Attachment A

City of Calabasas
Local Roadway Safety Plan (LRSP)

APRIL 2022

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1.0 EXECUTIVE SUMMARY

The California Department of Transportation (Caltrans) established a program for cities to prepare a Local Roadway Safety Plan (LRSP) to identify safety needs and recommend projects to address these needs. This document serves as the LRSP for the City of Calabasas.

Overview

An LRSP analyzes crash data, assesses infrastructure deficiencies through an inventory of roadway system elements, and identifies roadway safety solutions on a citywide basis. The State created the LRSP to help local agencies develop safety projects that can be submitted for funding by the Highway Safety Improvement Program (HSIP). HSIP Cycle 11, expected around April 2022, and subsequent cycles will require an LRSP or equivalent plans such as a Vision Zero Plan or System Safety Analysis Report.

This report has been prepared per Caltrans LRSP guidelines and the *Caltrans Local Roadway Safety Manual* (LRSM) version 1.5 dated June 2020. The general content of this LRSP report follows this outline:

- Crash data source and analysis techniques
- Crash data analysis results and highest occurring crash types
- High-risk corridor and intersection analysis and safety countermeasures
- Cost estimates of recommended improvements
- Prioritization of projects based on cost-benefit ratio and effectiveness of safety improvement
- Strategies for safety project implementation
- Traffic safety enforcement size analysis based on Office of Traffic Safety (OTS) data

The LRSP fulfills the following purposes:

- Identify the highest occurring crash types and the roadway characteristics contributing to the crashes.
- Identify high-risk corridors and intersections.
- Propose safety countermeasures to address the safety issues.
- Prioritize safety improvement projects based on benefit/cost ratio and other considerations.

Prominent Crash Pattern

Six years of crash records were utilized from January 2015 to December 2020, adhering to the maximum period permitted by the HSIP for a safety infrastructure project application for federal funding. The crashes were categorized by severity, crash type, Primary Crash Factor (PCF), involved parties, lighting conditions, and facility type (signalized intersections, non-signalized intersections, and mid-block locations). A total of 797 crashes were recorded from 2015 to 2020. The following summarizes the crash patterns within the City:

- Most common crash types were rear end, sideswipe, and broadside.
- Unsafe speed- related crashes accounted for approximately twenty percent of total crashes, one percent of severe injury crashes, and sixty-one percent of property damage crashes.
- Rear-end crash related to unsafe speeding is one of the prominent crash patterns.

Safety Measures

The following transportation safety emphasis areas were identified based on the crash data analysis:

- Improper Turning, Hit Object, and Sideswipe Crashes
- Pedestrians
- Signalized Intersections
- Speeding and Rear End Crashes

The LRSP recommends engineering countermeasures derived based on discussions with the Public Works Department and the Traffic and Transportation Commission to identify emphasis areas, and crash patterns. The following recommended countermeasures and non-infrastructure programs can be considered to address safety and speeding concerns in Calabasas:

- Traffic signal infrastructure improvements along Parkway Calabasas, Calabasas Road, and Las Virgenes Road, to enhance safety, including retroreflective back plates for signal indications, addition of secondary signal indications, protected left turn phasing, and striping changes.

- Currently, the City has an Emergency Vehicle Preemption (EVP) system installed at the intersection of Calabasas Road and Parkway Calabasas serving the adjacent LA County Fire Station Number 68. Signal preemption allows emergency vehicles to interrupt a normal signal cycle in order to proceed through the intersection more quickly and under safer conditions while reducing emergency response times. As a systemic safety improvement the City should consider installing EVP systems along signalized corridors along Las Virgenes Road, Calabasas Road, Parkway Calabasas, Lost Hills road, Old Topanga/Valmar Road and Mulholland Highway.

- Intersections and traffic signals have become more complex, and it can be challenging for pedestrians with hearing and visual impairments, younger and older in age, and along high speed corridors to cross intersections. A systemic safety improvement, the City should consider installing pedestrian countdown signal heads with Accessible Pedestrian Signal (APS). APS is a pedestrian push button that communicates when to cross the street in a non-visual manner, such as audible tones, speech messages, and vibrating surfaces. The City should also consider leading pedestrian intervals (LPI) at a few locations such as Calabasas Road and Park Granada where there is a higher level of pedestrian activity and conflicting turning movements. LPI allows pedestrians to begin the walk cycle earlier than vehicles receive a green indication so they can enter the crosswalk and be more visible to traffic.

- Advance dilemma zone detection may address the frequency of red-light violations, reducing the frequency of crashes associated with the traffic signal phase change. Based on the traffic signal plan, improvements were not implemented at the advance loops. Consider installing advanced dilemma zone detection at the following intersections in the City where red light running appears to be prevalent:
  a) Parkway Calabasas and Calabasas Road
  b) Lost Hills Road and Agoura Road

  The selected intersections are part of a systemic improvement.

- Deploying additional speed display signs on roadway segments that have a history of unsafe speed crashes can help minimize these trends from occurring. By keeping drivers aware of their speed, it can reduce overall speeding down corridors, resulting in fewer unsafe speed crashes.

- In addition to the infrastructure improvements mentioned above, non-engineering safety measures address traffic safety concerns through education, encouragement, and enforcement. List the non-infrastructure programs that are being recommended such as suggested route to school program, high school vehicle safety education, enhanced speed enforcement, DUI checkpoints, etc.
  Several state and federal grant programs offer funds for non-engineering roadway safety projects, as shown below:
  a) Advanced Transportation and Congestion Management Technologies Deployment Program
  b) Active Transportation Program
  c) Sustainable Communities Grant Program
  d) Office of Traffic Safety Grants

2.0 INTRODUCTION

The City of Calabasas has retained KOA Corporation (KOA) to develop a Local Roadway Safety Plan (LRSP). Traditionally, agencies have selected safety projects based on historical crash records, focusing on sites with a concentration of recent severe crashes. By contrast, the LRSP shares a similar framework with the California Statewide Strategic Highway Safety Plan (SHSP), which focuses on engineering and non-engineering solutions to roadway safety issues. The LRSP identifies the most common crash categories across a roadway network to target projects that address the factors associated with those categories. The LRSP allows agencies to assess risks before a crash by focusing on causal factors rather than crashes. Systemic improvements target broader geography than the traditional spot location improvements. The systemic project selection favors the broad implementation of cost-effective countermeasures.

2.1 FOUR E'S OF SAFETY

The LRSP not only focuses on engineering improvements to mitigate crashes. The LRSP also addresses the other safety improvements in other areas such as enforcement, education, and emergency services. According to the SHSP 2020-2024, two-thirds of all crashes are the result of aggressive driving. Male drivers are more likely to be at fault in aggressive driving-related crashes regardless of age. Making roadways safer requires the Four E's (Engineering, Enforcement, Education, and Emergency Services). Working together with the Four E's at the city level will help make city roads safer. Recently, Federal and State agencies have also considered Emerging Technologies and Equity as additional E's to improve traffic safety. For instance, considering the use of emerging technologies such as smarter traffic signal equipment can improve traffic safety.

2.2 PURPOSE OF THE LRSP

The LRSP systematically identifies and analyzes safety problems and recommends safety improvements. Preparing the LRSP facilitates collaboration by developing partnerships between Calabasas and stakeholders, which includes the Los Angeles County Sheriff's Department and the Los Angeles County Fire Department. The results of the LRSP are summarized with a prioritized list of improvements and actions. The LRSP offers a proactive approach to addressing roadway safety needs in Calabasas.

