID S20PB

CRF 15%

CRASH TYPE

A **bike box** is a designated area at the head of a traffic lane at a signalized intersection that provides bicyclists with a safe and visible way to get ahead of queuing traffic during the red signal phase.

Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Opportunity	Very High

Bike Conflict Striping/ Mixing Zone

Countermeasure not currently listed in the Caltrans LRSM

Bike conflict striping are markings painted in a dashed pattern on bike lanes approaching an intersection and/or going through an intersection. Conflict striping highlights potential conflict points and communicates the expected trajectory of bicyclists through those conflict points. Green paint is typically used for conflict striping to enhance the visibility of the conflict zone.

Operations/Warning

Centerline Rumble Strips

LRSM ID R30

CRF 20%

CRASH TYPE

Centerline rumble strips create noise and vibration inside the vehicle that alert a driver as they cross the center or edge line. Often this alert is strong enough to get the attention of a distracted or drowsy driver, who can quickly make a corrective steering action to return to the roadway safely.

Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Opportunity	High

High Friction Surface Treatment

LRSM ID R21

CRF 55%

CRASH TYPE

A roadway must have an appropriate level of pavement friction to ensure that drivers are able to keep their vehicles safely in the lane. **Pavement friction** is critical for changing vehicle direction and ensuring the vehicle remains in its lane. Traditional friction courses or high friction surface treatments should be considered for curves with numerous wet weather crashes or severe curves with higher operating speeds.

Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Opportunity	High

Stripe New Crosswalk

LRSM ID S18PB

CRF 25%

CRASH TYPE

Install **new pedestrian crossings** at signalized locations where there are currently no striped crosswalks or pedestrian signal heads. 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.

Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Opportunity	Medium

Modified Sign R10-15 "Turning Vehicles Yield to Ped" to include bicycles

LRSM ID NS06

CRF 15%

CRASH TYPE

Installing **additional warning signs** can help bring awareness to an intersection. These enhancements improve safety by increasing visibility of the information provided. CTCDC approval is currently needed for the modified R10-15. It is used in cities in CA and other states and is consistent with a previous CTCDC experimentation request approved in August 2018.

Expected Life (Years)	10
Federal Funding Eligibility	100%
Systemic Opportunity	High

Operations/Warning

LRSM Countermeasure

Rectangular Rapid Flashing Beacon

LRSM ID NS22PB

CRF 45%

CRASH TYPE

A **rectangular rapid flashing beacon (RRFB)** is a pedestrian-activated flashing light with additional signage to alert motorists of a pedestrian crossing. An RRFB improves safety by increasing motorist yield compliance at uncontrolled locations.

Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Opportunity	Medium

Sign R9-5 "Bikes Use Ped Signal"

Countermeasure not currently listed in Caltrans LRSM

Sign R9-5 "Bikes Use Ped Signal" should be used in conjunction with LPIs or at trail crossings where bicyclists are intended to cross with the pedestrian movement.

Adding signage helps clarify the intended rules of the road for all users.

Speed Feedback Sign

Countermeasure not currently listed in Caltrans LRSM

A **speed feedback sign** notifies drivers of their current speed, usually followed by a reminder of the posted speed limit. A Speed Feedback Sign improves safety by providing a cue for drivers to check their speed and slow down, if necessary.

Operations/Warning

Upgrade to High-Visibility Crosswalk Striping

Countermeasure not currently listed in Caltrans LRSM

A **high-visibility crosswalk** has a striped pattern with markings made of high-visibility material, such as thermoplastic tape, instead of paint. A high-visibility crosswalk improves safety with a clearly marked pedestrian crossing so motorists exercise caution and yield to pedestrians. High-visibility crosswalk upgrades can be implemented systemically at existing marked crosswalks. See further information on crosswalks in Section 3B.18 of the CA MUTCD for more detail. FHWA's Proven Safety Countermeasures lists a CRF of up to 40% for high-visibility crosswalks.

Upgrade Intersection Pavement Markings

LRSM ID **NS07**

CRF **25%**

CRASH TYPE

Upgrading intersection pavement markings can include "Stop Ahead" markings and the addition of centerlines and stop bars. Upgrading intersection pavement markings improve safety by increasing the visibility of intersections for drivers approaching and at the intersection.

Expected Life (Years)	**10**
Federal Funding Eligibility	**100%**
Systemic Opportunity	**Very High**

Lighting

LRSM Countermeasure

Intersection Lighting

LRSM ID S01/NS01

CRF 40%

CRASH TYPE NIGHT

Adding Intersection Lighting 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. Upgrading to LED lighting also has a documented safety benefit.

Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Opportunity	Medium

Segment Lighting

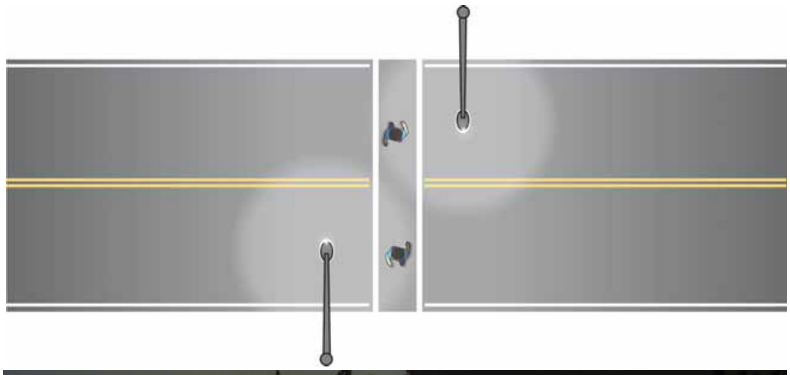
LRSM ID R01

CRF 35%

CRASH TYPE NIGHT

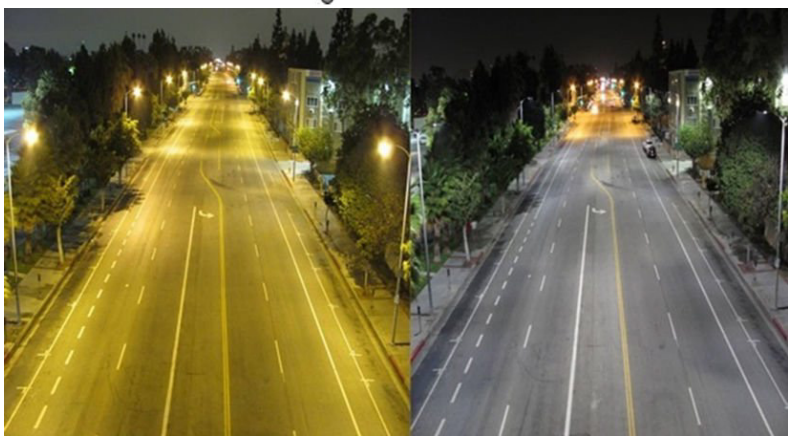
Providing **segment lighting** improves safety during nighttime conditions by making drivers more aware of the surroundings, which improves drivers' perception-reaction times; enhancing drivers' available sight distances to perceive roadway characteristic in advance of the change; and improving non-motorist's visibility and navigation. Upgrading to LED lighting also has a documented safety benefit.

Expected Life (Years)	20
Federal Funding Eligibility	100%
Systemic Opportunity	Medium



GUIDANCE FOR LIGHTING AT MIDBLOCK CROSSWALKS

Source: FHWA



HIGH PRESSURE SODIUM (HPS) STREET LIGHTS (shown left) **TO LIGHT EMITTING DIODE (LED) LIGHTS** (shown right)

Programmatic

Countermeasures that Work
Effectiveness Rating

Countermeasures That Work
National Highway Traffic Safety Administration, 2017

Demonstrated to be effective
by several high-quality evaluations with consistent results

Demonstrated to be effective
in certain situations

Likely to be effective
based on balance of evidence from high-quality evaluations or other sources

Effectiveness still undetermined;
different methods of implementing this countermeasure produce different results

Limited or no high-quality evaluation evidence

Advanced Bicycle Light Distribution Program

Distribute bicycle taillights that react based on detected risk, such as oncoming cars or bicyclists breaking in a peloton.

Best Practice Resource	-
Lead Agency	Irvine Public Works and Transportation Department in partnership with local bicycle clubs and shops
Effectiveness	-
Funding Source	SCAG Go Human Grants

Programmatic

Education & Public Awareness Campaign

Expand upon the existing public awareness campaigns to establish an ongoing public education media campaign focused on safe and responsible driving, educating on the dangers of red-light running, speeding, and drinking and driving. An example of this campaign would be collaborating with local school districts and radio stations to disseminate safety messages. Ensure that messaging is consistent and in alignment with rules of the road, per the California Vehicle Code and City of Irvine Municipal Code.

Best Practice Resource	**SCAG Go Human Campaign; OTS Go Safety California Campaign** **USDOT Traffic Safety Marketing** **San Francisco Municipal Transportation Agency's "Be Nice, Look Twice" pedestrian safety campaign and "Safety - It's Your Turn" campaign**
Lead Agency	**Irvine Public Works and Transportation Department with support from the Irvine Public Safety Department**
Effectiveness	 **Mass Media Campaign on DUI**
Funding Source	**California Office of Traffic Safety (OTS) Grants** **SCAG Go Human Grants**

High-Visibility DUI Patrols

Irvine Public Safety Department should continue their use of high-visibility enforcement for DUIs, publicized checkpoints, and deterrence policies, focusing on raising the actual and perceived risk of detection of driving under the influence. Enforcement should be paired with widespread dissemination of multi-lingual educational messaging and promotion of safe rides home programs in advance of major enforcement efforts to mitigate equity concerns about disproportionate impacts of fines/fees on lower income residents.

EQUITY CONSIDERATIONS

Enforcement of traffic laws is a common strategy to increase street safety, but historical enforcement techniques and strategies have raised concerns about racial profiling, police violence, and the impacts of policing on communities of color. According to the US Department of Justice, Black and Hispanic people are more likely than white people to experience use of force when they are stopped by police. To ensure that efforts to improve safety recognize that all people have the right to move about their communities safely, enforcement should be paired with equity-oriented programs such as enacting progressive fine structures, analyzing demographic data in traffic citations, and culturally relevant education and outreach.

Best Practice Resource	-
Lead Agency	**Irvine Public Safety Department**
Effectiveness	 **Publicized Sobriety Checkpoints**  **High-Visibility Saturation Patrols**
Funding Source	**California Office of Traffic Safety (OTS) Grants**

Programmatic

Safe Ride Home Program

Develop partnerships with transportation network companies (e.g., Uber, Lyft) and OCTA to offer promotional codes for free or discounted rides home from establishments or events to reduce the potential for DUI, drowsy driving, or distracted driving. This program may be focused on particular holidays or event days or applied more broadly to weekend nights. The program could also be specifically catered toward college students throughout the City.

Best Practice Resource	Portland Bureau of Transportation Safe Ride Home Program
Lead Agency	Irvine Public Works and Transportation Department with support from OCTA
Effectiveness	★★★☆☆ Alternative Transportation
Funding Source	User Fees

Suggested Routes to School Program

Expand upon the existing Suggested Routes to School program to identify school area traffic safety measures. Integrate existing student outreach and education efforts into the program to establish a single, comprehensive program.

Best Practice Resource	Safe Routes - National Center for Safe Routes to School
Lead Agency	Irvine Public Works and Transportation Department with support from the Irvine Public Safety Department
Effectiveness	★★★☆☆ Safe Routes to School
Funding Source	California Active Transportation Program (ATP) Grants

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CHAPTER 7

Implementation & Evaluation

This chapter describes the process that can be used by the City to evaluate the success of the LRSP, ensure implementation, and identify funding sources for projects.

Implementation

To successfully implement programs and projects outlined in this LRSP, partnerships, trust, funding, and coordination need to be proactively managed. Successful implementation requires sustained and coordinated support from key stakeholders, elected officials, and City staff. Strategies include the following:

Continue stakeholder engagement

Continue close coordination with the internal stakeholder group established through this LRSP process, who will ultimately be responsible for implementing the countermeasures identified in this LRSP. This multi-disciplinary group will ensure that an integrated approach will be taken to implementation - ensuring that City-led engineering countermeasures are supported by coordinated enforcement, education, and engagement programs led by local and regional partners. It is recommended that this group meet biannually or quarterly to maintain momentum.

Provide regular updates to the community

Having continued communication and transparency with stakeholders and community members can allow for greater trust and support of the LRSP's goals. Strategies could include conducting briefings and presentations at board and agency meetings, collecting and sharing information on a regular basis, and updating a public-facing database (or scorecard) on LRSP goal progress.

Identify efficiencies in project delivery

Look for funding and implementation efficiencies through mechanisms such as project bundling, scope modifications of capital improvement projects, and integration of safety projects into routine maintenance work.

Evaluation

Evaluation identifies possible opportunities to inform future decision-making and allows the City to understand how it is doing against the goal of reducing the number of fatal and severe injury collisions on City roadways. Annual evaluation is encouraged.

CITY OF IRVINE LRSP VISION AND GOALS	METRIC
The City takes a proactive approach in advancing transportation safety for all who share our streets by reducing the number of fatal and severe injury collisions on City roadways.	**Total KSI collisions**
	Number of HSIP grant applications submitted
Prioritize infrastructure and programmatic investments that address the City's most frequent and severe collision profiles.	**Number of safety engineering countermeasures implemented**
	Percent of Public Works and Transportation Department projects with a safety component
Educate road users on the role they play in creating safer streets.	**Number of education, engagement, and enforcement campaigns or programs implemented**
	Percent of transportation projects paired with education, engagement, or enforcement strategy
Support the mobility of the City's most vulnerable road users by reducing the number of collisions involving pedestrians, bicyclists, and children.	**Total pedestrian and bicycle collisions**
	Total injury collisions involving a victim under 19
Establish safe and context-appropriate speeds on all City roadways.	**85th percentile speeds**

Funding

While the primary purpose of this LRSP is to prepare the City to submit successful Highway Safety Improvement Program (HSIP) applications, safety projects can be funded through a wide range of additional sources at the regional, state, and federal levels. HSIP funds are largely awarded based on a benefit/cost analysis using a set of Caltrans-approved countermeasures with documented collision reduction factors and historic collision data. While many safety projects will perform well in the HSIP process, others may be successfully funded through other sources that consider additional factors, such as the Active Transportation Program (ATP). The sources in this chapter may be used to fund a broad scope of projects targeting air quality and sustainability, affordable housing, and transportation. Successful projects often entail creative solutions that address impact areas beyond transportation safety alone.

FUNDING LEVEL	GRANT	NEXT OPPORTUNITY
Local/Regional	SCAG Sustainable Communities Program	2022
Local/Regional	OCTA Bicycle Corridor Improvement Program	2023/2024 (TBD)
Local/Regional	Regional Traffic Signal Synchronization Program	TBD
State	Highway Safety Improvement Program (HSIP)	2022 - Spring
State	Active Transportation Program (ATP)	2022- June 15
State	SB 1 Local Streets and Roads Program (LSRP)	2022 - Summer/Fall (TBD)
State	Caltrans Sustainable Communities Grants	2022 - Fall (TBD)
State	California Office Of Traffic Safety (OTS) Grant Programs	TBD
State	SB 1 Solutions for Congested Corridors Program (SCCP)	2022 - Spring
State	SB 1 Local Partnership Program (LPP)	2022 - Spring
State	SB 1 State Transportation Improvement Program (STIP)	2022 - Spring
State	California Natural Resources Agency Urban Greening Program	2022 (TBD)
Federal	RAISE Grants (Formerly BUILD and TIGER)	2022 - April
Federal	Safe Streets and Roads for All (SS4A) Grant Program	2022 - Spring

Local and Regional Sources

SCAG SUSTAINABLE COMMUNITIES PROGRAM

Provides direct technical assistance to SCAG member jurisdictions to complete planning and policy efforts that enable implementation of the regional SCS). Grants are available in four categories: Civic Engagement, Equity & Environmental Justice; Smart Cities & Mobility Innovations; Housing & Sustainable Development; Active Transportation & Safety.

OCTA BICYCLE CORRIDOR IMPROVEMENT PROGRAM

The Bicycle Corridor Improvement Program (BCIP) makes funding available to local Orange County agencies for bicycle and pedestrian projects that reduce traffic congestion and improve air quality.

REGIONAL TRAFFIC SIGNAL SYNCHRONIZATION PROGRAM

On August 9, 2021, the Orange County Transportation Authority's (OCTA) Board of Directors authorized staff to issue calls for projects for the Regional Traffic Signal Synchronization Program. This program includes competitive funding for the coordination of traffic signals across jurisdictional boundaries including project based operational and maintenance funding. OCTA will provide funding priority to programs and projects, which are multi-jurisdictional in nature.

State Sources

HIGHWAY SAFETY IMPROVEMENT PROGRAM (HSIP)

HSIP is a core federal-aid program to States for the purpose of achieving a significant reduction in fatalities and serious injuries on all public roads. California's Local HSIP focuses on infrastructure projects with nationally recognized crash reduction factors (CRFs). This is the primary grant funding source to support roadway projects identified through the LRSP.

ACTIVE TRANSPORTATION PROGRAM (ATP)

ATP is a statewide competitive grant application process with the goal of encouraging increased use of active modes of transportation. The ATP consolidates existing federal and state transportation programs, including the Transportation Alternatives Program (TAP), Bicycle Transportation Account (BTA), and State Safe Routes to School (SRTS), into a single program with a focus to make California a national leader in active transportation. The ATP administered by the Division of Local Assistance, Office of State Programs.

SB 1 LOCAL STREETS AND ROADS PROGRAM (LSRP)

SB 1 dedicated approximately $1.5 billion per year in new formula revenues apportioned by the State Controller to cities and counties for basic road maintenance, rehabilitation, and critical safety projects on the local streets and roads system.

CALTRANS SUSTAINABLE COMMUNITIES GRANTS

To encourage local and regional planning that furthers state goals, including, but not limited to, the goals and best practices cited in the Regional Transportation Plan Guidelines adopted by the California Transportation Commission.

CALIFORNIA OFFICE OF TRAFFIC SAFETY (OTS) GRANT PROGRAMS

OTS administers traffic safety grants in the following areas: Alcohol Impaired Driving, Distracted Driving, Drug-Impaired Driving, Emergency Medical Services, Motorcycle Safety, Occupant Protection, Pedestrian and Bicycle Safety, Police Traffic Services, Public Relations, Advertising, and Roadway Safety and Traffic Records.

SB 1 SOLUTIONS FOR CONGESTED CORRIDORS PROGRAM (SCCP)

The Solutions for Congested Corridors Program funds projects designed to reduce congestion in highly traveled and highly congested corridors. This statewide, competitive program makes $250 million available annually for projects that implement specific transportation performance improvements and are part of a comprehensive corridor plan by providing more transportation choices while preserving the character of local communities and creating opportunities for neighborhood enhancement.

SB1 LOCAL PARTNERSHIP PROGRAM (LPP)

The purpose of this program is to provide local and regional transportation agencies that have passed sales tax measures, developer fees, or other imposed transportation fees with a continuous appropriation of $200 million annually from the Road Maintenance and Rehabilitation Account to fund road maintenance and rehabilitation, sound walls, and active transportation projects. There is also a competitive grant portion of this project.

SB1 STATE TRANSPORTATION IMPROVEMENT PROGRAM (STIP)

The State Transportation Improvement Program (STIP) is the biennial five-year plan for future allocations of certain state transportation funds for state highway improvements, intercity rail, and regional highway and transit improvements.

CALIFORNIA NATURAL RESOURCES AGENCY URBAN GREENING PROGRAM

This program supports projects that "use natural systems or systems that mimic natural systems to achieve multiple benefits." Eligible projects include "non-motorized urban trails that provide safe routes for travel between residences, workplaces, commercial centers, and schools."

