Tuolumne County Local Roadway Safety Plan

NOVEMBER 2021

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.

The analysis and recommendations in this report are conceptual in nature based upon limited information, and before implementing any changes, or using any of its information for design or construction, more detailed analysis should be conducted to make sure that the design or construction documents reflect specific, detailed, local and field conditions.

John Gard, T.E.
Registered Professional Traffic Engineer
Fehr & Peers

Acknowledgments

The 2021 Tuolumne County Local Roadway Safety Plan was funded through a Local Roadway Safety Plan (LRSP) grant provided by the California Department of Transportation (Caltrans). Input was sought from an advisory group consisting of staff from Tuolumne County and partner agencies. Fehr & Peers assisted Tuolumne County in preparing the plan.

CALTRANS LRSP GRANT ID: LRSPL-5932 (100)

ADVISORY GROUP MEMBERS

Arvinder Bajwa
Caltrans

Gregoria Ponce
Caltrans

Thienan Nguyentan
Caltrans

Bill Pooley
Sheriff's Office

Cathy Parker
Tuolumne County Superintendent of Schools

Trevor Stewart
Columbia College

Darin Grossi
Tuolumne County Transportation Council

Tyler Summersett
Tuolumne County Transportation Council

Shannan Thaggard
Tuolumne County Transportation Council

Destiny Tafoya
California Highway Patrol

Adam Croxton
California Highway Patrol

TUOLUMNE COUNTY STAFF

Denise Zitnik
Blossom Scott-Heim, PE
Dore Bietz
Elizabeth Ramos
Michael Cognetti

FEHR & PEERS TEAM

Carly Hoyt
John Gard, TE, RSP1
Eric Howard
Terence Zhao
Melanie Gill
Adrian Engel, PE, LEED AP, CASp
Rodney Brown, AICP, PTP, RSP1

Glossary

AASHTO American Association of State Highway and Transportation Officials

ADT average daily traffic

AHSC Affordable Housing and Sustainable Communities

ATP Active Transportation Program

CIP Capital Improvement Plan

CMF Crash Modification Factor

CRF Crash Reduction Factor

DUI Driving Under the Influence

FAST Act Fixing America's Surface Transportation Act

FHWA Federal Highway Administration

GHG Greenhouse Gas Emissions

HCD Housing and Community Development

HSIP Highway Safety Improvement Program

HSM Highway Safety Manual

ICP Integrated Connectivity Project

ITE Institute of Transportation Engineers

KSI Killed or Severely Injured

LPP Local Partnership Program

LRSM Local Roadway Safety Manual

LRSP Local Roadway Safety Plan

LSRP Local Streets and Roads Program

LTF Local Transportation Fund

MPH Miles Per Hour

MUTCD Manual on Uniform Traffic Control Devices

OTS Office of Traffic Safety

PCF Primary Collision Factor

PHB Pedestrian Hybrid Beacon

RAISE Rebuilding American Infrastructure with Sustainability and Equity

RIPA Rural Innovation Project Areas

RRFB Rectangular Rapid Flashing Beacon

RTP Regional Transportation Plan

SRTS Safe Routes to School

STIP State Transportation Improvement Program

SWITRS Statewide Integrated Traffic Records System

TCC Transportation Climate Communities

TCTC Tuolumne County Transportation Council

TIMS Transportation Injury Mapping System

TOD Transit Oriented Development

VMT Vehicle Miles Traveled

Table of Contents

Chapter 1

Introduction

Local Roadway Safety Plans (LRSP) are critically important documents used to establish a framework and process for identifying, analyzing, and prioritizing roadway safety improvement needs within a specified area. Tuolumne County is committed to prioritizing transportation safety for all users and reducing the amount of traffic related deaths and serious injuries on local roads, thus, this LRSP was created.

About Tuolumne County

Tuolumne County, located along the western slope of the Sierra Nevada mountain range, has a population of approximately 54,500 residents.[1] The county encompasses approximately 2,274 square miles; approximately 77% is under jurisdiction of government agencies such as the United States Forest Service, Yosemite National Park, Bureau of Land Management, schools, Caltrans, or irrigation districts. The county includes one incorporated city, the city of Sonora, and 19 identified communities.[2]

The roadway network is comprised of approximately 139 miles of State highways, 610 miles of maintained county roads, and 26 miles of maintained city streets. Additionally, there are several hundred miles of federal forest service roads and privately owned roads.

About the LRSP

This LRSP is the first comprehensive safety plan that focuses exclusively on local roads within unincorporated Tuolumne County and is intended to assist the county when it applies for safety infrastructure funding sources. For example, the Cycle 11 Highway Safety Improvement Program (HSIP) funding cycle anticipated in 2022 will require an LRSP for an agency to be eligible to apply for funds.

This LRSP utilizes a systemic safety approach that focuses on identifying the top systemic collision patterns throughout the county. Ultimately, this collision analysis is used to identify proven countermeasures that can be implemented through the current and future Capital Improvement Plan (CIP). This section defines the Safe Systems approach, an idea which underlies this LRSP.

ITE Safe System Framework: Focus on Safe Speeds

The ITE Safe System framework provides important context for the focus on safe speeds within a Safe System approach. For vulnerable users, speed is a determining factor in survivability – a human's chance of surviving being struck by a vehicle increases from 20% at 40 miles per hour to 60% at 30 miles per hour to 90% at 20 miles per hour. Reducing speed in the presence of vulnerable users is a key Safe System strategy. Approaches include:

- *Physical roadway designs (width, horizontal alignment) to limit free flow speeds,*
- *Traffic calming treatments that induce slower speeds,*
- *Traffic signal timing that minimizes high speed flow,*
- *Traditional or automated enforcement that discourages speeding.*

What is the Safe System approach?

The Safe System approach essentially anticipates human mistakes, with the goal of eliminating fatal and serious injuries for all road users. A Safe System acknowledges the vulnerability of the human body— in terms of the amount of kinetic energy transfer a body can withstand—when designing and operating a transportation network to minimize serious consequences of crashes.

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.

According to the World Health Organization, the goal of a Safe System is to ensure that if crashes occur, they "do not result in serious human injury."[3] A 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 (see Figure 1).

Creating a Safe System means responsibility for road safety is not born solely by road users. "Individual road users have the responsibility to abide by laws and regulations"[3] and do so by exhibiting due care and proper behavior on the transportation system. While road users are responsible for their own behavior, safety is a shared responsibility with those who design, operate, and maintain the transportation network, including the automotive industry, law enforcement, elected officials, and government bodies.[4]

In a Safe System, roadway system designers provide safe roadways by using engineering standards, guidance from organizations such as Caltrans and the American Association of State Highway and Transportation Officials (AASHTO), and engineering judgment to create context-sensitive safety solutions.

The LRSP applies a data-driven process to:

- Address fatal and severe injuries for people who are walking, biking, and driving;
- Identify high risk roadway characteristics;
- Recommend countermeasures to address these collision types and characteristics;
- Develop an implementation and evaluation plan;
- Identify potential funding sources to assist with implementation of countermeasures.

Figure 01: The Safe System Approach
Source: Fehr & Peers for FHWA

Endnotes

1. Census 2019 Population Estimates
2. Tuolumne County General Plan
3. World Health Organization (2011). Decade of Action for Road Safety 2011-2020. Retrieved from https://www.who.int/roadsafety/decade_of_action/plan/plan_en.pdf, p. 9.
4. World Health Organization (2011). Decade of Action for Road Safety 2011-2020. Retrieved from https://www.who.int/roadsafety/decade_of_action/plan/plan_en.pdf


PAN FOR GOLD
XING
PED

Chapter 2

Vision & Goals

Tuolumne County Safety Vision Statement

Minimize fatalities and serious injuries on Tuolumne County roadways by making travel safer for all modes of transportation.

The Tuolumne County vision statement was developed at the first stakeholder meeting. While discussing the vision statement, it was noted that although eliminating all fatalities and serious injuries would be ideal, this would be challenging. A more realistic goal would be to minimize fatalities and serious injuries. In order to achieve this vision, countermeasures referenced in this document and in Caltrans's Local Roadway Safety Manual[5] should be implemented, along with continuous monitoring of actual and perceived safety risk factors.

Specifically, the following goals support and guide the County's efforts in achieving its vision:

GOAL 1
Discourage people from driving under the influence through educational and enforcement programs, and decrease the severity of DUI collisions through roadway infrastructure enhancements.

GOAL 2
Encourage people to drive at lower speeds with roadway design and signage.

GOAL 3
Increase motorists' awareness of curves and upcoming intersections along the roadway.

GOAL 4
Reduce the likelihood of collisions and severity of collisions by providing safe recovery zones along roadways.

GOAL 5
Foster a countywide culture of safety where all road users have shared responsibility.

[5] Caltrans (April 2020). Local Roadway Safety, A Manual for California's Local Road Owners, Version 1.5


URTIS CREEK
Home of the Mustangs
HAVE A SAFE
SUMMER MUSTANGS !

Chapter 3

Safety Partners

Stakeholders were identified in collaboration with Tuolumne County staff early on to ensure the LRSP included the perspective of various departments and organizations.

The stakeholder group included representatives from the following:

- California Department of Transportation
- California Highway Patrol
- Columbia College
- Tuolumne County Department of Public Health
- Tuolumne County Department of Public Works
- Tuolumne County Department of Road Maintenance
- Tuolumne County Office of Emergency Services
- Tuolumne County Sheriff's Office
- Tuolumne County Superintendent's Office
- Tuolumne County Transportation Council

First Stakeholder Meeting

At the first stakeholder meeting on May 27, 2021, the group discussed the safety vision, priorities, and existing conditions in Tuolumne County. An overview of recent collision trends was provided, including collisions by mode; collision types; location; and time of day, month, and year in which collisions occurred during the study period. A webmap identifying the location of all collisions and KSI (killed or severely injured) collisions was developed and stakeholders were encouraged to provide comments on the webmap, particularly regarding areas with high safety concerns and areas where near miss collisions frequently occur. Appendix A displays the comments received on the webmap.

Stakeholders requested that this report include an analysis by age, and expressed concerns with driving under the influence collisions specifically. As discussed in Chapter 5, DUI collisions represent approximately 17 percent of all collisions and 30 percent of KSI collisions. This was unsurprising to the stakeholder group and a Department of Public Health representative noted that Tuolumne County ranks among the highest in the state regarding self-reported excessive alcohol abuse. Stakeholders also requested additional review of bicycle and pedestrian collisions to determine if there are trends (whether collision type, time of day, near schools or parks, etc.) for these collisions.

Second Stakeholder Meeting

At the second stakeholder meeting on September 28, 2021, the group discussed the proposed safety countermeasure toolbox for both engineering and non-engineering strategies, as well as the proposed emphasis areas and next steps for the project. The stakeholder group was supportive of the proposed countermeasure toolbox and provided insight on recent safety studies and safety improvements implemented by either the County or Caltrans.


DOLLAR GENERAL

Chapter 4

Existing Efforts

In recent years, Tuolumne County and the Tuolumne County Transportation Commission (TCTC) have made efforts to improve safety through a range of plans, policies, and improvement projects. The following section provides a summary of recent efforts.

Active Transportation Plan

The 2020 Tuolumne County Active Transportation Plan (ATP) was adopted by TCTC in September 2020. The primary goal of the ATP is to enhance walking, biking, and multimodal mobility throughout the county. Infrastructure improvements and programs are identified and prioritized with the goals of increasing safety, access, and health. The ATP highlights the difficulty residents face due to the rural nature and geography of the county. Residents often live far from employment areas, schools, health care centers, public services, and parks and recreation facilities, making it difficult to provide feasible, safe, and efficient bicycle and pedestrian facilities that connect over these long distances. Lack of bicycle and pedestrian facilities results in increased safety concerns and can deter walking and biking.

2018 Tuolumne County General Plan

The Transportation chapter of the 2018 Tuolumne County General Plan includes goals, policies, and implementation measures aimed at prioritizing and improving safety on local roads.

Tuolumne County and TCTC Recent Efforts

Pictured: 2020 Tuolumne County Active Transportation Plan, 2016 Final Regional Transportation Plan, 2018 Tuolumne County General Plan

Specifically, the following policies and implementation programs are identified in the General Plan and are relevant for the LRSP:

Policy 4.A.1 – Support and work with the TCTC to regularly conduct assessments of the current status of the highway system to determine the current level of needs in the system and report those needs to the Board of Supervisors.

- *Implementation Program 4.A.c* – Establish priorities based on available funding for road improvement projects while balancing the need to support employment generating uses, affordable housing, and educational facilities. Emphasize, consistent with legal and funding constraints, the following road improvement projects in the County Road Improvement Program:
  - 1. Projects needed to maximize the safety of the road system on high accident road segments and intersections, including, but not limited to, additional road widths and turn lanes, realignments, shoulder improvements, bridge improvements, hazard elimination, and hazard control devices.
- *Implementation Program 4.A.d* – Prioritize safety related road improvement projects needed on streets and highways which experience an unusual number of motor vehicle traffic accidents. Design and implement necessary improvements in a timely manner to the greatest extent possible.
- *Implementation Program 4.A.d.2* – Prioritize a Safe Routes to School Program by partnering with school districts and the TCTC to improve safety and increase walking and bicycling to school.
- *Implementation Program 4.A.d.3* – Support a regional effort for a Local Road Safety Plan for planning and prioritizing safety improvement projects.

Policy 4.B.2 – Expand and improve pedestrian sidewalks and facilities focusing on safety, connectivity, and accessibility.

- *Implementation Program 4.B.f* – Require safe and adequate crossing facilities that minimize pedestrian exposure to vehicular traffic, such as curb extensions or refuge islands, wherever feasible.
- *Implementation Program 4.B.g* – Develop new or revised street and street crossing design standards to improve pedestrian safety, convenience, and comfort, both as part of routing public works projects and as part of ongoing development.
- *Implementation Program 4.B.h* – Update the local street design standards for urban areas, where practicable, to include complete street components for street infrastructure such as sidewalks, pedestrian curb ramps, crosswalks, street lighting, shade trees, and curb extensions to accommodate all users, including people with disabilities and other special needs.

Policy 4.B.3 – Expand and improve the bikeways within Tuolumne County, focusing on safety, connectivity, and accessibility.

- *Implementation Program 4.B.j.1* – Use local road funds to construct sidewalks, bike lanes, and roadway shoulders when performing major pavement maintenance projects.

Tuolumne County 2016 Final Regional Transportation Plan

The Tuolumne County 2016 Final Regional Transportation Plan (RTP) was adopted by Tuolumne County Transportation Council in 2017. The RTP is a vision, policy, action, and

financial plan that is focused on the transportation needs of Tuolumne County for the next 25 years. The RTP focuses on short-range (0-10 years) and long-range (11-25 years) transportation investments for all modes including highways, public transportation, bicycle facilities, pedestrian facilities, railroads, aviation, and goods movement, within a financially constrained environment. Various elements that focus on specific topics are included.

The Regional Transportation Element discusses the big picture transportation issues, goals, and policies that affect multiple modes in the county; there are six separate, but related, elements that focus on specific modes of transportation (such as State highways, local streets, aviation, etc.). Each of these elements has goals and performance measures that are specific to safety in the county.

For example, the Regional Transportation Element identifies a goal to consider transportation safety and security in all transportation funding decisions. The goal is also to consider regional performance measure specific to serious injuries per vehicle miles traveled (VMT), fatalities per VMT, number of serious injuries, and number of fatalities.

Each element includes a short-range and long-range financially constrained expenditure plan. On multiple occasions, safety is cited as the purpose and need for the improvement.

J-59 Improvement Plan

J-59 (also called La Grange Road) is a north-south minor arterial that provides a connection from Tuolumne County to SR 132 and communities south of SR 132. As a result of multiple collisions in past years, TCTC is currently preparing the J-59 Improvement Plan. The plan is essentially analyzing potential improvements along the corridor that may reduce collisions and improve safety. TCTC staff has indicated that the plan will be completed near the end of 2021.

Tuolumne County Hotspot Analysis

Tuolumne County staff performs a hotpot analysis to identify high crash concentration locations, both intersections and roadway segments, roughly annually (in addition to the analysis performed for this plan).

Chapter 5

Safety Analysis

This section summarizes the results of a broad collision analysis for Tuolumne County, which will inform future project prioritization and countermeasures for the county.

This analysis considers injury collisions from January 2015 through December 2019, available through UC Berkeley SafeTREC's Transportation Injury Mapping System (TIMS) as of March 2021. TIMS contains geocoded collision data from the California Statewide Integrated Records System (SWITRS), which is a collision database maintained by the California Highway Patrol. Each collision has extensive details, such as collision location, type, severity, parties involved, and contributing factors. Data from 2019 is the most recent data which has been finalized by SafeTREC, and also excludes effects of the COVID-19 pandemic.

Table 01: Collision Summary

	Vehicle	Bike	Ped	Total
Total	914	14	17	945
Fatal or Severe	137	6	8	151

The following parameters are used for the collision dataset:

- **Geographic Limits**: Entirety of unincorporated Tuolumne County with the exception of the city of Sonora.
- **Collision Severity**: All collisions included with the exception of property damage-only.
- **Lead Agency**: Collisions on Caltrans facilities and forest service roads only included if they occurred within 175 feet of a local (Tuolumne County) road.

Caltrans Local Roadway Safety Manual (LRSM)

Chapter 2 of Caltrans's LRSM states that safety practitioners should "consider a wide range of data sources to get an overall picture of the safety needs" (p. 14).

Crash data and contextual data were collected and analyzed as part of this plan, as well as anecdotal input from County staff and stakeholders.

Killed or Severely Injured in a Collision

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.

Driving under the influence collisions disproportionately result in a fatality or severe injury.