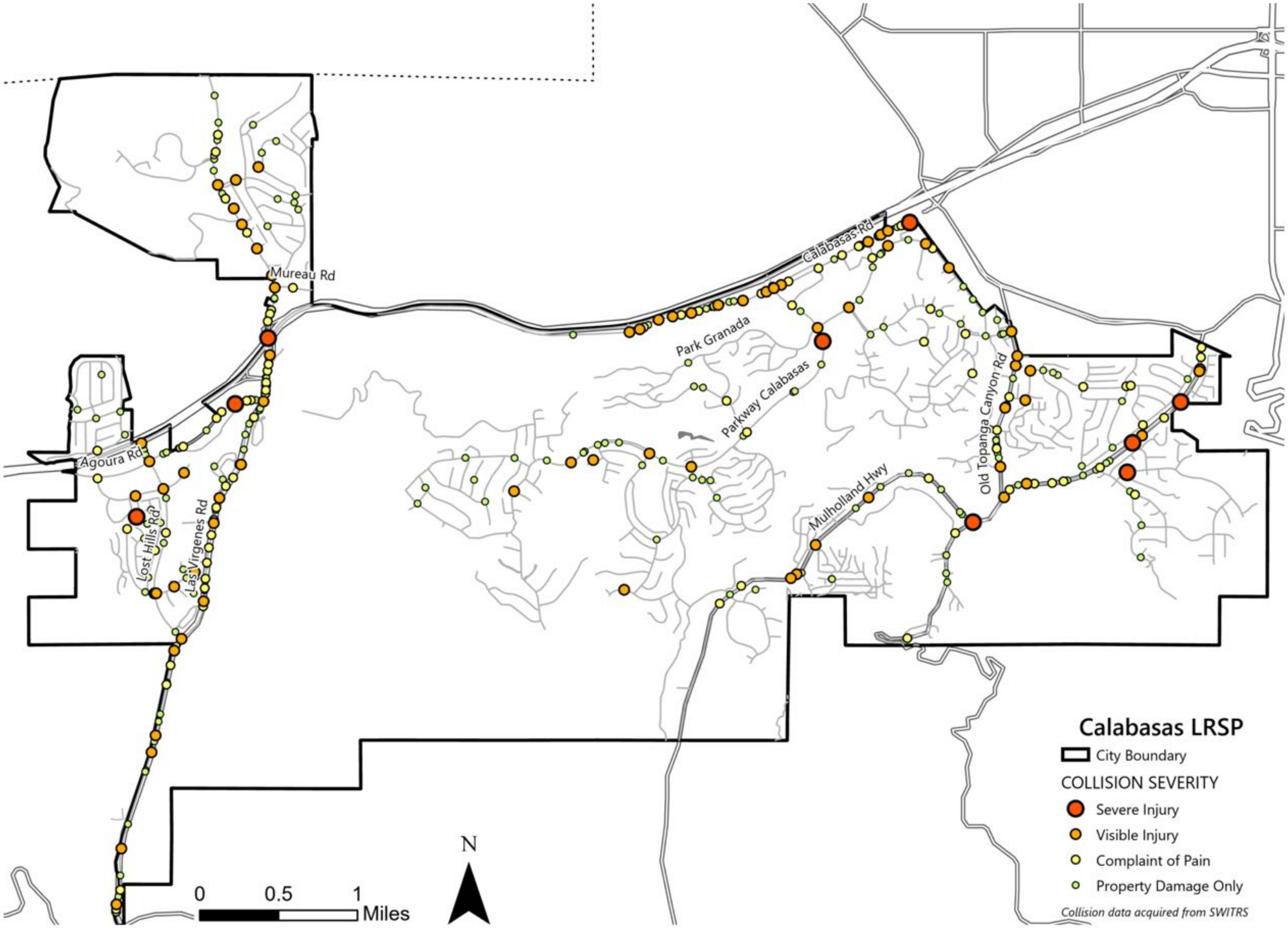
2.3 CITY OF CALABASAS

Calabasas is a city in western Los Angeles County. According to the 2010 census, the Calabasas had a population of 23,058 the US Census estimated the 2020 population at 23,241[1].

Based on the Statewide Integrated Traffic Records System (SWITRS) database, between January 2015 and December 2020 there were 797 crashes in Calabasas, of which 9 crashes resulted in severe injuries. **Figure 2.1** illustrates a map of the crashes citywide.

[1] *Source: United States Census Bureau*

Figure 2.1 Calabasas Citywide Crash Severity Map (2015-2020)



2.4 LRSP OVERVIEW

The LRSP project includes six primary tasks. The following sections include a brief description of the tasks associated with this project, with a more detailed description of each task in subsequent sections of this document.

2.4.1 DATA COLLECTION

A comprehensive Geographic Information Systems (GIS) project database was developed by utilizing the following data, which was provided by Calabasas:

- Six-years (1/1/2015 to 12/31/2020) of crash data collected via the SWITRS crash database
- Location of signalized intersections

2.4.2 SAFETY DATA ANALYSIS

Following the development of the comprehensive GIS project database, the crash data was analyzed for Calabasas. Crashes were compared to the safety emphasis areas as defined in the California SHSP. The safety data analysis is summarized in Section 4 of this document. The transportation emphasis areas are identified based on the crash data analysis and are discussed in Section 5 of this document.

2.4.3 IDENTIFY SAFETY MEASURES

In coordination with city staff, a list of engineering-related safety countermeasures and non-engineering safety measures were developed for use as recommendations in this LRSP. These countermeasures are discussed in Section 6 and Section 7 of this document.

2.4.4 DEVELOP SAFETY PROJECTS AND COST ESTIMATES

Roadways and intersections were ranked based on EPDO (Eqivalent Property Damage Only), and the crash frequency. The top 11 locations of interest will be investigated for further evaluation and potential safety improvements. The improvements include signal hardware improvement, additional warning signage, and bikeway-related features. Planning-level cost estimations are provided for each safety project. The list of safety projects are prioritized based on the following considerations:

- Benefit/Cost Ratio (for engineering solutions only)
- Funding availability for engineering and non-engineering programs
- Other factors recommended by city staff

The safety projects and cost estimates are discussed in Section 8 of this document.

3.0 METHODOLOGY

3.1 CRASH DATA SOURCES

The crash data drew from SWITRS. The crash trend data was derived between 2015 and 2020 from the California Highway Patrol's Statewide Integrated Traffic Records System (SWITRS) database. SWITRS is a database that collects and processess data gathered from a crash scene.

3.1.1 SWITRS

The California Highway Patrol's SWITRS database contains data on statewide crashes. The SWITRS application provides geographically- and temporally-targeted crash reports in an electronic format. KOA used SWITRS to evaluate data on Calabasas crashes between 2015 and 2020, both in aggregate and classified by control type (signalized, non-signalized, and midblock locations).

3.1.2 TIMS

The TIMS database contains geocoded crashes included in the SWITRS database. TIMS geocodes SWITRS crashes that involve either an injury or fatality (i.e., excluding property damage-only crashes). Thus, TIMS provides local agencies with an efficient and straightforward tool to conduct geographic analysis. KOA utilized TIMS data from 2015 to 2020 to compare Calabasas with Los Angeles County at-large to identify prominent transportation safety issues in the City.

3.2 IDENTIFYING LOCATIONS FOR ENGINEERING COUNTERMEASURES

Crash data analysis for this LRSP was conducted using crash data from the SWITRS crash database. The crash records include a variety of information about each crash, including the location, date, time of the day, crash type, crash severity, primary violation category, transportation mode of the involved parties, and movement of the involved parties prior to the crash. Per California state law, motor vehicle crashes must be reported when vehicle or property damage exceeds $1,000 or when any of the parties suffer an injury or fatality. Crashes with no injured parties or minor property damage might not be reported and, therefore, are not included in the crash database.

Caltrans' *Local Roadway Safety, A Manual for California's Local Road Owners*, Version 1.5, April 2020 (LRSM) encourages a pro-active rather than reactive approach to safety issue identification. Traditionally, agencies using a reactive approach have located and implemented safety projects solely based on recent crashes, specific crash concentrations, or safety issues raised by stakeholders. A pro-active approach is preferred, according to the LRSM, because with traditional methods, "crash concentrations and crash trends may be missed if local agencies rely exclusively on these identifiers for their roadway safety effort." A proactive approach would identify safety improvements by analyzing the safety of the entire roadway network. For this document, the process for identifying candidate locations for safety improvements considers any one of the following three factors:

- An extensive crash history at high-crash frequency locations provides insight into which roadway characteristics are associated with certain types of crashes
- Professional engineering judgment regarding the availability of feasible engineering countermeasures to fix the safety issues

- Applicability of the engineering countermeasures at other locations with roadway characteristics associated with similar types of crashes regardless of their crash history.

The LRSM guidelines require analyzing at least three to five years of the most recent crash data. Six years-worth of crash data from January 2015 to December 2020 was reviewed for the Calabasas LRSP. Six years of crash data usage adheres to the maximum threshold permitted by the Highway Safety Improvement Program (HSIP) for a safety infrastructure project application for federal funding.

3.2.1 RANKING FUNCTION

A candidate intersection or roadway segment for safety improvements does not necessarily need to demonstrate a history of high or severe crashes to be considered for further evaluation. However, locations with high numbers of crashes are often good starting points for safety analysis due to the rich information provided by the crash history. EPDO ranking methods were utilized to identify high crash frequency intersections and roadway segments.

3.2.2 AVERAGE CRASH FREQUENCY

Average Crash Frequency is the most basic method for assessing crash incidence. The analysis tallies the numbers of crashes at each location in the roadway network, both in aggregate and by a category of interest (e.g. level of severity, crash type, and others). The analysis then ranks intersections or roadway segments based on the crashes' frequency.

3.2.3 CRASH RATE

The Crash Rate method goes a step beyond average crash frequency, normalizing facilities' crash frequency by the amount of vehicle traffic or travel. This method divides the number of crashes (or crashes in a particular category) by the quantity of Million Entering Vehicles (for intersections) or 100 Million Vehicle Miles Traveled (for roadway segments). While the Crash Rate method accounts for differences in facilities' length and traffic volume, it may instead unduly favor low-volume and low-crash roadways where countermeasures produce the lowest net benefit for travelers.

3.2.4 EPDO SCORES

Equivalent Property Damage Only (EPDO) scores assign weighting factors to crashes by severity relative to property damage only (PDO) crashes. The weight generally reflects an order of magnitude difference between the cost of fatal/severe injury crashes and non-severe injury crashes. The weights by crash severity come from the 2020 Local Roadway Safety Manual.

- Fatal and Severe Injury at signalized intersections – $1,590,000
- Fatal and Severe Injury at non-signalized intersections – $2,530,000
- Fatal and Severe Injury at Roadway – $2,190,000
- Other Visible Injury – $142,300
- Compliant of Pain – $80,900
- PDO – $13,300

EPDO scores are useful for a benefit-to-cost analysis as crash costs can be translated into measurable benefits from installing improvements that reduce the crashes in question. However, EPDO scores may place undue weight on the injury outcomes of previous crashes rather than overall trends suggested by crash patterns regardless of injury outcome. Furthermore, a location's EPDO score could be inflated by a fatal or severe crash caused by DUI.

3.3 STAKEHOLDER OUTREACH

In addition to using analytical methods to identify locations for treatments and make recommendations, the LRSP also focuses on partnerships with the public agency and community to offer input into this process and provide feedback on areas that the LRSP should focus on. Stakeholders are contacted after completing the crash analysis but before emphasis areas and specific infrastructure improvements or programs are finalized. Stakeholders are asked to provide feedback about traffic safety issues they have observed through their work and possible approaches to resolving these issues. For the Calabasas LRSP, input and feedback was provided by Public Works staff and A.C. Stelle Middle School via on-site/in-field surveys, as well as the Traffic & Transportation Commission via two (2) public virtual meetings.