Federal Sources

RAISE GRANTS (FORMERLY BUILD AND TIGER)

The Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Discretionary Grant program provides a unique opportunity for the DOT to invest in road, rail, transit, and port projects that promise to achieve national objectives. This cycle's program selection criteria encompass safety, environmental sustainability, quality of life, economic competitiveness, state of good repair, innovation, and partnerships with a broad range of stakeholders. The first round of RAISE grants awarded $417m to bicycle and pedestrian projects, and $30m for planning grants (eligible for the first time).

SAFE STREETS AND ROADS FOR ALL GRANTS

The recent federal infrastructure bill established the new Safe Streets for All program to provide $5b in grant funding to develop and implement Vision Zero safety plans. Current legislation emphasizes funding of planning efforts, but the focus on implementation funding is expected to increase over the next few years.

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FEHR PEERS

Irvine LRSP Appendix A

Date: February 2022

Subject: Irvine Local Road Safety Plan Systemic Analysis

OC21- 0803

Systemic analysis is a proactive safety approach that focuses on evaluating an entire roadway network using a defined set of criteria. It looks at collision history on an aggregate basis to identify high-risk roadway characteristics in addition to looking at high-collision concentration locations. By merging roadway and intersection features with collision data, relationships can be uncovered between contextual factors and the risk of frequent and severe collisions.

Collision data was paired with geographic roadway and other contextual data to develop collision types. Outputs from this analysis were used to populate a set of matrices that allow us to look at crosstabs (collision data in rows and geographic data in columns) for collisions across the entire roadway network. The matrices allowed for identification of the combinations of factors that contributed to a high number of all collisions, and combinations that led to a high number of fatal and severe collisions.

Contextual Data Assumptions

To better understand systemic collision patterns in Irvine, several contextual factors were analyzed in conjunction with collision characteristics. Key contextual factors include:

- Roadway type and number of lanes
- Signalized & unsignalized intersections and midblock locations
- Proximity to schools, parks, civic centers, and bus stops
- Roadway speed

Additionally, collisions were matched with the characteristics of a roadway in which they occurred, including roadway classification, number of lanes, and posted speed limit. The proximity to each contextual factor varied based on its area of influence (e.g. a school has a much larger area of influence than a transit stop). The distances for each factor are summarized in the following tables. Irvine roadways by General Plan classification, number of lanes, and posted speed can be seen in the maps included in this appendix.

Table A-1: Contextual Factor Assumptions

Contextual Factors	Distance
Bicycle Facilities *Class I, II, III*	100'
Transit Stops	250'
Metrolink Stations	1,240'
Number of Lanes	100'
Posted Roadway Speeds	100'
Roadway Type	100'
Signalized Intersections	50' Minor Roadway 250' Major Roadway
Unsignalized Intersections	50' Minor Roadway 250' Major Roadway

Source: Fehr & Peers, 2021.

Table A-2: Land Use Contextual Factor Assumptions

Land Use Type	Distance
Schools	1000'
Parks	1000'
Civic Centers	1000'
Disadvantaged Communities	100'

Source: Fehr & Peers, 2021.

Table A-3: Number of Lane Assumptions

City of Irvine General Plan Roadway Classifications	Lanes	Exceptions
Expressway	8	
Major 8 Lane	8	Red Hill south of Macarthur has 4 lanes
Major 6 Lane	6	
Primary	4	University segment has 5 lanes Laguna Canyon north of Pavona has 6 lanes
Secondary	4	A few residential streets like Creek, Eastwood, Hicks, portion of Shady Canyon have 2 lanes
Commuter	2	
Local	2	
Private	2	

Source: Fehr & Peers, 2021.

ALL INJURY COLLISIONS		Roadway Type															Location Type			
		3 Lanes or Less					4 Lanes					6+ Lanes					Signal	Unsignalized Intersection		Midblock
	Speed:	15-25	30-35	40-45	50-55	60-65	15-25	30-35	40-45	50-55	60-65	15-25	30-35	40-45	50-55	60-65		Major	Minor	
Violation	Driving Under Influence	0	21	0	1	0	0	2	26	33	0	0	0	14	63	3	97	14	5	47
	Unsafe Speed	1	65	12	6	3	0	11	105	91	1	0	0	64	432	15	405	46	26	329
	Improper Turning	0	42	8	5	0	0	4	36	30	1	0	0	13	74	3	101	20	17	78
	Vehicle Right of Way Violation	1	85	9	0	2	0	13	99	54	0	0	0	21	105	3	178	65	60	89
	Traffic Signals and Signs	2	22	10	4	1	0	1	90	87	0	0	0	77	190	13	457	11	18	11
Type	Head-On	0	15	2	2	2	0	3	24	17	0	0	0	15	43	4	86	12	7	22
	Sideswipe	0	24	4	0	0	0	0	27	19	1	0	0	17	70	6	91	14	6	57
	Rear End	1	43	8	3	4	0	7	104	92	1	0	0	76	470	15	470	38	13	303
	Broadside	2	115	21	5	0	3	14	175	155	0	0	0	101	330	15	668	75	76	117
	Hit Object	0	38	8	4	0	0	7	31	29	0	0	0	7	58	6	63	21	14	90
Time of Day	mid-3 am	0	9	1	0	0	0	2	14	7	1	0	0	6	24	1	39	5	4	17
	3 am - 6 am	0	9	2	0	0	0	1	11	7	0	0	0	6	18	0	33	5	0	16
	6 am - 9 am	0	52	7	2	2	1	7	72	52	1	0	0	22	125	8	191	36	41	83
	9 am - noon	1	40	11	5	1	0	3	67	54	0	0	0	39	167	10	270	23	21	84
	noon- 3 pm	0	68	9	1	0	0	9	105	87	0	0	0	47	228	8	341	47	36	138
	3 pm - 6 pm	3	68	12	6	2	1	11	120	93	0	0	0	65	288	14	381	60	39	203
	6 pm - 9 pm	2	57	9	1	0	1	5	60	46	0	0	0	45	167	6	236	24	28	111
	9 pm - mid	0	24	2	2	1	0	1	29	27	0	0	0	18	62	3	109	11	10	39
Driver At Fault Movement	Proceeding Straight	4	120	21	8	3	1	16	203	201	0	0	0	134	642	24	887	64	62	364
	Making Right Turn	1	29	4	4	1	0	3	33	23	1	0	0	9	57	0	110	14	20	21
	Making Left Turn	1	63	12	1	1	0	8	101	55	0	0	0	23	116	4	201	66	47	71
Victim Age	Under 19	3	88	11	4	1	3	13	112	61	1	0	0	29	163	6	256	51	64	124
	60+	1	48	8	5	1	0	5	79	57	1	0	0	38	165	10	265	35	24	94
TOTAL		6	327	53	17	6	3	39	478	373	2	0	0	248	1,079	50	1,600	211	179	691
	Share of roadway/intersections:	1%	73%	3%	0%	0%	0%	2%	6%	5%	0%	0%	0%	1%	8%	1%				
	Share of collisions:	0%	12%	2%	1%	0%	0%	1%	18%	14%	0%	0%	0%	9%	40%	2%				

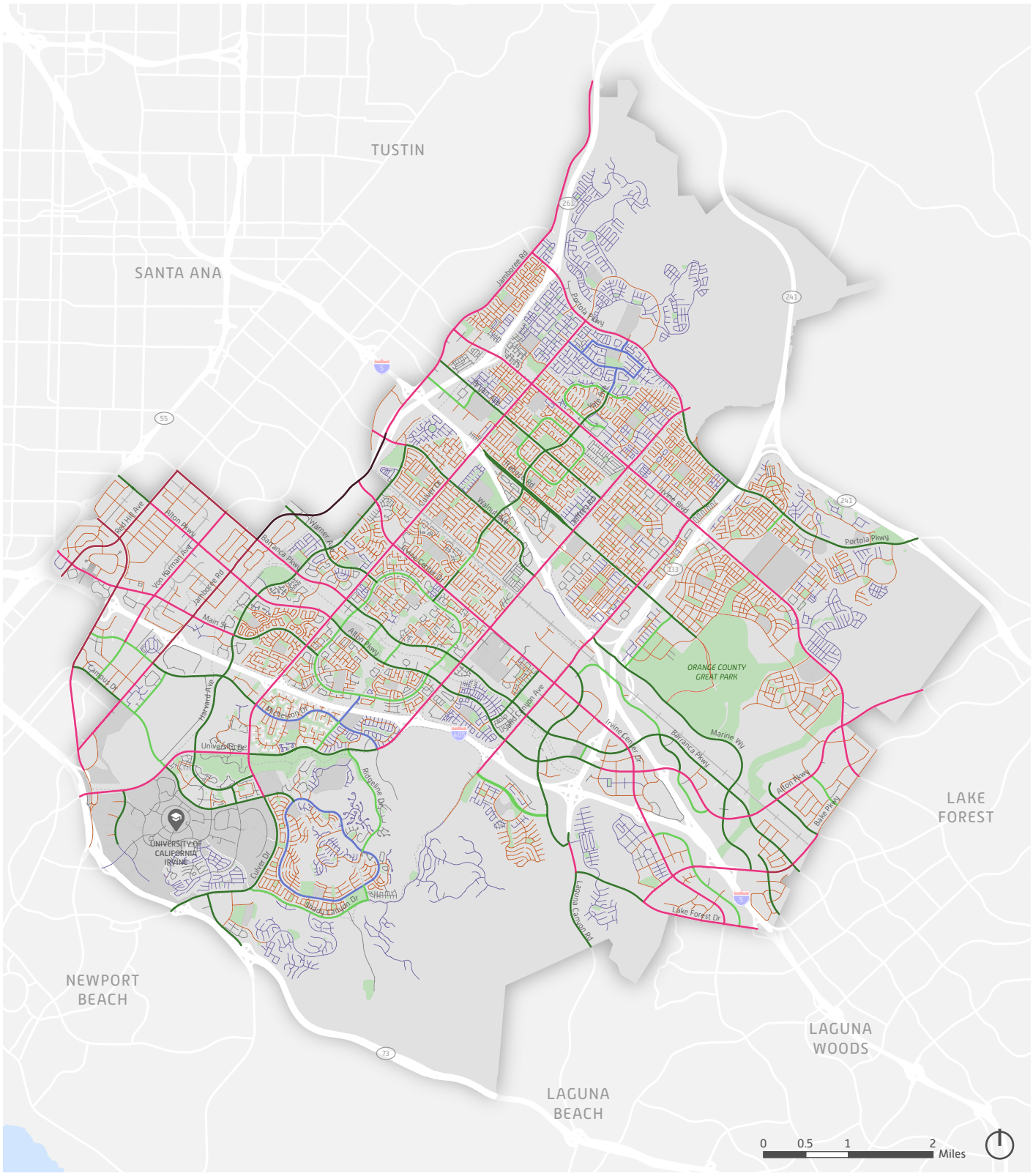
ALL INJURY COLLISIONS		General Plan Class								Near School	Near Park	Near Civic Center	Near Bus Stop	Development Areas					TOTAL
		Major 8 Lane	Major 6 Lane	Expressway	Primary	Secondary	Commuter	Local	Private					1	2	3	4	5	
Violation	Driving Under Influence	18	69	0	40	12	3	19	2	35	99	11	62	36	30	56	27	14	163
	Unsafe Speed	89	427	5	162	22	11	77	5	218	470	35	301	179	141	296	129	61	806
	Improper Turning	17	76	2	50	17	8	45	0	56	136	8	71	39	48	75	44	10	216
	Vehicle Right of Way Violation	21	116	0	120	25	16	88	1	92	235	15	147	75	65	150	65	37	392
	Traffic Signals and Signs	38	272	11	126	11	6	25	2	103	249	27	291	92	54	236	74	41	497
Type	Head-On	9	56	0	33	5	3	18	2	26	74	7	53	27	14	52	23	11	127
	Sideswipe	18	78	1	38	5	1	26	1	45	89	10	60	40	22	64	26	16	168
	Rear End	111	449	7	168	19	11	53	2	211	464	32	342	203	129	320	120	52	824
	Broadside	69	429	11	232	41	18	123	2	216	510	45	467	190	133	384	150	79	936
	Hit Object	8	65	1	44	16	8	43	3	48	131	8	40	21	48	48	48	23	188
Time of Day	mid-3 am	3	31	0	14	5	2	10	0	15	43	7	19	7	14	25	14	5	65
	3 am - 6 am	7	18	1	13	4	1	9	1	9	29	3	21	10	16	14	7	7	54
	6 am - 9 am	24	136	3	95	20	14	55	2	102	223	11	124	59	56	140	72	24	351
	9 am - noon	33	188	8	98	8	5	53	1	98	221	18	177	93	71	142	62	30	398
	noon- 3 pm	38	259	3	146	30	12	68	2	159	337	28	243	92	82	255	93	40	562
	3 pm - 6 pm	66	310	4	170	33	16	76	2	168	390	26	280	159	121	232	112	59	683
	6 pm - 9 pm	36	194	2	82	10	10	61	2	77	237	13	177	75	67	166	64	27	399
	9 pm - mid	19	77	1	32	9	3	21	1	38	95	12	82	34	24	65	33	13	169
Driver At Fault Movement	Proceeding Straight	137	700	15	312	46	21	134	3	329	774	68	629	294	212	556	210	105	1,377
	Making Right Turn	11	56	1	49	6	5	33	0	42	98	6	76	33	33	59	31	9	165
	Making Left Turn	24	130	0	117	24	16	69	3	95	246	12	149	65	68	151	72	29	385
Victim Age	Under 19	19	184	3	136	29	21	92	2	151	374	27	177	39	91	226	113	26	495
	60+	30	187	5	111	20	13	46	4	106	268	24	179	61	79	170	79	29	418
TOTAL		226	1,213	22	650	119	63	353	11	666	1,575	118	1,123	529	451	1,039	457	205	
	Share of roadway/intersections:	1%	8%	0%	10%	4%	2%	50%	26%					20%	17%	39%	17%	8%	
	Share of collisions:	9%	46%	1%	24%	4%	2%	13%	0%										

KSI COLLISIONS		Roadway Type																		
		3 Lanes or Less					4 Lanes					6+ Lanes					Signal	Unsignalized Intersection		Midblock
	Speed:	15-25	30-35	40-45	50-55	60-65	15-25	30-35	40-45	50-55	60-65	15-25	30-35	40-45	50-55	60-65		Major	Minor	
Violation	Driving Under Influence	0	0	0	1	0	0	1	5	9	0	0	0	2	5	1	13	4	0	7
	Unsafe Speed	0	2	0	0	0	0	0	6	6	0	0	0	3	11	1	13	5	0	11
	Improper Turning	0	5	1	0	0	0	0	4	2	0	0	0	2	5	0	8	1	1	9
	Vehicle Right of Way Violation	0	3	1	0	0	0	1	4	5	0	0	0	3	4	1	14	2	3	3
	Traffic Signals and Signs	0	1	1	0	0	0	0	10	6	0	0	0	3	8	2	29	1	1	0
Type	Head-On	0	1	1	0	0	0	0	0	3	0	0	0	3	5	1	9	3	1	1
	Sideswipe	0	3	1	0	0	0	0	1	3	0	0	0	0	6	0	6	1	0	7
	Rear End	0	0	0	0	0	0	0	2	0	0	0	0	2	4	0	4	0	0	4
	Broadside	0	4	1	0	0	0	1	14	14	0	0	0	5	20	3	51	4	1	6
	Hit Object	0	4	0	1	0	0	1	5	9	0	0	0	1	4	1	9	3	1	13
Time of Day	mid-3 am	0	0	0	0	0	0	0	6	2	0	0	0	1	3	0	8	2	0	2
	3 am - 6 am	0	1	0	0	0	0	0	2	2	0	0	0	2	2	0	7	0	0	2
	6 am - 9 am	0	5	0	0	0	0	0	5	3	0	0	0	1	5	0	11	3	2	3
	9 am - noon	0	2	1	0	0	0	0	8	3	0	0	0	4	20	0	27	2	1	8
	noon- 3 pm	0	3	2	0	0	0	0	5	4	0	0	0	1	5	1	11	3	2	5
	3 pm - 6 pm	1	6	1	0	0	0	3	7	13	0	0	0	6	13	3	32	4	4	13
	6 pm - 9 pm	0	7	0	0	0	0	0	3	8	0	0	0	2	3	1	12	3	1	8
	9 pm - mid	0	2	1	1	0	0	0	1	2	0	0	0	1	2	0	3	1	2	4
Driver At Fault Movement	Proceeding Straight	0	9	3	1	0	0	1	17	18	0	0	0	4	22	3	49	7	6	16
	Making Right Turn	0	1	0	0	0	0	0	0	1	0	0	0	1	4	0	5	0	1	1
	Making Left Turn	1	5	1	0	0	0	1	7	4	0	0	0	2	4	2	16	3	4	4
Victim Age	Under 19	1	5	1	0	0	0	3	5	6	0	0	0	1	6	1	18	2	3	6
	60+	0	8	1	0	0	0	0	6	4	0	0	0	2	11	2	16	4	6	8
TOTAL		1	26	5	1	0	0	3	37	37	0	0	0	18	53	5	111	18	12	45

Share of roadway/intersections:	1%	68%	2%	7%	0%	0%	1%	6%	5%	0%	0%	0%	1%	8%	1%	
Share of collisions:	1%	14%	3%	1%	0%	0%	2%	20%	20%	0%	0%	0%	10%	28%	3%	

KSI COLLISIONS		General Plan Class								Near School	Near Park	Near Civic Center	Near Bus Stop	Development Areas					TOTAL
		Major 8 Lane	Major 6 Lane	Expressway	Primary	Secondary	Commuter	Local	Private					1	2	3	4	5	
Violation	Driving Under Influence	2	8	0	8	6	0	0	0	8	17	1	8	7	9	4	3	1	24
	Unsafe Speed	1	14	0	10	2	0	2	0	5	16	3	10	6	5	8	7	3	29
	Improper Turning	0	8	0	5	0	0	6	0	3	10	1	4	1	3	7	6	2	19
	Vehicle Right of Way Violation	2	6	0	9	0	0	5	0	4	12	0	6	2	4	6	4	6	22
	Traffic Signals and Signs	1	14	2	11	1	0	2	0	5	13	0	18	5	5	14	3	4	31
Type	Head-On	1	8	0	3	0	0	2	0	3	8	0	5	3	3	3	3	2	14
	Sideswipe	1	5	0	3	1	0	4	0	4	8	0	3	2	3	4	3	2	14
	Rear End	2	4	0	2	0	0	0	0	2	2	1	4	6	0	2	0	0	8
	Broadside	5	25	2	23	1	0	6	0	13	29	1	31	12	12	20	8	10	62
	Hit Object	1	8	0	8	5	0	4	0	7	19	2	4	2	10	5	7	2	26
Time of Day	mid-3 am	0	5	0	5	2	0	0	0	5	10	1	6	0	5	5	2	0	12
	3 am - 6 am	1	3	0	4	0	0	1	0	1	5	0	3	1	3	3	1	1	9
	6 am - 9 am	1	5	0	7	1	1	4	0	2	11	0	9	3	7	2	5	2	19
	9 am - noon	3	21	0	10	1	0	3	0	9	19	4	16	6	10	10	9	3	38
	noon- 3 pm	0	8	0	7	1	0	5	0	6	13	1	8	3	3	7	5	3	21
	3 pm - 6 pm	3	19	2	16	2	2	9	0	12	29	0	16	8	14	16	7	8	53
	6 pm - 9 pm	1	9	0	6	1	0	7	0	5	13	0	9	5	8	6	2	3	24
	9 pm - mid	1	2	0	2	2	0	3	0	4	7	0	4	3	1	3	3	0	10
Driver At Fault Movement	Proceeding Straight	4	28	2	25	7	1	11	0	18	44	3	33	13	21	23	12	9	78
	Making Right Turn	0	5	0	1	0	0	1	0	2	3	0	3	1	0	1	4	1	7
	Making Left Turn	0	9	0	10	0	1	7	0	7	19	1	9	2	10	6	5	4	27
Victim Age	Under 19	1	7	1	10	1	1	8	0	6	23	1	9	3	7	12	6	1	29
	60+	1	14	0	8	1	2	8	0	9	23	3	11	3	6	10	10	5	34
TOTAL		10	72	2	57	10	3	32	0	44	107	6	71	29	51	52	34	20	