The approach described ensures the study focuses on local roadways and intersections that Tuolumne County has full or partial control over, and therefore, has a greater ability to implement countermeasures on.

Collisions are categorized as either an intersection or roadway collision. For intersection collisions, a set of non-overlapping areas of influence is generated based on a 175-foot radius around intersections. Intersection collisions are further categorized as:

- **Unsignalized Local Intersection** – Side-street stop controlled intersection where all approaches are local roads maintained by Tuolumne County.
- **Unsignalized Local-Highway Intersection** – Side-street stop controlled intersection where at least one approach is a local road maintained by Tuolumne County and one approach is a State Highway maintained by Caltrans.
- **Signalized Intersection** – Intersection with traffic signal control that may be either a "local" or "local-highway" intersection.

All collisions outside of the 175-radius are categorized as roadway collisions.

It is important to note that collision databases have been found to have certain reporting biases, including:

- Collision involving people walking, on bicycles, or on motorcycles are less likely to be reported than collisions with people driving.
- Property-only damage collisions are less likely to be reported compared to more severe collisions.
- Younger victims are less likely to report collisions.
- Alcohol-involved collisions may be underreported.
- Distracted driving may not be consistently captured in collision reports.

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

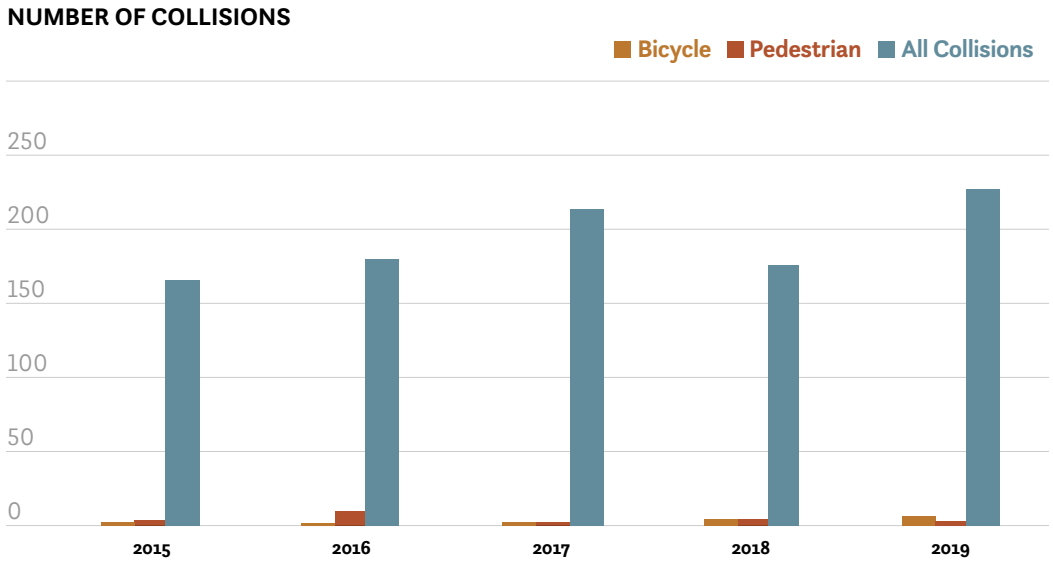
With those caveats in mind, this analysis identified several collision trends and risk factors in Tuolumne County, including:

- Drugs and alcohol increase the likelihood that a collision will be more severe
- Collisions at unsignalized local-highway intersections are more likely to be severe than at unsignalized local-local intersections or signalized intersections
- Hit object and overturned collision types on roadway segments and at intersections represent the largest share of all collisions and KSI collisions
- A large share of injuries to people walking occurs when people are crossing in an area where there is no crosswalk or when walking in the road or on the shoulder.

Collisions by Year by Mode

From 2015 to 2019, there were 945 total injury collisions; 14 involved a bicyclist and 17 involved a pedestrian.

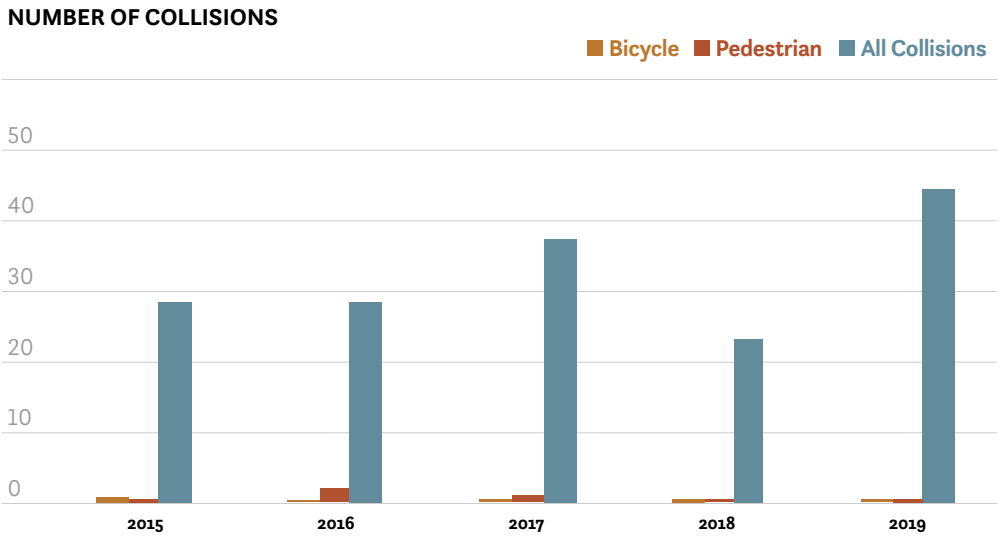
Figure 02: Collisions by Year by Mode, 2015-2019



KSI Collisions by Year by Mode

From 2015 to 2019, there were 151 KSI collisions; six involved a bicyclist and eight involved a pedestrian. During this period, there were 17 fatal collisions, resulting in the loss of 21 lives. This indicates that, on average, four to five people are killed each year in collisions on Tuolumne County roadways.

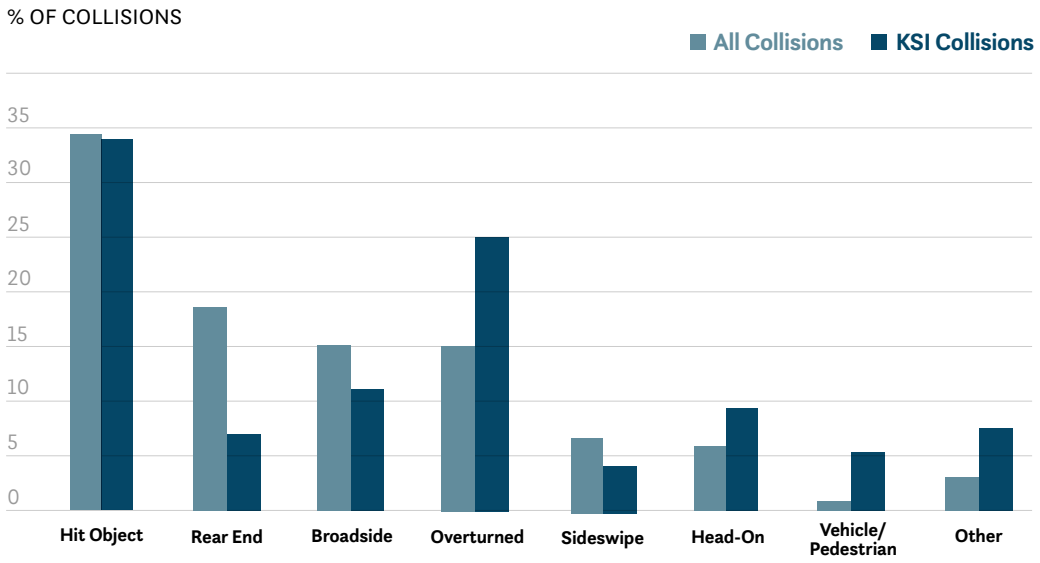
Figure 03: KSI Collisions by Mode by Year, 2015-2019



Collision Type

The most common collision types in the study area are Hit Object (34%), Rear End (18%), Broadside (15%), and Overturned (15%). For KSI collisions, Hit Object (33%) and Overturned (25%) collisions are most common and combined represent almost 60 percent of all KSI collisions.

Figure 04: Collisions by Collision Type, 2015-2019



Driving Under the Influence

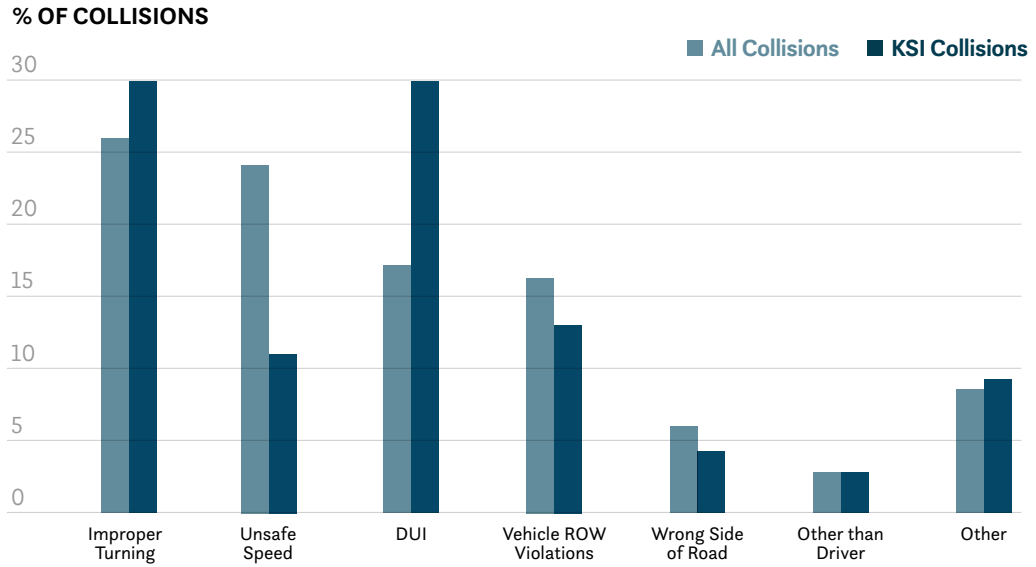
Drugs or alcohol increase the likelihood that a collision will be more severe in unincorporated Tuolumne County. While 17 percent of all collisions involve drugs or alcohol, 30 percent of KSI collisions involve drugs or alcohol.

Figure 05: Collisions by Driving Under the influence, 2015-2019

Primary Collision Factor (PCF)

The most common PCFs in the study area are Improper Turning (26%), Unsafe Speed (24%), Driving Under the Influence (17%), and Vehicle Right of Way Violation (16%). For KSI collisions, the most common PCFs are Driving Under the Influence (30%), Improper Turning (30%), Vehicle Right of Way (13%) and Unsafe Speed (11%). As previously noted, driving under the influence collisions disproportionately result in a fatality or severe injury.

Figure 06: Collisions by Primary Collision Factor, 2015-2019



Victim Age Profile

Table 2 displays the population age distribution percentage in Tuolumne County (US Census Bureau, 2019 ACS 5-Year Estimates) and the collision victim age distribution percentage by all collision victims, KSI collision victims, bicycle/pedestrian collision victims, and bicycle/pedestrian KSI collision victims. A victim is any party injured in a collision. As displayed, victims under 15 years of age are overrepresented in bicycle/pedestrian KSI and victims age 15-24 are overrepresented in all four categories shown.

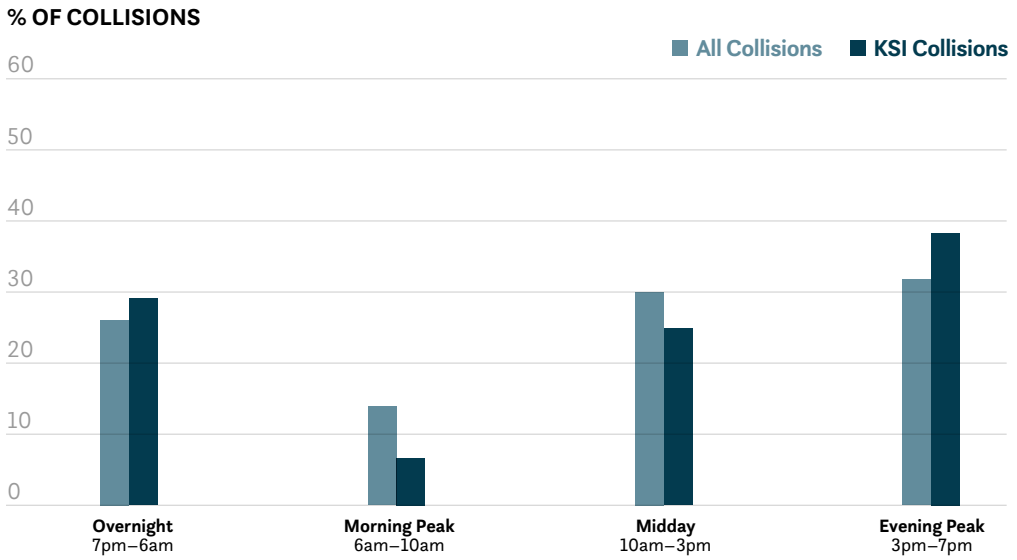
Table 02: Victim Age Distribution

Age	Population %	All Collision Victim %	KSI Victim %	Bike/Ped Victim %	Bike/Ped KSI Victim %
Under 15	14	8	5	13	25
15-24	10	24	21	36	15
25-44	23	29	27	23	30
45-64	28	26	31	17	15
65+	25	14	16	11	15

Time of Day

All collisions are dispersed fairly evenly throughout the day, with the exception of the morning peak of 6 AM to 10 AM, which is when the lowest number of collisions occurs. However, KSI collisions are disproportionately high during the evening peak of 3 PM to 7 PM and overnight between 7 PM and 6 AM.

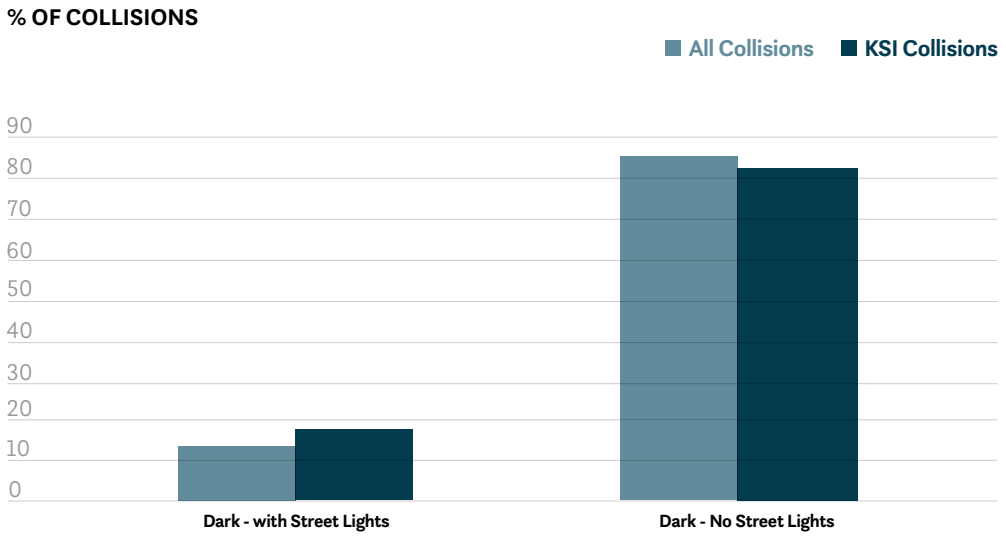
Figure 07: Collisions by Time of Day, 2015-2019



Lighting Conditions

Collisions that occurred in areas without streetlights represent 82 percent of all collisions that occurred when it was dark and 86 percent of KSI collisions that occurred when it was dark.

Figure 08: Overnight Collisions by Lighting Condition, 2015-2019



Systemic Analysis

Systemic analysis is a proactive safety approach that focuses on evaluating an entire roadway network using a defined set of criteria. It begins by examining collision history on an aggregate basis to identify high-risk roadway characteristics in addition to reviewing high-collision concentration locations. By merging adjacent road and intersection features with collision data, relationships can be uncovered between contextual factors and the risk of frequent and severe collisions. This systemic process relied on a collision typing analysis to identify key safety issues and collision types to prioritize.

Hot Spot Analysis

Following conventional collision mapping processes, a hot spot analysis was conducted to identify locations that have significantly higher collisions. Average Daily Traffic (ADT) conditions for all roadways was unavailable; therefore, the hot spot analysis is necessarily based exclusively on total number of collisions, rather than collision rates. Hot spots for all collisions and KSI collisions are displayed in Figures 9 and 10.

Collision Typing

When conducting systemic safety analysis, it is important to understand the relationship between collision characteristics (e.g., primary collision factor, collision type, etc.) and the contextual characteristics (e.g., speed limit, intersection or mid-block, etc.) of the collision location. This data is combined in a systemic matrix that illustrates how the collision characteristic and contextual characteristic overlap. Each combination of a collision characteristic and a contextual characteristic represents a collision type (e.g., rear end collisions at unsignalized intersections). The highest occurring collision types and collision types with the largest share of severe or fatal injuries were mapped and considered for further study. This systemic approach identifies roadway characteristics that have a high number of collisions, rather than focusing on individual roadways or intersections with a high number of collisions. By doing so, this process evaluates safety across the entire roadway system, rather than only focusing on spot improvements at individual locations where collisions have occurred.

Key Issues

The hotspot identification, collision typing, and stakeholder feedback informed the development of key issues that are divided into violations, crash types, and locations.