3.4 PROPOSING ENGINEERING COUNTERMEASURES

After ranking the intersections and roadway segments, and evaluating comments received through public stakeholder outreach, the following steps were used to propose engineering countermeasures:

- Make citywide crash maps for dominant crash types such as rear-end crashes, broadside crashes, bicycle and pedestrian crashes, and crashes due to unsafe speed. Identify high-risk locations by crash type.
- Review crash details (party involved, movement before the crash, primary crash factor, violation code, time of the day, and others) at high-risk locations. Obtain detailed police reports from the City and reviewed for all the fatal and severe injury crashes.
- Manually create crash diagrams for high-risk locations. Review field conditions through physical site visits in the City. Assess the nature of prevalent crash types with respect to the intersection's control type, geometrical features, and signal phasing/timing.
- Review current conditions and recent historical conditions via Google Map Street View, whenever necessary, to check whether any geometry, signal, or signage changes have been made in the past few years.
- Evaluate and screen countermeasures from the LRSM or Crash Modification Factor (CMF) Clearinghouse (http://www.cmfclearinghouse.org/), a searchable database that can be easily queried to identify CMFs and Crash Reduction Factors (CRFs).
- Identify intersections/roadway segments that do not have a demonstrated crash history but resemble other locations with documented crash history and risk factors or were identified through public outreach. Once identified, these locations can also be analyzed through the steps mentioned above.

3.5 PROPOSING NON-INFRASTRUCTURE SAFETY MEASURES

Following similar steps in proposing engineering countermeasures, the crash maps and diagrams were used to determine certain driving behavior needing to be corrected. Non-infrastructure safety measures were developed through education, encouragement, and enforcement.

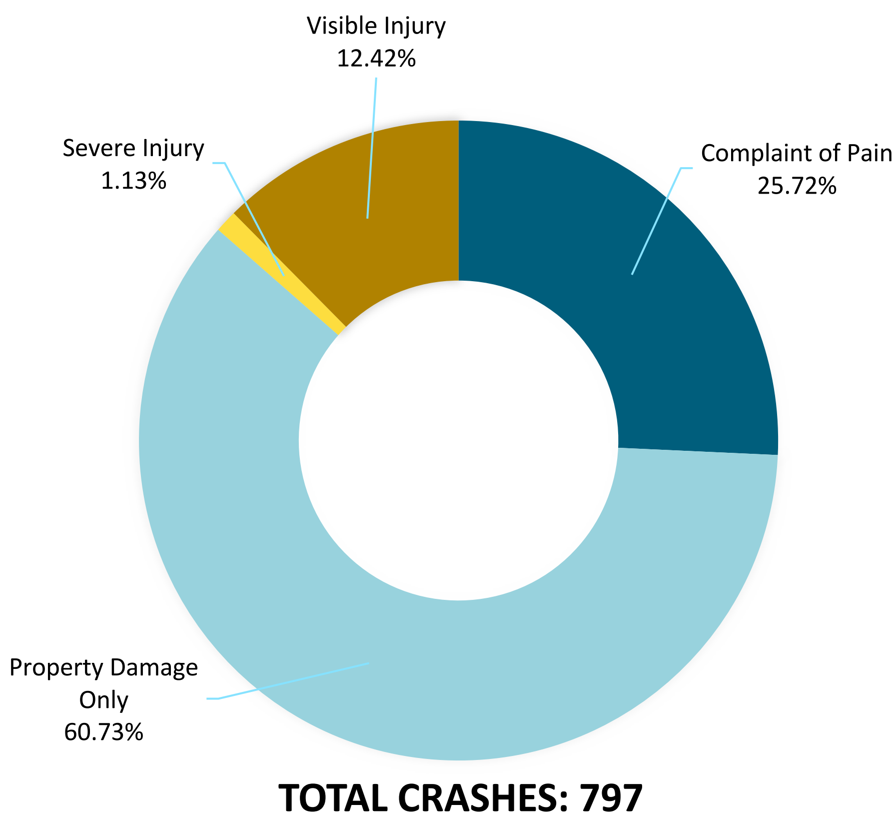
4.0 SYSTEMIC SAFETY ANALYSIS – CRASH TREND AND PATTERNS

4.1 TOTAL CRASHES AND KSI CRASHES

The crash trend analysis draws from the six years of data obtained from the SWITRS database. From 2015 to 2020, a total of 797 crashes occurred on Calabasas's roadways. Nine crashes resulted in fatal or severe injuries (KSI), as shown in **Figure 4.1**. **Figure 4.2** shows that the annual number of crashes increased substantially, from around 113 to 179 crashes between 2015 and 2017. Crashes decreased slightly, from 179 to 124 crashes between 2017 and 2019, and experienced a sharp drop to 96 crashes between 2019 and 2020.

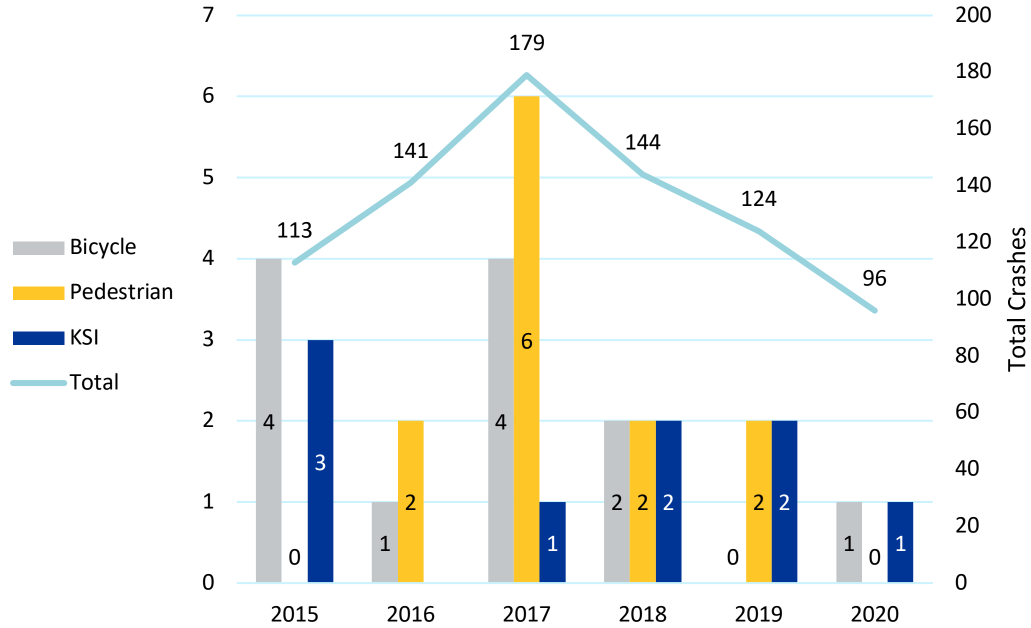
In contrast, bicycle and pedestrian crashes display an upward trend across the six years of data, as shown in Figure 4.2. The annual number of bicycle crashes decreased from four in 2015 to one in 2020, while the annual number of pedestrian crashes remain same through 2015 to 2020. The number of KSI crashes decreases from three crashes in 2015 to one crash in 2020.

Figure 4.1 Crash Severity



Source: SWITRS, 2015-2020

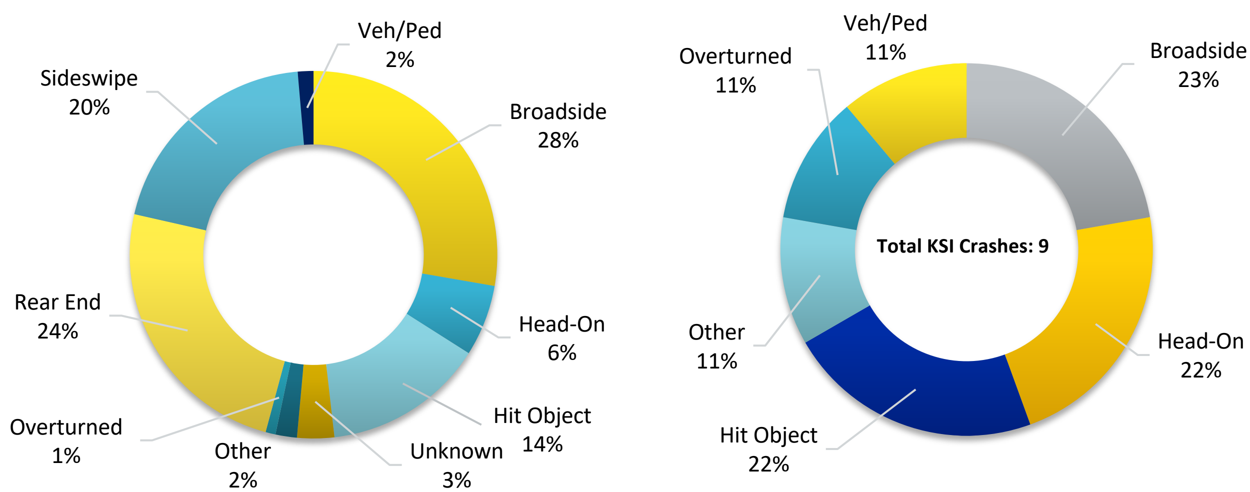
Figure 4.2 Total Crashes by Year



Source: SWITRS, 2015-2020

Figure 4.3 breaks down the total and KSI crashes by crash type. Broadside accounted for the largest category, comprising 28 percent of total crashes Rear End (24 percent of total) and Sideswipe (20 percent of total) made up the second- and third-largest crash categories. Among the KSI crashes, Broadside (23 percent), Head-On (22 percent), Hit Object (22 percent), and Vehicle-Pedestrian (11 percent) crashes were the four most-frequently-occurring categories. Overall, the data attest to the high frequency of rear-end, sideswipe, and broadside crashes in Calabasas.