Share of roadway/intersections:	1%	8%	0%	10%	4%	2%	50%	26%					16%	27%	28%	18%	11%	
Share of collisions:	5%	39%	1%	31%	5%	2%	17%	0%										

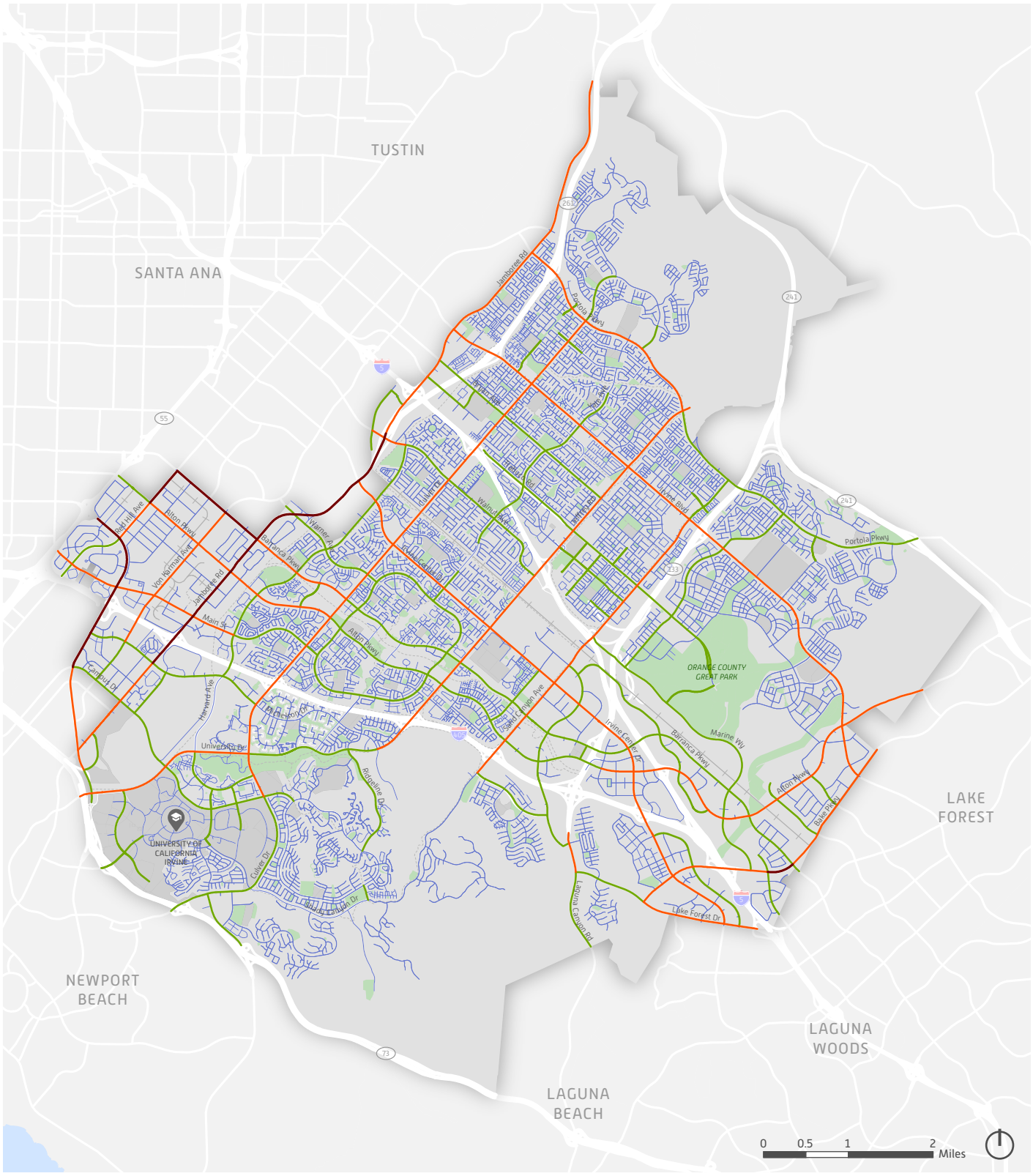


City of Irvine

Roadway Classification

ROADWAY CLASSIFICATION

- Expressway
- Major 8-Lane
- Major 6-Lane
- Commuter
- Primary
- Secondary
- Local
- Private
- Named & Un-Named Driveway
- Parks
- Schools



City of Irvine

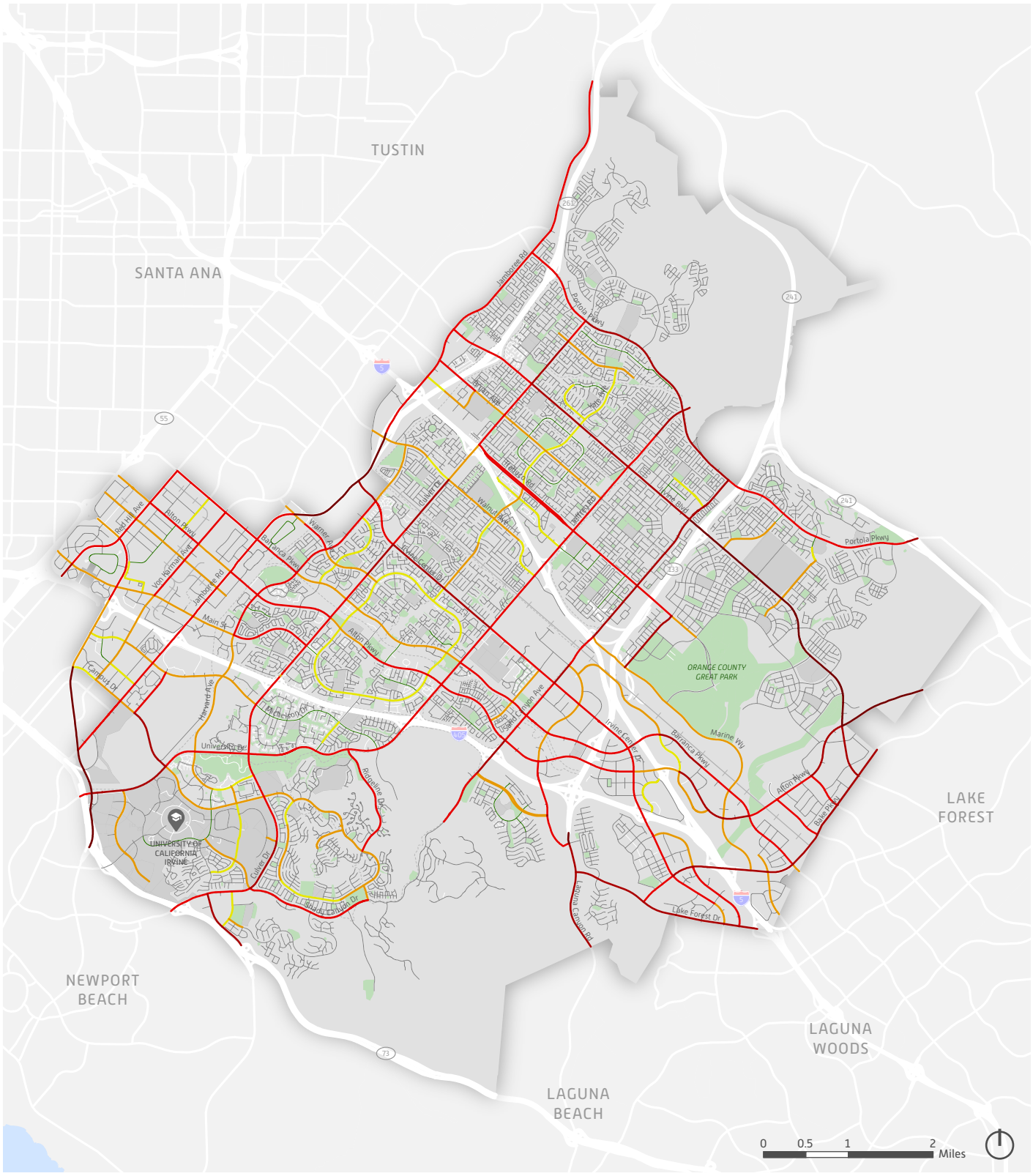
Number of Lanes

NUMBER OF LANES

2
4
6
8

Parks

Schools



City of Irvine

Posted Speed

POSTED SPEED (MPH)

- <=30
- 35
- 40
- 45
- 50
- 55
- 60+

Parks

Schools

FEHR PEERS

Irvine LRSP Appendix B

Date: May 2022

Subject: Irvine LRSP Hot Spot ROM Costs and Benefit-Cost Ratios

OC21-0803

Planning-level costs and benefit-cost ratios (BCRs) were developed for each of the five hot spot locations presented in the Irvine LRSP. The costs and BCRs presented in this appendix are intended to be used for prioritization purposes when selecting which locations and countermeasures to include in HSIP applications.

The cost estimates developed for each hot spot are inclusive of all recommendations for the location as documented in the LRSP. Unit costs are based on available cost data, including recent procurements in Southern California, and were adjusted for inflation. The estimates also consider costs for design (PS&E), contractor mobilization, traffic control, environmental clearance, appraisals, acquisitions, and utilities, construction engineering as appropriate and a planning level contingency. These preliminary planning level cost estimates were developed for prioritization purposes, as well as to compare across projects. They are planning level costs not intended to be used for bidding purposes.

The BCRs established are intended to be used to prioritize/compare each hot spot's potential competitiveness in the upcoming Highway Safety Improvement Program (HSIP) grant cycle. The following are important assumptions/considerations when reviewing and comparing these BCRs:

- **Analysis tool:** All BCRs were calculated utilizing the 2018 HSIP Analyzer Tool, a Caltrans-provided PDF-based BCR calculator developed specifically for HSIP grant applications. However, Caltrans has not yet released their BCR calculation methodology for the upcoming cycle, and we cannot predict how any changes might impact the relative competitiveness of these projects.
- **Costs:** HSIP grant applications allow for a maximum of three countermeasures to be utilized in calculating the "benefits" of a project. For this reason, the three most strategic countermeasures were identified for each hot spot. The associated costs for those three countermeasures were used for the "cost" portion of the calculation, as opposed to the total project cost. This methodology allows for simpler comparison across projects. As

part of the HSIP grant application process, the City can consider strategically adding in additional projects costs where BCRS are high enough to allow for that flexibility.

- **Benefits:** For each countermeasure, associated collisions were identified to understand the "benefit" of the measure. Collisions are assigned a value based on severity – fatal, severe injury, other visible injury, complaint of pain, and property-damage only (PDO). The Irvine LRSP analysis was limited to injury collisions only, as they are the most significant (and are weighted the heaviest under HSIP). Therefore, PDO collisions were not considered in the BCR calculations and the City can expect a slightly higher BCR ratio than shown for hot spots where there is a history of PDO collisions,

In addition to BCR-based grant applications, Caltrans historically includes set-asides for specific countermeasure (e.g., high-friction surface treatments; pedestrian crossings). When compiling HSIP applications, the City of Irvine can consider which countermeasures to include in BCR-based applications versus set-asides.

Findings

The cost estimates and HSIP Analyzer tools for each hot spot location are attached. **Table 1** includes the following:

- **Total Project cost:** Total planning-level cost for the complete set of recommendations included in the LRSP for each hot spot. Both Harvard and Roosevelt hot spot recommendations include a "menu of options" at intersections. To reflect this, a low- and high-cost range were developed.
- **Estimated HSIP Funding:** Isolated cost for the three countermeasures used in the BCR calculation
- **Share of total project cost:** The percentage of the "Total project cost" covered by the BCR calculation
- **Estimated BCR:** The outcome of the calculation, based on the cost and benefit of the three countermeasures. These BCRs do not include PDO collisions.

Table 1: Irvine LRSP Hot Spot Cost Estimates and BCR Calculations

	Total Project Cost - Low	Total Project Cost - High	Estimated HSIP Funding	Share of Total Project Cost (Low)	Estimated BCR
Harvard	$1,496,000.00	$3,352,000.00	$227,000.00	15%	24.7
Roosevelt	$1,156,000.00	$7,698,000.00	$916,000.00	79%	6.4
Campus	--	$2,319,000.00	$1,357,000.00	59%	6.7
Jeffrey	--	$1,323,000.00	$1,172,000.00	89%	9.9
Alton/Gateway	--	$536,000.00	$487,000.00	91%	13.7

Benefit-Cost Ratio (BCR) Considerations

Harvard

- There has historically been an HSIP set-aside for pedestrian crossings. If that is the case in HSIP Cycle 11, consider applying for the signalized trail crossing at the Walnut Trail through that set-aside, as opposed to through a BCR application
- The roundabout option on Harvard at Poplar and Deerfield is not as competitive (estimated BCR drops to around 4) as maintaining and enhancing the stop control due to the large costs for roundabouts. If the City is interested in funding roundabouts through HSIP, consider lower-cost roundabout designs (e.g., limited landscaping or doweled concrete) or developing a systemic application that includes the roundabout recommendations on Roosevelt as well

Roosevelt

- Similar to Harvard, the roundabout option is not competitive due to high costs of installation. If roundabouts are desired, consider developing a systemic application that includes the stop-controlled intersections on Harvard as well as other locations primary or local roadway intersections throughout the City with significant collision history.

Campus

- Upgrading from standard to buffered bike lanes is not currently an LRSM countermeasure, although it may be in HSIP Cycle 11. For a more competitive application, consider including vertical separation and swapping the bicycle treatment out for the signal installation at Paseo Montoya in the HSIP application if there are other local funding options for the signal.

Jeffrey

- Previous HSIP cycles have included a set-aside of high-friction surface treatments. If this set-aside is available, consider applying for the high-friction surface treatment separately.

Alton/Gateway

- The relatively high estimated BCR for this location may provide an opportunity to include additional improvements while remaining competitive.

Number	Location	Project	Total Cost - Low	Total Cost - High
Priority Location Costs				
1	**Harvard Avenue** *Walnut to Irvine Center*	Intersection/Corridor improvements	$ 676,420	$ 1,544,094
		Mobilization (10% of construction costs)	$ 67,642	$ 154,409
		Traffic Control (10% of construction costs)	$ 67,642	$ 154,409
		Contingency (20% of construction costs)	$ 162,341	$ 308,819
	Construction Subtotal		**$ 974,100**	**$ 2,161,800**
		Project Approval & Environmental Document (25% of construction costs)	$ 169,200	$ 386,100
		PS&E (25% of construction costs)	$ 169,200	$ 386,100
		Right-of-Way Engineering (5% of construction costs)	$ 33,900	$ 77,300
		Appraisals, Acquisitions, and Utilities (2% of construction costs)	$ 13,600	$ 30,900
		Construction Engineering (20% of construction costs)	$ 135,300	$ 308,900
	Project Total		**$ 1,496,000**	**$ 3,352,000**
Priority Location Costs				
2	**Roosevelt** *Huntington to Sand Canyon*	Intersection/Corridor improvements	$ 522,504	$ 3,483,001
		Mobilization (10% of construction costs)	$ 52,250	$ 348,300
		Traffic Control (10% of construction costs)	$ 52,250	$ 348,300
		Contingency (20% of construction costs)	$ 125,401	$ 835,920
	Construction Subtotal		**$ 752,500**	**$ 5,015,600**
		Project Approval & Environmental Document (25% of construction costs)	$ 130,700	$ 870,800
		PS&E (25% of construction costs)	$ 130,700	$ 870,800
		Right-of-Way Engineering (5% of construction costs)	$ 26,200	$ 174,200
		Appraisals, Acquisitions, and Utilities (2% of construction costs)	$ 10,500	$ 69,700
		Construction Engineering (20% of construction costs)	$ 104,600	$ 696,700
	Project Total		**$ 1,156,000**	**$ 7,698,000**
Priority Location Costs				
3	**Campus Drive** *Riparian View to Turtle Rock*	Intersection/Corridor improvements	$ 1,049,099	
		Mobilization (10% of construction costs)	$ 104,910	
		Traffic Control (10% of construction costs)	$ 104,910	
		Contingency (20% of construction costs)	$ 251,784	
	Construction Subtotal		**$ 1,510,800**	
		Project Approval & Environmental Document (25% of construction costs)	$ 262,300	
		PS&E (25% of construction costs)	$ 262,300	
		Right-of-Way Engineering (5% of construction costs)	$ 52,500	
		Appraisals, Acquisitions, and Utilities (2% of construction costs)	$ 21,000	
		Construction Engineering (20% of construction costs)	$ 209,900	
	Project Total		**$ 2,319,000**	
Priority Location Costs				
4	**Jeffrey Road** *Portola Parkway to Venta Spur Trail*	Intersection/Corridor improvements	$ 598,084	
		Mobilization (10% of construction costs)	$ 59,808	
		Traffic Control (10% of construction costs)	$ 59,808	
		Contingency (20% of construction costs)	$ 143,540	
	Construction Subtotal		**$ 861,300**	
		Project Approval & Environmental Document (25% of construction costs)	$ 149,600	
		PS&E (25% of construction costs)	$ 149,600	
		Right-of-Way Engineering (5% of construction costs)	$ 30,000	
		Appraisals, Acquisitions, and Utilities (2% of construction costs)	$ 12,000	
		Construction Engineering (20% of construction costs)	$ 119,700	
	Project Total		**$ 1,323,000**	
Priority Location Costs				
5	**Alton Parkway & Gateway**	Intersection/Corridor improvements	$ 242,376	
		Mobilization (10% of construction costs)	$ 24,238	
		Traffic Control (10% of construction costs)	$ 24,238	
		Contingency (20% of construction costs)	$ 58,170	
	Construction Subtotal		**$ 349,100**	
		Project Approval & Environmental Document (25% of construction costs)	$ 60,600	
		PS&E (25% of construction costs)	$ 60,600	
		Right-of-Way Engineering (5% of construction costs)	$ 12,200	
		Appraisals, Acquisitions, and Utilities (2% of construction costs)	$ 4,900	
		Construction Engineering (20% of construction costs)	$ 48,500	
	Project Total		**$ 536,000**	