Violations

- Improper Turning and Unsafe Speed are the top violations for all collisions, accounting for approximately 50 percent of all collisions.
- Improper Turning and Driving Under the Influence are tied for the top violation for KSI collisions, accounting for approximately 60 percent of all KSI collisions.

Crash Types

- Hit Object collisions account for the highest number of total collisions and KSI collisions.
- Many collisions involving a vehicle overturning result in a fatality or severe injury.
- Half of all collisions involving a pedestrian result in a fatality or severe injury.

Locations

- Most KSI collisions occur at unsignalized intersections.
- Almost all collisions at unsignalized intersections are at side-street stop controlled intersections.
- Although more collisions occur at unsignalized local intersections, more KSI collisions occur at unsignalized local-highway intersections.
- Roadway segment collisions are disproportionately high on 35, 50 and 55 MPH roadways.
- Most nighttime collisions occurred in an area with no streetlights.

Figure 9
All Collisions

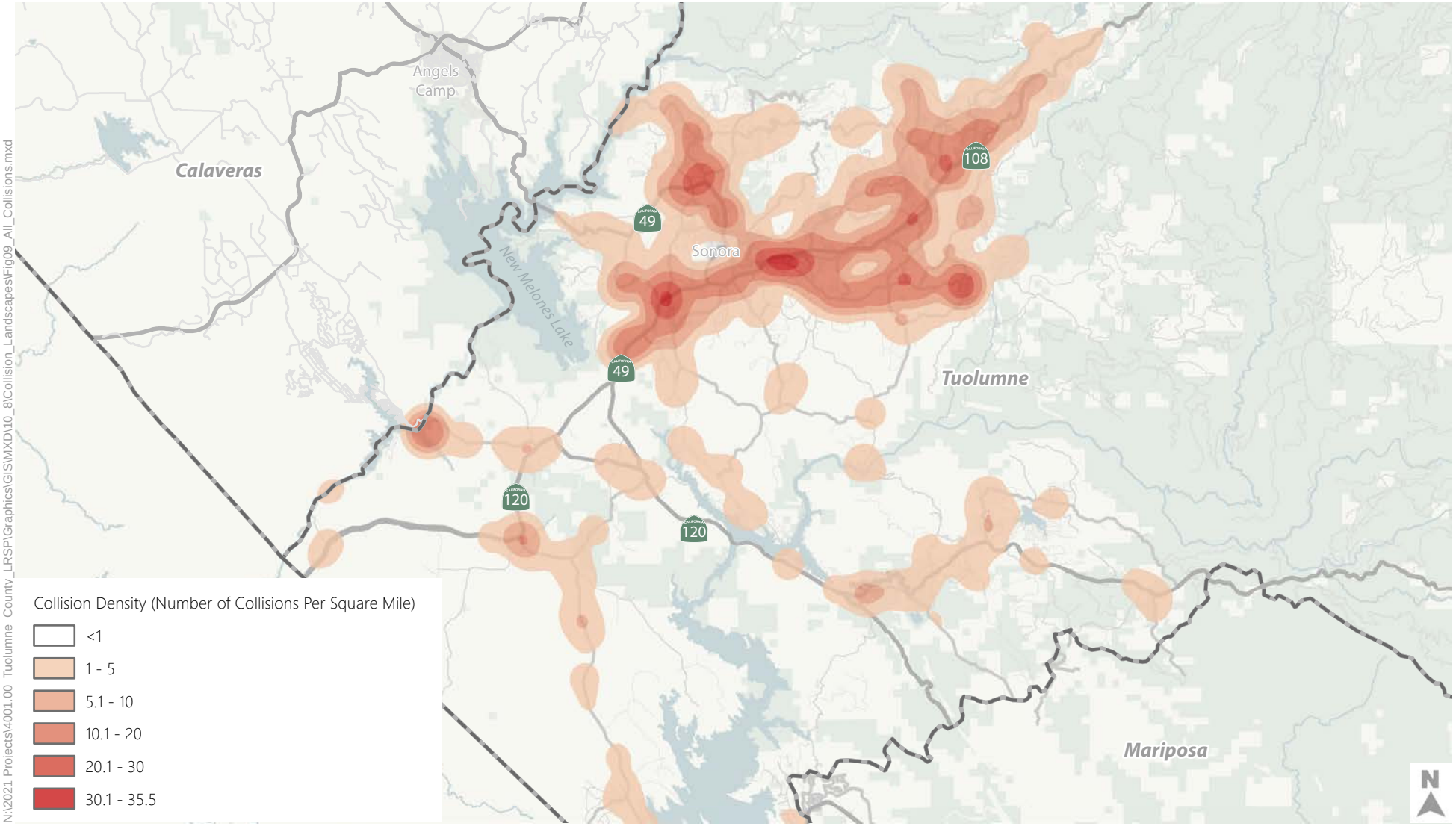
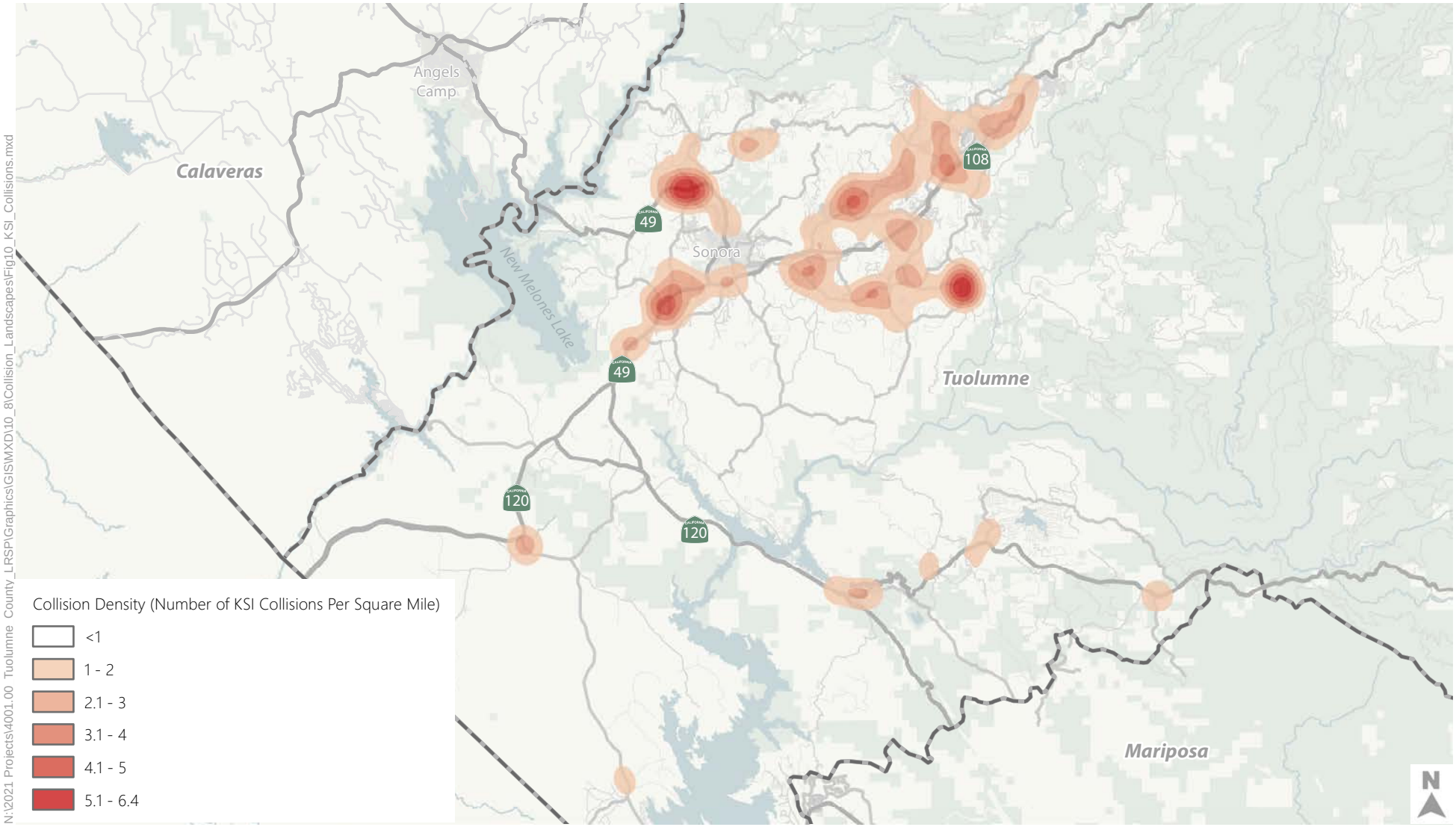


Figure 10
KSI Collisions



Systemic Safety Analysis

Systemic Matrices

The collision data is paired with geographic roadway and other contextual data to develop collision types. Outputs from this analysis are used to populate a set of matrices that allow for cross-tabulation of results (collision data in rows and geographic data in columns) across the entire roadway network. The matrices allow for identification of a combination of factors that contributed to a high number of all collisions, and combinations that lead to a high number of KSI collisions.
A matrix for motorcycle collisions is also included as Tuolumne County ranked 9th out of 58 counties in California in terms of number of collisions involving motorcycles.
Appendix B displays the matrices for all collisions, motorcycle collisions, and KSI collisions.
These matrices are used to evaluate the most common and severe collision patterns in the county, which are used to develop six collision profiles that serve as the emphasis areas for this LRSP.

Tuolumne County
Fehr & Peers, 2021

Chapter 6

Emphasis Areas & Countermeasures

This section provides an overview of the six emphasis areas that have been chosen for this LRSP. Emphasis areas are essentially collision profiles that have been selected based on the number of total collisions, number of KSI collisions, and stakeholder input. These emphasis areas provide a blueprint for the county to prioritize countermeasures to reduce KSI collisions. Each emphasis area is presented on a cutsheet that includes a collision summary, a map identifying the locations in which collisions have occurred, and potential countermeasures.

A Countermeasure Toolbox is presented after the last collision profile. The toolbox provides a detailed description of all of the countermeasures identified as well as additional information that should be taken into consideration when determining the appropriate countermeasure.

Collision Profiles

1. Driving Under the Influence Collisions

2. Hit Object and Overturned Collisions on 35+ MPH Roads

3. Broadside Collisions at Unsignalized intersections

4. Hit Object and Overturned Collisions at Side-Street Stop Controlled Intersections

5. Rear End Collisions at Unsignalized Intersections

6. Pedestrian Collisions at Unsignalized Intersections

↗ **Collision Profiles**
Source: Fehr & Peers, 2021

PROFILE 1

Driving Under the Influence Collisions

In unincorporated Tuolumne County, 160 driving under the influence (DUI) collisions occurred during the study period. Approximately 54 percent of all DUI collisions occurred overnight between 7 PM and 6 AM.

Figure 11 displays all DUI collisions and Figure 12 displays all overnight DUI collisions.

Although engineering countermeasures can assist with reducing the severity of DUI collisions, DUI collisions require special attention for non-infrastructure prevention programs. These generally fall under three categories:

1. Deterrence policies focus on raising the actual and perceived risk of detection of driving under the influence. Policies should be highly visible to increase awareness of the risks of driving under the influence. Publicized sobriety check points, saturation patrol, and other forms of high-visibility enforcement are effective for safety outcomes.

2. Prevention and education policies focus on mobilizing and educating the community and intervening before driving under the influence takes place.

3. Limited access policies focus on making underage access to alcohol and drugs more difficult and limiting excessive alcohol consumption.

Profile Statistics

45

KSI COLLISIONS FIT THIS PROFILE

30%

SHARE OF KSI COLLISIONS

Potential Countermeasures

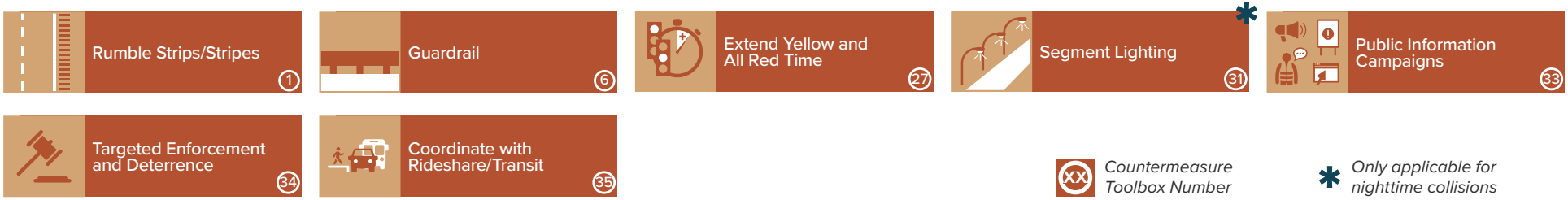
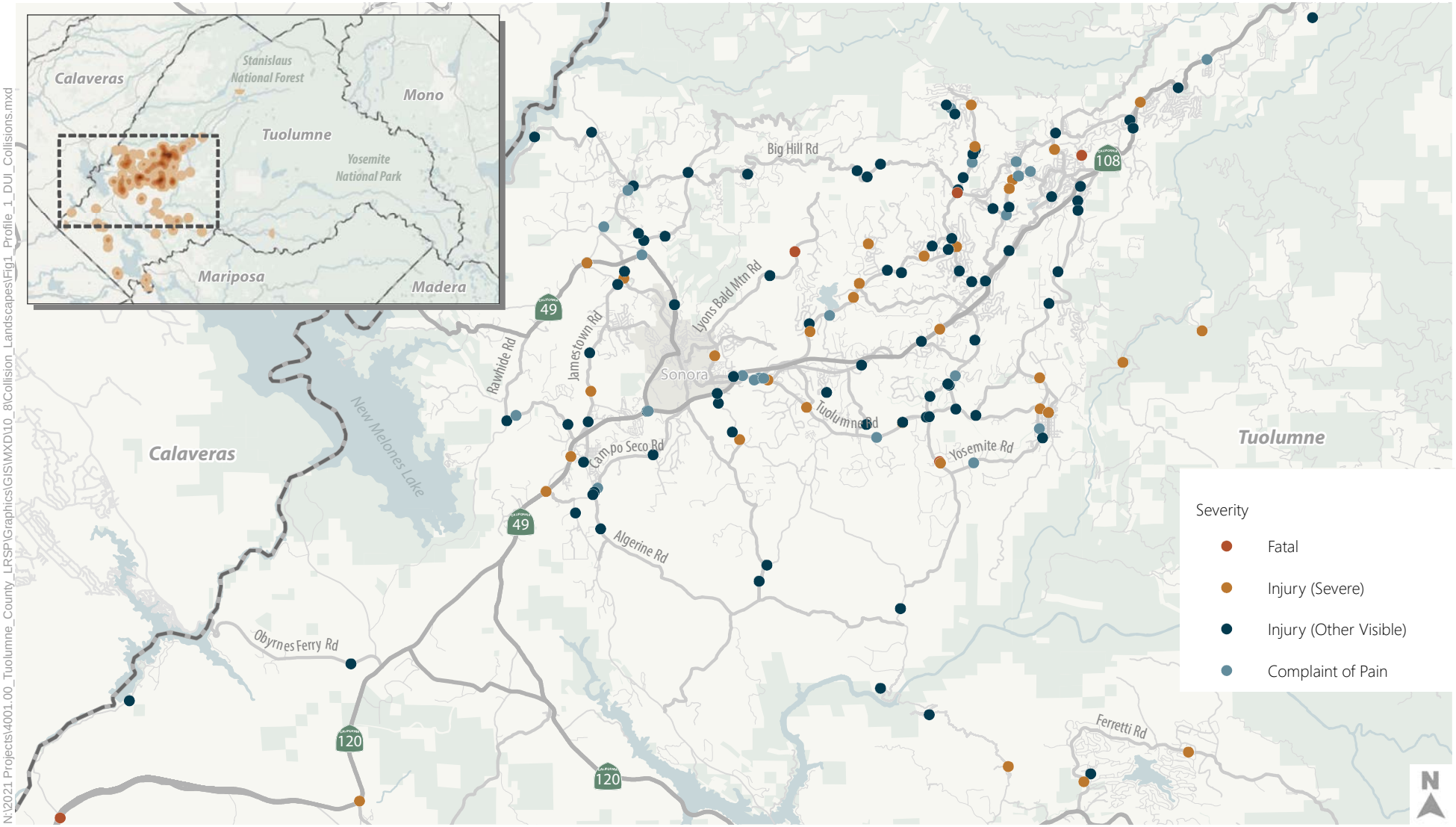
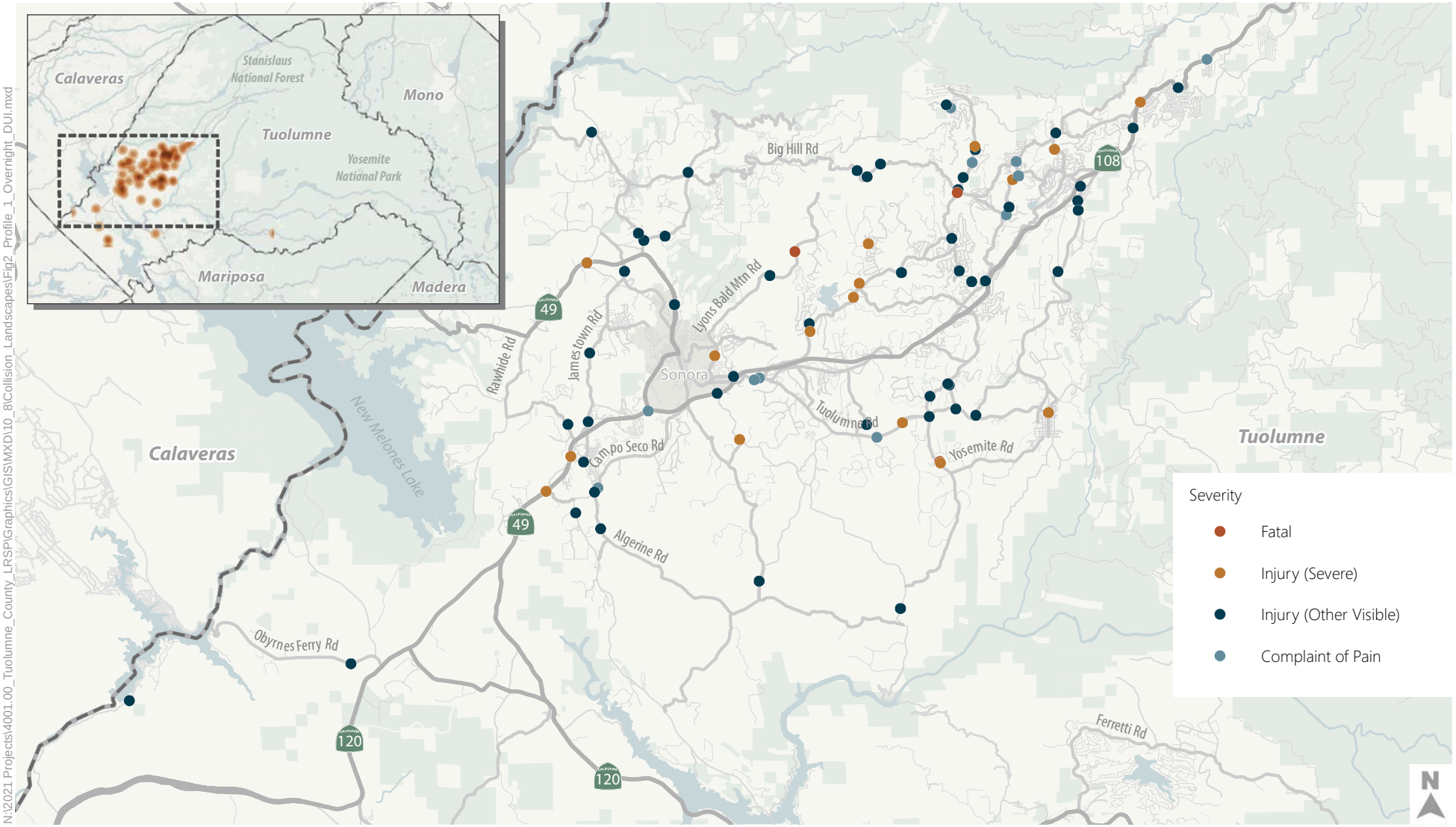