Figure 4.3 Crashes by Type, Total Crashes vs. KSI Crashes

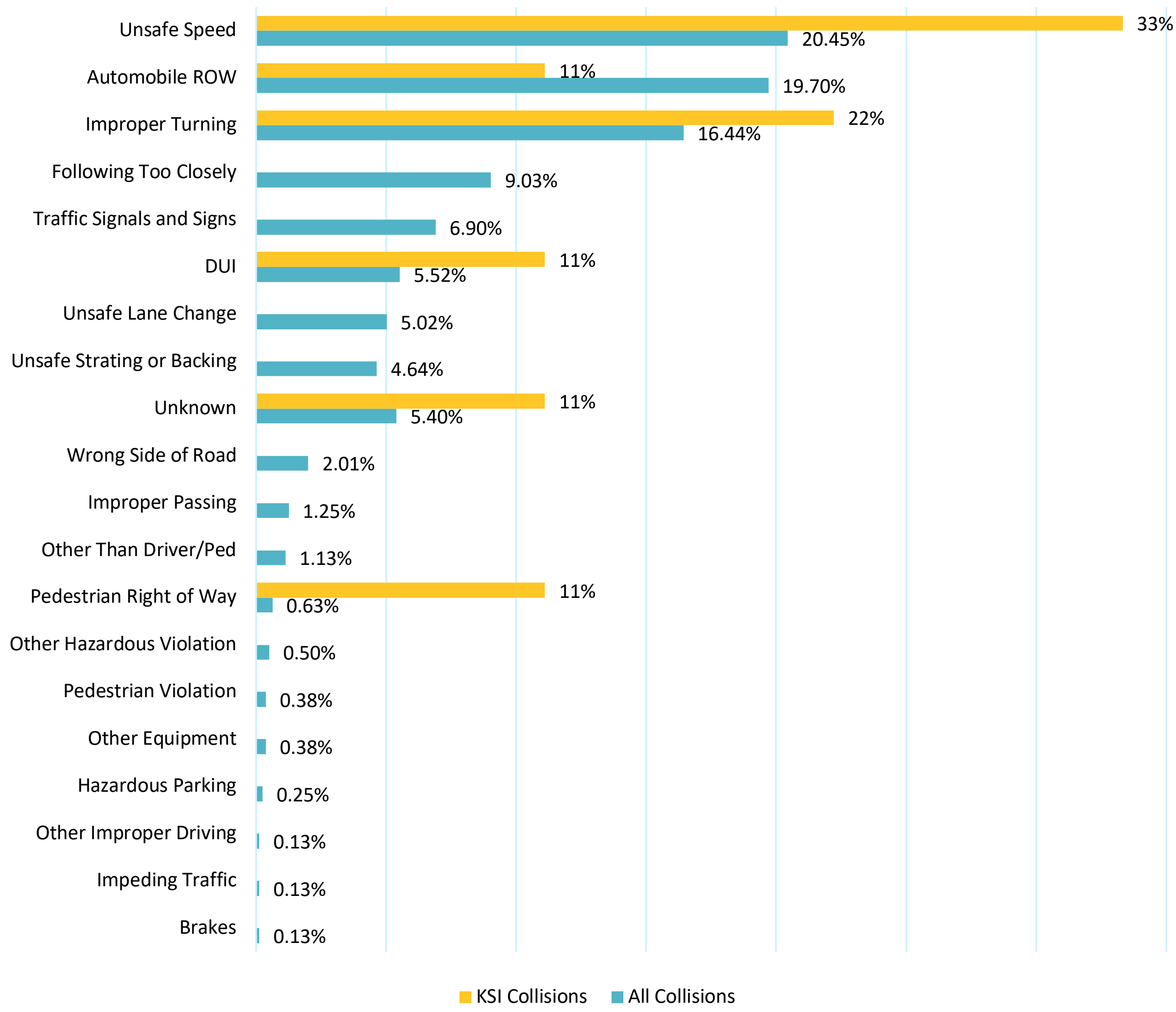


Source: SWITRS, 2015-2020

Figure 4.4 summarizes the Primary Crash Factor (PCF) for all the crashes in the past five years. PCF is the leading cause of a crash based on the opinion of the police officer who conducted the investigation.

Among the total set of crashes, unsafe speed (20.45%), automobile right of way (19.7%), and improper turning (16.44%) were the top three PCFs. For KSI crashes, the top four PCF categories were unsafe speed (33%), improper turning (22%), automobile right-of-way (11%), and driving or bike under influence (11%). The other improper driving and pedestrian violation PCFs occurred more frequently among KSI crashes than among total crashes. The latter instance of over-representation reflects the prevalence of vehicle-pedestrian crashes among severe injury crashes.

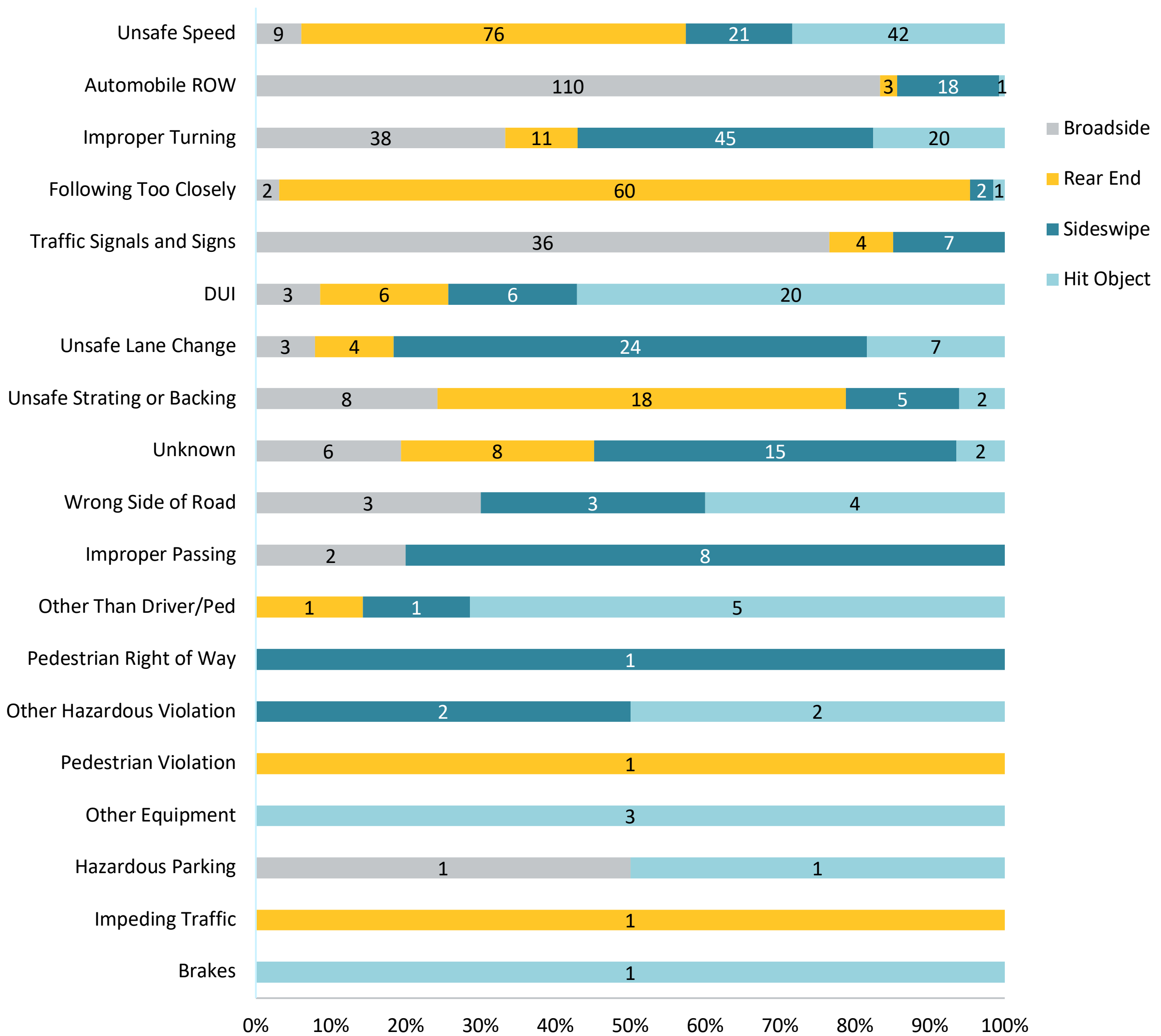
Figure 4.4 Crashes by Primary Crash Factor (PCF), Total Crashes vs. KSI Crashes



Source: SWITRS, 2015-2020

Figure 4.5 illustrates how the most-frequently-occurring PCFs correlate with the four largest crash types. PCF of unsafe speed and following too closely was mostly associated with rear-end crashes. Rear-end crashes often result from a motorist traveling so fast to be unable to decelerate swiftly or not maintain a proper distance from the vehicle ahead of them. Improper turning, unsafe lane changes, and unsafe speed were most frequently associated with sideswipe crashes. Automobile right-of-way, traffic signal and signs, and improper turning were the three most common PCFs for broadside crashes. And unsafe speed, improper turning, and DUI PCFs were responsible for the significant number of hit object crashes (although hit object crashes only comprised a range of crashes in the DUI category). Rear-end and broadside crashes were the second-most-common crash types associated with unsafe speed and automobile right-of-way violations, respectively.