Project	Treatment	Unit Type	Units	Per Unit Cost*	Total Cost*	Assumptions
Harvard Avenue *Walnut to Irvine Center*				Low	$676,420	
				High	$1,544,094	
Corridor-wide						
Buffered Bike Lane	3' Buffered Bike Lane	mile	0.80	$ 150,379.00	$ 120,303.20	Does not include intersection improvements
Walnut/Harvard						
Advance Warning Flashing Beacons	Advance Warning Flashing Beacon	each	1.00	$ 12,000.00	$ 12,000.00	Westbound approach
Green Conflict Striping - Walnut	Green Conflict Zone Striping	location	2.00	$ 7,108.00	$ 14,216.00	All approaches
Bicycle Boxes	Bike Lane Pavement Marking	each	2.00	$ 138.45	$ 276.90	two-stage turnboxes for WBL
Leading Pedestrian Interval	Leading Pedestrian Interval/Signal Retiming	location	1.00	$ 553.80	$ 553.80	
Bike Signage	Ground Mounted Regulatory or Warning Sign	each	4.00	$ 387.66	$ 1,550.64	Signage to accompany LPIs
Deerfield and Poplar						
Roundabouts	Roundabout (single-lane)	each	2.00	$ 443,040.00	$ 886,080.00	Harvard & Deerfield
High-Visibility Crosswalk	Thermoplastic Solid White 24" Crosswalk Lines	lf	580.00	$ 38.77	$ 22,484.28	Crosswalks on all approaches at Deerfield and Poplar
Turn Pocket Removal	Remove Paint Stripe	lf	2,000.00	$ 3.32	$ 6,645.60	assuming 200' per approach
Turn Pocket Removal	Thermoplastic Solid Double Yellow Centerline	lf	5,000.00	$ 2.22	$ 11,076.00	assuming 500' per approach
LED Stop Signs	Flashing LED Stop Sign	each	4.00	$ 6,000.00	$ 24,000.00	NB and SB approaches at Poplar and Deerfield
Advance Stop Bars	Stop Line	lf	80.00	$ 4.43	$ 354.43	NB and SB approaches at Poplar and Deerfield
Railroad Crossing						
Advance Stop Bars	Stop Line	lf	40.00	$ 4.43	$ 177.22	NB and SB approaches at Walnut Trail Crossing
High-Visibility Crosswalk	Thermoplastic Solid White 24" Crosswalk Lines	lf	50.00	$ 38.77	$ 1,938.30	Across Harvard at Walnut Trail
Widen Median	Median Refuge Island (incl. associated asphalt excavation)	sf	260.00	$ 66.46	$ 17,278.56	20x13 at Walnut Trail Crossing
Signalized Pedestrian Crossing	New Traffic Signal	each	1.00	$ 400,000.00	$ 400,000.00	At Walnut Trail crossing
Irvine Center						
Retroreflective Backplates	Retroreflective Backplates	each	18.00	$ 300.00	$ 5,400.00	18 signal heads at Harvard & Edinger
Intelligent Dilemma Zone Detection	Intelligent Dilemma Zone Detection	each	1.00	$ 50,000.00	$ 50,000.00	
Green Conflict Striping - Irvine Center	Green Conflict Zone Striping	location	2.00	$ 7,108.00	$ 14,216.00	All approaches
Bicycle Boxes	Bike Lane Pavement Marking	each	2.00	$ 138.45	$ 276.90	two-stage turnboxes for EBL
Leading Pedestrian Interval	Leading Pedestrian Interval/Signal Retiming	location	1.00	$ 553.80	$ 553.80	
Bike Signage	Ground Mounted Regulatory or Warning Sign	each	4.00	$ 387.66	$ 1,550.64	Signage to accompany LPIs
Roosevelt *Huntington to Sand Canyon*				Low	$ 522,504.25	
				High	$ 3,483,001.49	
Signalized locations - Jeffrey & Sand Canyon						
High-Visibility Crosswalk (Jeffrey only)	Thermoplastic Solid White 24" Crosswalk Lines	lf	500.00	$ 38.77	$ 19,383.00	All approaches at Jeffrey
Advance Stop Bars (Jeffrey only)	Stop Line	lf	250.00	$ 4.43	$ 1,107.60	All approaches at Jeffrey
Leading Pedestrian Interval (Jeffrey only)	Leading Pedestrian Interval/Signal Retiming	location	1.00	$ 553.80	$ 553.80	Jeffrey
Bike Signage (Jeffrey only)	Ground Mounted Regulatory or Warning Sign	each	4.00	$ 387.66	$ 1,550.64	Signage to accompany LPIs
Intelligent Dilemma Zone Detection	Intelligent Dilemma Zone Detection	each	2.00	$ 50,000.00	$ 100,000.00	Jeffrey & Sand Canyon
Retroreflective Backplates	Retroreflective Backplates	each	44.00	$ 300.00	$ 13,200.00	All signal heads at Jeffrey (22) & Sand Canyon (22)
Additional Signal Heads (Sand Canyon only)	New Traffic Signal Head on Existing Mast Arm	each	2.00	$ 2,500.00	$ 5,000.00	One additional head NB and SB at Sand Canyon
Bay Tree & Vision						
Roundabout	Roundabout (single-lane)	each	2.00	$ 443,040.00	$ 886,080.00	
Green Conflict Striping	Green Conflict Zone Striping	location	2.00	$ 7,108.00	$ 14,216.00	If maintaining signal
Leading Pedestrian Interval	Leading Pedestrian Interval/Signal Retiming	location	2.00	$ 553.80	$ 1,107.60	If maintaining signal
Bike Signage	Ground Mounted Regulatory or Warning Sign	each	8.00	$ 387.66	$ 3,101.28	If maintaining signal
Stop Controlled Intersections						
Roundabout	Roundabout (single-lane)	each	5.00	$ 443,040.00	$ 2,215,200.00	Tulip, Rush Lily, Scented Violet, Truman, Huntington
High-Visibility Crosswalk	Thermoplastic Solid White 24" Crosswalk Lines	lf	1,060.00	$ 38.77	$ 41,091.96	If keeping stop control
Advance Stop Bars	Stop Line	lf	600.00	$ 4.43	$ 2,658.24	If keeping stop control
Turn Pocket Removal	Remove Paint Stripe	lf	2,400.00	$ 3.32	$ 7,974.72	Assuming 150' per approach
Turn Pocket Removal	Thermoplastic Solid Double Yellow Centerline	lf	4,800.00	$ 2.22	$ 10,632.96	Assuming 300' per approach

LED Stop Signs	Flashing LED Stop Sign	each	10.00	$ 6,000.00	$	60,000.00	If keeping stop control, LED conversion for stop signs on Roosevelt
Corridor-Wide							
Buffered Bike Lane	3' Buffered Bike Lane	mile	1.30	$ 150,379.00	$	195,492.70	Entire corridor, does not include intersection improvements
Lane Reduction	Remove Paint Stripe	lf	5,860.00	$ 3.32	$	19,471.61	In 4-lane segments
Lane Reduction	Thermoplastic Solid Double Yellow Centerline	lf	11,720.00	$ 2.22	$	25,962.14	In 4-lane segments
Campus Drive *University to Turtle Rock*					**$**	**1,049,098.92**	
Corridor-Wide							
Buffered Bike Lane	3' Buffered Bike Lane	mile	1.80	$ 150,379.00	$	270,682.20	Entire corridor, does not include intersection improvements
Speed Feedback Signs	Speed Feedback Sign	each	4.00	$ 11,076.00	$	44,304.00	4 midblock locations
Signalized Intersections							
High-Visibility Crosswalks	Thermoplastic Solid White 24" Crosswalk Lines	lf	2,520.00	$ 38.77	$	97,690.32	Upgrading/adding at all approaches at signalized locations
Advance Stop Bars	Stop Line	lf	1,200.00	$ 4.43	$	5,316.48	All approaches at all signalized locations
Green Conflict Striping	Green Conflict Zone Striping	location	2.00	$ 7,108.00	$	14,216.00	California and Culver
Bikes Use Ped Signage paired with LPIs	Ground Mounted Regulatory or Warning Sign	each	12.00	$ 387.66	$	4,651.92	Bridge, Culver, Stanford
Leading Pedestrian Interval	Leading Pedestrian Interval/Signal Retiming	location	3.00	$ 553.80	$	1,661.40	Bridge, Culver, Stanford
Retroreflective Backplates	Retroreflective Backplates	each	76.00	$ 300.00	$	22,800.00	All signal heads at University (22), Bridge (15), Culver (21), Stanford (18)
Advance Warning Flashing Beacons (University only)	Advance Warning Flashing Beacon	each	1.00	$ 12,000.00	$	12,000.00	WB at University
Intelligent Dilemma Zone Detection	Intelligent Dilemma Zone Detection	each	3.00	$ 50,000.00	$	150,000.00	Bridge, Culver, Berkeley
Driveways							
Modified Sign R10-15 "Turning Vehicles Yield to Ped"	Ground Mounted Regulatory or Warning Sign	each	3.00	$ 387.66	$	1,162.98	3 approaches at driveways
High-Visibility Crosswalk	Thermoplastic Solid White 24" Crosswalk Lines	lf	45.00	$ 38.77	$	1,744.47	Driveway west of California only
Green Conflict Striping	Green Conflict Zone Striping	location	1.00	$ 7,108.00	$	7,108.00	Both driveways (1 "location" has two approaches)
Paseo Montoya/Cobblestone/Turtle Rock							
Traffic Signal at Paseo Montoya	New Traffic Signal	each	1.00	$ 400,000.00	$	400,000.00	Paseo Montoya
Two new crosswalks (Paseo Montoya and Turtle Rock)	Thermoplastic Solid White 24" Crosswalk Lines	lf	150.00	$ 38.77	$	5,814.90	West leg at Paseo Montoya, South leg at Turtle Rock
Left Turn Restriction at Cobblestone	Curb and gutter	lf	100.00	$ 77.53	$	7,753.20	
Left Turn Restriction at Cobblestone	Planting Sod	sf	400.00	$ 2.77	$	1,107.60	
Left Turn Restriction at Cobblestone	Deconstruct Concrete/Curb	sf	30.00	$ 3.32	$	99.68	
Left Turn Restriction at Cobblestone	Ground Mounted Regulatory or Warning Sign	each	1.00	$ 387.66	$	387.66	
Striping Removal (Channelized Right Turn) at Turtle Rock	Remove Paint Stripe	lf	180.00	$ 3.32	$	598.10	At Turtle Rock
Jeffrey Road *Portola Parkway to Venta Spur Trail*					**$**	**598,084.49**	
Corridor-Wide							
Speed Feedback Signs	Speed Feedback Sign	each	4.00	$ 11,076.00	$	44,304.00	4 midblock locations.
Signalized Intersections							
Retroreflective Backplates	Retroreflective Backplates	each	67.00	$ 300.00	$	20,100.00	All signal heads at Portola (22), Encore (22), Irvine (23)
Intelligent Dilemma Zone Detection	Intelligent Dilemma Zone Detection	each	3.00	$ 50,000.00	$	150,000.00	Portola, Encore, Irvine
High-Friction Surface Treatment	High Friction Surface Treatments	sq yd	7,200.00	$ 50.00	$	360,000.00	Portola and Irvine
High-Visibility Crosswalk at Irvine	Thermoplastic Solid White 24" Crosswalk Lines	lf	540.00	$ 38.77	$	20,933.64	All approaches at Irvine Blvd
Advance Stop Bars at Irvine	Stop Line	lf	270.00	$ 4.43	$	1,196.21	All approaches at Irvine Blvd
Modified Sign R10-15 "Turning Vehicles Yield to Ped"	Ground Mounted Regulatory or Warning Sign	each	4.00	$ 387.66	$	1,550.64	Bike lane approaches at Portola
Alton Parkway & Gateway					**$**	**242,375.88**	
High-Visibility Crosswalk	Thermoplastic Solid White 24" Crosswalk Lines	lf	485.00	$ 38.77	$	18,801.51	All approaches
Advance Stop Bars	Stop Line	lf	242.50	$ 4.43	$	1,074.37	
Additional Signal Head	New Traffic Signal Head on Existing Mast Arm	each	1.00	$ 2,500.00	$	2,500.00	
High-Friction Surface Treatment	High Friction Surface Treatments	sq yd	3,400.00	$ 50.00	$	170,000.00	
Intelligent Dilemma Zone Detection	Intelligent Dilemma Zone Detection	each	1.00	$ 50,000.00	$	50,000.00	

HSIP ANALYZER

Cost Estimate, Crash Data and Benefit Cost Ratio (BCR) Calculation for Highway Safety Improvement Program (HSIP) Application

Important: Review and follow the step-by-step instructions in "Manual for HSIP Analyzer". Completing the HSIP Analyzer without referencing to the manual may result in an application with fatal flaws that will be disqualified from the ranking and selection process.

All yellow highlighted fields must be filled in. The gray fields are calculated and read-only. This is a dynamic form (later steps vary depending on the data entered in earlier steps). If any error messages in red appear, fix the errors prior to proceeding to the next steps.

1. Application ID, Project Location and Project Description (copy from the HSIP Application Form):

Application ID: **Harvard-Low Cost**

Save this file using the Application ID plus "Calc" as the file name (e.g. "07-Los Angeles-01Calc.pdf").

Project Location: (limited to 250 characters)

Harvard Ave Walnut to Irvine Center

Project Description: (limited to 250 characters)

CM 1 Intelligent Dilemma Zone Detection at Irvine Center
CM 2 Upgrade xwalks at unsignalized locations - remove turn pockets, strip advance stop bars, and add high visibility crosswalk striping at Deerfield/Poplar
CM 3 Convert to AWSC at Deerfield

2. Application Category (Check one):

Application Categories that require a Benefit Cost Ratio (BCR):

- ☒ Common BCR Application
- ☐ Set-aside for High Friction Surface Treatment

Application Categories that do NOT require a Benefit Cost Ratio (BCR):

- ☐ Set-aside for Guardrail Upgrades
- ☐ Set-aside for Horizontal Curve Signing
- ☐ Set-aside for Pedestrian Crossing Enhancements
- ☐ Set-aside for Tribes

Dual consideration?

☐ If an Application Category that does not require a BCR is selected above, check this box to indicate your desire that this application will be considered as a Common BCR Application as well in case it does not get selected for funding under the set-aside category. If this box is checked, a benefit cost analysis is required so the project will have a BCR.

A safety benefit cost analysis is required for this application. This tool will guide through cost estimate, safety benefit evaluation and Benefit Cost Ratio (BCR) calculation.

Section I. Construction Cost Estimate and Cost Breakdown

The purpose of this section is to:

- Provide detailed engineer's estimate (for construction items only). The costs for other phases (PE, ROW, and CE) will be included in Section II.
- Test if countermeasures (CMs) (up to 3) are eligible for being used in the project benefit calculation. For a CM to be used in the project benefit calculation, the construction cost of the CM must be at least 15% of the project's total construction cost, unless an exception is requested. And
- Determine the project's maximum Federal Reimbursement Ratio (FRR).

I.1 Select up to 3 countermeasures (CMs) to be tested in the Engineer's Estimate:

Number of CMs to be used in this project:	3

CM No. 1:	S4: Provide Advanced Dilemma Zone Detection for high speed approaches
CM No. 2:	NS18: Install pedestrian crossing at uncontrolled locations (with enhanced safety features)
CM No. 3:	NS2: Convert to all-way STOP control (from 2-way or Yield control)

I.2 Detailed Engineer's Estimate for Construction Items:

Cost breakdown by CMs. For each item, enter a cost percentage for each of the CMs and "Other Safety-Related" (OS) components. (e.g. enter 10 for 10%). The cost % for "Non-Safety-Related" (NS) components is calculated.

	No.	Item Description	Unit	Quantity	Unit Cost	Total	% for CM#1 (S4)	% for CM#2 (NS18)	% for CM#3 (NS2)	% for OS*	% for NS**
+ -	1	Intelligent Dilemma Zone Detection at Irvine Center	LS	1	$50000.00	50,000	100%	0%	0%	%	0
+ -	2	Upgrade crosswalks at unsignalized locations by removing turn pockets, striping advance stop bars, and adding high visibility crosswalk striping at Deerfield/Poplar	LS	1	$40560.31	40,560	%	100%	%	%	0
+ -	3	Convert to AWSC at Deerfield	LS	1	$12000.00	12,000	%	%	100%	%	0
+ -	4	Mobilization, TC	LS	1	$20512.06	20,512	50%	40%	10%	0%	0
					Weighted Average (%)		49%	40%	11%		
					Total ($)	$123,072					

* % for OS: Cost % for Other Safety-Related components;
** % for NS: Cost % for Non Safety-Related components.

Contingencies, as % of the above "Total" of the construction items: (e.g. enter 10 for 10%)	20 %	$24,614
Total Construction Cost (Con Items & Contingencies): (Rounded up to the nearest hundreds)		$147,700

I.3 Summary

3 CM(s) are eligible to be used in the project benefit calculation.

Countermeasure ID	Federal Funding Eligibility (FFE)	Cost %	Eligible to be used in benefit calculation?	Request exception to the 15% rule*
S4	100%	48.96%	Yes (>=15% cost)	☐
NS18	100%	39.62%	Yes (>=15% cost)	☐
NS2	100%	11.42%	Yes (<15% cost) (Exception being requested)	☒

*By requesting an exception to the 15% rule, the CM with less than 15% of the construction cost will then be eligible to be used in the benefit calculation. if an exception is requested for any CM(s) above, please provide the reason (low cost treatment with significant safety benefits, etc.):

Project's Maximum Federal Reimbursement Ratio = 100.0%

The project's Maximum Federal Reimbursement Ratio is calculated as the least of the FFEs of the above countermeasures, minus the percentage of the non-safety related costs in excess of 10%. **This is the maximum value allowed to be entered in "HSIP/Total (%)" column in Section II (Project Cost Estimate).**

Section II. Project Cost Estimate

All project costs, **for all phases and by all funding sources**, must be accounted for on this form.

i. "**Total Cost**": Round all costs up to the nearest hundred dollars.

ii. "**HSIP/Total (%)**": The maximum allowed is the project's Federal Reimbursement Ratio (FRR) as determined in Section I. Click the button to assign the maximum to all, OR enter if not the maximum.

iii. "**HSIP Funds**" and "**Local/Other Funds**" are calculated.

Pay attention to the interactive warning/error messages below the table. The messages, if any, must be fixed, or exceptions should be justified in Question No. 5 in Section II of the HSIP Application Form.

Project's maximum Federal Reimbursement Ratio (FRR) (from Section I, rounded up to integer): 100 %

To set all "HSIP/Total (%)" in the below table to the above maximum FRR, click "Set": Set

Description	Total Cost	HISP/Total (%)	HSIP Funds	Local/Other Funds
Preliminary Engineering (PE) Phase				
Environmental	$25,700	100 %	$25,700	$0
PS&E	$25,600	100 %	$25,600	$0
Subtotal - PE	**$51,300**	**100 %**	**$51,300**	**$0**
Right of Way (ROW) Phase				
Right of Way Engineering	$5,200	100 %	$5,200	$0
Appraisals, Acquisitions & Utilities	$2,100	100 %	$2,100	$0
Subtotal - Right of Way (ROW)	**$7,300**	**100 %**	**$7,300**	**$0**
Construction (CON) Phase				
Construction Engineering (CE)	$20,600	100 %	$20,600	$0
Construction Items	$147,700 (Read only - from Section I)	100 %	$147,700	$0
Subtotal - Construction	**$168,300**	**100 %**	**$168,300**	**$0**
PROJECT TOTAL	$226,900	100 %	$226,900	$0

☐ Agency does NOT request **HSIP** funds for PE Phase (automatically checked if PE - HSIP funds is $0).

Interactive Warning/Error Messages:

If there are any messages in the below box, please fix OR explain justification for exceptions in Question No 5, Section II in the HSIP Application.

1. The HSIP amount for PE exceeds 25% of the HSIP amount for Construction Items.

Section III. Project Location Groups, Countermeasures and Crash Data

The benefit of an HSIP safety project is achieved by reducing potential future crashes due to the application of the safety countermeasures (CMs). In this section, you will need to provide information regarding the project's safety CMs and historical crash data at the project sites. The data will be used to estimate the project benefit in Section IV.

1. Divide the project locations into groups.

It is quite often that an HSIP project has multiple locations. Theoretically the benefit for every single location may be calculated separately and then sum them up. However, that may be time consuming or almost impossible when there are a lot of locations. It is more efficient that the project locations with exactly the same safety countermeasures are combined into a group. The benefits of the locations in the same group can then be calculated at once.

When only one group is needed:

If your project consists of only one location or multiple locations that have similar features, address similar safety issues and utilize the same countermeasure(s). The crash data of all the locations can be combined and only one group is needed.

When multiple groups are needed:

If your project include multiple locations that have various safety issues and the proposed safety improvements (countermeasures) are not exactly the same for all the locations. The locations must be divided into different groups. The project benefits are then calculated multiple times, once for each location group. The project total benefit is the sum of the benefits from the different groups.

It should be noted that within a group, all locations should be of the same type: Signalized Intersection (S), Non-Signalized Intersection (NS), or Roadway (R).

If necessary, you may explain the location grouping for your project in details in Question No. 3 (Crash Data Evaluation), Section II in the HSIP Application Form.

2. After the number of location groups is entered, one subform will be populated for each location group. For each location group:

1) First, select the applicable CMs. *Note: If a Roundabout CM (S18 or NS4A or NS4B) is selected, additional information is required.*

For each group, only the CMs of the same type as the group location type can be used. For example, if a group consists of 5 signalized intersections, only "Signalized Intersection" CMs may be used for this group.

2) Based on the selected CMs, crash data tables of the required types are displayed for data entry.