Figure 11
Severity of Driving Under the Influence (DUI) Collisions



N:\2021 Projects\4001.00_Tuolumne_County_LRSP\Graphics\GIS\MXD\10_8\Collision_Landscapes\Fig1_Profile_1_DUI_Collisions.mxd

Figure 12
Severity of Overnight (7 PM to 6 AM) Driving Under the Influence (DUI) Collisions



N:\2021 Projects\4001.00_Tuolumne_County_LRSP\Graphics\GIS\MXD\10_8\Collision_Landscapes\Fig2_Profile_1_Overnight_DUI.mxd

PROFILE 2

Hit Object and Overturned Collisions on 35+ MPH Roads

This profile includes hit object and overturned collisions on roadways with a 35+ MPH speed limit where motorists ran off the road or made an unsafe turning movement prior to the collision occurring. These collisions are included in roadway departure collisions, which occur after a vehicle crosses an edgeline, crosses a center line, or otherwise leaves the traveled right of way. During the study period, there were 181 collisions that fit this profile; these collisions are displayed on Figure 13. Notably, these collisions are overrepresented on 35 MPH roadways, despite what is considered a relatively moderate speed limit.

FHWA provides countermeasures aimed at achieving the following general goals:[1]

- Keeping vehicles on the roadway (such as pavement friction, rumble strips, segment lighting)
- Providing safe recovery zone (such as a safety edge, paved shoulder, clear zone)
- Reducing crash severity (such as guardrails or other types of barriers)

1. FHWA. Roadway Departure Safety. https://saftey.fhwa.dot.gov/roadway_dept/

Profile Statistics

29

KSI COLLISIONS FIT THIS PROFILE

19%

SHARE OF KSI COLLISIONS

Potential Countermeasures

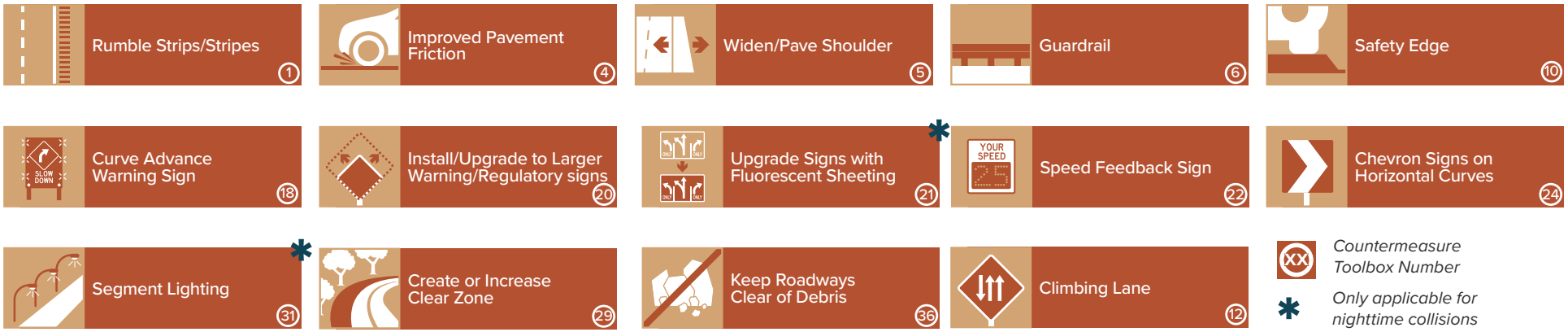
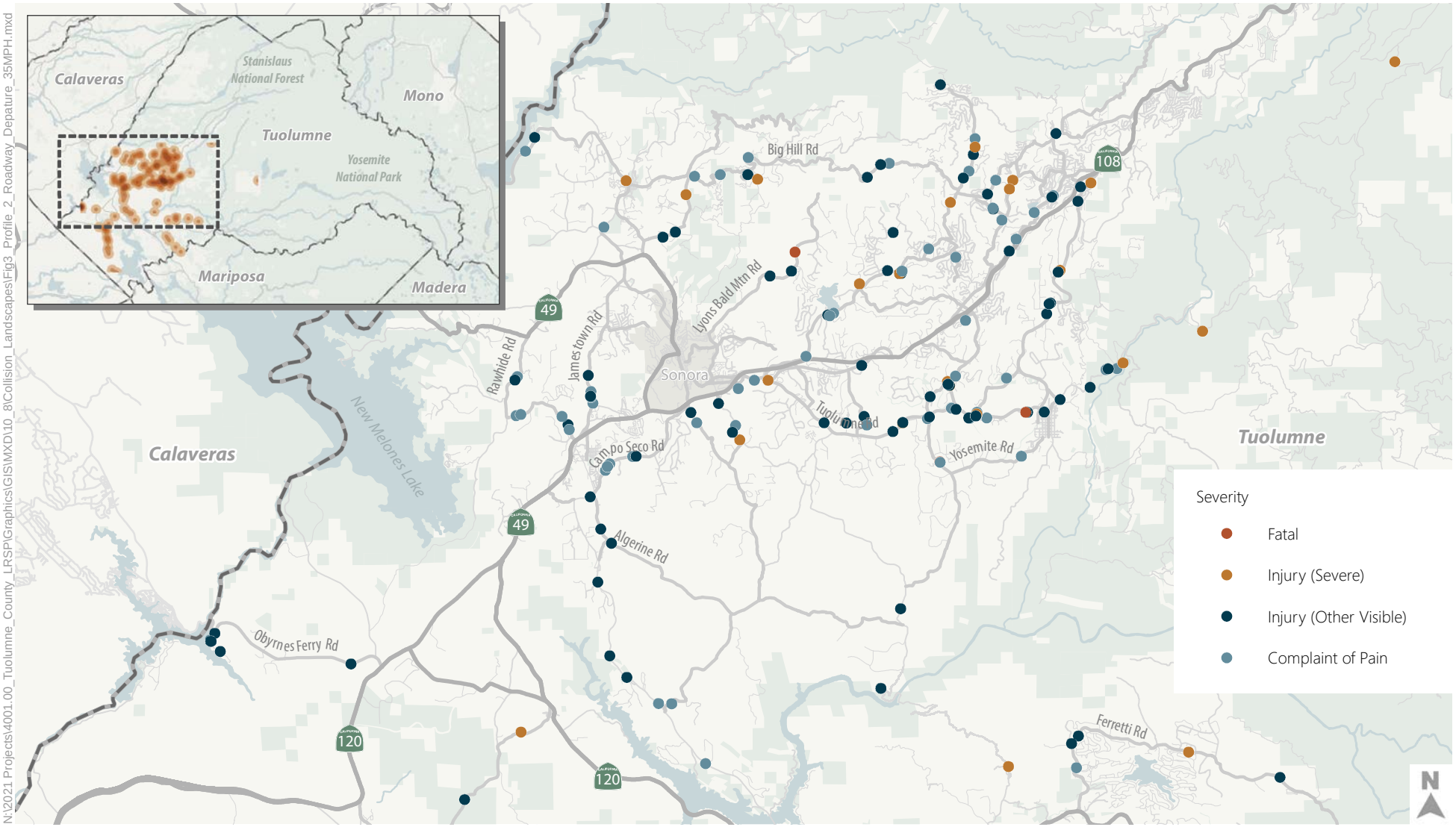


Figure 13
Severity of Hit Object and Overturned Collisions on 35+ MPH Roads



N:\2021 Projects\4001.00_Tuolumne_County_LRSP\Graphics\GIS\MXD\10_8\Collision_Landscapes\Fig3_Profile_2_Roadway_Depature_35MPH.mxd

PROFILE 3

Broadside Collisions at Unsignalized Intersections

This profile focuses on broadside collisions at unsignalized intersections. During the study period, there were 114 collisions that fit this profile; collisions are displayed on Figures 14 and 15. Notably, approximately 61 percent of these collisions involved a vehicle making a left turn at the intersection. This collision type was also overrepresented at unsignalized local road – State highway intersections, indicating that a coordinated effort with Caltrans may be necessary to reduce a large portion of the collisions that fit this profile.

While all but one collision occurred at an intersection with side-street stop control, most countermeasures could be applicable for either a side-street stop control or all-way stop control intersection.

Profile Statistics

13

KSI COLLISIONS FIT THIS PROFILE

9%

SHARE OF KSI COLLISIONS

Potential Countermeasures

XX *Countermeasure Toolbox Number*

* *Only applicable for nighttime collisions*


U-HAUL
U-HAUL
STOP
49

Figure 14
Severity of Broadside Collisions at Local Unsignalized Intersections

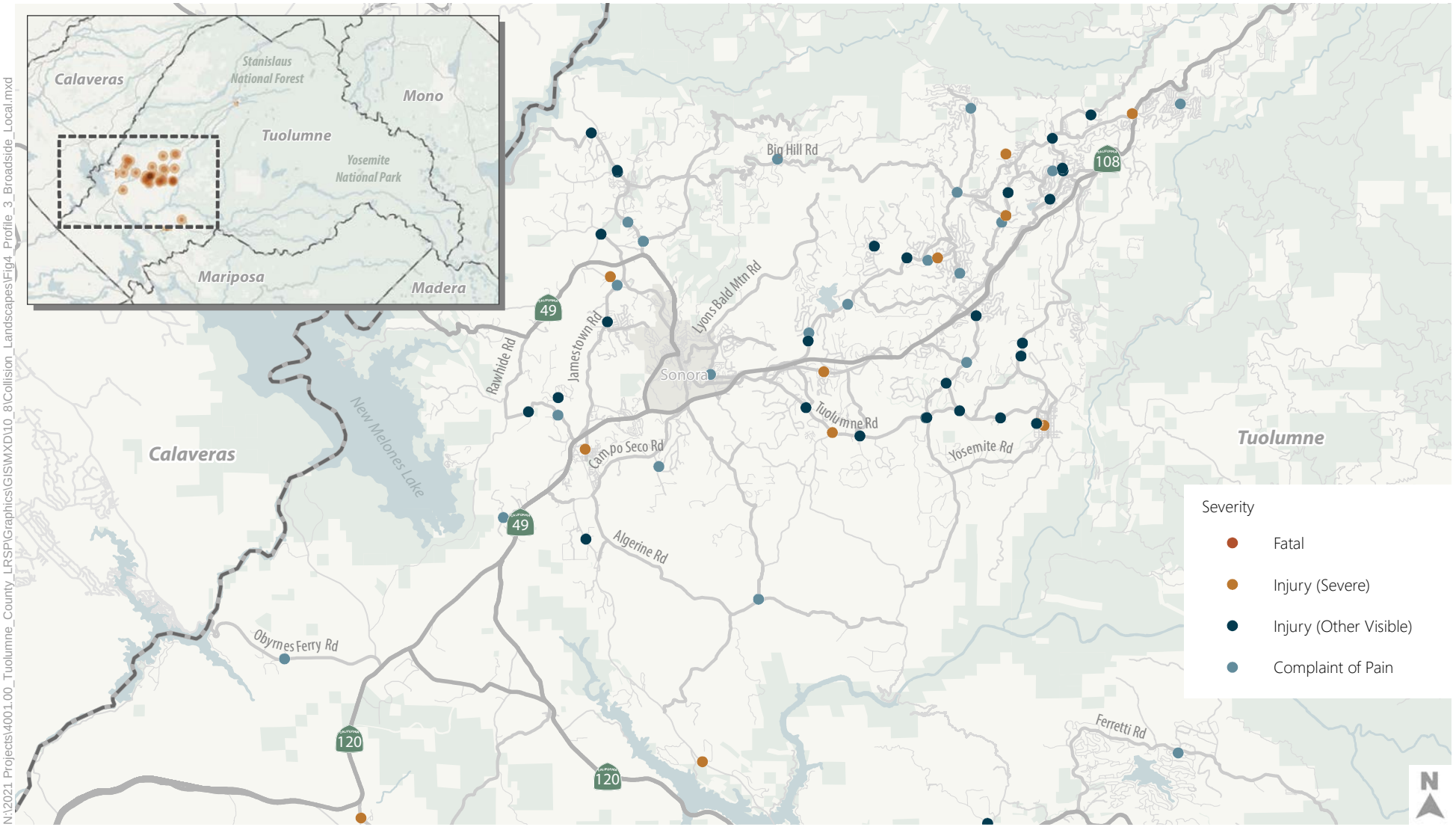
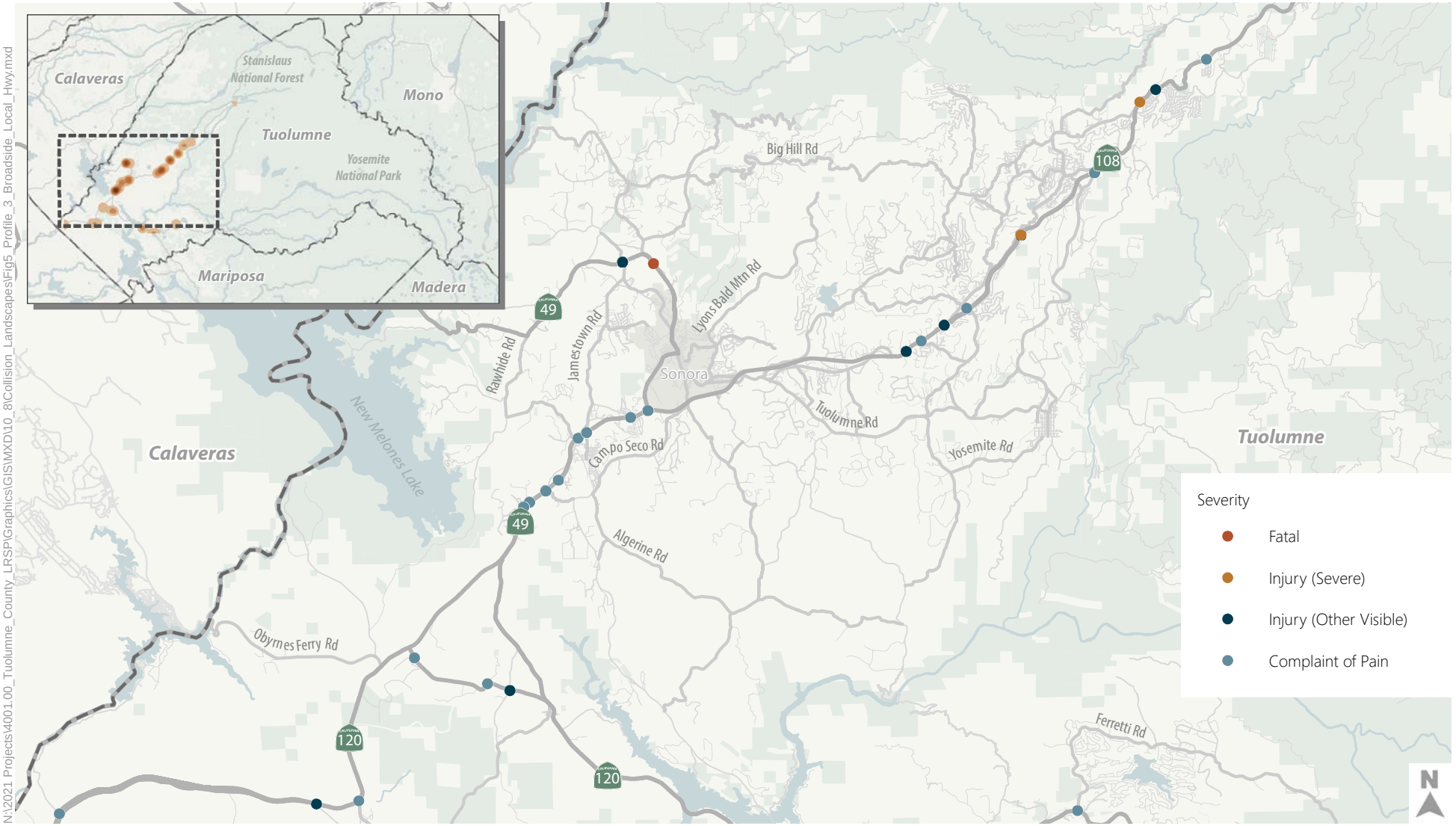


Figure 15
Severity of Broadside Collisions at Local-Highway Unsignalized Intersections



N:\2021 Projects\4001.00_Tuolumne_County_LRSP\Graphics\GIS\MXD\10_8\Collision_Landscapes\Fig5_Profile_3_Broadside_Local_Hwy.mxd

PROFILE 4

Hit Object or Overturned Collisions at Side-Street Stop Controlled Intersections

This profile focuses on hit object or overturned collisions at unsignalized side-street stop controlled intersections as a result of unsafe speeds, improper turning, or failure to yield. During the study period, there were 107 collisions that fit this profile; collisions are displayed on Figures 16 and 17. Approximately 65 percent occurred at unsignalized intersections of two or more local roads; the remainder occurred at the intersections of local roads with State highways.