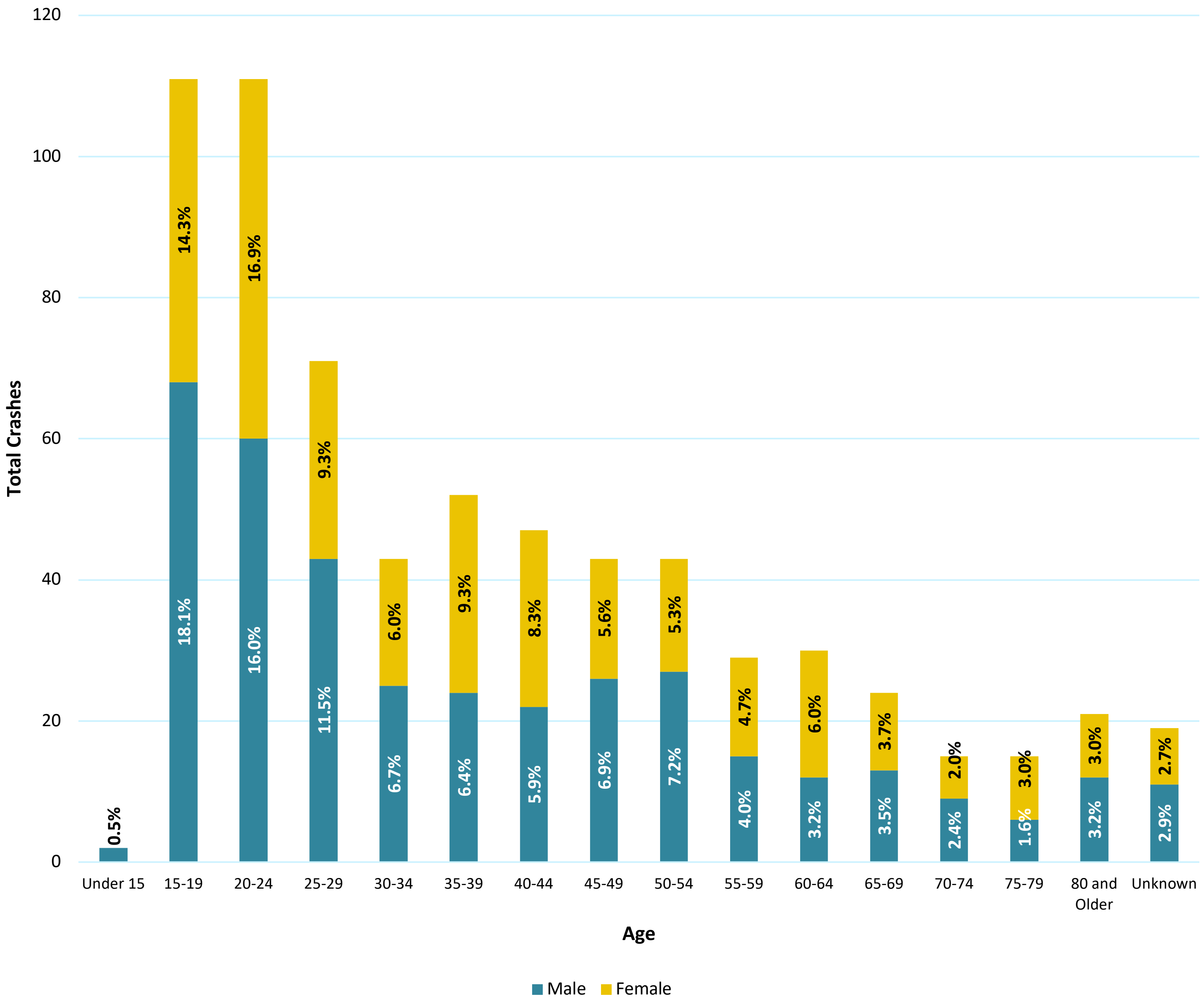
Figure 4.5 Primary Crash Factor vs. Top 4 Crash Types



Source: SWITRS, 2015-2020

At-fault drivers in crashes in Calabasas tended to be young males, as shown in **Figure 4.6**. Nearly 33 percent of drivers were 20-24 and nearly 66 percent of drivers between the ages of 15 and 24. Section 7.2.1 discusses potential education programs directed at this demographic. This age range accounts for the largest share of at-fault motorists, with the number of at-fault motorists decreasing as the age groups grow older. In most age groups, men accounted for more of the at-fault motorists.

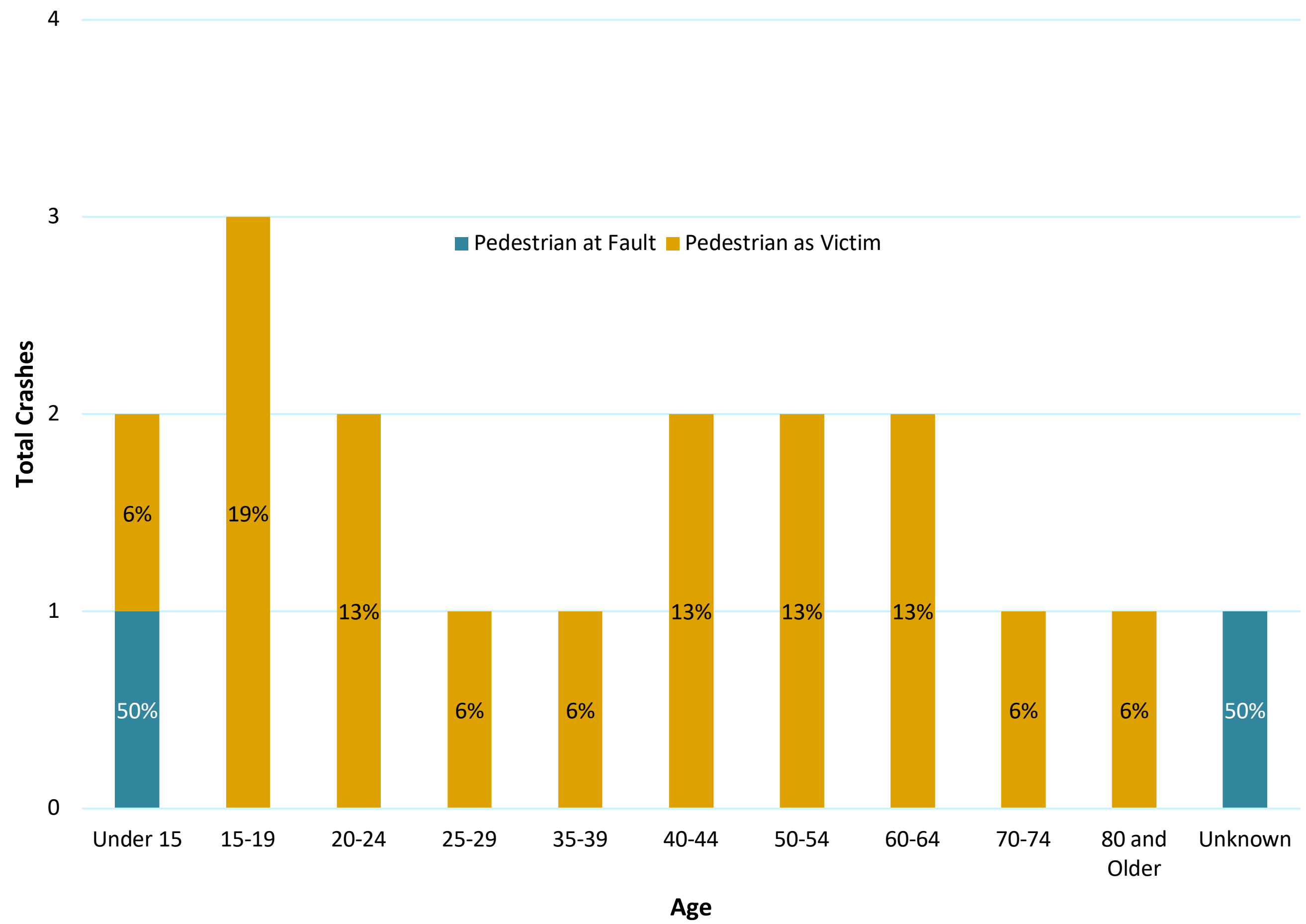
Figure 4.6 At-Fault Parties by Age and Gender



Source: SWITRS, 2015-2020

KOA also analyzed the age and at-fault status of pedestrian parties in pedestrian crashes. **Figure 4.7** shows that while pedestrian parties were somewhat evenly distributed across age groups. All but one party under 15 years old were deemed as a victim. Although the single crash identified at fault in the youngest group may be statistically insignificant the City should continue to monitor this data trend. A lack of familiarity with pedestrian safety laws and practices in younger pedestrian and/or inadequate crossing accommodations may contribute to inconsistent crossing behavior.

Figure 4.7 Pedestrian Crashes At-Fault vs. As Victim



Source: SWITRS, 2015-2020

4.2 CRASHES BY FACILITY TYPE

Crash patterns were analyzed by facility type (intersections vs. mid-block locations) using the most recent six years of crash data (2015 to 2020). This analysis allowed for the determination of the effect of access control and intersection geometry on crash frequency. The analysis classifies crashes by facility type as follows:

- Crashes that occurred within 250 feet of signalized intersections are considered signalized intersection crashes;
- Crashes that occurred within 150 feet of non-signalized intersections are considered non-signalized intersection crashes;
- Crashes that occur more than 250 feet away from any signalized intersection and more than 150 feet away from any non-signalized intersection are classified as mid-block crashes.

Table 4.1 shows the total number of crashes associated with each type of facility, 34 percent of all crashes took place at signalized intersections, 28 percent of all crashes took place at non-signalized intersections, and 36 percent of crashes took place at mid-block locations. Both bicycle and pedestrian crashes showed similar patterns, with most crashes occurring at midblock locations (67 percent for bicycle crashes and 58 percent for pedestrian crashes).

The majority of signalized intersections among crash locations reflect limited intersection density and driveway access on arterial roadways like Parkway Calabasas, Las Virgenes Road and Calabasas Road. These three roadways alone account for over 50 percent of all crashes in Calabasas.

Table 4.1 Crashes by Facility Type

Crash Grouping	Signalized Intersection		Non-Signalized Intersection		Midblock Locations		Grand Total	
	Crashes	%	Crashes	%	Crashes	%	Crashes	%
Total Number of Crashes	275	34.5%	229	28.7%	293	36.8%	797	100%
Bicycle Crashes	2	16.7%	2	16.7%	8	66.6%	12	100%
Pedestrian Crashes	2	16.7%	3	25%	7	58.3%	12	100%

Source: SWITRS, 2015-2020

Table 4.2 shows how the crash type varies by location. Broadside crashes comprise the largest share of crashes at signalized and non-signalized intersections locations (32 percent and 24 percent, respectively). Rear-end and Sideswipe crashes are the second- and third-most-common crash types (27 percent and 19 percent of the total) at signalized intersections.