Different CMs will reduce crashes of different types during the life of the safety improvements. Depending on the selected CMs for the group, you will be required to fill in one or more crash data tables, for any combination of the five crash types (datasets): "All" , "Night" , Ped & Bike", "Emergency Vehicle", and "Animal" (Each of the later four datasets is a sub-dataset of the "All" dataset.)

For more information regarding grouping project locations and examples, please refer to the Manual for HSIP Analyzer.

III.1 List of Project Locations and Location Groups

List all locations/sites included in this project by groups. The locations entered in Table III.1 below will be automatically populated in the crash data tables in III.2.

Based on the criteria described on the last page, the locations/sites need to be divided into 3 groups.

Table III.1 List of Project Locations by Groups

Highlighted fields must be filled in. For each group:
1) Must select a Location Type;
2) Initially each group has one location line. Click "+"/"-" to add a new line/delete an existing line;
3) Enter location description for each line. The same descriptions will be auto-populated in III.2.

*Note: If your project has a large number of locations, please aggregate some locations into one description, e.g. 10 stop controlled intersections, 5 horizontal curves, etc., as long as they have similar features and the safety improvements to be implemented are the same.

	No.	No. in Group	Location Description (Intersection Name or Road Limit or General Description)	
GROUP 1			Select Location Type:	NS (Non-signalized Intersections)
+ -	1	G1-1	Deerfield	
GROUP 2			Select Location Type:	NS (Non-signalized Intersections)
+ -	2	G2-1	Poplar	
+ -	3	G2-2	Deerfield	
GROUP 3			Select Location Type:	S (Signalized Intersections)
+ -	4	G3-1	Irvine Center	

III.2: Countermeasures and Crash Data

(Repeats for each location group)

Countermeasures and Crash Data -Location Group No. 1 of 3

Hide Group Details

Step 1: Select countermeasure(s) to be applied to this location group

This group's location type: NS (Non-signalized Intersections)

Please check the CMs for this location group. All the CMs that have passed the test in Section I AND match the location type of this group are listed below.

	No.	Countermeasure (CM) Name	CM Type*	Crash Reduction Factor (CRF)	Expected Life (Years)	Crash Type	Federal Funding Eligibility
☐	1	NS18: Install pedestrian crossing at uncontrolled locations (with enhanced safety features)	NS	0.35	20	Ped & Bike	100%
☒	2	NS2: Convert to all-way STOP control (from 2-way or Yield control)	NS	0.5	10	All	100%
	*CM Type: S-Signalized Intersection; NS-Non-Signalized Intersection; R-Roadway.						

Step 2: Provide crash data.

2.1 Crash Data Period: must be between 3 and 5 years.

from (MM/DD/YYYY): 01/01/2015 To (MM/DD/YYYY): 12/31/2019 Crash Data Period (years) = 5

2.2 Fill out the crash data table(s) for the crash type(s) as required by the selected countermeasure(s) in Step 1.

Based on the countermeasures selected in Step 1 , the crash data types to be provided are:

(1) All

Crash Data Table for Crash Type: ALL

No.	Location (from Table III.1)	Fatal (ALL)	Severe Injury (ALL)	Other Visible Injury (ALL)	Complaint of Pain (ALL)	PDO (ALL)	Total
1	Deerfield	0	0	2	1	0	3
	Total	0	0	2	1	0	3

III.2: Countermeasures and Crash Data

(Repeats for each location group)

Countermeasures and Crash Data -Location Group No. 2 of 3

Hide Group Details

Step 1: Select countermeasure(s) to be applied to this location group

This group's location type: NS (Non-signalized Intersections)

Please check the CMs for this location group. All the CMs that have passed the test in Section I AND match the location type of this group are listed below.

	No.	Countermeasure (CM) Name	CM Type*	Crash Reduction Factor (CRF)	Expected Life (Years)	Crash Type	Federal Funding Eligibility
☒	1	NS18: Install pedestrian crossing at uncontrolled locations (with enhanced safety features)	NS	0.35	20	Ped & Bike	100%
☐	2	NS2: Convert to all-way STOP control (from 2-way or Yield control)	NS	0.5	10	All	100%
	*CM Type: S-Signalized Intersection; NS-Non-Signalized Intersection; R-Roadway.						

Step 2: Provide crash data.

2.1 Crash Data Period: must be between 3 and 5 years.

from (MM/DD/YYYY): 01/01/2015 To (MM/DD/YYYY): 12/31/2019 Crash Data Period (years) = 5

2.2 Fill out the crash data table(s) for the crash type(s) as required by the selected countermeasure(s) in Step 1.

Based on the countermeasures selected in Step 1 , the crash data types to be provided are:

(1) Ped & Bike

Crash Data Table for Crash Type: Pedestrians and Bicyclists Involved (P&B)

No.	Location (from Table III.1)	Fatal (P&B)	Severe Injury (P&B)	Other Visible Injury (P&B)	Complaint of Pain (P&B)	PDO (P&B)	Total
1	Poplar	0	1		0	0	1
2	Deerfield	0	0	1	0	0	1
	Total	0	1	1	0	0	2

III.2: Countermeasures and Crash Data

(Repeats for each location group)

Countermeasures and Crash Data -Location Group No. 3 of 3

Hide Group Details

Step 1: Select countermeasure(s) to be applied to this location group

This group's location type: S (Signalized Intersections)

Please check the CMs for this location group. All the CMs that have passed the test in Section I AND match the location type of this group are listed below.

	No.	Countermeasure (CM) Name	CM Type*	Crash Reduction Factor (CRF)	Expected Life (Years)	Crash Type	Federal Funding Eligibility
☒	1	S4: Provide Advanced Dilemma Zone Detection for high speed approaches	S	0.4	10	All	100%
	*CM Type: S-Signalized Intersection; NS-Non-Signalized Intersection; R-Roadway.						

Step 2: Provide crash data.

2.1 Crash Data Period: must be between 3 and 5 years.

from (MM/DD/YYYY): 01/01/2015 To (MM/DD/YYYY): 12/31/2019 Crash Data Period (years) = 5

2.2 Fill out the crash data table(s) for the crash type(s) as required by the selected countermeasure(s) in Step 1.

Based on the countermeasures selected in Step 1 , the crash data types to be provided are:

(1) All

Crash Data Table for Crash Type: ALL

No.	Location (from Table III.1)	Fatal (ALL)	Severe Injury (ALL)	Other Visible Injury (ALL)	Complaint of Pain (ALL)	PDO (ALL)	Total
1	Irvine Center	0	1	3	7	0	11
	Total	0	1	3	7	0	11

Section IV. Calculation and Results

Click the "Calculate" button to calculate. The script will first check if there are any errors or inconsistencies in the countermeasure selections and crash data. If errors are detected and displayed below, the errors must be fixed first before you click the "Calculate" button again. If no errors are displayed, the calculation results are provided in this section. Please refer to the Manual for HSIP Analyzer for details regarding possible errors.

Calculate

Project Summary Information:

Project Total Cost: 226900
3 countermeasures are eligible in benefit calculation. (S4 NS18 NS2)
Project location(s) are divided into 3 group(s) for calculating the benefits.

IV.1 Benefit Summary by location groups

Group No.	Group Info/Data*	Benefit from CM #1	Benefit from CM #2	Benefit from CM #3	Total Benefit of the group
1	Location type: NS (Non-signalized Intersections) Number of location(s): 1 Number of selected countermeasure(s): 1 (NS2) Crash Data Information: Crash data period (years): 5 Number of crashes(F/SI/OVI/I-CP/PDO)*: All: 0,0,2,1,0	$0	$0	$324,900	$324,900
2	Location type: NS (Non-signalized Intersections) Number of location(s): 2 Number of selected countermeasure(s): 1 (NS18) Crash Data Information: Crash data period (years): 5 Number of crashes(F/SI/OVI/I-CP/PDO)*: Ped & Bike: 0,1,1,0,0	$0	$3,411,101	$0	$3,411,101
3	Location type: S (Signalized Intersections) Number of location(s): 1 Number of selected countermeasure(s): 1 (S4) Crash Data Information: Crash data period (years): 5 Number of crashes(F/SI/OVI/I-CP/PDO)*: All: 0,1,3,7,0	$1,874,240	$0	$0	$1,874,240
Sum		**$1,874,240**	**$3,411,101**	**$324,900**	**$5,610,241**

*Number of crashes: five crash numbers are for Fatal (F), Severe Injury (SI), Other Visible Injury (OVI), Injury - Complaint of Pain (I-CP), and Property Damage Only (PDO), respectively.

IV.2. Project Benefit and BCR Summary

No.	Countermeasure Name	Benefit	Cost	Resulting B/C
1	S4	$1,874,240	$111,090	**16.9**
2	NS18	$3,411,101	$89,905	**37.9**
3	NS2	$324,900	$25,905	**12.5**
	Entire Project	**$5,610,241**	**$226,900**	**24.7**

Data to be transferred to the HSIP Application Form

This section is generated automatically once the data entry and calculation have been completed. Transfer the data on this page to Section III of the HSIP Application Form.

Safety Countermeasure Information

Number of countermeasures: 3
S4: Provide Advanced Dilemma Zone Detection for high speed approaches
NS18: Install pedestrian crossing at uncontrolled locations (with enhanced safety features)
NS2: Convert to all-way STOP control (from 2-way or Yield control)

Cost, FRR, Benefit and BCR:

Total Project Cost:	$226,900
HSIP Funds Requested:	$226,900
Max. Federal Reimbursement Ratio (FRR):	100%
Total Expected Benefit:	$5,610,241
Benefit Cost Ratio:	24.73

HSIP ANALYZER

Cost Estimate, Crash Data and Benefit Cost Ratio (BCR) Calculation for Highway Safety Improvement Program (HSIP) Application

Important: Review and follow the step-by-step instructions in "Manual for HSIP Analyzer". Completing the HSIP Analyzer without referencing to the manual may result in an application with fatal flaws that will be disqualified from the ranking and selection process.

All yellow highlighted fields must be filled in. The gray fields are calculated and read-only. This is a dynamic form (later steps vary depending on the data entered in earlier steps). If any error messages in red appear, fix the errors prior to proceeding to the next steps.

1. Application ID, Project Location and Project Description (copy from the HSIP Application Form):

Application ID: **Roosevelt-Low Cost**

Save this file using the Application ID plus "Calc" as the file name (e.g. "07-Los Angeles-01Calc.pdf").

Project Location: (limited to 250 characters)

Roosevelt Huntington to Sand Canyon

Project Description: (limited to 250 characters)

CM 1 Intelligent Dilemma Zone at Jeffrey & Sand Canyon
CM 2 Upgrade to LED stop signs with turn pocket removal and high vis crosswalks at Scented Violet, Truman, and Huntington (collision locations)
CM 3 Lane reduction with buffered bike lane

2. Application Category (Check one):

Application Categories that require a Benefit Cost Ratio (BCR):

- ☒ Common BCR Application
- ☐ Set-aside for High Friction Surface Treatment

Application Categories that do NOT require a Benefit Cost Ratio (BCR):

- ☐ Set-aside for Guardrail Upgrades
- ☐ Set-aside for Horizontal Curve Signing
- ☐ Set-aside for Pedestrian Crossing Enhancements
- ☐ Set-aside for Tribes

☐ **Dual consideration?**
If an Application Category that does not require a BCR is selected above, check this box to indicate your desire that this application will be considered as a Common BCR Application as well in case it does not get selected for funding under the set-aside category. If this box is checked, a benefit cost analysis is required so the project will have a BCR.

A safety benefit cost analysis is required for this application. This tool will guide through cost estimate, safety benefit evaluation and Benefit Cost Ratio (BCR) calculation.

Section I. Construction Cost Estimate and Cost Breakdown

The purpose of this section is to:

- Provide detailed engineer's estimate (for construction items only). The costs for other phases (PE, ROW, and CE) will be included in Section II.
- Test if countermeasures (CMs) (up to 3) are eligible for being used in the project benefit calculation. For a CM to be used in the project benefit calculation, the construction cost of the CM must be at least 15% of the project's total construction cost, unless an exception is requested. And
- Determine the project's maximum Federal Reimbursement Ratio (FRR).

I.1 Select up to 3 countermeasures (CMs) to be tested in the Engineer's Estimate:

Number of CMs to be used in this project:	3

CM No. 1:	S4: Provide Advanced Dilemma Zone Detection for high speed approaches
CM No. 2:	NS7: Install Flashing Beacons at Stop-Controlled Intersections
CM No. 3:	R15: Road Diet (Reduce travel lanes from 4 to 3 and add a two way left-turn and bike lanes)

I.2 Detailed Engineer's Estimate for Construction Items:

Cost breakdown by CMs. For each item, enter a cost percentage for each of the CMs and "Other Safety-Related" (OS) components. (e.g. enter 10 for 10%). The cost % for "Non-Safety-Related" (NS) components is calculated.

	No.	Item Description	Unit	Quantity	Unit Cost	Total	% for CM#1 (S4)	% for CM#2 (NS7)	% for CM#3 (R15)	% for OS*	% for NS**
+ -	1	Intelligent Dilemma Zone Detection at Jeffrey and Sand Canyon	LS	1	100,000	100,000	100%	%	%	%	0
+ -	2	Upgrade to LED stop signs with turn pocket removal and high vis crosswalks only at Scented Violet, Truman, and Huntington (collision locations)	LS	1	$73414.73	73,415	%	100%	%	%	0
+ -	3	Lane reduction with buffered bike lane	LS	1	240,926.45	240,926	%	%	100%	%	0
+ -	4	Mobilization, TC	LS	1	$82868.24	82,868	30%	20%	50%	%	0
		Weighted Average (%)					25%	18%	57%		
		Total ($)				$497,209					

* % for OS: Cost % for Other Safety-Related components;
** % for NS: Cost % for Non Safety-Related components.

Contingencies, as % of the above "Total" of the construction items: (e.g. enter 10 for 10%)	20 %	$99,442
Total Construction Cost (Con Items & Contingencies): (Rounded up to the nearest hundreds)		$596,700

I.3 Summary

3 CM(s) are eligible to be used in the project benefit calculation.

Countermeasure ID	Federal Funding Eligibility (FFE)	Cost %	Eligible to be used in benefit calculation?	Request exception to the 15% rule*
S4	100%	25.11%	Yes (>=15% cost)	☐
NS7	100%	18.10%	Yes (>=15% cost)	☐
R15	90%	56.79%	Yes (>=15% cost)	☐

*By requesting an exception to the 15% rule, the CM with less than 15% of the construction cost will then be eligible to be used in the benefit calculation. if an exception is requested for any CM(s) above, please provide the reason (low cost treatment with significant safety benefits, etc.):

Project's Maximum Federal Reimbursement Ratio = 90.0%

The project's Maximum Federal Reimbursement Ratio is calculated as the least of the FFEs of the above countermeasures, minus the percentage of the non-safety related costs in excess of 10%. **This is the maximum value allowed to be entered in "HSIP/Total (%)" column in Section II (Project Cost Estimate).**

Section II. Project Cost Estimate

All project costs, **for all phases and by all funding sources**, must be accounted for on this form.

i. "**Total Cost**": Round all costs up to the nearest hundred dollars.

ii. "**HSIP/Total (%)**": The maximum allowed is the project's Federal Reimbursement Ratio (FRR) as determined in Section I. Click the button to assign the maximum to all, OR enter if not the maximum.

iii. "**HSIP Funds**" and "**Local/Other Funds**" are calculated.

Pay attention to the interactive warning/error messages below the table. The messages, if any, must be fixed, or exceptions should be justified in Question No. 5 in Section II of the HSIP Application Form.

Project's maximum Federal Reimbursement Ratio (FRR) (from Section I, rounded up to integer): 90 %

To set all "HSIP/Total (%)" in the below table to the above maximum FRR, click "Set": Set

Description	Total Cost	HISP/Total (%)	HSIP Funds	Local/Other Funds
Preliminary Engineering (PE) Phase				
Environmental	$103,700	90 %	$93,330	$10,370
PS&E	$103,700	90 %	$93,330	$10,370
Subtotal - PE	**$207,400**	**90 %**	**$186,660**	**$20,740**
Right of Way (ROW) Phase				
Right of Way Engineering	$20,800	90 %	$18,720	$2,080
Appraisals, Acquisitions & Utilities	$8,400	90 %	$7,560	$840
Subtotal - Right of Way (ROW)	**$29,200**	**90 %**	**$26,280**	**$2,920**
Construction (CON) Phase				
Construction Engineering (CE)	$83,000	90 %	$74,700	$8,300
Construction Items	$596,700 (Read only - from Section I)	90 %	$537,030	$59,670
Subtotal - Construction	**$679,700**	**90 %**	**$611,730**	**$67,970**
PROJECT TOTAL	$916,300	90 %	$824,670	$91,630

☐ Agency does NOT request **HSIP** funds for PE Phase (automatically checked if PE - HSIP funds is $0).

Interactive Warning/Error Messages:

If there are any messages in the below box, please fix OR explain justification for exceptions in Question No 5, Section II in the HSIP Application.

1. The HSIP amount for PE exceeds 25% of the HSIP amount for Construction Items.

Section III. Project Location Groups, Countermeasures and Crash Data

The benefit of an HSIP safety project is achieved by reducing potential future crashes due to the application of the safety countermeasures (CMs). In this section, you will need to provide information regarding the project's safety CMs and historical crash data at the project sites. The data will be used to estimate the project benefit in Section IV.

1. Divide the project locations into groups.

It is quite often that an HSIP project has multiple locations. Theoretically the benefit for every single location may be calculated separately and then sum them up. However, that may be time consuming or almost impossible when there are a lot of locations. It is more efficient that the project locations with exactly the same safety countermeasures are combined into a group. The benefits of the locations in the same group can then be calculated at once.

When only one group is needed:

If your project consists of only one location or multiple locations that have similar features, address similar safety issues and utilize the same countermeasure(s). The crash data of all the locations can be combined and only one group is needed.

When multiple groups are needed:

If your project include multiple locations that have various safety issues and the proposed safety improvements (countermeasures) are not exactly the same for all the locations. The locations must be divided into different groups. The project benefits are then calculated multiple times, once for each location group. The project total benefit is the sum of the benefits from the different groups.

It should be noted that within a group, all locations should be of the same type: Signalized Intersection (S), Non-Signalized Intersection (NS), or Roadway (R).

If necessary, you may explain the location grouping for your project in details in Question No. 3 (Crash Data Evaluation), Section II in the HSIP Application Form.

2. After the number of location groups is entered, one subform will be populated for each location group. For each location group:

1) First, select the applicable CMs. *Note: If a Roundabout CM (S18 or NS4A or NS4B) is selected, additional information is required.*

For each group, only the CMs of the same type as the group location type can be used. For example, if a group consists of 5 signalized intersections, only "Signalized Intersection" CMs may be used for this group.

2) Based on the selected CMs, crash data tables of the required types are displayed for data entry.

Different CMs will reduce crashes of different types during the life of the safety improvements. Depending on the selected CMs for the group, you will be required to fill in one or more crash data tables, for any combination of the five crash types (datasets): "All" , "Night" , Ped & Bike", "Emergency Vehicle", and "Animal" (Each of the later four datasets is a sub-dataset of the "All" dataset.)

For more information regarding grouping project locations and examples, please refer to the Manual for HSIP Analyzer.

III.1 List of Project Locations and Location Groups

List all locations/sites included in this project by groups. The locations entered in Table III.1 below will be automatically populated in the crash data tables in III.2.

Based on the criteria described on the last page, the locations/sites need to be divided into 3 groups.

Table III.1 List of Project Locations by Groups

Highlighted fields must be filled in. For each group:
1) Must select a Location Type;
2) Initially each group has one location line. Click "+"/"-" to add a new line/delete an existing line;
3) Enter location description for each line. The same descriptions will be auto-populated in III.2.

*Note: If your project has a large number of locations, please aggregate some locations into one description, e.g. 10 stop controlled intersections, 5 horizontal curves, etc., as long as they have similar features and the safety improvements to be implemented are the same.