Countermeasures focus on slowing speeds, warning drivers that an intersection is coming up, and reducing conflict points.

Profile Statistics

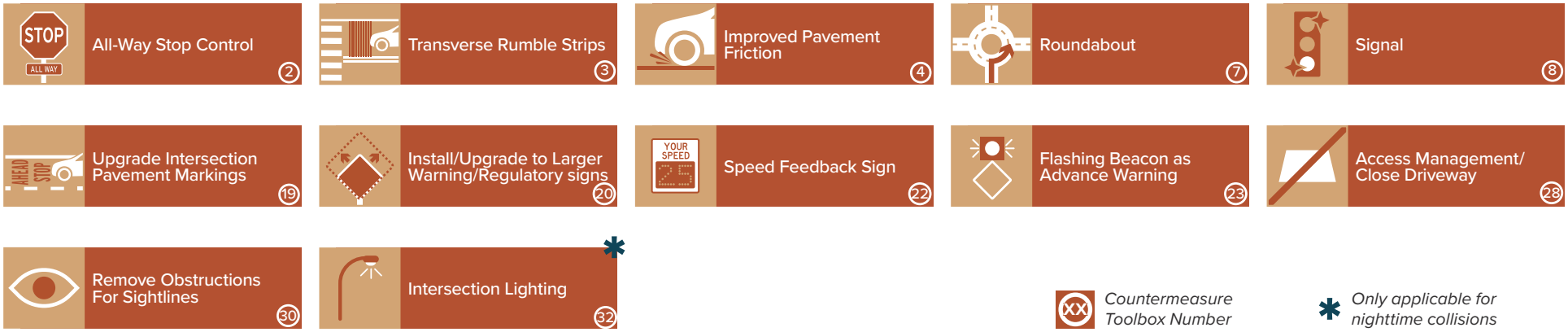
22

KSI COLLISIONS FIT THIS PROFILE

15%

SHARE OF KSI COLLISIONS

Potential Countermeasures




COLUMBIA
COLLEGE

Figure 16

Severity of Hit Object or Overturned Collisions at Unsignalized Local Side-Street Stop Controlled Intersections

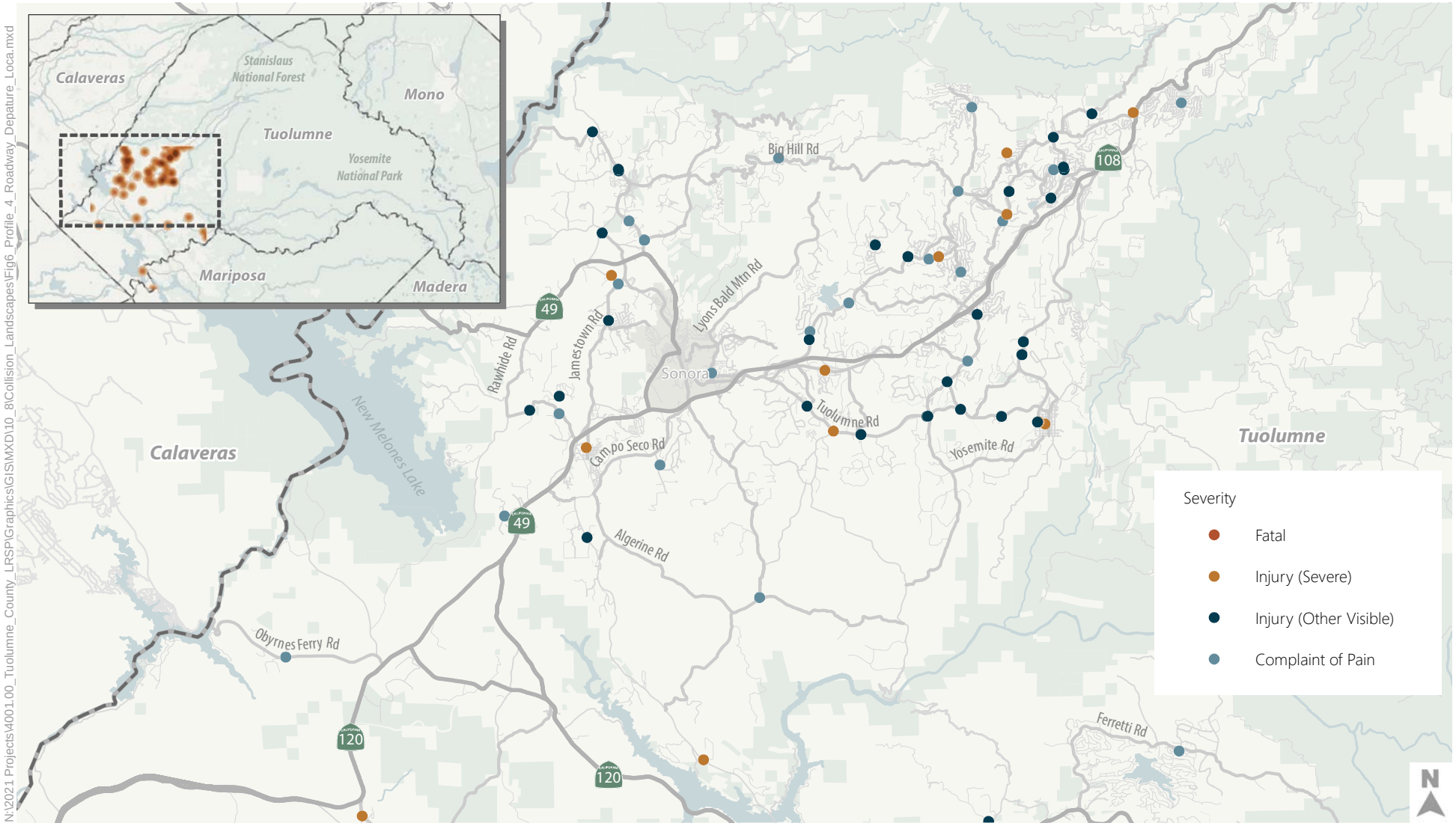
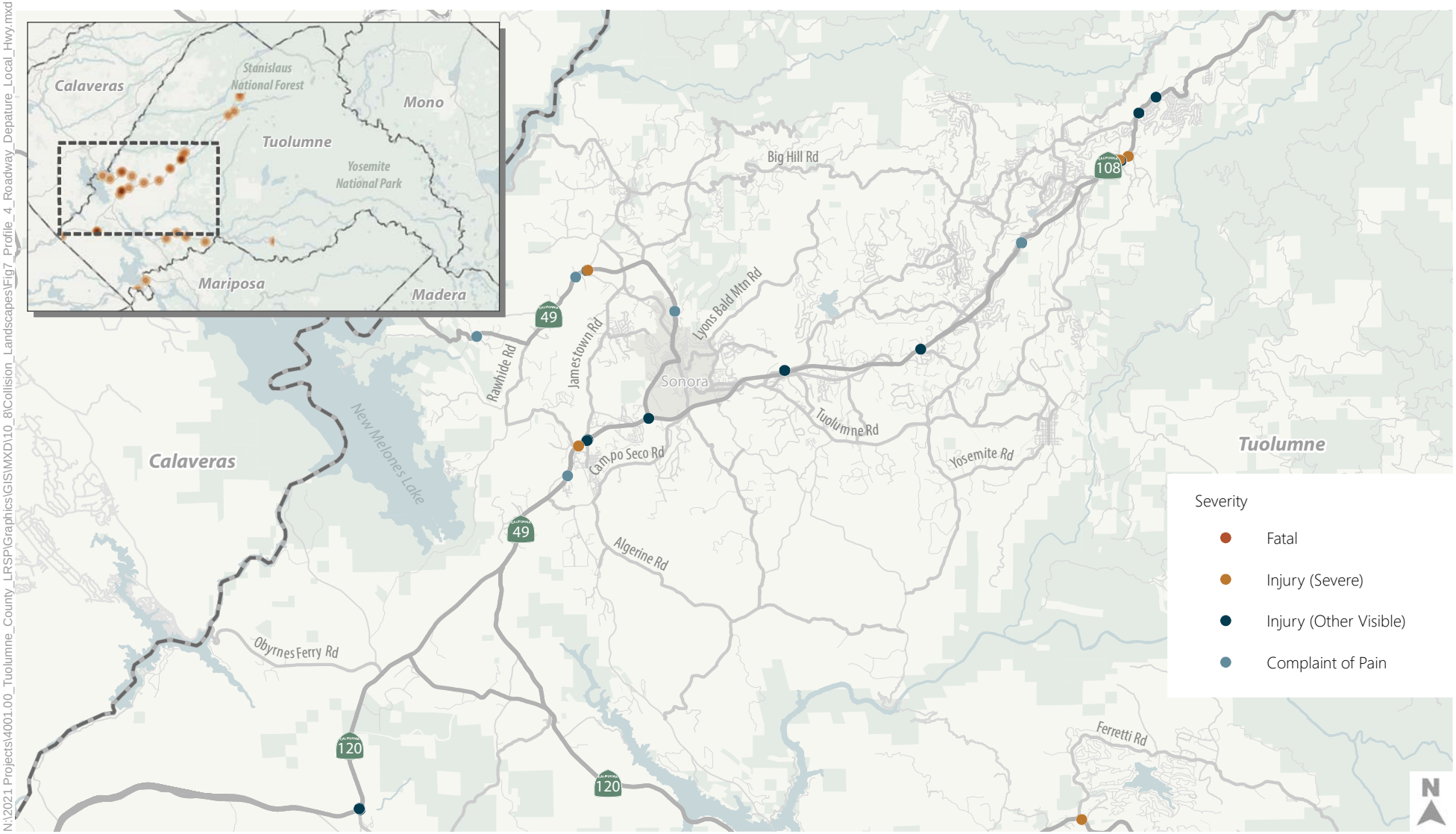


Figure 17

Severity of Hit Object or Overturned Collisions at Unsignalized Local-State Highway Side-Street Stop Controlled Intersections



N:\2021 Projects\4001.00_Tuolumne_County_LRSP\Graphics\GIS\MXD\10_8Collision_LandscapesFig7_Profile_4_Roadway_Depature_Local_Hwy.mxd

PROFILE 5

Rear End Collisions at Unsignalized Intersections

This profile focuses on rear end collisions at unsignalized intersections. During the study period, there were 84 collisions that fit this profile; 82 percent of which are attributed to motorists traveling at an unsafe speed. The remaining rear end collisions are primarily attributed to drivers following too closely. Compared to other collision profiles, a lower share of these collisions were KSI collisions. These collisions are displayed on Figure 18.

The primary goals of countermeasures for this profile are to slow speeds and increase driver awareness as they approach an intersection.

Profile Statistics

8

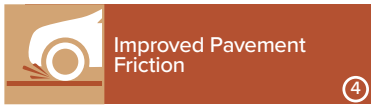
KSI COLLISIONS FIT THIS PROFILE

5%

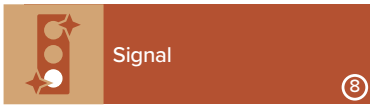
SHARE OF KSI COLLISIONS

Potential Countermeasures


Transverse Rumble Strips (3)

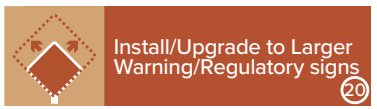

Improved Pavement Friction (4)

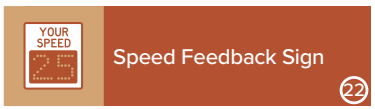

Roundabout (7)


Signal (8)


Install Acceleration/ Deceleration Lanes (11)

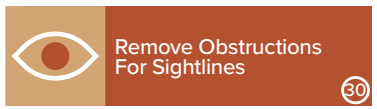
Upgrade Intersection Pavement Markings (19)

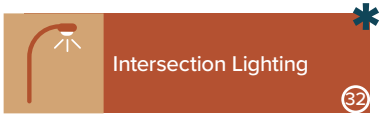

Install/Upgrade to Larger Warning/Regulatory signs (20)



Speed Feedback Sign (22)


Flashing Beacon as Advance Warning (23)

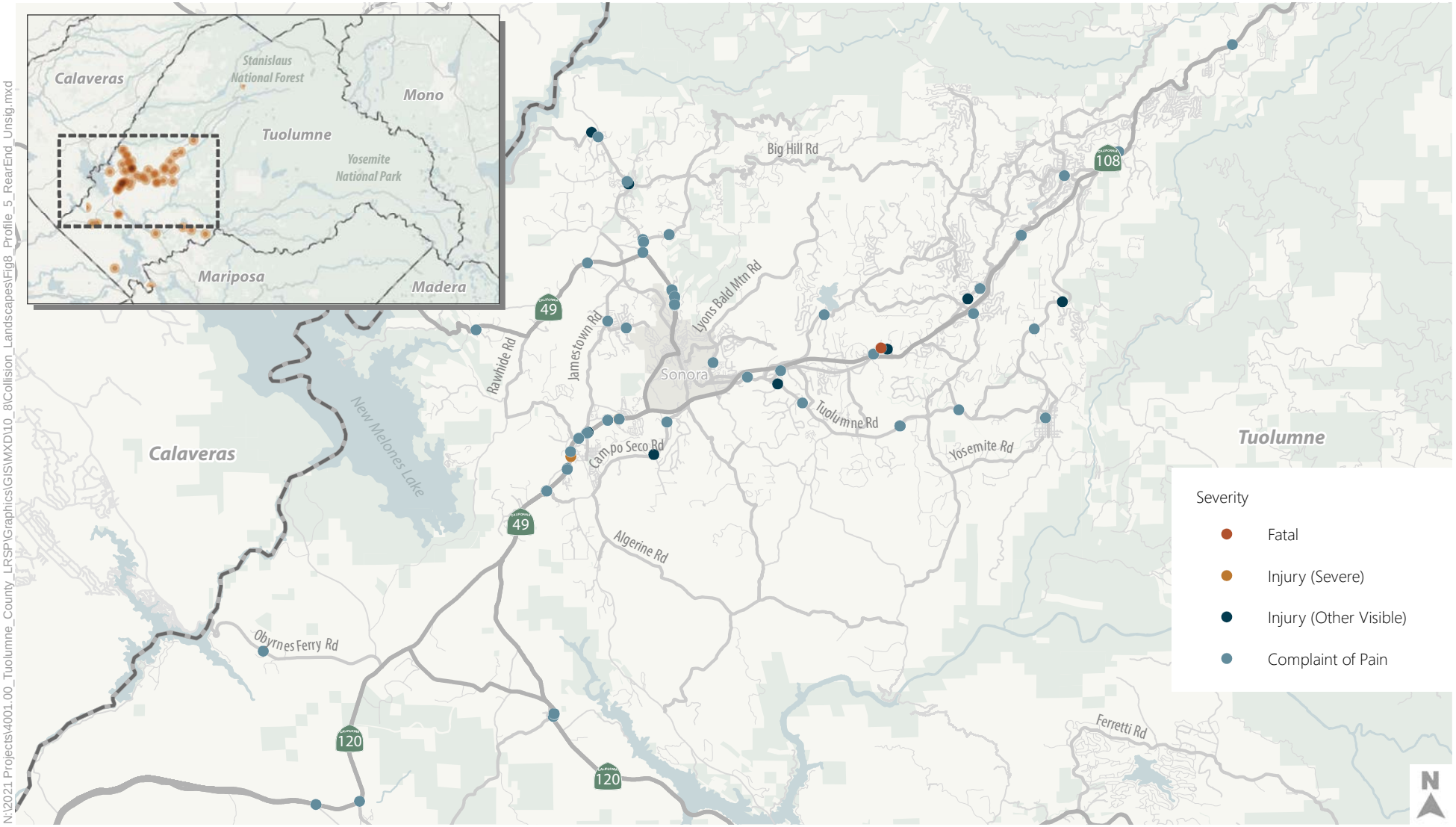

Remove Obstructions For Sightlines (30)


Intersection Lighting * (32)

XX *Countermeasure Toolbox Number*

* *Only applicable for nighttime collisions*

Figure 18
Severity of Rear End Collisions at Unsignalized Intersections



N:\2021 Projects\4001.00_Tuolumne_County_LRSP\Graphics\GIS\MXD\10_8\Collision_Landscapes\Fig8_Profile_5_RearEnd_Unsig.mxd

PROFILE 6

Pedestrian Collisions at Unsignalized Intersections

On rural roads where marked crosswalks or sidewalks are not often present, pedestrians must walk along the roadway and cross when they see gaps in oncoming traffic. There were 11 pedestrian collisions at unsignalized intersections, which represents 79 percent of all of the pedestrian collisions that occurred during the study period. Pedestrian collisions were therefore more likely to occur at an intersection than along a road segment. Collisions are displayed on Figure 19.