Broadside crashes are the dominant category at non-signalized intersections (24 percent). Hit-object and Sideswipe crashes are the second- and third-most-common crash types (23 and 21 percent) at non-signalized intersections. Rear-end crashes comprised a substantially-larger share of crashes at midblock locations (29 percent). Vehicle-pedestrian related crashes that occurred at midblock locations accounted for 6 out of the 11 total vehicle-pedestrian crashes.

Table 4.2 Crash Types by Facility Type

	Signalized Intersections		Non-Signalized Intersections		Midblock		Grand Total	
Crash Type	Crashes	%	Crashes	%	Crashes	%	Crashes	%
Broadside	89	32.4%	56	24.5%	76	25.9%	221	27.7%
Head-On	23	8.4%	19	8.3%	8	2.7%	50	6.2%
Hit Object	22	8.0%	53	23.1%	38	13.0%	113	14.1%
Unknown	12	4.4%	4	1.7%	10	3.4%	26	3.2%
Other	1	0.4%	7	3.1%	7	2.4%	15	1.8%
Overturned	0	0.0%	3	1.3%	4	1.4%	7	0.87%
Rear End	74	26.9%	35	15.3%	85	29.0%	194	24.3%
Sideswipe	53	19.3%	48	21.0%	59	20.1%	160	20%
Vehicle/Ped	1	0.4%	4	1.7%	6	2.0%	11	1.38%
Total	275	100%	229	100%	293	100%	797	100%

Source: SWITRS, 2015-2020

Table 4.3 shows the relationship between street lighting conditions and facility type. More than 90 percent of crashes occurred in the presence of lighting (i.e. either in daylight or night-time with street-lighting) at all three location types. Only 2 percent of all crashes took place in the dark with no street lighting, with this figure ranging from 0.7 percent at signalized intersections to 2.4 percent at midblock locations.

Table 4.3 Street Lighting by Facility Type

Crash Type	Signalized Intersections		Non-Signalized Intersections		Midblock		Grand Total	
	Crashes	%	Crashes	%	Crashes	%	Crashes	%
Daylight	206	74.9%	153	66.8%	205	70.0%	564	70.8%
Dark - Street Lights	51	18.5%	62	27.1%	70	23.9%	183	23.0%
Dark - No Street Lights	2	0.7%	3	1.3%	7	2.4%	12	1.5%
Unknown	2	0.7%	3	1.3%	1	0.3%	6	0.8%
Dusk - Dawn	13	4.7%	8	3.5%	10	3.4%	31	3.9%
Dark - Street Lights Not Functioning	1	0.4%	0	0.0%	0	0.0%	1	0.1%
Total	275	100%	229	100%	293	100%	797	100%

Source: SWITRS, 2015-2020

Table 4.4 tabulates the PCFs by facility type. The three largest PCF categories included automobile right-of-way, improper turning, and unsafe speed at all three location types. The ranking order varied by location types:

- At signalized intersections, the leading PCFs were automobile right-of-way, unsafe speed and improper turning (comprising roughly 26 percent, 15 percent, and 14 percent of the total).

- At non-signalized intersections, unsafe speed, improper turning, and automobile right-of-way violations were the dominant PCFs (comprising 27 percent, 18 percent, and 14 percent of the total).
- At midblock locations, the most frequent PCFs were unsafe speed, automobile right-of-way, and improper turning violations were the dominant PCFs (comprising 20 percent, 18 percent, and 17 percent of the total).

Table 4.4 Primary Crash Factor by Facility Type

Crash Type	Signalized Intersections		Non-Signalized Intersections		Midblock		Grand Total	
	Crashes	%	Crashes	%	Crashes	%	Crashes	%
Brakes	1	0.4%	1	0.4%	0	0.0%	1	0.1%
Impeding Traffic	1	0.4%	0	0.0%	0	0.0%	1	0.1%
Other Improper Driving	0	0.0%	1	0.4%	0	0.0%	1	0.1%
Hazardous Parking	0	0.0%	0	0.0%	2	0.7%	2	0.3%
Other Equipment	1	0.4%	0	0.0%	2	0.7%	3	0.4%
Pedestrian Violation	0	0.0%	2	0.9%	1	0.3%	3	0.4%
Other Hazardous Violation	0	0.0%	3	1.3%	1	0.3%	4	0.5%
Pedestrian Right of Way	1	0.4%	2	0.9%	2	0.7%	5	0.6%
Other Than Driver/Ped	0	0.0%	3	1.3%	6	2.0%	9	1.1%
Improper Passing	3	1.1%	3	1.3%	4	1.4%	10	1.3%
Wrong Side of Road	0	0.0%	6	2.6%	10	3.4%	16	2.0%
Unknown	15	5.5%	12	5.2%	15	5.1%	46	4.6%
Unsafe Starting or Backing	13	4.7%	9	3.9%	15	5.1%	37	5.4%
Unsafe Lane Change	22	8.0%	11	4.8%	7	2.4%	40	5.0%
DUI	10	3.6%	15	6.6%	19	6.5%	44	5.5%
Traffic Signals and Signs	33	12.0%	15	6.6%	7	2.4%	55	6.9%
Following Too Closely	22	8.0%	10	4.4%	40	13.7%	72	9.0%
Improper Turning	**40**	**14.5%**	**41**	**17.9%**	**50**	**17.1%**	**131**	**16.4%**
Automobile ROW	**72**	**26.2%**	**32**	**14.0%**	**53**	**18.1%**	**157**	**19.7%**
Unsafe Speed	**41**	**14.9%**	**63**	**27.5%**	**59**	**20.1%**	**163**	**20.5%**
Total	275	100%	229	100%	293	100%	797	100%

Source: SWITRS, 2015-2020

As mentioned earlier, broadside crashes were the most-frequently-occurring crash type in Calabasas. Automobile right-of-way was the most-common PCF in the City and the leading cause of broadside crashes. Improper turning was the third-most common PCF and second-largest PCF associated with broadside crashes. Approximately 50 percent of broadside crashes from 2015 to 20120 resulted from automobile right-of-way, while roughly 17 percent of broadside crashes during this period were caused by improper turning.

Table 4.5 breaks down Broadside crashes caused by automobile right-of-way by facility type. **Table 4.6** breaks down broadside crashes caused by improper turning by facility type. The broadside crashes caused by automobile right-of-way ranged from 37 percent at non-signalized intersections to 57 percent at signalized intersections. Likewise, the percentage of broadside crashes caused by improper turning ranged from 21 at percent non-signalized intersections to 9 percent at signalized intersections.

The greater incidence of broadside crashes induced by automobile right-of-way- and improper turning at signalized intersections suggests that the poor singing and striping, and low signalized intersection density on the city's arterial roads lead many motorists to decelerate improper turning or mislead right-of-way as the approach to signalized intersections.

Table 4.5 Automobile Right-of-Way due to Broadside Crashes by Facility Type

Facility Type	Total Broadside Crashes	Broadside Crashes due to Automobile ROW	Percentage of Broadside Crashes due to Automobile ROW
Non-signalized intersections	56	21	37.5%
Midblock locations	76	38	50%
Signalized intersections	89	51	57.3%
Total	221	110	49.7%

Source: SWITRS, 2015-2020

Table 4.6 Improper Turning due to Broadside Crashes by Facility Type

Facility Type	Total broadside Crashes	Broadside Crashes due to Improper Turning	Percentage of Broadside Crashes due to Improper Turning
Non-signalized intersections	56	12	21.4%
Midblock locations	76	18	23.6%
Signalized intersections	89	8	9.0%
Total	221	38	17.2%

Source: SWITRS, 2015-2020

In Calabasas, broadside crashes are the most common crash type at non-signalized intersections. Crashes caused by automobile right-of-way, the second most-commonly-occurring PCF, are primarily associated with sideswipe and head-on crashes. **Table 4.7** shows the percentage of crashes with an automobile right-of-way PCF classified as head-on and sideswipe crashes. Approximately 10 percent (16 crashes) of automobile right-of-way crashes were head-on crashes, and 11 percent (18 crashes) were sideswipe crashes.

Most automobile right-of-way crashes associated with head-on occurred at signalized intersections. Also, most automobile right-of-way crashes are associated with sideswipes at mid-block locations. Likewise, signalized intersections had the most head-on crashes due to automobile right-of-way. However, sideswipe crashes comprised the highest percentage of automobile right-of-way crashes at non-signalized intersections.

Table 4.7 Automobile Right-of-Way with Head-On and Sideswipe Crashes by Facility Type

Facility Type	Automobile Right-of-Way Total Crashes	Head-On Crashes		Sideswipe Crashes	
		Crash	%	Crash	%
Non-Signalized Intersection	32	3	9.3%	5	15.6%
Midblock Locations	53	4	7.5%	7	13.2%
Signalized Intersection	72	9	12.5%	6	8.3%
Total	157	16	10.2%	18	11.4%

Source: SWITRS, 2015-2020

4.3 CALABASAS VS. LOS ANGELES COUNTY

Six years of TIMS data were used to compare the characteristics of injury and fatality crashes for the City of Calabasas with those for all of Los Angeles County. As shown in **Table 4.8**, from 2015 to 2020, Calabasas experienced 313 non-PDO crashes (excluding freeways). As the City had an estimated 23,241 residents in 2020, this amounted to 2,244 crashes per one million residents per year. A total of 305,653 crashes occurred in Los Angeles County during the same period, making for a significantly higher rate of 6,049 crashes per million residents per year. Thus, Calabasas had a lower normalized crash rate than the county average.

Relative to its population, the following statistics compare the results between Calabasas and LA County.

- **Fatal and severe (KSI) Crashes:** 1.2 percent vs. 6.1 percent,
- **Pedestrian Crashes:** 1.4 percent vs. 9.1 percent, and
- **Bicycle Crashes:** 1.5 percent vs. 6.1 percent.