	No.	No. in Group	Location Description (Intersection Name or Road Limit or General Description)	
GROUP 1			Select Location Type:	S (Signalized Intersections)
+ -	1	G1-1	Sand Canyon	
+ -	2	G1-2	Jeffrey	
GROUP 2			Select Location Type:	NS (Non-signalized Intersections)
+ -	3	G2-1	Scented Violet, Truman, and Huntington	
GROUP 3			Select Location Type:	R (Roadways)
+ -	4	G3-1	Areas with lane reduction proposed (see report)	

III.2: Countermeasures and Crash Data

(Repeats for each location group)

Countermeasures and Crash Data -Location Group No. 1 of 3

Hide Group Details

Step 1: Select countermeasure(s) to be applied to this location group

This group's location type: S (Signalized Intersections)

Please check the CMs for this location group. All the CMs that have passed the test in Section I AND match the location type of this group are listed below.

	No.	Countermeasure (CM) Name	CM Type*	Crash Reduction Factor (CRF)	Expected Life (Years)	Crash Type	Federal Funding Eligibility
☒	1	S4: Provide Advanced Dilemma Zone Detection for high speed approaches	S	0.4	10	All	100%
	*CM Type: S-Signalized Intersection; NS-Non-Signalized Intersection; R-Roadway.						

Step 2: Provide crash data.

2.1 Crash Data Period: must be between 3 and 5 years.

from (MM/DD/YYYY): 01/01/2015 To (MM/DD/YYYY): 12/31/2019 Crash Data Period (years) = 5

2.2 Fill out the crash data table(s) for the crash type(s) as required by the selected countermeasure(s) in Step 1.

Based on the countermeasures selected in Step 1 , the crash data types to be provided are:

(1) All

Crash Data Table for Crash Type: ALL

No.	Location (from Table III.1)	Fatal (ALL)	Severe Injury (ALL)	Other Visible Injury (ALL)	Complaint of Pain (ALL)	PDO (ALL)	Total
1	Sand Canyon	0	1	1	2	0	4
2	Jeffrey	0	0	3	6	0	9
	Total	0	1	4	8	0	13

III.2: Countermeasures and Crash Data

(Repeats for each location group)

Countermeasures and Crash Data -Location Group No. 2 of 3

Hide Group Details

Step 1: Select countermeasure(s) to be applied to this location group

This group's location type: NS (Non-signalized Intersections)

Please check the CMs for this location group. All the CMs that have passed the test in Section I AND match the location type of this group are listed below.

	No.	Countermeasure (CM) Name	CM Type*	Crash Reduction Factor (CRF)	Expected Life (Years)	Crash Type	Federal Funding Eligibility
☒	1	NS7: Install Flashing Beacons at Stop-Controlled Intersections	NS	0.15	10	All	100%
	*CM Type: S-Signalized Intersection; NS-Non-Signalized Intersection; R-Roadway.						

Step 2: Provide crash data.

2.1 Crash Data Period: must be between 3 and 5 years.

from (MM/DD/YYYY): 01/01/2015 To (MM/DD/YYYY): 12/31/2019 Crash Data Period (years) = 5

2.2 Fill out the crash data table(s) for the crash type(s) as required by the selected countermeasure(s) in Step 1.

Based on the countermeasures selected in Step 1 , the crash data types to be provided are:

(1) All

Crash Data Table for Crash Type: ALL

No.	Location (from Table III.1)	Fatal (ALL)	Severe Injury (ALL)	Other Visible Injury (ALL)	Complaint of Pain (ALL)	PDO (ALL)	Total
1	Scented Violet, Truman, and Huntington	0	1	2	4	0	7
	Total	0	1	2	4	0	7

III.2: Countermeasures and Crash Data

(Repeats for each location group)

Countermeasures and Crash Data -Location Group No. 3 of 3

Hide Group Details

Step 1: Select countermeasure(s) to be applied to this location group

This group's location type: R (Roadways)

Please check the CMs for this location group. All the CMs that have passed the test in Section I AND match the location type of this group are listed below.

	No.	Countermeasure (CM) Name	CM Type*	Crash Reduction Factor (CRF)	Expected Life (Years)	Crash Type	Federal Funding Eligibility
☒	1	R15: Road Diet (Reduce travel lanes from 4 to 3 and add a two way left-turn and bike lanes)	R	0.3	20	All	90%
	*CM Type: S-Signalized Intersection; NS-Non-Signalized Intersection; R-Roadway.						

Step 2: Provide crash data.

2.1 Crash Data Period: must be between 3 and 5 years.

from (MM/DD/YYYY): 01/01/2015 To (MM/DD/YYYY): 12/31/2019 Crash Data Period (years) = 5

2.2 Fill out the crash data table(s) for the crash type(s) as required by the selected countermeasure(s) in Step 1.

Based on the countermeasures selected in Step 1 , the crash data types to be provided are:

(1) All

Crash Data Table for Crash Type: ALL

No.	Location (from Table III.1)	Fatal (ALL)	Severe Injury (ALL)	Other Visible Injury (ALL)	Complaint of Pain (ALL)	PDO (ALL)	Total
1	Areas with lane reduction proposed (see report)	1	0	1	5	0	7
	Total	1	0	1	5	0	7

Section IV. Calculation and Results

Click the "Calculate" button to calculate. The script will first check if there are any errors or inconsistencies in the countermeasure selections and crash data. If errors are detected and displayed below, the errors must be fixed first before you click the "Calculate" button again. If no errors are displayed, the calculation results are provided in this section. Please refer to the Manual for HSIP Analyzer for details regarding possible errors.

Calculate

Project Summary Information:

Project Total Cost: 916300
3 countermeasures are eligible in benefit calculation. (S4 NS7 R15)
Project location(s) are divided into 3 group(s) for calculating the benefits.

IV.1 Benefit Summary by location groups

Group No.	Group Info/Data*	Benefit from CM #1	Benefit from CM #2	Benefit from CM #3	Total Benefit of the group
1	Location type: S (Signalized Intersections) Number of location(s): 2 Number of selected countermeasure(s): 1 (S4) Crash Data Information: Crash data period (years): 5 Number of crashes(F/SI/OVI/I-CP/PDO)*: All: 0,1,4,8,0	$2,032,960	$0	$0	$2,032,960
2	Location type: NS (Non-signalized Intersections) Number of location(s): 1 Number of selected countermeasure(s): 1 (NS7) Crash Data Information: Crash data period (years): 5 Number of crashes(F/SI/OVI/I-CP/PDO)*: All: 0,1,2,4,0	$0	$855,181	$0	$855,181
3	Location type: R (Roadways) Number of location(s): 1 Number of selected countermeasure(s): 1 (R15) Crash Data Information: Crash data period (years): 5 Number of crashes(F/SI/OVI/I-CP/PDO)*: All: 1,0,1,5,0	$0	$0	$2,983,201	$2,983,201
Sum		**$2,032,960**	**$855,181**	**$2,983,201**	**$5,871,342**

*Number of crashes: five crash numbers are for Fatal (F), Severe Injury (SI), Other Visible Injury (OVI), Injury - Complaint of Pain (I-CP), and Property Damage Only (PDO), respectively.

IV.2. Project Benefit and BCR Summary

No.	Countermeasure Name	Benefit	Cost	Resulting B/C
1	S4	$2,032,960	$230,104	**8.8**
2	NS7	$855,181	$165,838	**5.2**
3	R15	$2,983,201	$520,358	**5.7**
	Entire Project	**$5,871,342**	**$916,300**	**6.4**

Data to be transferred to the HSIP Application Form

This section is generated automatically once the data entry and calculation have been completed. Transfer the data on this page to Section III of the HSIP Application Form.

Safety Countermeasure Information

Number of countermeasures: 3
S4: Provide Advanced Dilemma Zone Detection for high speed approaches
NS7: Install Flashing Beacons at Stop-Controlled Intersections
R15: Road Diet (Reduce travel lanes from 4 to 3 and add a two way left-turn and bike lanes)

Cost, FRR, Benefit and BCR:

Total Project Cost:	$916,300
HSIP Funds Requested:	$824,670
Max. Federal Reimbursement Ratio (FRR):	90%
Total Expected Benefit:	$5,871,342
Benefit Cost Ratio:	6.41

HSIP ANALYZER

Cost Estimate, Crash Data and Benefit Cost Ratio (BCR) Calculation for Highway Safety Improvement Program (HSIP) Application

Important: Review and follow the step-by-step instructions in "Manual for HSIP Analyzer". Completing the HSIP Analyzer without referencing to the manual may result in an application with fatal flaws that will be disqualified from the ranking and selection process.

All yellow highlighted fields must be filled in. The gray fields are calculated and read-only. This is a dynamic form (later steps vary depending on the data entered in earlier steps). If any error messages in red appear, fix the errors prior to proceeding to the next steps.

1. Application ID, Project Location and Project Description (copy from the HSIP Application Form):

Application ID: **Campus**

Save this file using the Application ID plus "Calc" as the file name (e.g. "07-Los Angeles-01Calc.pdf").

Project Location: (limited to 250 characters)
Campus from University to Turtle Rock

Project Description: (limited to 250 characters)
CM 1 LPIs with signage and high visibility crosswalks at Bridge, Culver, and Stanford
CM 2 Intelligent Dilemma Zone Detection at Bridge, Culver, and Berkely
CM 3 Signal install at Paseo Montoya

2. Application Category (Check one):

Application Categories that require a Benefit Cost Ratio (BCR):

- ☒ Common BCR Application
- ☐ Set-aside for High Friction Surface Treatment

Application Categories that do NOT require a Benefit Cost Ratio (BCR):

- ☐ Set-aside for Guardrail Upgrades
- ☐ Set-aside for Horizontal Curve Signing
- ☐ Set-aside for Pedestrian Crossing Enhancements
- ☐ Set-aside for Tribes

☐ **Dual consideration?**
If an Application Category that does not require a BCR is selected above, check this box to indicate your desire that this application will be considered as a Common BCR Application as well in case it does not get selected for funding under the set-aside category. If this box is checked, a benefit cost analysis is required so the project will have a BCR.

A safety benefit cost analysis is required for this application. This tool will guide through cost estimate, safety benefit evaluation and Benefit Cost Ratio (BCR) calculation.

Section I. Construction Cost Estimate and Cost Breakdown

The purpose of this section is to:

- Provide detailed engineer's estimate (for construction items only). The costs for other phases (PE, ROW, and CE) will be included in Section II.
- Test if countermeasures (CMs) (up to 3) are eligible for being used in the project benefit calculation. For a CM to be used in the project benefit calculation, the construction cost of the CM must be at least 15% of the project's total construction cost, unless an exception is requested. And
- Determine the project's maximum Federal Reimbursement Ratio (FRR).

I.1 Select up to 3 countermeasures (CMs) to be tested in the Engineer's Estimate:

Number of CMs to be used in this project: 3

CM No. 1:	S22: Modify signal phasing to implement a Leading Pedestrian Interval (LPI)
CM No. 2:	S4: Provide Advanced Dilemma Zone Detection for high speed approaches
CM No. 3:	NS3: Install signals

I.2 Detailed Engineer's Estimate for Construction Items:

Cost breakdown by CMs. For each item, enter a cost percentage for each of the CMs and "Other Safety-Related" (OS) components. (e.g. enter 10 for 10%). The cost % for "Non-Safety-Related" (NS) components is calculated.

	No.	Item Description	Unit	Quantity	Unit Cost	Total	% for CM#1 (S22)	% for CM#2 (S4)	% for CM#3 (NS3)	% for OS*	% for NS**
+ -	1	LPIs with signage and high visibility crosswalks at Bridge, Culver, and Stanford	LS	1	$57816.72	57,817	100%	%	%	%	0
+ -	2	Intelligent Dilemma Zone Detection at Bridge, Culver, and Berkely	LS	1	150,000	150,000	%	100%	%	%	0
+ -	3	Signal install at Paseo Montoya	LS	1	405,814.9	405,815	%	%	100%	%	0
+ -	4	Mobilization, TC	LS	1	122,726.32	122,726	10%	30%	60%	%	0
					Weighted Average (%)		10%	25%	65%		
					Total ($)	$736,358					

* % for OS: Cost % for Other Safety-Related components;
** % for NS: Cost % for Non Safety-Related components.

Contingencies, as % of the above "Total" of the construction items: 20 % $147,272
(e.g. enter 10 for 10%)

Total Construction Cost (Con Items & Contingencies): $883,700
(Rounded up to the nearest hundreds)

I.3 Summary

3 CM(s) are eligible to be used in the project benefit calculation.

Countermeasure ID	Federal Funding Eligibility (FFE)	Cost %	Eligible to be used in benefit calculation?	Request exception to the 15% rule*
S22	100%	9.52%	Yes (<15% cost) (Exception being requested)	☒
S4	100%	25.37%	Yes (>=15% cost)	☐
NS3	100%	65.11%	Yes (>=15% cost)	☐

*By requesting an exception to the 15% rule, the CM with less than 15% of the construction cost will then be eligible to be used in the benefit calculation. if an exception is requested for any CM(s) above, please provide the reason (low cost treatment with significant safety benefits, etc.):

Project's Maximum Federal Reimbursement Ratio = 100.0%

The project's Maximum Federal Reimbursement Ratio is calculated as the least of the FFEs of the above countermeasures, minus the percentage of the non-safety related costs in excess of 10%. **This is the maximum value allowed to be entered in "HSIP/Total (%)" column in Section II (Project Cost Estimate).**

Section II. Project Cost Estimate

All project costs, **for all phases and by all funding sources**, must be accounted for on this form.

i. "**Total Cost**": Round all costs up to the nearest hundred dollars.

ii. "**HSIP/Total (%)**": The maximum allowed is the project's Federal Reimbursement Ratio (FRR) as determined in Section I. Click the button to assign the maximum to all, OR enter if not the maximum.

iii. "**HSIP Funds**" and "**Local/Other Funds**" are calculated.

Pay attention to the interactive warning/error messages below the table. The messages, if any, must be fixed, or exceptions should be justified in Question No. 5 in Section II of the HSIP Application Form.

Project's maximum Federal Reimbursement Ratio (FRR) (from Section I, rounded up to integer): 100 %

To set all "HSIP/Total (%)" in the below table to the above maximum FRR, click "Set": Set

Description	Total Cost	HISP/Total (%)	HSIP Funds	Local/Other Funds
Preliminary Engineering (PE) Phase				
Environmental	$153,500	100 %	$153,500	$0
PS&E	$153,500	100 %	$153,500	$0
Subtotal - PE	**$307,000**	**100 %**	**$307,000**	**$0**
Right of Way (ROW) Phase				
Right of Way Engineering	$30,800	100 %	$30,800	$0
Appraisals, Acquisitions & Utilities	$12,300	100 %	$12,300	$0
Subtotal - Right of Way (ROW)	**$43,100**	**100 %**	**$43,100**	**$0**
Construction (CON) Phase				
Construction Engineering (CE)	$122,800	100 %	$122,800	$0
Construction Items	$883,700 (Read only - from Section I)	100 %	$883,700	$0
Subtotal - Construction	**$1,006,500**	**100 %**	**$1,006,500**	**$0**
PROJECT TOTAL	$1,356,600	100 %	$1,356,600	$0

☐ Agency does NOT request **HSIP** funds for PE Phase (automatically checked if PE - HSIP funds is $0).

Interactive Warning/Error Messages:

If there are any messages in the below box, please fix OR explain justification for exceptions in Question No 5, Section II in the HSIP Application.

1. The HSIP amount for PE exceeds 25% of the HSIP amount for Construction Items.

Section III. Project Location Groups, Countermeasures and Crash Data

The benefit of an HSIP safety project is achieved by reducing potential future crashes due to the application of the safety countermeasures (CMs). In this section, you will need to provide information regarding the project's safety CMs and historical crash data at the project sites. The data will be used to estimate the project benefit in Section IV.

1. Divide the project locations into groups.

It is quite often that an HSIP project has multiple locations. Theoretically the benefit for every single location may be calculated separately and then sum them up. However, that may be time consuming or almost impossible when there are a lot of locations. It is more efficient that the project locations with exactly the same safety countermeasures are combined into a group. The benefits of the locations in the same group can then be calculated at once.

When only one group is needed:

If your project consists of only one location or multiple locations that have similar features, address similar safety issues and utilize the same countermeasure(s). The crash data of all the locations can be combined and only one group is needed.

When multiple groups are needed:

If your project include multiple locations that have various safety issues and the proposed safety improvements (countermeasures) are not exactly the same for all the locations. The locations must be divided into different groups. The project benefits are then calculated multiple times, once for each location group. The project total benefit is the sum of the benefits from the different groups.

It should be noted that within a group, all locations should be of the same type: Signalized Intersection (S), Non-Signalized Intersection (NS), or Roadway (R).

If necessary, you may explain the location grouping for your project in details in Question No. 3 (Crash Data Evaluation), Section II in the HSIP Application Form.

2. After the number of location groups is entered, one subform will be populated for each location group. For each location group:

1) First, select the applicable CMs. *Note: If a Roundabout CM (S18 or NS4A or NS4B) is selected, additional information is required.*

For each group, only the CMs of the same type as the group location type can be used. For example, if a group consists of 5 signalized intersections, only "Signalized Intersection" CMs may be used for this group.

2) Based on the selected CMs, crash data tables of the required types are displayed for data entry.

Different CMs will reduce crashes of different types during the life of the safety improvements. Depending on the selected CMs for the group, you will be required to fill in one or more crash data tables, for any combination of the five crash types (datasets): "All" , "Night" , Ped & Bike", "Emergency Vehicle", and "Animal" (Each of the later four datasets is a sub-dataset of the "All" dataset.)

For more information regarding grouping project locations and examples, please refer to the Manual for HSIP Analyzer.

III.1 List of Project Locations and Location Groups

List all locations/sites included in this project by groups. The locations entered in Table III.1 below will be automatically populated in the crash data tables in III.2.

Based on the criteria described on the last page, the locations/sites need to be divided into 4 groups.

Table III.1 List of Project Locations by Groups

Highlighted fields must be filled in. For each group:
1) Must select a Location Type;
2) Initially each group has one location line. Click "+"/"-" to add a new line/delete an existing line;
3) Enter location description for each line. The same descriptions will be auto-populated in III.2.

*Note: If your project has a large number of locations, please aggregate some locations into one description, e.g. 10 stop controlled intersections, 5 horizontal curves, etc., as long as they have similar features and the safety improvements to be implemented are the same.

	No.	No. in Group	Location Description (Intersection Name or Road Limit or General Description)	
GROUP 1			Select Location Type:	S (Signalized Intersections)
+ -	1	G1-1	Bridge	
+ -	2	G1-2	Culver	
GROUP 2			Select Location Type:	S (Signalized Intersections)
+ -	3	G2-1	Stanford	
GROUP 3			Select Location Type:	S (Signalized Intersections)
+ -	4	G3-1	Berkeley	
GROUP 4			Select Location Type:	NS (Non-signalized Intersections)
+ -	5	G4-1	Paseo Montoya	

III.2: Countermeasures and Crash Data

(Repeats for each location group)

Countermeasures and Crash Data -Location Group No. 1 of 4

Hide Group Details

Step 1: Select countermeasure(s) to be applied to this location group

This group's location type: S (Signalized Intersections)

Please check the CMs for this location group. All the CMs that have passed the test in Section I AND match the location type of this group are listed below.

	No.	Countermeasure (CM) Name	CM Type*	Crash Reduction Factor (CRF)	Expected Life (Years)	Crash Type	Federal Funding Eligibility
☒	1	S22: Modify signal phasing to implement a Leading Pedestrian Interval (LPI)	S	0.6	10	Ped & Bike	100%
☒	2	S4: Provide Advanced Dilemma Zone Detection for high speed approaches	S	0.4	10	All	100%
	*CM Type: S-Signalized Intersection; NS-Non-Signalized Intersection; R-Roadway.						

Step 2: Provide crash data.