Five of these collisions occurred when it was dark, seven involved a pedestrian walking in the road or shoulder, and three involved a pedestrian crossing where no crosswalk was present.

Profile Statistics

5

KSI COLLISIONS FIT THIS PROFILE

3%

SHARE OF KSI COLLISIONS

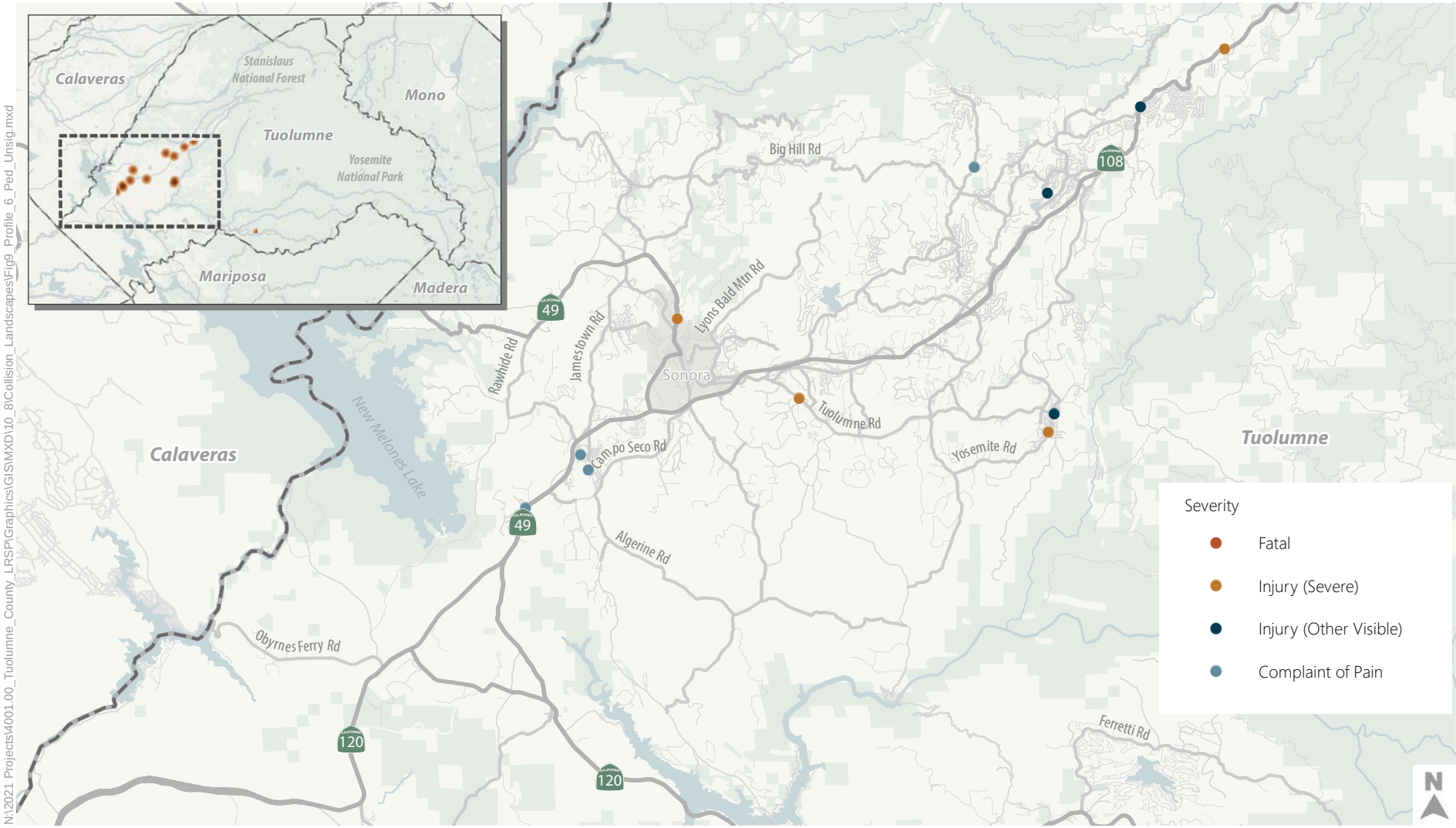
Potential Countermeasures

- Rumble Strips/Stripes (1)
- Widen/Pave Shoulder (5)
- Pedestrian Hybrid Beacon (14)
- Rectangular Rapid Flashing Beacon (15)
- High-Visibility Crosswalk (16)
- Widen Sidewalk (17)
- Speed Feedback Sign (22)
- Advance Yield Markings (25)
- Yield To Pedestrians Sign (26)
- Remove Obstructions For Sightlines (30)
- Intersection Lighting (32) *

(XX) *Countermeasure Toolbox Number*

* *Only applicable for nighttime collisions*

Figure 19
Severity of Pedestrian Collisions at Unsignalized Intersections



Countermeasure Toolbox

A countermeasure is a strategy or action taken to increase roadway safety and decrease collision frequency and severity. This countermeasure toolbox includes engineering (infrastructure related) countermeasures as well as non-engineering (education and enforcement driven) countermeasures.

The bulk of engineering countermeasures are listed in the LRSM, which means they are eligible to receive HSIP funding. However, additional engineering countermeasures have been incorporated that may be applicable for specific collision types. Although these countermeasures may not be eligible for HSIP funding, they may be eligible for safety funding through other programs, which are described in Chapter 7.

Because multiple countermeasures may be applicable for a particular collision type, the County should consider the countermeasure's crash modification factor (CMF), implementation cost and expected life of the improvement prior to determining the appropriate countermeasure(s) to implement.

A CMF is essentially a multiplicative factor used to help calculate the anticipated number of collisions after a specific countermeasure is implemented. A countermeasure with a CMF lower than 1 is expected to reduce collisions while a countermeasure with a CMF greater than 1 is expected to increase collisions.

While a crash reduction factor (CRF) is similar to a CMF, they are expressed slightly differently. A CRF is defined as a percentage of crash reduction that may be expected after the implementation of a given countermeasure: a greater CRF indicates a greater expected reduction. Mathematically, a CRF is calculated as 1-CMF. The LRSM references both CMFs and CRFs.

Because the CMF for a countermeasure can vary depending on a variety of factors (e.g., type of collision, time of day of collision, local setting (urban vs. rural), and number of lanes), caution should be used when selecting the appropriate CMF.

The following should be considered when selecting the appropriate CMF:

- CMFs should be selected from the Highway Safety Manual (HSM) Part D, the LRSM, or from the FHWA CMF Clearinghouse website (http://www.cmfclearinghouse.org).
- Review the countermeasure abstract and confirm the selected CMF is applicable to the collision type hoping to be reduced.
- Only CMFs with a four- or five-star rating should be considered for use in analysis.
- When multiple countermeasures are proposed, the application of multiple CMFs can overestimate the expected crash reduction. Unless each CMF addresses independent crash types, multiple CMFs should not be used. The LRSM indicates no more than three CMFs can be applied when applying for HSIP funding.

Section 4.1 of the LRSM provides additional guidance on selecting the appropriate CMF.


SPEED
LIMIT
35

What You'll Find in This Toolbox

Countermeasure number

8

Countermeasure category

INTERSECTIONS & ROADWAYS

Countermeasure title and icon

Signal

Countermeasure description

Traffic signals at intersections control the flow of traffic. Traffic signals have the potential to reduce the most severe type crashes but will likely cause an increase in rear-end collisions. A reduction in overall injury severity is likely the largest benefit of traffic signal installation.

Approximate cost to implement

Cost **$$$**

LRSM ID, if applicable

LRSM ID **NS03**

Crash Reduction Factor (CRF)*, if applicable

CRF **30%**

Expected Life, if applicable.

Expected Life **20 years**

Any other reference information, if applicable

Other Reference Information

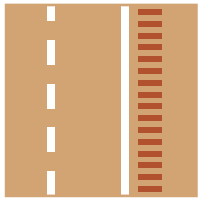
Currently the CMF Clearinghouse has only one reference for pedestrian/vehicle collisions which indicates an increase in crash likelihood. However, a majority of references for all crash types show a decrease in collisions. See additional reference: FHWA Manual for Selecting Safety Improvements on High Risk Rural Roads

*

CRF is based on CRF percentages documented in *Caltrans Local Roadway Safety - A Manual for California's Local Road Owners*, Version 1.5, dated April 2020. This CRF is to be used for HSIP applications as of September 2021. However, it is important to note that percentages vary from the FHWA State Clearinghouse and percentages may change overtime as new data is released. CRFs for specific countermeasures should be reviewed prior to requesting funding for implementation of the countermeasure to ensure the most recent and accurate CRF is being applied.

1

INTERSECTIONS & ROADWAYS



Rumble Strips/Stripes

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. Rumble strips also alert drivers to the lane limits when conditions such as rain, fog, snow, or dust reduce driver visibility.

Cost **$**

LRSM ID	**R30 (centerline)/R31 (edgeline)**
CRF	**20%/15%**
Expected Life	**10 years**

Other Reference Information
FHWA Manual for Selecting Safety Improvements on High Risk Rural Roads

2

INTERSECTIONS & ROADWAYS

All-Way Stop Control

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” sign should be placed under the octagonal stop sign at all-way stop-controlled intersections as required by the California Manual on Uniform Traffic Control Devices (MUTCD).

Cost **$**

LRSM ID	**NS02**
CRF	**50%**
Expected Life	**10 years**

3

INTERSECTIONS & ROADWAYS

Transverse Rumble Strips

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

Cost **$$**

LRSM ID	**NS10**
CRF	**20%**
Expected Life	**20 years**

4

INTERSECTIONS & ROADWAYS

Improved Pavement Friction

A roadway must have an appropriate level of pavement friction to ensure that drivers are able to keep their vehicles safely in the lane. Poor pavement conditions, especially wet pavement, have been identified as one of the major contributing factors in roadway departure crashes. When a pavement surface is wet, the level of pavement friction is reduced, and this may lead to skidding or hydroplaning. 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.

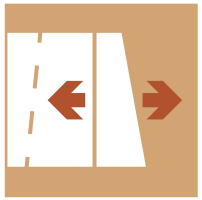
Cost **$$**

LRSM ID	**R21**
CRF	**55%**
Expected Life	**10 years**

Other Reference Information
FHWA Manual for Selecting Safety Improvements on High Risk Rural Roads

5

INTERSECTIONS & ROADWAYS



Widen/Pave Shoulder

Widened and paved shoulders, which may also include flattening the slopes along the sides of the roadway, create a separated space for bicyclists and also provide motor vehicle safety benefits, such as space for inoperable vehicles to pull out of the travel lane. The addition of a paved shoulder to an existing road can help to reduce run-off-road crashes. Benefits can be realized for high risk rural roads without paved shoulders, regardless of existing lane pavement width. Adding paved shoulders within horizontal curve sections may help agencies maximize benefits of the treatment while minimizing costs as opposed to adding paved shoulders to an entire corridor.

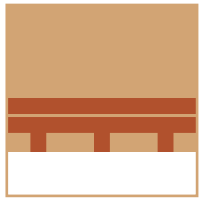
Cost **$$**

LRSM ID	**R15**
CRF	**30%**
Expected Life	**20 years**

Other Reference Information
FHWA Manual for Selecting Safety Improvements on High Risk Rural Roads

6

INTERSECTIONS & ROADWAYS



Guardrail

A guardrail redirects a vehicle away from embankment slopes or fixed objects and dissipates the energy of an errant vehicle. A guardrail is installed to reduce the severity of lane departure crashes. However, a guardrail can reduce crash severity only for those conditions where striking the guardrail is less severe than going down an embankment or striking a fixed object.

Cost **$$**

LRSM ID	**R04**
CRF	**25%**
Expected Life	**20 years**

Other Reference Information
FHWA Manual for Selecting Safety Improvements on High Risk Rural Roads

7

INTERSECTIONS & ROADWAYS

Roundabout

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 forces drivers to reduce speeds as they proceed through the intersection; the range of vehicle speeds is also narrowed, reducing the severity of crashes when they do occur. Pedestrians only have to cross one direction of traffic at a time at roundabouts, thus reducing the potential for vehicle/pedestrian conflicts.

Cost **$$$**

Low Cost / Quick Build alternative available

LRSM ID	**S16/NS04/NS05**
CRF	**(varies)**
Expected Life	**20 years**

8

INTERSECTIONS & ROADWAYS

Signal

Traffic signals at intersections control the flow of traffic. Traffic signals have the potential to reduce the most severe type crashes but will likely cause an increase in rear-end collisions. A reduction in overall injury severity is likely the largest benefit of traffic signal installation.

Cost **$$$**

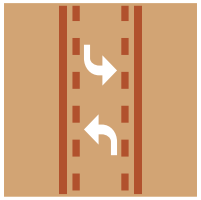
LRSM ID	**NS03**
CRF	**30%**
Expected Life	**20 years**

Other Reference Information

Currently the CMF Clearinghouse has only one reference for pedestrian/vehicle collisions which indicates an increase in crash likelihood. However, a majority of references for all crash types show a decrease in collisions. See additional reference: FHWA Manual for Selecting Safety Improvements on High Risk

9

INTERSECTIONS & ROADWAYS



Add Two-Way Left-Turn Lane or Left-Turn Lane

Center and right-turn lanes provide space for drivers to decelerate and wait for an acceptable gap to turn out of the primary travel lane. They can reduce rear-end, head-on, and turning-related crashes.

Cost **$$**

LRSM ID	**NS18 (pocket)/R13 (two-way)**
CRF	**30%/35%**
Expected Life	**20 years**

10

INTERSECTIONS & ROADWAYS

Safety Edge

When a vehicle leaves the traveled way and encounters a pavement-shoulder drop-off, it can be difficult for the driver to return safely to the roadway. A safety edge is a treatment intended to minimize drop-off-related crashes. With this treatment, the shoulder pavement edge is sloped at an angle (30-35 degrees) to make it easier for a driver to safely reenter the roadway after inadvertently driving onto the shoulder. This treatment is designed to be a standard policy for any overlay project.

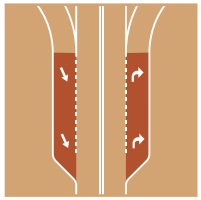
Cost **$**

Expected Life **20 years**

Other Reference Information
FHWA Manual for Selecting Safety Improvements on High Risk Rural Roads

11

INTERSECTIONS & ROADWAYS



Install Acceleration/ Deceleration Lanes

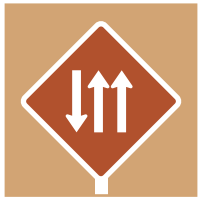
An acceleration lane is an auxiliary or speed-change lane that allows vehicles to accelerate to the roadway speed before entering the through-traffic lane. Conversely, a deceleration lane provides space outside of the through-traffic lane for vehicles to decelerate to an appropriate turning speed, without affecting traffic in the through lane.

Cost **$$**

LRSM ID	**R11**
CRF	**20%**
Expected Life	**20 years**

12

INTERSECTIONS & ROADWAYS



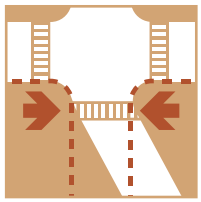
Climbing Lane

Climbing lanes are auxiliary lanes typically constructed on roadway segments with steep grades and high truck volumes. Steep grades can reduce speed for heavy vehicles, which can result in congestion and delay for passenger vehicles on the roadway segment. Climbing lanes provide an opportunity for passenger vehicles to pass slower moving vehicles without having to cross into the opposing traffic lane. Caution should be used when installing climbing lanes as they are only appropriate under certain circumstances. The AASHTO Greenbook and Highway Capacity Manual should be referenced prior to proposing climbing lanes; both documents provide guidance on when climbing lanes may be appropriate.

Cost **$$$**

13

INTERSECTIONS & ROADWAYS



Intersection Reconstruction and Tightening

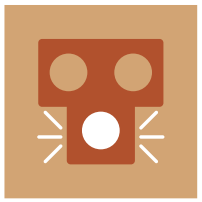
Irregular intersections can be overbuilt and confusing, presenting safety hazards to all users. “Squaring up” an intersection as close to 90 degrees as possible involves intersection reconstruction to provide better visibility for all road users, also reducing high speed turns and reducing pedestrian crossing length.

Cost **$$$**

Low Cost / Quick Build alternative available

14

PEDESTRIAN FACILITIES



Pedestrian Hybrid Beacon

A pedestrian-hybrid beacon (PHB) is used at unsignalized intersections or mid-block crosswalks to notify oncoming motorists to stop with a series of red and yellow lights. Unlike a traffic signal, the PHB rests in dark until a pedestrian activates it via pushbutton or other form of detection.

Cost **$$$**

LRSM ID	**NS23PB**
CRF	**55%**
Expected Life	**20 years**

15

PEDESTRIAN FACILITIES

Rectangular Rapid Flashing Beacon

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 the visibility of marked crosswalks and provides motorists a cue to slow down and yield to pedestrians.

Cost **$$**

LRSM ID	**NS22PB**
CRF	**35%**
Expected Life	**20 years**

16

PEDESTRIAN FACILITIES

High-Visibility Crosswalk

A high-visibility crosswalk has a striped pattern with ladder markings made of high-visibility material, such as thermoplastic tape, instead of paint. A high-visibility crosswalk improves safety by increasing the visibility of marked crosswalks and provides motorists a cue to slow down and yield to pedestrians.