Table 4.8 Total Crash Comparison, Calabasas vs. Los Angeles County

Total Crashes	City of Calabasas	Los Angeles County
Population (2020 estimates)	23,241	10,039,107
Total Crashes	313	305,653
Crash/1,000,000/Year	2,244	**6,049**
Fatal and Severe Crashes (KSI)	9	18,540
KSI %	*1.2%*	***6.1%***
Pedestrian Crashes	11	27,835
Pedestrian %	*1.4%*	***9.1%***
Bicycle Crashes	12	18,573
Bicycle %	*1.5%*	***6.1%***

Source: SWITRS, 2015-2020

Table 4.9 focuses on KSI crashes in Calabasas and Los Angeles County between 2015 and 2020 TIMS data. Calabasas had a substantially lower KSI crash per million residents per year than Los Angeles County (64 vs. 367). Among KSI crashes, Calabasas had 100 percentages of severe injury (100 percent versus 81.7 percent) crashes. Bicycle crashes comprised a smaller proportion of KSI crashes in Calabasas (3 percent versus 7.6 percent for the County), while pedestrian crashes comprised a substantially higher proportion (33.3 percent versus 27.1 percent for the County).

Table 4.9 KSI Crash Comparison, Calabasas vs. Los Angeles County

KSI Crashes	City of Calabasas	Los Angeles County
Population (2020 estimates)	23,241	10,039,107
Fatal and Severe Crashes (KSI)	9	18,540
KSI Crash/1,000,000/Year	64	**367**
Fatal	0	3,386
Fatal %	*0%*	***18.3%***
Severe Injury	9	15154
Severe Injury %	***100%***	*81.7%*
Pedestrian	11	5,020
Pedestrian %	***33.3%***	*27.1%*
Bicyclist	12	1401
Bicyclist %	*3.0%*	***7.6%***

Source: SWITRS/TIMS, 2015-2020

Table 4.10 breaks down the 2015-2020 TIMS data by crash type for Calabasas and Los Angeles County. In Calabasas broadside accounted for the highest proportion of crashes, followed by rear-end and sideswipe. Sideswipe crashes were over-represented in Calabasas relative to the County (36 percent versus 32 percent of crashes in the respective geographies). In comparison, broadside and hit object crashes were slightly under-represented (28 percent versus 29 percent in the County and 7 percent versus 7 percent in the County). Head-on and rear-end crashes comprised a more significant proportion of crashes in Calabasas (6 percent and 24 percent) than in Los Angeles County (7 percent and 32 percent).

Table 4.10 Crash Type Comparison, Calabasas vs. Los Angeles County

Type of Crash	City of Calabasas	Los Angeles County
Broadside	27.7%	**29.53%**
Head-On	6.3%	**7.19%**
Hit Object	**14.2%**	6.67%
Other	1.9%	**2.24%**
Overturned	0.9%	**1.64%**
Rear End	24.3%	**31.7%**
Sideswipe	**20.1%**	11.89%
Vehicle/Pedestrian	1.0%	**7.82%**
Unknown	**3.3%**	1.32%
Total %	**100.0%**	**100.0%**

Source: SWITRS, 2015-2020

Table 4.11 compares PCFs for the City and the County based on the 2015-2020 TIMS data. As with crash type, the ranking of PCF categories in Calabasas aligns with Los Angeles County. Unsafe speed, automobile right-of-way, and improper turning comprise the top three PCF categories in both geographies. Compared with the County, Calabasas had a substantially higher percentage of crashes (16 percent in Calabasas versus 11 percent in the County) caused by improper turning. In contrast, the county has a slightly higher share of automobile right-of-way and unsafe speed (19 percent and 20 percent in Calabasas and 20 percent and 29 percent in Los Angeles County).

Table 4.11 PCF Comparison, Calabasas vs. Los Angeles County

Primary Crash Factor	City of Calabasas	Los Angeles County
Automobile Right of Way	19.70%	**20.46%**
Brakes	**0.13%**	0.02%
Driving or Bicycling Under the Influence of Alcohol or Drug	**5.52%**	5.30%
Following Too Closely	**9.03%**	3.12%
Hazardous Parking	**0.25%**	0.06%
Impeding Traffic	**0.13%**	0.06%
Improper Passing	**1.25%**	0.68%
Improper Turning	**16.44%**	11.07%
Lights	-	0.01%
Other Equipment	**0.38%**	0.03%
Other Hazardous Violation	0.50%	**0.82%**
Other Improper Driving	0.13%	**0.46%**
Other Than Driver (or Pedestrian)	**1.13%**	1.08%
Pedestrian Right of Way	0.63%	**3.62%**
Pedestrian Violation	0.38%	**2.86%**
Traffic Signals and Signs	6.90%	**8.90%**
Unknown	**4.64%**	2.64%
Unsafe Lane Change	5.02%	**5.07%**
Unsafe Speed	20.45%	**29.03%**
Unsafe Starting or Backing	**4.64%**	1.80%
Wrong Side of Road	2.01%	**2.37%**
Total %	100.0%	100.0%

Source: SWITRS, 2015-2020

4.4 CALABASAS VS. CITIES OF SIMILAR SIZES

In the State of California's OTS Crash Ranking system, Calabasas falls under Group E. This group consists of 103 cities in the state of California with a population between 10,001 and 25,000. **Table 4.12** shows the City's 2019 crash ranking among the cities in Group E (1 being the highest or worst and 103 being the lowest or best). Overall, the City's traffic safety performance raises concern in three areas:

- 38 DUI arrests were issued in the City in 2019. This ranked 39th compared with the 103 cities
- The City of Calabasas ranked 7th out of 103 in injury-related motorcycle crashes (9 total), compared with the 103 cities
- Total Fatal and Injury ranked in the higher 1/3 of the 103 comparable cities.

Table 4.12 2019 OTS Ranking, Calabasas

Type of Crash	Victims Injured and/or Killed	OTS Ranking
Total Fatal and Injury	78	34/103
Alcohol Involved	7	44/103
Had Been Drinking Driver < 21	1	16/103
Had Been Drinking Driver 21 – 34	1	45/103
Motorcycles	9	**7/103**
Pedestrians	1	92/103
Pedestrians < 15	0	100/103
Pedestrians 65+	0	102/103
Bicyclists	0	100/103
Bicyclists < 15	0	101/103
Composite	22	49/103
Type of Crash	**Fatal and Injury Crashes**	**OTS Ranking**
Speed Related	8	49/103
Nighttime (9:00pm-2:59am)	3	69/103
Hit and Run	2	68/103
Type of Arrests	**Arrests**	**OTS Ranking**
DUI Arrests	38	39/103

Source: OTS, 2019

5.0 TRANSPORTATION SAFETY EMPHASIS AREAS

Transportation safety emphasis areas provide a strategic framework for developing and implementing the Local Roadway Safety Plan (LRSP). The emphasis areas show the City of Calabasas where to focus when developing projects and programs based on the LRSP. The implementation of the emphasis areas should directly relate to the goals, policies, and strategies of the LRSP. Based on the crash data analysis conducted for the City of Calabasas, the following transportation safety emphasis areas:

- Automobile right-of-way, Head On, and Sideswipe Crashes
- Pedestrians
- Signalized Intersections
- Speeding and Broadside Crashes
- Young Drivers

5.1 AUTOMOBILE RIGHT-OF-WAY, HEAD ON, AND SIDESWIPE CRASHES

Improper turning usually results from careless or aggressive driving. Motorists that speed through or abruptly turn at intersections are more likely to collide with other vehicles, pedestrians, or bicyclists. The first part of this memo showed that automobile right-of-way was the second-largest primary crash factor (PCF) in Calabasas between 2015 and 2020 and was over-represented as a PCF among KSI crashes. Calabasas has a lower proportion of crashes with automobile right of way PCFs than Los Angeles County (according to TIMS), indicating that the City has conditions contributing to this behavior.

Sideswipe and head on crashes were the two types of crashes, most often associated with automobile right-of-way. Sideswipe were the third-most-frequent category in Calabasas between 2015 and 2020 (per SWITRS). Hit object crashes were the fourth-most-common crash type and the second-most-common crash type among KSI crashes in Calabasas.

Given their overall frequency and association with severe crashes, the automobile right-of-way, sideswipe, and head on crashes are identified as an emphasis area. Automobile right-of-way, sideswipe, and head on crash occurred more frequently at non-signalized intersections and mid-block locations than at signalized intersections.

5.2 ACTIVE TRANSPORTATION

Pedestrians and bicyclists are among the most vulnerable roadway users. Active transportation roadway users in suburban communities are often too young or too old to drive or lack the means to purchase a car. Wide arterial roadways, high-speed roadways, and limited crossing facilities may be uncomfortable for walking and biking and are not as safe as separated facilities or improved crossings. Based on observations in the field, the City has a relatively low volume of bicyclist using the roadways for travel. The lower volume may indicate the lack of safer bicycle and pedestrian facilities and preference for motor driven alternatives.

Pedestrians:

While vehicle-pedestrian crashes comprised only slightly more than one percent of total crashes in

Calabasas (per the 2015-2020 SWITRS data), they accounted for nearly 11 percent of fatal and severe injury crashes (see Figure 4.3). In the 2019 OTS Rankings, Calabasas ranked 102 out of 103 among peer cities for the number of killed or injured pedestrians over 65 years of age, indicating that elderly pedestrians are not facing as many safety challenges as other comparable cities in the State of California. Nevertheless, vehicle and pedestrian crashes occurring at signalized intersections suggest that pedestrian-focused interventions should target these locations (see Table 4.12).

Bicyclists:
Crashes involving bicyclists amounted to 12 crashes during the analysis period, which is 1.5% of the total collisions in the city. Compared to Los Angeles' County's rate of 6.1% of bicycle crashes, Calabasas has a significantly lower rate (See Table 4.8). The data shows that bicyclists are also not facing many safety issues as other comparable cities in the state.