2.1 Crash Data Period: must be between 3 and 5 years.

from (MM/DD/YYYY): 01/01/2015 To (MM/DD/YYYY): 12/31/2019 Crash Data Period (years) = 5

2.2 Fill out the crash data table(s) for the crash type(s) as required by the selected countermeasure(s) in Step 1.

Based on the countermeasures selected in Step 1 , the crash data types to be provided are:

(1) All (2) Ped & Bike

Crash Data Table for Crash Type: ALL

No.	Location (from Table III.1)	Fatal (ALL)	Severe Injury (ALL)	Other Visible Injury (ALL)	Complaint of Pain (ALL)	PDO (ALL)	Total
1	Bridge	0	2	2	3	0	7
2	Culver	0	1	3	7	0	11
	Total	0	3	5	10	0	18

Crash Data Table for Crash Type: Pedestrians and Bicyclists Involved (P&B)

No.	Location (from Table III.1)	Fatal (P&B)	Severe Injury (P&B)	Other Visible Injury (P&B)	Complaint of Pain (P&B)	PDO (P&B)	Total
1	Bridge	0	1	1	2	0	4
2	Culver	0	1	2	0	0	3
	Total	0	2	3	2	0	7

III.2: Countermeasures and Crash Data

(Repeats for each location group)

Countermeasures and Crash Data -Location Group No. 2 of 4

Hide Group Details

Step 1: Select countermeasure(s) to be applied to this location group

This group's location type: S (Signalized Intersections)

Please check the CMs for this location group. All the CMs that have passed the test in Section I AND match the location type of this group are listed below.

	No.	Countermeasure (CM) Name	CM Type*	Crash Reduction Factor (CRF)	Expected Life (Years)	Crash Type	Federal Funding Eligibility
☒	1	S22: Modify signal phasing to implement a Leading Pedestrian Interval (LPI)	S	0.6	10	Ped & Bike	100%
☐	2	S4: Provide Advanced Dilemma Zone Detection for high speed approaches	S	0.4	10	All	100%
	*CM Type: S-Signalized Intersection; NS-Non-Signalized Intersection; R-Roadway.						

Step 2: Provide crash data.

2.1 Crash Data Period: must be between 3 and 5 years.

from (MM/DD/YYYY): 01/01/2015 To (MM/DD/YYYY): 12/31/2019 Crash Data Period (years) = 5

2.2 Fill out the crash data table(s) for the crash type(s) as required by the selected countermeasure(s) in Step 1.

Based on the countermeasures selected in Step 1 , the crash data types to be provided are:

(1) Ped & Bike

Crash Data Table for Crash Type: Pedestrians and Bicyclists Involved (P&B)

No.	Location (from Table III.1)	Fatal (P&B)	Severe Injury (P&B)	Other Visible Injury (P&B)	Complaint of Pain (P&B)	PDO (P&B)	Total
1	Stanford	0	1	1	0	0	2
	Total	0	1	1	0	0	2

III.2: Countermeasures and Crash Data

(Repeats for each location group)

Countermeasures and Crash Data -Location Group No. 3 of 4

Hide Group Details

Step 1: Select countermeasure(s) to be applied to this location group

This group's location type: S (Signalized Intersections)

Please check the CMs for this location group. All the CMs that have passed the test in Section I AND match the location type of this group are listed below.

	No.	Countermeasure (CM) Name	CM Type*	Crash Reduction Factor (CRF)	Expected Life (Years)	Crash Type	Federal Funding Eligibility
☐	1	S22: Modify signal phasing to implement a Leading Pedestrian Interval (LPI)	S	0.6	10	Ped & Bike	100%
☒	2	S4: Provide Advanced Dilemma Zone Detection for high speed approaches	S	0.4	10	All	100%
	*CM Type: S-Signalized Intersection; NS-Non-Signalized Intersection; R-Roadway.						

Step 2: Provide crash data.

2.1 Crash Data Period: must be between 3 and 5 years.

from (MM/DD/YYYY): 01/01/2015 To (MM/DD/YYYY): 12/31/2019 Crash Data Period (years) = 5

2.2 Fill out the crash data table(s) for the crash type(s) as required by the selected countermeasure(s) in Step 1.

Based on the countermeasures selected in Step 1 , the crash data types to be provided are:

(1) All

Crash Data Table for Crash Type: ALL

No.	Location (from Table III.1)	Fatal (ALL)	Severe Injury (ALL)	Other Visible Injury (ALL)	Complaint of Pain (ALL)	PDO (ALL)	Total
1	Berkeley	0	0	0	2	0	2
	Total	0	0	0	2	0	2

III.2: Countermeasures and Crash Data

(Repeats for each location group)

Countermeasures and Crash Data -Location Group No. 4 of 4

Hide Group Details

Step 1: Select countermeasure(s) to be applied to this location group

This group's location type: NS (Non-signalized Intersections)

Please check the CMs for this location group. All the CMs that have passed the test in Section I AND match the location type of this group are listed below.

	No.	Countermeasure (CM) Name	CM Type*	Crash Reduction Factor (CRF)	Expected Life (Years)	Crash Type	Federal Funding Eligibility
☒	1	NS3: Install signals	NS	0.25	20	All	100%
	*CM Type: S-Signalized Intersection; NS-Non-Signalized Intersection; R-Roadway.						

Additional information is required:

Since Roundabout is selected, the below additional information is required for calculating Roundabout benefit.

Roundabout Location	Please select:	Urban				
Intersection Type	Please select:	Four-leg Intersection				
Roundabout Lanes	Please select:	2 Lanes				
ADT	Major Road:	20,500	Minor Road:	10,000	**Total**	**30,500**

Step 2: Provide crash data.

2.1 Crash Data Period: must be between 3 and 5 years.

from (MM/DD/YYYY): 01/01/2015 To (MM/DD/YYYY): 12/31/2019 Crash Data Period (years) = 5

2.2 Fill out the crash data table(s) for the crash type(s) as required by the selected countermeasure(s) in Step 1.

Based on the countermeasures selected in Step 1 , the crash data types to be provided are:

(1) All

Crash Data Table for Crash Type: ALL

No.	Location (from Table III.1)	Fatal (ALL)	Severe Injury (ALL)	Other Visible Injury (ALL)	Complaint of Pain (ALL)	PDO (ALL)	Total
1	Paseo Montoya	0	1	3	4	0	8
	Total	0	1	3	4	0	8

Section IV. Calculation and Results

Click the "Calculate" button to calculate. The script will first check if there are any errors or inconsistencies in the countermeasure selections and crash data. If errors are detected and displayed below, the errors must be fixed first before you click the "Calculate" button again. If no errors are displayed, the calculation results are provided in this section. Please refer to the Manual for HSIP Analyzer for details regarding possible errors.

Calculate

Project Summary Information:

Project Total Cost: 1356600
3 countermeasures are eligible in benefit calculation. (S22 S4 NS3)
Project location(s) are divided into 4 group(s) for calculating the benefits.

IV.1 Benefit Summary by location groups

Group No.	Group Info/Data*	Benefit from CM #1	Benefit from CM #2	Benefit from CM #3	Total Benefit of the group
1	Location type: S (Signalized Intersections) Number of location(s): 2 Number of selected countermeasure(s): 2 (S22 S4) Crash Data Information: Crash data period (years): 5 Number of crashes(F/SI/OVI/I-CP/PDO)*: All: 0,3,5,10,0 Ped & Bike: 0,2,3,2,0	$2,479,176	$4,585,200	$0	$7,064,376
2	Location type: S (Signalized Intersections) Number of location(s): 1 Number of selected countermeasure(s): 1 (S22) Crash Data Information: Crash data period (years): 5 Number of crashes(F/SI/OVI/I-CP/PDO)*: Ped & Bike: 0,1,1,0,0	$1,903,801	$0	$0	$1,903,801
3	Location type: S (Signalized Intersections) Number of location(s): 1 Number of selected countermeasure(s): 1 (S4) Crash Data Information: Crash data period (years): 5 Number of crashes(F/SI/OVI/I-CP/PDO)*: All: 0,0,0,2,0	$0	$115,040	$0	$115,040
4	Location type: NS (Non-signalized Intersections) Number of location(s): 1 Number of selected countermeasure(s): 1 (NS3) Crash Data Information: Crash data period (years): 5 Number of crashes(F/SI/OVI/I-CP/PDO)*: All: 0,1,3,4,0	$0	$0	$0	$0
Sum		**$4,382,977**	**$4,700,240**	**$0**	**$9,083,217**

*Number of crashes: five crash numbers are for Fatal (F), Severe Injury (SI), Other Visible Injury (OVI), Injury - Complaint of Pain (I-CP), and Property Damage Only (PDO), respectively.

IV.2. Project Benefit and BCR Summary

No.	Countermeasure Name	Benefit	Cost	Resulting B/C
1	S22	$4,382,977	$129,126	**33.9**
2	S4	$4,700,240	$344,177	**13.7**
3	NS3	$0	$883,297	**0**
	Entire Project	**$9,083,217**	**$1,356,600**	**6.7**

Data to be transferred to the HSIP Application Form

This section is generated automatically once the data entry and calculation have been completed. Transfer the data on this page to Section III of the HSIP Application Form.

Safety Countermeasure Information

Number of countermeasures: 3

S22: Modify signal phasing to implement a Leading Pedestrian Interval (LPI)

S4: Provide Advanced Dilemma Zone Detection for high speed approaches

NS3: Install signals

Cost, FRR, Benefit and BCR:

Total Project Cost:	$1,356,600
HSIP Funds Requested:	$1,356,600
Max. Federal Reimbursement Ratio (FRR):	100%
Total Expected Benefit:	$9,083,217
Benefit Cost Ratio:	6.70

HSIP ANALYZER

Cost Estimate, Crash Data and Benefit Cost Ratio (BCR) Calculation for Highway Safety Improvement Program (HSIP) Application

Important: Review and follow the step-by-step instructions in "Manual for HSIP Analyzer". Completing the HSIP Analyzer without referencing to the manual may result in an application with fatal flaws that will be disqualified from the ranking and selection process.

All yellow highlighted fields must be filled in. The gray fields are calculated and read-only. This is a dynamic form (later steps vary depending on the data entered in earlier steps). If any error messages in red appear, fix the errors prior to proceeding to the next steps.

1. Application ID, Project Location and Project Description (copy from the HSIP Application Form):

Application ID: **Jeffrey**

Save this file using the Application ID plus "Calc" as the file name (e.g. "07-Los Angeles-01Calc.pdf").

Project Location: (limited to 250 characters)
Jeffrey from Portola Parkway to Venta Spur Trail

Project Description: (limited to 250 characters)
CM 1 Intelligent Dilemma Zone Detection at Portola, Encore, and Irvine
CM 2 High-Friction Surface Treatments at Portola and Irvine
CM 3 Retroreflective backplates at Portola, Encore, and Irvine

2. Application Category (Check one):

Application Categories that require a Benefit Cost Ratio (BCR):

- ☒ Common BCR Application
- ☐ Set-aside for High Friction Surface Treatment

Application Categories that do NOT require a Benefit Cost Ratio (BCR):

- ☐ Set-aside for Guardrail Upgrades
- ☐ Set-aside for Horizontal Curve Signing
- ☐ Set-aside for Pedestrian Crossing Enhancements
- ☐ Set-aside for Tribes

☐ **Dual consideration?**
If an Application Category that does not require a BCR is selected above, check this box to indicate your desire that this application will be considered as a Common BCR Application as well in case it does not get selected for funding under the set-aside category. If this box is checked, a benefit cost analysis is required so the project will have a BCR.

A safety benefit cost analysis is required for this application. This tool will guide through cost estimate, safety benefit evaluation and Benefit Cost Ratio (BCR) calculation.

Section I. Construction Cost Estimate and Cost Breakdown

The purpose of this section is to:

- Provide detailed engineer's estimate (for construction items only). The costs for other phases (PE, ROW, and CE) will be included in Section II.
- Test if countermeasures (CMs) (up to 3) are eligible for being used in the project benefit calculation. For a CM to be used in the project benefit calculation, the construction cost of the CM must be at least 15% of the project's total construction cost, unless an exception is requested. And
- Determine the project's maximum Federal Reimbursement Ratio (FRR).

I.1 Select up to 3 countermeasures (CMs) to be tested in the Engineer's Estimate:

Number of CMs to be used in this project: 3

CM No. 1:	S4: Provide Advanced Dilemma Zone Detection for high speed approaches
CM No. 2:	S11: Improve pavement friction (High Friction Surface Treatments)
CM No. 3:	S2: Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number

I.2 Detailed Engineer's Estimate for Construction Items:

Cost breakdown by CMs. For each item, enter a cost percentage for each of the CMs and "Other Safety-Related" (OS) components. (e.g. enter 10 for 10%). The cost % for "Non-Safety-Related" (NS) components is calculated.

	No.	Item Description	Unit	Quantity	Unit Cost	Total	% for CM#1 (S4)	% for CM#2 (S11)	% for CM#3 (S2)	% for OS*	% for NS**
+ -	1	Intelligent Dilemma Zone Detection at Portola, Encore, and Irvine	LS	1	150,000	150,000	100%	%	%	%	0
+ -	2	High-Friction Surface Treatments at Portola and Irvine	LS	1	360,000	360,000	%	100%	%	%	0
+ -	3	Retroreflective backplates at Portola, Encore, and Irvine	LS	1	$20100.00	20,100	%	%	100%	%	0
+ -	4	Mobilization, TC	1	1	106,020	106,020	20%	75%	5%	0%	0
		Weighted Average (%) / Total ($)				$636,120	27%	69%	4%		

* % for OS: Cost % for Other Safety-Related components;
** % for NS: Cost % for Non Safety-Related components.

Contingencies, as % of the above "Total" of the construction items: 20 % $127,224
(e.g. enter 10 for 10%)

Total Construction Cost (Con Items & Contingencies): $763,400
(Rounded up to the nearest hundreds)

I.3 Summary

3 CM(s) are eligible to be used in the project benefit calculation.

Countermeasure ID	Federal Funding Eligibility (FFE)	Cost %	Eligible to be used in benefit calculation?	Request exception to the 15% rule*
S4	100%	26.91%	Yes (>=15% cost)	☐
S11	100%	69.09%	Yes (>=15% cost)	☐
S2	100%	3.99%	Yes (<15% cost) (Exception being requested)	☒

*By requesting an exception to the 15% rule, the CM with less than 15% of the construction cost will then be eligible to be used in the benefit calculation. if an exception is requested for any CM(s) above, please provide the reason (low cost treatment with significant safety benefits, etc.):

Project's Maximum Federal Reimbursement Ratio = 100.0%

The project's Maximum Federal Reimbursement Ratio is calculated as the least of the FFEs of the above countermeasures, minus the percentage of the non-safety related costs in excess of 10%. **This is the maximum value allowed to be entered in "HSIP/Total (%)" column in Section II (Project Cost Estimate).**

Section II. Project Cost Estimate

All project costs, **for all phases and by all funding sources**, must be accounted for on this form.

i. "**Total Cost**": Round all costs up to the nearest hundred dollars.

ii. "**HSIP/Total (%)**": The maximum allowed is the project's Federal Reimbursement Ratio (FRR) as determined in Section I. Click the button to assign the maximum to all, OR enter if not the maximum.

iii. "**HSIP Funds**" and "**Local/Other Funds**" are calculated.

Pay attention to the interactive warning/error messages below the table. The messages, if any, must be fixed, or exceptions should be justified in Question No. 5 in Section II of the HSIP Application Form.

Project's maximum Federal Reimbursement Ratio (FRR) (from Section I, rounded up to integer): 100 %

To set all "HSIP/Total (%)" in the below table to the above maximum FRR, click "Set": Set

Description	Total Cost	HISP/Total (%)	HSIP Funds	Local/Other Funds
Preliminary Engineering (PE) Phase				
Environmental	$135,600	100 %	$135,600	$0
PS&E	$132,600	100 %	$132,600	$0
Subtotal - PE	**$268,200**	**100 %**	**$268,200**	**$0**
Right of Way (ROW) Phase				
Right of Way Engineering	$26,600	100 %	$26,600	$0
Appraisals, Acquisitions & Utilities	$10,700	100 %	$10,700	$0
Subtotal - Right of Way (ROW)	**$37,300**	**100 %**	**$37,300**	**$0**
Construction (CON) Phase				
Construction Engineering (CE)	$106,100	100 %	$106,100	$0
Construction Items	$763,400 (Read only - from Section I)	100 %	$763,400	$0
Subtotal - Construction	**$869,500**	**100 %**	**$869,500**	**$0**
PROJECT TOTAL	$1,175,000	100 %	$1,175,000	$0

☐ Agency does NOT request **HSIP** funds for PE Phase (automatically checked if PE - HSIP funds is $0).

Interactive Warning/Error Messages:

If there are any messages in the below box, please fix OR explain justification for exceptions in Question No 5, Section II in the HSIP Application.

1. The HSIP amount for PE exceeds 25% of the HSIP amount for Construction Items.

Section III. Project Location Groups, Countermeasures and Crash Data

The benefit of an HSIP safety project is achieved by reducing potential future crashes due to the application of the safety countermeasures (CMs). In this section, you will need to provide information regarding the project's safety CMs and historical crash data at the project sites. The data will be used to estimate the project benefit in Section IV.

1. Divide the project locations into groups.

It is quite often that an HSIP project has multiple locations. Theoretically the benefit for every single location may be calculated separately and then sum them up. However, that may be time consuming or almost impossible when there are a lot of locations. It is more efficient that the project locations with exactly the same safety countermeasures are combined into a group. The benefits of the locations in the same group can then be calculated at once.

When only one group is needed:

If your project consists of only one location or multiple locations that have similar features, address similar safety issues and utilize the same countermeasure(s). The crash data of all the locations can be combined and only one group is needed.

When multiple groups are needed:

If your project include multiple locations that have various safety issues and the proposed safety improvements (countermeasures) are not exactly the same for all the locations. The locations must be divided into different groups. The project benefits are then calculated multiple times, once for each location group. The project total benefit is the sum of the benefits from the different groups.

It should be noted that within a group, all locations should be of the same type: Signalized Intersection (S), Non-Signalized Intersection (NS), or Roadway (R).

If necessary, you may explain the location grouping for your project in details in Question No. 3 (Crash Data Evaluation), Section II in the HSIP Application Form.

2. After the number of location groups is entered, one subform will be populated for each location group. For each location group:

1) First, select the applicable CMs. *Note: If a Roundabout CM (S18 or NS4A or NS4B) is selected, additional information is required.*

For each group, only the CMs of the same type as the group location type can be used. For example, if a group consists of 5 signalized intersections, only "Signalized Intersection" CMs may be used for this group.

2) Based on the selected CMs, crash data tables of the required types are displayed for data entry.

Different CMs will reduce crashes of different types during the life of the safety improvements. Depending on the selected CMs for the group, you will be required to fill in one or more crash data tables, for any combination of the five crash types (datasets): "All" , "Night" , Ped & Bike", "Emergency Vehicle", and "Animal" (Each of the later four datasets is a sub-dataset of the "All" dataset.)

For more information regarding grouping project locations and examples, please refer to the Manual for HSIP Analyzer.

III.1 List of Project Locations and Location Groups

List all locations/sites included in this project by groups. The locations entered in Table III.1 below will be automatically populated in the crash data tables in III.2.

Based on the criteria described on the last page, the locations/sites need to be divided into 2 groups.

Table III.1 List of Project Locations by Groups

Highlighted fields must be filled in. For each group:
1) Must select a Location Type;
2) Initially each group has one location line. Click "+"/"-" to add a new line/delete an existing line;
3) Enter location description for each line. The same descriptions will be auto-populated in III.2.

*Note: If your project has a large number of locations, please aggregate some locations into one description, e.g. 10 stop controlled intersections, 5 horizontal curves, etc., as long as they have similar features and the safety improvements to be implemented are the same.