Cost **$**

Low Cost / Quick Build alternative available

LRSM ID	**NS20PB**
CRF	**25%**
Expected Life	**20 years**

17

PEDESTRIAN FACILITIES

Widen Sidewalk

Widening sidewalks provides a more comfortable space for pedestrians, particularly in locations with high volumes of pedestrians, and provides space to accommodate people in wheelchairs. Widening sidewalks improves safety by minimizing collisions with pedestrians walking in the road.

Cost **$$**

18

SIGNING & STRIPING

Curve Advance Warning Sign

A curve advance warning sign notifies drivers of an approaching curve and may include an advisory speed limit as drivers navigate around the curve. This warning sign is ideally combined with other infrastructure that alerts drivers of the curve, such as chevron signs, delineators, and flashing beacons. A curve advance warning sign improves safety by giving drivers additional time to slow down for the curve.

Cost **$**

Low Cost / Quick Build alternative available

LRSM ID	**R24**
CRF	**25%**
Expected Life	**10 years**

Other Reference Information
FHWA Manual for Selecting Safety Improvements on High Risk Rural Roads

19

SIGNING & STRIPING

Upgrade Intersection Pavement Markings

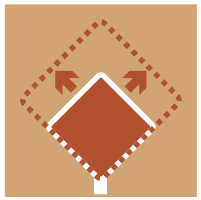
Upgrading intersection pavement markings can include “Stop Ahead” markings and the addition of centerlines and stop bars. Upgrading intersection pavement markings can improve safety by increasing the visibility of intersections for drivers approaching and at the intersection.

Cost **$**
Low Cost / Quick Build alternative available

LRSM ID	**NS07**
CRF	**25%**
Expected Life	**10 years**

20

SIGNING & STRIPING



Install/Upgrade to Larger Warning/Regulatory signs

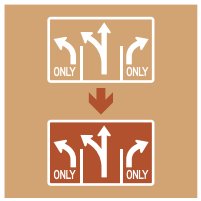
Upgrading to larger warning/regulatory signs replaces existing signs with physically larger signs with larger warning informaiton. Upgrading to larger warning signs improves safety by increasing visibility of the information provided, particularly for older drivers.

Cost **$**
Low Cost / Quick Build alternative available

LRSM ID	**NS06**
CRF	**15%**
Expected Life	**10 years**

21

SIGNING & STRIPING



Upgrade Signs with Fluorescent Sheeting

Upgrading signs with fluorescent sheeting replaces existing signs with new signs that can clearly display warnings by reflecting headlamp light back to vehicles. Upgrading signs with fluorescent sheeting improves safety by increasing visibility of signs to drivers at night. It can also be effective for roadway segments with a pattern of head-on, nighttime, non-intersection, run-off road, and sideswipe crashes related to lack of driver awareness of the presence of a specific roadway feature or regulatory requirement.

Cost **$**
Low Cost / Quick Build alternative available

LRSM ID **R22**

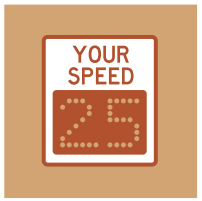
CRF **15%**

Expected Life **10 years**

Other Reference Information
FHWA Manual for Selecting Safety Improvements on High Risk Rural Roads

22

SIGNING & STRIPING



Speed Feedback Sign

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.

Cost **$**
Low Cost / Quick Build alternative available

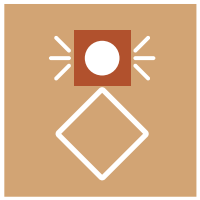
LRSM ID **R26**

CRF **30%**

Expected Life **10 years**

23

SIGNING & STRIPING



Flashing Beacon as Advance Warning

A flashing beacon as advanced 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.

Cost **$$**

LRSM ID	**NS09**
CRF	**30%**
Expected Life	**10 years**

Other Reference Information
FHWA Manual for Selecting Safety Improvements on High Risk Rural Roads

24

SIGNING & STRIPING

Chevron Signs on Horizontal Curves

Post-mounted chevrons are intended to warn drivers of an approaching curve and provide tracking information and guidance to the drivers. They can be beneficial on roadways that have an unacceptable level of crashes on relatively sharp curves during periods of light and darkness.

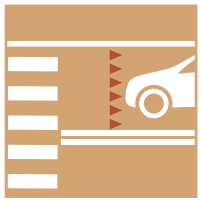
Cost **$**
Low Cost / Quick Build alternative available

LRSM ID	**R23**
CRF	**40%**
Expected Life	**10 years**

Other Reference Information
FHWA Manual for Selecting Safety Improvements on High Risk Rural Roads

25

SIGNING & STRIPING



Advance Yield Markings

Yield lines are placed 20 to 50 feet in advance of multi-lane pedestrian crossings to increase visibility of pedestrians. They can reduce the likelihood of a multiple-threat crash.

Cost **$**

Low Cost / Quick Build alternative available

26

SIGNING & STRIPING

Yield To Pedestrians Sign

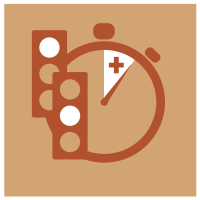
"Yield Here to Pedestrians" signs alert drivers about the presence of pedestrians. These signs are required with advance yield lines. Other sign types can be placed on the centerline in the roadway.

Cost **$**

Low Cost / Quick Build alternative available

27

SIGNALS



Extend Yellow and All Red Time

Extending yellow and all red time increases the time allotted for the yellow and red lights during a signal phase. Extending yellow and all red time improves safety by allowing drivers and bicyclists to safely cross through a signalized intersection before conflicting traffic movements are permitted to enter the intersection.

Cost **$**

Low Cost / Quick Build alternative available

LRSM ID **S03**

CRF **10%**

Expected Life **10 years**

28

OTHER

Access Management/ Close Driveway

Vehicles entering and exiting driveways may confict with pedestrians and with vehicles on the main road, especially at driveways within 250 feet of intersections. Closing driveways near intersections with high collision rates related to driveways may reduce potential conficts.

Cost **$$**

Other Reference Information

The CMF Clearinghouse has limited research related to vehicle/pedestrian crashes. See additional reference: FHWA Pedestrian Safety Guide and Countermeasure Selection System. http://www.pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=20

29

OTHER

Create or Increase Clear Zone

A clear zone is an unobstructed, traversable roadside area that allows a driver to stop safely or regain control of a vehicle that has left the roadway. The width of the clear zone should be based on risk (also called exposure). Key factors in assessing risk include traffic volumes, speeds, and slopes. Clear roadsides reduce risk from fixed objects (such as utility poles) as well as terrain that may increase the likelihood of a rollover. Creating or increasing clear zones within horizontal curve sections may help agencies maximize benefits of the treatment while minimizing costs, as opposed to providing a clear zone throughout an entire corridor.

Cost **$$**

LRSM ID	**R02**
CRF	**35%**
Expected Life	**20 years**

Other Reference Information
FHWA Manual for Selecting Safety Improvements on High Risk Rural Roads

30

OTHER

Remove Obstructions For Sightlines

Remove objects that may prevent drivers and pedestrians from having a clear sightline. May include installing red curb at intersection approaches to remove parked vehicles (also called “daylighting”), trimming or removing landscaping, or removing or relocating large signs.

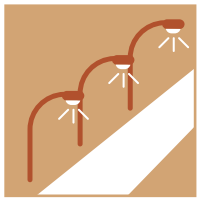
Cost **$**
Low Cost / Quick Build alternative available

LRSM ID	**NS11**
CRF	**20%**
Expected Life	**10 years**

Other Reference Information
FHWA Manual for Selecting Safety Improvements on High Risk Rural Roads

31

OTHER



Segment Lighting

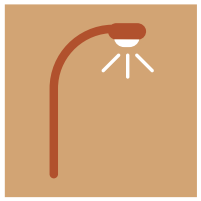
Providing roadway lighting improves safety during nighttime conditions by increasing driver awareness, increasing sight distance, and improving visibility of pedestrians and bicyclists.

Cost **$$**

LRSM ID	**R01**
CRF	**35%** * *Only applicable if a significant number of crashes occur at night*
Expected Life	**20 years**

32

OTHER



Intersection Lighting

Adding intersection and/or pedestrian-scale lighting at intersections improves safety by increasing visibility of all road users. This countermeasure is most effective at reducing or preventing collisions at intersections at night.

Cost **$$**

LRSM ID	**NS01**
CRF	**40%** * *Only applicable if a significant number of crashes occur at night*
Expected Life	**20 years**

Other Reference Information
Pedestrian-Level Lighting: FHWA Pedestrian Safety Guide and Countermeasure Selection System. http://www.pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=8

33

NON-ENGINEERING: EDUCATION

Public Information Campaigns

Highly visible public information campaigns can increase awareness of the risks of driving under the influence. Publicized sobriety checkpoints, saturation patrol, and other forms of high-visibility enforcement are effective for safety outcomes. They should also focus on mobilizing and educating the community, and intervening before driving under the influence takes place. Public education may also involve making safety and crash data publically available on project websites, local agencies' data portal, social media, and other avenues as appropriate.

Non-Engineering Countermeasure

34

NON-ENGINEERING: POLICIES AND PROGRAMS

Targeted Enforcement and Deterrence

When developing a program of targeted enforcement and deterrence, use collision history and corridors with a high frequency of fatal and severe injury collisions as one criterion for where to concentrate enforcement efforts. Add extra patrols to look for distracted drivers as part of a statewide distracted driving campaign, with focus on where data indicates that the most traffic safety benefit can be realized. Implement deterrence policies that are highly visible, such as publicized sobriety checkpoints, saturation patrol, and other forms of high visibility enforcement that are effective for safety outcomes. Tuolumne County Public Works has used mobile radar speed feedback signs to deter speeding drivers.

Non-Engineering Countermeasure

35

NON-ENGINEERING: POLICIES AND PROGRAMS

Coordinate with Rideshare/Transit

Coordinate with rideshare companies/transit agencies to ensure consistent and reliable service is provided, particularly later in the evening. If possible, provide subsidies and assist with marketing the rideshare/transit services to ensure residents are aware these services exist and are encouraged to use them.

Non-Engineering Countermeasure

36

NON-ENGINEERING: MAINTENANCE

Keep Roadways Clear of Debris

A smoothly paved surface free of debris enhances safety for vehicles and bicyclists.

Non-Engineering Countermeasure


Frosty


NEW
COIN STORE
7KRB624

Chapter 7

Implementation, Evaluation, and Funding

Implementation

Implementation of the LRSP is a vital step in the process of executing identified strategies and projects. To implement programs and projects successfully, partnerships, trust, funding, and coordination need to be managed proactively. Successful implementation requires continuous coordinated support from key stakeholders, elected officials, and County staff. Strategies for successful implementation are described in this chapter.

Oversight & Accountability

To ensure effective delivery of safety projects and programs, a committee or task force with key officials and stakeholders that meets bi-annually or quarterly is recommended. The leadership provided by this committee will be a crucial part of maintaining buy-in and support from both local officials and the community as the County implements countermeasures identified in the LRSP. In addition to County planning and engineering staff, leadership may include members from identified LRSP partners such as Caltrans, Tuolumne County Sheriff's Office, California Highway Patrol, Tuolumne County Public Health Department, and Tuolumne County Superintendent of Schools.

Routine collaboration between stakeholders and partners will ensure that County-led engineering countermeasures are supported by coordinated enforcement, education, and engagement programs. Committee/task force duties may 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.

Coordination, Communication, and Partnership

Coordination, communication, and partnership among the committee or task force members are essential for effective project delivery. Strategies include:

- Sharing progress and key milestones;
- Consulting partner agencies early on in the implementation process to gather suggestions and feedback; and
- Finding opportunities for partnership via project bundling (e.g., integrating countermeasures identified in the LRSP with pavement resurfacing and maintenance projects, future Caltrans projects, or transportation improvements constructed with development projects).

Continued communication and transparency with stakeholders and community members can allow for greater trust and support of the LRSP's goals. Strategies include:

- Communication across diverse channels (e.g., updated webpage, news, and social media);
- Actively addressing community concerns;
- Publishing regularly updated factsheets on plan progress; and
- Hosting regular public meetings using effective community engagement techniques.

These tasks could be led by a member of the committee or task force.

Establish Development and Design Standards

Tuolumne County is in the process of establishing development and design standards. These standards should incorporate safety measures where appropriate and provide clear direction as to when safety measures should be required with future projects. Features including, but not limited to, roadway and intersection lighting, sidewalks and/or wide shoulders, and site access management should be incorporated with development projects. Clear zones, safety edges, rumble strips, safety signage, and similar improvements should be included as roadway infrastructure projects are completed, either with development projects or as standalone infrastructure projects.

Evaluation

Ongoing evaluation of safety performance vs. safety goals is an essential component of a robust safety plan. Evaluation provides an opportunity for the County to understand its progress towards achieving its safety goals and allows re-prioritization of those goals as new areas of concern arise. Recommendations for evaluating implementation of the LRSP include:

1. Safety Scorecard – Regular measurement of goal progress in reducing emphasis area collision types should be performed at least annually. Safety scorecards can be a powerful tool for measuring effectiveness, highlighting areas that need further attention and resources, and identifying tasks and deadlines for responsible stakeholder parties.

A scorecard may include:

- KSIs specific to the goals outlined in this plan
- The number of safety infrastructure improvements completed
- Monitoring public engagement and response to non-infrastructure countermeasures

2. Continued Community Engagement – The County should consider conducting pre- and post-surveys with community members to measure how their actions and views have shifted after engagement about traffic safety. Local partners can be tasked with disseminating the pre- and post-surveys to residents. Surveys should evaluate whether respondents express a shift in behavior and attitude after having participated in traffic safety programming. The metrics for evaluation can also be developed in partnership with local partners to ensure accessibility for the public.

Tuolumne County
Fehr & Peers, 2021

Tuolumne County
Fehr & Peers, 2021

Funding

Funding is often a major hurdle to implementation of safety projects. The committee or task force or County staff should frequently review the list of current capital improvement projects to determine which LRSP projects could overlap for possible project bundling.

County staff should also monitor and seek grant opportunities and regularly submit applications for competitive projects and secure local funds for safety improvements whenever possible. Local, state, and federal funding sources that could be sought for transportation safety projects are as follows.

State and Federal Funding Sources

Highway Safety Improvement Program (HSIP)

The HSIP is a core federal-aid program with the purpose of achieving a significant reduction in traffic fatalities and serious injuries on all public roads, including non-state-owned roads and roads on tribal land. The HSIP is allotted funding via Fixing America's Surface Transportation (FAST) Act; each state is apportioned a lump sum, which is then divided among apportioned programs. According to FHWA, HSIP estimated funding in 2020 was over $2.4 billion nationwide. Caltrans has indicated that the HSIP Cycle 11 Call for Projects is anticipated to open in April 2022.

Senate Bill (SB) 1 Funding

California SB 1, also known as the Road Repair and Accountability Act of 2017, is a landmark transportation investment to rebuild California by fixing neighborhood streets, freeways, and bridges in communities across California and target funding toward transit and congested trade and commute corridor improvements. The largest portion of SB 1 funding goes to California's

State-maintained transportation infrastructure. With this funding, Caltrans has a goal of repairing or replacing 17,000 miles of pavement in 10 years, spending $250 million annually for congestion solutions and over $700 million for better transit commutes and supporting freight improvements. The other portion of SB 1 funding will go to local roads, transit agencies, and expanding the state's pedestrian and cycle routes. SB 1 funds various grants:

- *Local Streets and Roads Program (LSRP)* – SB 1 has dedicated approximately $1.5 billion per year appointed by the State Controller to cities and counties for basic road maintenance, rehabilitation, and critical safety projects on local streets and roads. Cities and counties must submit a proposed project list adopted at a regular meeting by their board or council that is then submitted to the California Transportation Commission. Once reviewed and adopted by the Commission, eligible cities and counties receive funding from the Controller. An Annual Project Expenditure Report is sent to the Commission to maintain transparency regarding program funding received and expended.
- *Local Partnership Program (LPP)* – The LPP's purpose is to provide local and regional transportation agencies that have passed sales tax measures, developer fees, or other imposed transportation fees with a funding of $200 million annually from the Road Maintenance and Rehabilitation Account to fund aging infrastructure, road conditions, active transportation, and health and safety benefits projects. LPP funds are distributed through a 50 percent statewide competitive component and a 50 percent formulaic component. Both programs are eligible to jurisdictions with voter approved taxes, tolls, and fees dedicated solely to transportation and the competitive program. LPP also provides the opportunity for local governments to partner with Caltrans for enhancements on state facilities.

Active Transportation Program (ATP)

The ATP was created by SB 99 to encourage increased use of active modes of transportation such as walking and biking. The goals of the ATP include increasing the proportion of trips accomplished by walking and biking, increasing the safety and mobility of non-motorized users, advancing efforts of regional agencies to achieve greenhouse gas reduction goals, enhancing public health, and providing a broad spectrum of projects to benefit many types of users, including disadvantaged communities. Cycle 5, the most recent ATP Cycle Call for Projects, had a funding capacity of approximately $445.5 million. Funding is made up of federal funding, SB 1 funding, and State Highway Account funding.

Caltrans Sustainable Transportation Planning Grants

The Sustainable Transportation Planning Grants include two parts:

- *Sustainable Communities Grants* have $29.5 million set aside to encourage local and regional planning goals and best practices cited in the Regional Transportation Plan Guidelines.
- *Strategic Partnership Grants* have $4.5 million set aside to identify and address statewide, interregional, or regional transportation deficiencies on the State highway system in partnership with Caltrans.