	No.	No. in Group	Location Description (Intersection Name or Road Limit or General Description)	
GROUP 1			Select Location Type:	S (Signalized Intersections)
+ -	1	G1-1	Portola	
+ -	2	G1-2	Irvine	
GROUP 2			Select Location Type:	S (Signalized Intersections)
+ -	3	G2-1	Encore	

III.2: Countermeasures and Crash Data

(Repeats for each location group)

Countermeasures and Crash Data -Location Group No. 1 of 2

Hide Group Details

Step 1: Select countermeasure(s) to be applied to this location group

This group's location type: S (Signalized Intersections)

Please check the CMs for this location group. All the CMs that have passed the test in Section I AND match the location type of this group are listed below.

	No.	Countermeasure (CM) Name	CM Type*	Crash Reduction Factor (CRF)	Expected Life (Years)	Crash Type	Federal Funding Eligibility
☒	1	S4: Provide Advanced Dilemma Zone Detection for high speed approaches	S	0.4	10	All	100%
☒	2	SII: Improve pavement friction (High Friction Surface Treatments)	S	0.4	10	All	100%
☒	3	S2: Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number	S	0.15	10	All	100%
	*CM Type: S-Signalized Intersection; NS-Non-Signalized Intersection; R-Roadway.						

Step 2: Provide crash data.

2.1 Crash Data Period: must be between 3 and 5 years.

from (MM/DD/YYYY): 01/01/2015 To (MM/DD/YYYY): 12/31/2019 Crash Data Period (years) = 5

2.2 Fill out the crash data table(s) for the crash type(s) as required by the selected countermeasure(s) in Step 1.

Based on the countermeasures selected in Step 1 , the crash data types to be provided are:

(1) All

Crash Data Table for Crash Type: ALL

No.	Location (from Table III.1)	Fatal (ALL)	Severe Injury (ALL)	Other Visible Injury (ALL)	Complaint of Pain (ALL)	PDO (ALL)	Total
1	Portola	0	1	0	3	0	4
2	Irvine	1	3	1	9	0	14
	Total	1	4	1	12	0	18

III.2: Countermeasures and Crash Data

(Repeats for each location group)

Countermeasures and Crash Data -Location Group No. 2 of 2

Hide Group Details

Step 1: Select countermeasure(s) to be applied to this location group

This group's location type: S (Signalized Intersections)

Please check the CMs for this location group. All the CMs that have passed the test in Section I AND match the location type of this group are listed below.

	No.	Countermeasure (CM) Name	CM Type*	Crash Reduction Factor (CRF)	Expected Life (Years)	Crash Type	Federal Funding Eligibility
☒	1	S4: Provide Advanced Dilemma Zone Detection for high speed approaches	S	0.4	10	All	100%
☐	2	SII: Improve pavement friction (High Friction Surface Treatments)	S	0.4	10	All	100%
☒	3	S2: Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number	S	0.15	10	All	100%
	*CM Type: S-Signalized Intersection; NS-Non-Signalized Intersection; R-Roadway.						

Step 2: Provide crash data.

2.1 Crash Data Period: must be between 3 and 5 years.

from (MM/DD/YYYY): 01/01/2015 To (MM/DD/YYYY): 12/31/2019 Crash Data Period (years) = 5

2.2 Fill out the crash data table(s) for the crash type(s) as required by the selected countermeasure(s) in Step 1.

Based on the countermeasures selected in Step 1 , the crash data types to be provided are:

(1) All

Crash Data Table for Crash Type: ALL

No.	Location (from Table III.1)	Fatal (ALL)	Severe Injury (ALL)	Other Visible Injury (ALL)	Complaint of Pain (ALL)	PDO (ALL)	Total
1	Encore	0	0	1		0	1
	Total	0	0	1		0	1

Section IV. Calculation and Results

Click the "Calculate" button to calculate. The script will first check if there are any errors or inconsistencies in the countermeasure selections and crash data. If errors are detected and displayed below, the errors must be fixed first before you click the "Calculate" button again. If no errors are displayed, the calculation results are provided in this section. Please refer to the Manual for HSIP Analyzer for details regarding possible errors.

Calculate

Project Summary Information:

Project Total Cost: 1175000
3 countermeasures are eligible in benefit calculation. (S4 S11 S2)
Project location(s) are divided into 2 group(s) for calculating the benefits.

IV.1 Benefit Summary by location groups

Group No.	Group Info/Data*	Benefit from CM #1	Benefit from CM #2	Benefit from CM #3	Total Benefit of the group
1	Location type: S (Signalized Intersections) Number of location(s): 2 Number of selected countermeasure(s): 3 (S4 S11 S2) Crash Data Information: Crash data period (years): 5 Number of crashes(F/SI/OVI/I-CP/PDO)*: All: 1,4,1,12,0	$4,844,442	$4,844,442	$1,816,666	$11,505,550
2	Location type: S (Signalized Intersections) Number of location(s): 1 Number of selected countermeasure(s): 2 (S4 S2) Crash Data Information: Crash data period (years): 5 Number of crashes(F/SI/OVI/I-CP/PDO)*: All: 0,0,1,null,0	$90,161	$0	$33,810	$123,971
Sum		**$4,934,603**	**$4,844,442**	**$1,850,476**	**$11,629,521**

*Number of crashes: five crash numbers are for Fatal (F), Severe Injury (SI), Other Visible Injury (OVI), Injury - Complaint of Pain (I-CP), and Property Damage Only (PDO), respectively.

IV.2. Project Benefit and BCR Summary

No.	Countermeasure Name	Benefit	Cost	Resulting B/C
1	S4	$4,934,603	$316,237	**15.6**
2	S11	$4,844,442	$811,844	**6**
3	S2	$1,850,476	$46,919	**39.4**
	Entire Project	**11,629,521**	**$1,175,000**	**9.9**

Data to be transferred to the HSIP Application Form

This section is generated automatically once the data entry and calculation have been completed. Transfer the data on this page to Section III of the HSIP Application Form.

Safety Countermeasure Information

Number of countermeasures: 3
S4: Provide Advanced Dilemma Zone Detection for high speed approaches
S11: Improve pavement friction (High Friction Surface Treatments)
S2: Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number

Cost, FRR, Benefit and BCR:

Total Project Cost:	$1,175,000
HSIP Funds Requested:	$1,175,000
Max. Federal Reimbursement Ratio (FRR):	100%
Total Expected Benefit:	11,629,521
Benefit Cost Ratio:	9.90

HSIP ANALYZER

Cost Estimate, Crash Data and Benefit Cost Ratio (BCR) Calculation for Highway Safety Improvement Program (HSIP) Application

Important: Review and follow the step-by-step instructions in "Manual for HSIP Analyzer". Completing the HSIP Analyzer without referencing to the manual may result in an application with fatal flaws that will be disqualified from the ranking and selection process.

All yellow highlighted fields must be filled in. The gray fields are calculated and read-only. This is a dynamic form (later steps vary depending on the data entered in earlier steps). If any error messages in red appear, fix the errors prior to proceeding to the next steps.

1. Application ID, Project Location and Project Description (copy from the HSIP Application Form):

Application ID: **Alton/Gateway**

Save this file using the Application ID plus "Calc" as the file name (e.g. "07-Los Angeles-01Calc.pdf").

Project Location: (limited to 250 characters)
Alton/Gateway Intersection

Project Description: (limited to 250 characters)
CM 1 Intelligent Dilemma Zone Detection
CM 2 High-Friction Surface Treatments

2. Application Category (Check one):

Application Categories that require a Benefit Cost Ratio (BCR):

- ☒ Common BCR Application
- ☐ Set-aside for High Friction Surface Treatment

Application Categories that do NOT require a Benefit Cost Ratio (BCR):

- ☐ Set-aside for Guardrail Upgrades
- ☐ Set-aside for Horizontal Curve Signing
- ☐ Set-aside for Pedestrian Crossing Enhancements
- ☐ Set-aside for Tribes

Dual consideration?

☐ If an Application Category that does not require a BCR is selected above, check this box to indicate your desire that this application will be considered as a Common BCR Application as well in case it does not get selected for funding under the set-aside category. If this box is checked, a benefit cost analysis is required so the project will have a BCR.

A safety benefit cost analysis is required for this application. This tool will guide through cost estimate, safety benefit evaluation and Benefit Cost Ratio (BCR) calculation.

Section I. Construction Cost Estimate and Cost Breakdown

The purpose of this section is to:

- Provide detailed engineer's estimate (for construction items only). The costs for other phases (PE, ROW, and CE) will be included in Section II.
- Test if countermeasures (CMs) (up to 3) are eligible for being used in the project benefit calculation. For a CM to be used in the project benefit calculation, the construction cost of the CM must be at least 15% of the project's total construction cost, unless an exception is requested. And
- Determine the project's maximum Federal Reimbursement Ratio (FRR).

I.1 Select up to 3 countermeasures (CMs) to be tested in the Engineer's Estimate:

Number of CMs to be used in this project: 2

CM No. 1:	S4: Provide Advanced Dilemma Zone Detection for high speed approaches
CM No. 2:	S11: Improve pavement friction (High Friction Surface Treatments)

I.2 Detailed Engineer's Estimate for Construction Items:

Cost breakdown by CMs. For each item, enter a cost percentage for each of the CMs and "Other Safety-Related" (OS) components. (e.g. enter 10 for 10%). The cost % for "Non-Safety-Related" (NS) components is calculated.

	No.	Item Description	Unit	Quantity	Unit Cost	Total	% for CM#1 (S4)	% for CM#2 (S11)	% for OS*	% for NS**
+ -	1	Intelligent Dilemma Zone Detection	LS	1	$50000.00	50,000	100%	%	%	0
+ -	2	High-Friction Surface Treatments	LS	1	170,000	170,000	%	100%	%	0
+ -	3	Mobilization, TC	LS	1	$44000.00	44,000	25%	75%	%	0
					Weighted Average (%)		23%	77%		
					Total ($)	$264,000				

* % for OS: Cost % for Other Safety-Related components;
** % for NS: Cost % for Non Safety-Related components.

Contingencies, as % of the above "Total" of the construction items: 20 % $52,800
(e.g. enter 10 for 10%)

Total Construction Cost (Con Items & Contingencies): $316,800
(Rounded up to the nearest hundreds)

I.3 Summary

2 CM(s) are eligible to be used in the project benefit calculation.

Countermeasure ID	Federal Funding Eligibility (FFE)	Cost %	Eligible to be used in benefit calculation?	Request exception to the 15% rule*
S4	100%	23.11%	Yes (>=15% cost)	☐
S11	100%	76.89%	Yes (>=15% cost)	☐

*By requesting an exception to the 15% rule, the CM with less than 15% of the construction cost will then be eligible to be used in the benefit calculation. if an exception is requested for any CM(s) above, please provide the reason (low cost treatment with significant safety benefits, etc.):

Project's Maximum Federal Reimbursement Ratio = 100.0%

The project's Maximum Federal Reimbursement Ratio is calculated as the least of the FFEs of the above countermeasures, minus the percentage of the non-safety related costs in excess of 10%. **This is the maximum value allowed to be entered in "HSIP/Total (%)" column in Section II (Project Cost Estimate).**

Section II. Project Cost Estimate

All project costs, **for all phases and by all funding sources**, must be accounted for on this form.

i. "**Total Cost**": Round all costs up to the nearest hundred dollars.

ii. "**HSIP/Total (%)**": The maximum allowed is the project's Federal Reimbursement Ratio (FRR) as determined in Section I. Click the button to assign the maximum to all, OR enter if not the maximum.

iii. "**HSIP Funds**" and "**Local/Other Funds**" are calculated.

Pay attention to the interactive warning/error messages below the table. The messages, if any, must be fixed, or exceptions should be justified in Question No. 5 in Section II of the HSIP Application Form.

Project's maximum Federal Reimbursement Ratio (FRR) (from Section I, rounded up to integer): 100 %

To set all "HSIP/Total (%)" in the below table to the above maximum FRR, click "Set": Set

Description	Total Cost	HISP/Total (%)	HSIP Funds	Local/Other Funds
Preliminary Engineering (PE) Phase				
Environmental	$55,100	100 %	$55,100	$0
PS&E	$55,100	100 %	$55,100	$0
Subtotal - PE	**$110,200**	**100 %**	**$110,200**	**$0**
Right of Way (ROW) Phase				
Right of Way Engineering	$11,100	100 %	$11,100	$0
Appraisals, Acquisitions & Utilities	$4,500	100 %	$4,500	$0
Subtotal - Right of Way (ROW)	**$15,600**	**100 %**	**$15,600**	**$0**
Construction (CON) Phase				
Construction Engineering (CE)	$44,100	100 %	$44,100	$0
Construction Items	$316,800 (Read only - from Section I)	100 %	$316,800	$0
Subtotal - Construction	**$360,900**	**100 %**	**$360,900**	**$0**
PROJECT TOTAL	$486,700	100 %	$486,700	$0

☐ Agency does NOT request **HSIP** funds for PE Phase (automatically checked if PE - HSIP funds is $0).

Interactive Warning/Error Messages:

If there are any messages in the below box, please fix OR explain justification for exceptions in Question No 5, Section II in the HSIP Application.

1. The HSIP amount for PE exceeds 25% of the HSIP amount for Construction Items.

Section III. Project Location Groups, Countermeasures and Crash Data

The benefit of an HSIP safety project is achieved by reducing potential future crashes due to the application of the safety countermeasures (CMs). In this section, you will need to provide information regarding the project's safety CMs and historical crash data at the project sites. The data will be used to estimate the project benefit in Section IV.

1. Divide the project locations into groups.

It is quite often that an HSIP project has multiple locations. Theoretically the benefit for every single location may be calculated separately and then sum them up. However, that may be time consuming or almost impossible when there are a lot of locations. It is more efficient that the project locations with exactly the same safety countermeasures are combined into a group. The benefits of the locations in the same group can then be calculated at once.

When only one group is needed:

If your project consists of only one location or multiple locations that have similar features, address similar safety issues and utilize the same countermeasure(s). The crash data of all the locations can be combined and only one group is needed.

When multiple groups are needed:

If your project include multiple locations that have various safety issues and the proposed safety improvements (countermeasures) are not exactly the same for all the locations. The locations must be divided into different groups. The project benefits are then calculated multiple times, once for each location group. The project total benefit is the sum of the benefits from the different groups.

It should be noted that within a group, all locations should be of the same type: Signalized Intersection (S), Non-Signalized Intersection (NS), or Roadway (R).

If necessary, you may explain the location grouping for your project in details in Question No. 3 (Crash Data Evaluation), Section II in the HSIP Application Form.

2. After the number of location groups is entered, one subform will be populated for each location group. For each location group:

1) First, select the applicable CMs. *Note: If a Roundabout CM (S18 or NS4A or NS4B) is selected, additional information is required.*

For each group, only the CMs of the same type as the group location type can be used. For example, if a group consists of 5 signalized intersections, only "Signalized Intersection" CMs may be used for this group.

2) Based on the selected CMs, crash data tables of the required types are displayed for data entry.

Different CMs will reduce crashes of different types during the life of the safety improvements. Depending on the selected CMs for the group, you will be required to fill in one or more crash data tables, for any combination of the five crash types (datasets): "All" , "Night" , Ped & Bike", "Emergency Vehicle", and "Animal" (Each of the later four datasets is a sub-dataset of the "All" dataset.)

For more information regarding grouping project locations and examples, please refer to the Manual for HSIP Analyzer.

III.1 List of Project Locations and Location Groups

List all locations/sites included in this project by groups. The locations entered in Table III.1 below will be automatically populated in the crash data tables in III.2.

Based on the criteria described on the last page, the locations/sites need to be divided into 1 groups.

Table III.1 List of Project Locations by Groups

Highlighted fields must be filled in. For each group:
1) Must select a Location Type;
2) Initially each group has one location line. Click "+"/"-" to add a new line/delete an existing line;
3) Enter location description for each line. The same descriptions will be auto-populated in III.2.

*Note: If your project has a large number of locations, please aggregate some locations into one description, e.g. 10 stop controlled intersections, 5 horizontal curves, etc., as long as they have similar features and the safety improvements to be implemented are the same.

	No.	No. in Group	Location Description (Intersection Name or Road Limit or General Description)	
GROUP 1			Select Location Type:	S (Signalized Intersections)
+ -	1	G1-1	Alton/Gateway	

III.2: Countermeasures and Crash Data

(Repeats for each location group)

Countermeasures and Crash Data -Location Group No. 1 of 1

Hide Group Details

Step 1: Select countermeasure(s) to be applied to this location group

This group's location type: S (Signalized Intersections)

Please check the CMs for this location group. All the CMs that have passed the test in Section I AND match the location type of this group are listed below.

	No.	Countermeasure (CM) Name	CM Type*	Crash Reduction Factor (CRF)	Expected Life (Years)	Crash Type	Federal Funding Eligibility
☒	1	S4: Provide Advanced Dilemma Zone Detection for high speed approaches	S	0.4	10	All	100%
☒	2	SII: Improve pavement friction (High Friction Surface Treatments)	S	0.4	10	All	100%
	*CM Type: S-Signalized Intersection; NS-Non-Signalized Intersection; R-Roadway.						

Step 2: Provide crash data.

2.1 Crash Data Period: must be between 3 and 5 years.

from (MM/DD/YYYY): 01/01/2015 To (MM/DD/YYYY): 12/31/2019 Crash Data Period (years) = 5

2.2 Fill out the crash data table(s) for the crash type(s) as required by the selected countermeasure(s) in Step 1.

Based on the countermeasures selected in Step 1 , the crash data types to be provided are:

(1) All

Crash Data Table for Crash Type: ALL

No.	Location (from Table III.1)	Fatal (ALL)	Severe Injury (ALL)	Other Visible Injury (ALL)	Complaint of Pain (ALL)	PDO (ALL)	Total
1	Alton/Gateway	0	2	13	9	0	24
	Total	0	2	13	9	0	24

Section IV. Calculation and Results

Click the "Calculate" button to calculate. The script will first check if there are any errors or inconsistencies in the countermeasure selections and crash data. If errors are detected and displayed below, the errors must be fixed first before you click the "Calculate" button again. If no errors are displayed, the calculation results are provided in this section. Please refer to the Manual for HSIP Analyzer for details regarding possible errors.

Calculate

Project Summary Information:

Project Total Cost: 486700
2 countermeasures are eligible in benefit calculation. (S4 S11)
Project location(s) are divided into 1 group(s) for calculating the benefits.

IV.1 Benefit Summary by location groups

Group No.	Group Info/Data*	Benefit from CM #1	Benefit from CM #2	Benefit from CM #3	Total Benefit of the group
1	Location type: S (Signalized Intersections) Number of location(s): 1 Number of selected countermeasure(s): 2 (S4 S11) Crash Data Information: Crash data period (years): 5 Number of crashes(F/SI/OVI/I-CP/PDO)*: All: 0,2,13,9,0	$3,335,425	$3,335,425	$0	$6,670,850
Sum		**$3,335,425**	**$3,335,425**	**$0**	**$6,670,850**

*Number of crashes: five crash numbers are for Fatal (F), Severe Injury (SI), Other Visible Injury (OVI), Injury - Complaint of Pain (I-CP), and Property Damage Only (PDO), respectively.

IV.2. Project Benefit and BCR Summary

No.	Countermeasure Name	Benefit	Cost	Resulting B/C
1	S4	$3,335,425	$112,457	**29.7**
2	S11	$3,335,425	$374,243	**8.9**
3		$0	$0	**0**
	Entire Project	**$6,670,850**	**$486,700**	**13.7**

Data to be transferred to the HSIP Application Form

This section is generated automatically once the data entry and calculation have been completed. Transfer the data on this page to Section III of the HSIP Application Form.

Safety Countermeasure Information

Number of countermeasures: 2
S4: Provide Advanced Dilemma Zone Detection for high speed approaches
S11: Improve pavement friction (High Friction Surface Treatments)

Cost, FRR, Benefit and BCR:

Total Project Cost:	$486,700
HSIP Funds Requested:	$486,700
Max. Federal Reimbursement Ratio (FRR):	100%
Total Expected Benefit:	$6,670,850
Benefit Cost Ratio:	13.71