These grants were released for Fiscal Year 2022-23 and applications are due October 27, 2021. Grant announcements are anticipated in Spring 2022. Another round of grants is anticipated, but Caltrans has not released any new information yet.

State Transportation Improvement Program (STIP)

The STIP is a five-year capital improvement program that is updated and adopted by the California Transportation Commission every two years. The STIP is funded with revenues from the Transportation Investment Fund and other sources.

Safe Routes to School (SRTS) Funding

The SRTS program promotes walking and bicycling to school through infrastructure improvements, tools, safety education, and incentives to encourage these modes of travel. Nationally, 10 to 14 percent of car trips during the morning rush hour are for school travel. SRTS can be implemented at the State, community, or local school district level. Competitive federal funding is available through the FAST Act. Depending on the existing infrastructure, SRTS may require that education, transportation, public safety, and city planning agencies coordinate their efforts.

Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Grants

The U.S. Department of Transportation (DOT) is committed to creating high-quality jobs, improving safety, protecting our environment, and generating equitable economic opportunity for all americans with RAISE grants. Projects will be evaluated based on merit criteria that includes safety, environmental sustainability, quality of life, economic competitiveness, state of good repair, innovation, and partnership. RAISE grants are one of the few DOT discretionary programs for which regional and local governments can directly compete for multimodal transportation funding.

Affordable Housing and Sustainable Communities Program (AHSC)

The AHSC Program, administered by the Strategic Growth Council and implemented by the Department of Housing and Community Development (HCD), funds land use, housing, transportation, and land preservation projects to support infill and compact development that reduces greenhouse gas (GHG) emissions.

This program will assist project areas by providing grants, loans, or any combination thereof that will achieve GHG emission reductions and benefit disadvantaged communities, low-income communities, and low-income households through increased accessibility of affordable housing, employment centers, and key destinations via low-carbon transportation. This program results in fewer vehicle miles traveled through shortened or reduced trip lengths or mode shifts from single occupancy vehicles to use of transit, bicycling, or walking. The project areas this funding is geared toward are transit-oriented development (TOD) project areas, integrated connectivity project (ICP) areas, or rural innovation project areas (RIPA).

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.

Transformative Climate Communities (TCC) Program

The TCC Program funds community-led development and infrastructure projects that strive to make major advances in environmental, health, and economic benefits in California's most disadvantages communities. Eligible improvements for this funding source include active transportation and public transit projects, transit ridership programs and passes for low-income riders, and education and planning activities to promote increased use of active modes of transportation.

Local Funding Sources

Local Transportation Fund (LTF)

The Transportation Development Act (TDA) provides local funding for transit and non-transit related projects that comply with regional transportation plans. The LTF is one of two funding sources funded via the TDA and is used to fund transportation projects in Tuolumne County. The LTF is derived from a quarter cent of the general sales tax collected statewide. Sales tax collected in each county is returned to that county where the tax was generated. As the local Regional Transportation Planning Agency, TCTC oversees and administers LTF monies.

Traffic Impact Mitigation Fee

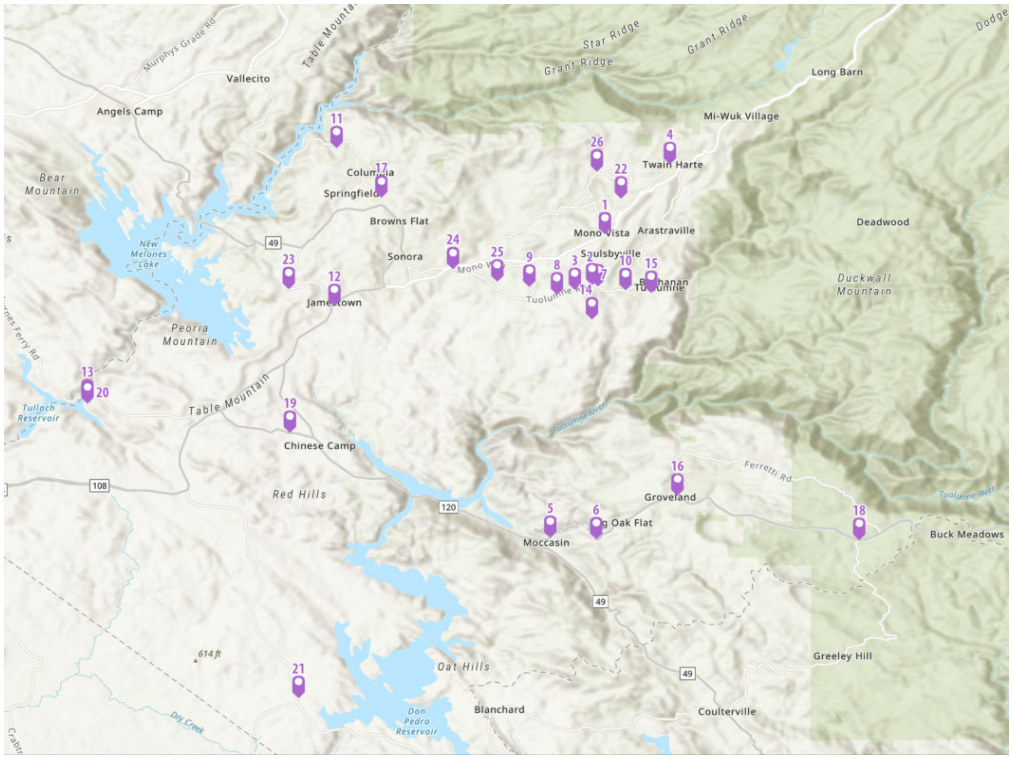
California law allows local governments to establish and charge a fee on residential and non-residential development in order to fund public facilities and to service population growth. Tuolumne County has a Traffic Impact Mitigation Fee which establishes development fees based on development type and size. Public facility fees can go to a variety of public facilities, one being local roadways. The County should evaluate the fee program and, where possible, allocate fees to roadway improvements that will improve safety on local roads.

Appendix A

Stakeholder Comments

Workshop 1 Stakeholder Comments

ID	Comment
1	concern
2	Discussed intersection control evaluation, or other intersection counter measures
3	Flashing Beacon or Intersection Control Evaluation discussed
4	Received reports of near misses with pedestrians in Twain Harte (Joaquin Gully/Twain Harte Drive). Ideas to address include circulation study to identify if intersection improvements, parking, or one way roads could address local concerns.
5	Guardrail? HFST? Intersection realignment?
6	Guardrail? Intersection realignment?
7	Start section locally called Buckhorn Grade - winter conditions = reported near misses/loose control of vehicles
8	End section locally called Buckhorn Grade - winter conditions = reported near misses/loose control of vehicles
9	Ped safety concerns near Curtis Creek Elementary, no shoulder
10	Safety concerns (near miss) reported near high school.
11	Considered high friction surface treatment on Parrotts Ferry Road for winding downhill stretch, frequent guardrail repair.
12	Frequent speeding/pedestrian safety concerns Main Street Jamestown
13	Rockfall issues after sharp turn
14	Curve/intersection considered for High Friction Surface Treatment
15	Community center coming in here - has ben issue before increased traffic will be generated
16	Pedestrian Safety - no crosswalk across Ferretti, missing sidwalk connection from Library to Two Guys Pizza
17	Intersection Hotspot - college traffic (intersection control evaluation?)
18	Fatalities @ county road intersecting with highway (caltrans)
19	Intersection control evaluation - Co Rd at State Highway hotspot (fatality)
20	Accident hotspot - intersection control evaluation/improvements
21	TCTC Study J59 corridor - in process.
22	Guardrail improvements (current standards)
23	Curve safety on Rawhide Road - guardrail?
24	Pedestrian improvements. Green Microsurfacing in shoulder has been discussed.
25	reports of run off road - curve signage?
26	Intersection near school reported for near misses



Appendix B

Collision Data

All Collisions		Roadway Type							Location Type					
		Speed Limit							Signal	Unsignalized Intersection		Near School	Near Park	Total
		25 MPH	30 MPH	35 MPH	40 MPH	45 MPH	50 MPH	55 MPH		Local-Local	Local-Highway			
Violation Category	Vehicle Right of Way Violation	0	0	1	8	1	5	1	5	56	70	19	11	147
	Wrong Side of Road	3	0	6	9	0	2	3	1	18	12	0	0	54
	Driving or Bicycling Under the Influence of Alcohol or Drug	12	0	33	20	4	8	6	4	53	20	7	6	160
	Unsafe Speed	10	0	15	35	3	24	10	26	56	47	14	16	226
	Improper Turning	17	2	44	52	1	16	20	6	57	34	10	8	249
	Other Than Driver (or Pedestrian)	1	0	4	4	1	2	2	1	14	1	0	1	30
	Following Too Closely	1	0	1	0	2	1	1	1	3	6	1	0	16
	Traffic Signals and Signs	0	0	0	0	1	0	0	13	1	1	3	2	16
	Unsafe Starting or Backing	1	0	0	1	2	0	0	9	1	2	1	4	16
Collision Type	Broadside	0	0	0	4	2	6	1	18	50	64	20	8	145
	Rear End	1	1	7	9	7	22	6	35	36	48	10	14	172
	Head-on	2	0	6	13	0	0	4	4	20	12	5	2	61
	Overturned	11	1	20	34	1	11	8	5	36	18	9	4	145
	Hit Object	28	0	68	54	3	18	20	4	88	37	9	15	320
	Sideswipe	4	0	4	13	2	2	4	2	17	14	2	2	62
Time of Day	Evening Peak (3PM-7PM)	18	1	25	50	7	17	13	24	72	65	19	19	292
	Morning Peak (6AM-10AM)	6	0	13	18	3	8	8	10	34	24	5	4	124
	Midday (10AM-3PM)	10	1	27	35	3	14	11	24	83	72	20	15	280
	Overnight (7PM-6AM)	14	0	42	29	3	20	13	11	76	37	14	11	245
	Unknown	1	0	0	1	0	0	0	0	1	1	0	2	4
Movement Preceding Collision by Party at Fault	Proceeding Straight	13	0	22	37	8	27	14	44	89	76	21	24	330
	Ran Off Road	20	0	48	45	2	20	15	2	50	27	10	7	229
	Making Left Turn	0	0	2	2	0	0	0	3	42	50	13	5	99
	Entering Traffic	0	0	0	3	1	3	0	2	14	16	6	3	39
	Other Unsafe Turning	9	2	24	24	0	5	8	5	25	10	3	7	112
	Crossed Into Opposing Lane	2	0	4	10	0	1	3	1	13	5	0	0	39
Total		49	2	107	133	16	59	45	69	266	199	58	51	

	Roadway Type							Location Type		
	Speed Limit							Signal	Unsignalized Intersection	
	25 MPH	30 MPH	35 MPH	40 MPH	45 MPH	50 MPH	55 MPH		Local-Local	Local-Highway
Share of Roadway/Intersections	30%	1%	7%	59%	0%	1%	2%	1%	91%	8%
Share of Collisions	12%	0%	26%	32%	4%	14%	11%	13%	50%	37%
Collisions per Mile	0.10	0.00	0.22	0.27	0.03	0.12	0.09			

KSI Collisions		Roadway Type							Location Type					
		Speed Limit							Signal	Unsignalized Intersection		Near School	Near Park	Total
		25 MPH	30 MPH	35 MPH	40 MPH	45 MPH	50 MPH	55 MPH		Local-Local	Local-Highway			
Violation Category	Vehicle Right of Way Violation	0	0	0	1	1	1	0	1	3	13	3	1	20
	Wrong Side of Road	0	0	0	0	0	0	1	0	4	1	0	0	6
	Driving or Bicycling Under the Influence of Alcohol or Drug	2	0	7	8	1	1	1	1	14	10	4	1	45
	Unsafe Speed	3	0	1	3	0	2	0	0	4	4	1	2	17
	Improper Turning	2	0	9	6	0	5	2	1	10	10	1	2	45
	Other Than Driver (or Pedestrian)	0	0	0	1	0	0	1	0	2	0	0	0	4
	Following Too Closely	0	0	0	0	0	0	0	0	1	1	0	0	2
	Traffic Signals and Signs	0	0	0	0	0	0	0	0	0	0	0	0	0
	Unsafe Starting or Backing	1	0	0	0	0	0	0	1	0	0	0	1	2
Collision Type	Broadside	0	0	0	0	1	1	1	0	3	10	3	0	16
	Rear End	0	0	0	1	0	2	0	0	2	6	0	0	11
	Head-on	0	0	1	2	0	0	0	0	5	6	0	0	14
	Overturned	2	0	0	9	0	1	4	2	13	6	4	1	37
	Hit Object	4	0	15	5	1	4	0	2	10	9	1	5	50
	Sideswipe	2	0	1	1	0	1	0	0	0	1	0	0	6
Time of Day	Evening Peak (3PM-7PM)	5	0	6	12	1	2	1	1	13	17	4	2	58
	Morning Peak (6AM-10AM)	0	0	2	3	0	1	0	0	1	2	0	0	9
	Midday (10AM-3PM)	1	0	4	2	1	2	3	1	10	13	1	1	37
	Overnight (7PM-6AM)	3	0	6	4	0	4	2	2	15	8	4	3	44
	Unknown	1	0	0	0	0	0	0	0	1	1	0	1	3
Movement Preceding Collision by Party at Fault	Proceeding Straight	2	0	3	4	0	3	2	1	14	12	2	3	41
	Ran Off Road	6	0	11	6	1	4	1	0	6	7	1	2	42
	Making Left Turn	0	0	0	0	0	0	0	0	7	12	3	1	19
	Entering Traffic	0	0	0	0	1	1	0	0	1	1	2	0	4
	Other Unsafe Turning	0	0	2	7	0	1	0	2	5	4	1	1	21
	Crossed Into Opposing Lane	0	0	1	1	0	0	0	0	2	0	0	0	4
Total		10	0	18	21	2	9	6	4	40	41	9	7	

	Roadway Type							Location Type		
	Speed Limit							Signal	Unsignalized Intersection	
	25 MPH	30 MPH	35 MPH	40 MPH	45 MPH	50 MPH	55 MPH		Local-Local	Local-Highway
Share of Roadway/Intersections	30%	1%	7%	59%	0%	1%	2%	1%	91%	8%
Share of KSI Collisions	15%	0%	27%	32%	3%	14%	9%	5%	47%	48%
Collisions per Mile	0.02	0.00	0.04	0.04	0.00	0.02	0.01			

Motorcycle Collisions		Roadway Type							Location Type					
		Speed Limit							Signal	Unsignalized Intersection		Near School	Near Park	Total
		25 MPH	30 MPH	35 MPH	40 MPH	45 MPH	50 MPH	55 MPH		Local-Local	Local-Highway			
Violation Category	Vehicle Right of Way Violation	0	0	0	0	0	0	0	1	12	5	2	1	18
	Wrong Side of Road	0	0	0	1	0	0	0	0	5	1	0	0	7
	Driving or Bicycling Under the Influence of Alcohol or Drug	2	0	2	8	0	0	1	1	7	1	2	0	22
	Unsafe Speed	1	0	3	3	0	1	1	3	9	5	2	3	26
	Improper Turning	2	0	7	8	0	0	3	1	11	6	1	0	38
	Other Than Driver (or Pedestrian)	0	0	1	2	0	0	1	0	4	1	0	0	9
	Following Too Closely	0	0	0	0	0	0	0	1	0	0	0	0	1
	Traffic Signals and Signs	0	0	0	0	0	0	0	1	0	0	0	0	1
	Unsafe Starting or Backing	0	0	0	0	0	0	0	2	0	0	0	2	2
Collision Type	Broadside	0	0	0	0	0	0	1	1	9	3	3	1	14
	Rear End	0	0	0	1	0	1	1	3	3	2	0	1	11
	Head-on	0	0	0	2	0	0	0	0	4	1	0	0	7
	Overturned	4	0	6	15	0	0	4	5	23	9	5	3	66
	Hit Object	2	0	5	4	0	0	0	1	5	1	0	1	18
	Sideswipe	1	0	1	1	0	0	1	0	3	3	0	0	10
Time of Day	Evening Peak (3PM-7PM)	3	0	4	10	0	0	0	3	18	5	2	4	43
	Morning Peak (6AM-10AM)	0	0	2	2	0	0	0	0	5	0	0	0	9
	Midday (10AM-3PM)	3	0	5	7	0	1	6	5	15	12	2	1	54
	Overnight (7PM-6AM)	1	0	2	4	0	0	2	2	11	3	4	1	25
	Unknown	0	0	0	0	0	0	0	0	1	0	0	0	1
Movement Preceding Collision by Party at Fault	Proceeding Straight	1	0	3	7	0	1	3	5	16	7	2	4	43
	Ran Off Road	5	0	5	4	0	0	2	1	1	1	0	1	19
	Making Left Turn	0	0	0	0	0	0	0	1	15	4	4	1	20
	Entering Traffic	0	0	0	0	0	0	0	0	2	2	1	0	4
	Other Unsafe Turning	0	0	4	6	0	0	0	1	4	1	1	0	16
	Crossed Into Opposing Lane	0	0	0	1	0	0	0	0	2	0	0	0	3
Total		7	0	13	23	0	1	8	10	50	20	8	6	

	Roadway Type							Location Type		
	Speed Limit							Signal	Unsignalized Intersection	
	25 MPH	30 MPH	35 MPH	40 MPH	45 MPH	50 MPH	50 MPH		Local-Local	Local-Highway
Share of Roadway/Intersections	30%	1%	7%	59%	0%	1%	2%	1%	91%	8%
Share of Motorcycle Collisions	13%	0%	25%	44%	0%	2%	15%	13%	63%	25%
Collisions per Mile	0.01	0.00	0.03	0.05	0.00	0.00	0.02			