A map of all pedestrian and bicycle collisions is displayed in **Figure 5.1.**

5.3 SIGNALIZED INTERSECTIONS

More than 35 percent of crashes in Calabasas from 2015 to 2020 occurred at signalized intersections. Low intersection or driveway density and high-speed on arterial roadways like Parkway Calabasas and Las Virgenes Road leave many drivers unprepared to stop or slow down as they approach a signal safely. Advanced warning signage and improvements to intersection and signal visibility can decrease signalized intersection crash frequency. KOA will address these and other countermeasures in the engineering recommendation memorandum.

5.4 SPEEDING AND BROADSIDE CRASHES

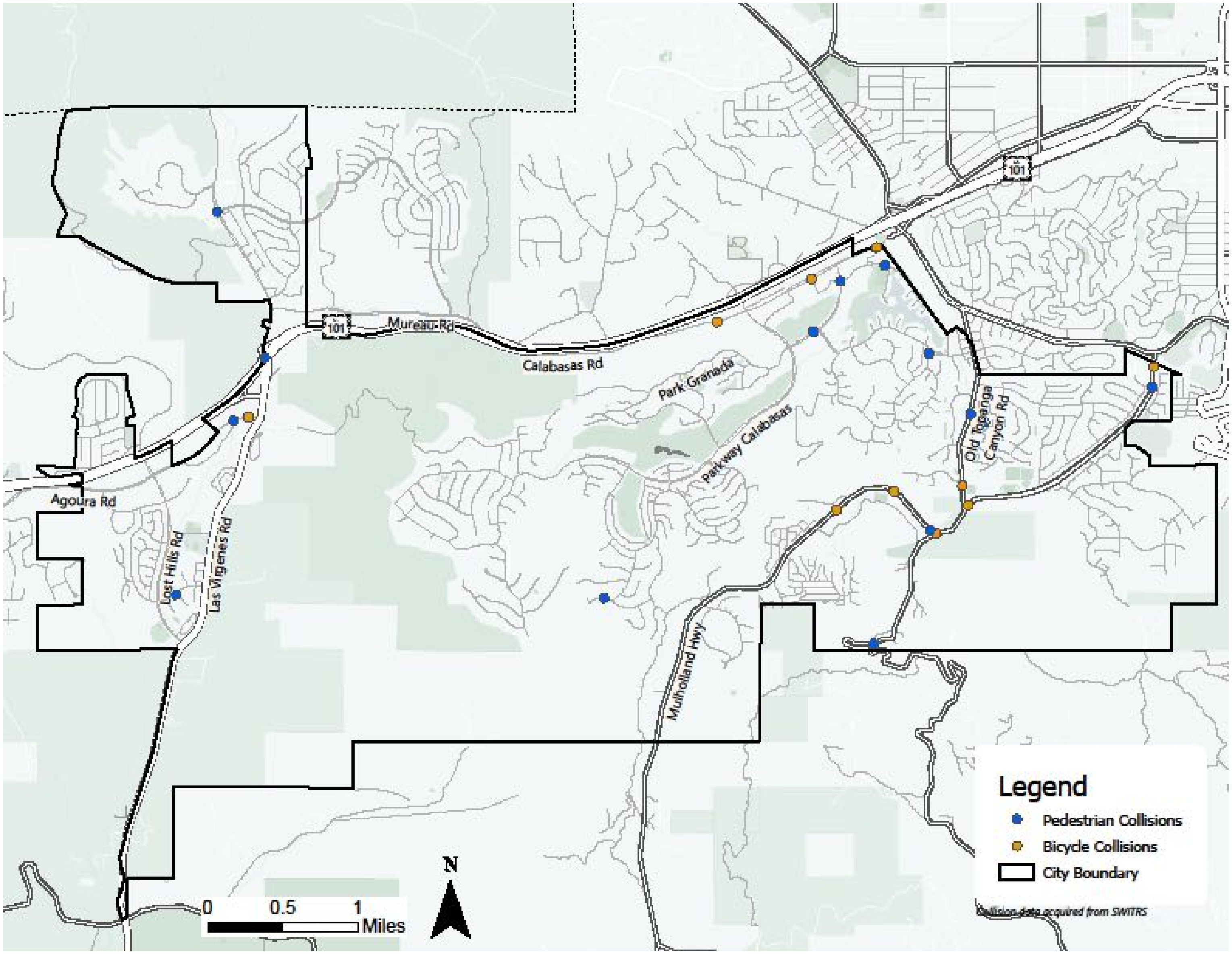
Broadsides constituted the most frequent crash type in Calabasas between 2015 and 2020 in the SWITRS databases. Los Angeles County had a substantially higher percentage of broadside crashes than Calabasas. Automobile right-of-way was the leading PCF and the most common cause of broadside crashes in Calabasas. Unsafe speed, a behavior often resulting from speeding, was the second-largest PCF associated with broadside crashes in Calabasas. Additionally, the majority of motorcycle crashes are caused by unsafe speeding. Focusing on reducing broadside crashes and unsafe speeding will also address the higher amount of injury-related motorcycle crashes in the city. Crashes caused by unsafe speeding and automobile right-of-way PCFs are most prevalent at signalized intersections.

5.5 YOUNG DRIVERS

Young drivers are more likely to be involved in a crash due to insufficient experience operating a motor vehicle when they are first licensed. Furthermore, young drivers tend to engage in risky driving behaviors, including speeding and distracted driving. The 2015-2020 SWITRS data show that male drivers between the ages of 15-19 were responsible for the second highest share of crashes in Calabasas and, combined with the highest age group (ages 20-24) show that 2/3rds of all crashes in the City involve young drivers.

Thus, a Transportation Safety Emphasis Area targeting young users should be considered. The encompassing programs should promote safe driving among young motorists.

Figure 5.1 Map of Pedestrian and Bicycle Crashes



6.0 ENGINEERING COUNTERMEASURES

The recommended Engineering Countermeasures (improvements to enhance transportation safety) address the emphasis areas on bicyclists, speeding/crashes, and emergency medical services. Six years of crash data from January 2015 to December 2020 were utilized to conduct a more in-depth review of the crash data. Safety countermeasures for the identified candidate locations were selected based on the following crash patterns:

- Crash severity
- Lighting conditions
- Involved parties, especially bicyclists and pedestrians
- Type of crash
- Primary crash factor
- Movements of the involved parties preceding the occurrence of the crash

The top three types of most frequently encountered crashes in Calabasas were broadside, rear end, and sideswipe. The common causes of these three crash types and the typical safety countermeasures addressing each crash type are listed in **Table 6.1**.

Table 6.1 Common Causes and Countermeasures-Citywide Crashes

TYPE	CAUSES	POTENTIAL COUNTERMEASURES
Broadside	• Automobile ROW • Traffic Signals and Signs • Improper Turning • Unknown • Unsafe Speed • Unsafe Starting or Backing • Wrong Side of Road	• Advanced dilemma zone detection • Upgrade signal hardware and improve the signal visibility • Improve signal timing (yellow, red intervals, pedestrian clearance) • Improve street lighting • Install retroreflective border on signal backplates
Rear End	• Unsafe Speed • Following Too Closely • Unsafe Starting or Backing • Improper Turning • Unknown • Driving or Biking under the influence • Automobile ROW	• Emergency Vehicle Preemption (EVP) system • Install lane striping • Upgrade pedestrian push button • Install 12-inch signal heads • Replace signs indicating permitted turning movements on signals • Install signal hardware
Sideswipe	• Improper Turning • Unsafe Lane Change • Unknown • Automobile ROW • Unsafe Speed • Unsafe Starting or Backing • Driving under the influence	• Install lane striping • Replace signs indicating permitted turning movements on signals • Improve signal hardware • Provide protected left turn phase • Install 12-inch signal heads

The Crash Reduction Factor (CRF) listed in the Local Roadway Safety Manual (LRSM) is directly connected to the Crash Modification Factor (CMF). A CRF is the percentage of crash reduction that might be expected after implementing a given countermeasure at a specific location. It plays an essential role in cost-effectiveness, which is the form of Benefit/Cost Ratio (BCR).

Table 6.2 summarizes the list of safety countermeasures included in the LRSM and applied to this project. The table summarizes each countermeasure's applicable crash types, CRF, project life of the recommended improvement, maximum federal reimbursement percentage, and the opportunity for a systemic approach.

Table 6.2 Safety Countermeasures Applied to Calabasas LRSP

CM No.	Countermeasure Name	Crash Type	CRF	Expected Life (Years)	HSIP Funding Eligibility	Systemic Approach Opportunity?
S01	Add intersection lighting	Night	40%	20	100%	High
S02	Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number	All	15%	10	100%	Very High
S04	Provide Advanced Dilemma Zone Detection	All	40%	10	100%	High
S05	Install emergency vehicle pre-emption systems	Emergency Vehicle	70%	10	100%	High
S07	Provide protected left turn phase	All	30%	20	100%	Very High
S09	Install raised pavement markers and striping	All	10%	10	100%	Medium
S12	Install raised median on approaches	All	25%	20	90%	High
NS06	Install/upgrade or additional stop sign or other intersection warning/regulatory signs	All	15%	10	100%	High
NS09	Install flashing beacons as advance warning (N.S.I)	All	30%	10	100%	High
NS11	Improve sight distance to intersection	All	20%	10	90%	High

Source: Local Roadway Safety Manual, Version 1.5 April 2020

The countermeasure numbers (far left column) in **Table 6.2** represent the ID number for the types of improvements that are eligible for HSIP funding. Throughout this document, countermeasures eligible for HSIP funding will have the ID number, and those that are not eligible will not have an ID number.

6.1 IDENTIFY PROJECT LOCATIONS

6.1.1 IDENTIFIED ROADWAY SEGMENT

The definition of the roadway segments was primarily based on major barriers such as freeways, major cross streets, roadway configuration, and land use. The roadway segment map is provided in **Figure 6.1**. Each corridor segment was analyzed based on the total number of crashes and crash severity. The ranking methods used to rank the roadway segments include crash frequency and the Equivalent Property Damage Only (EPDO).

As shown in **Figure 6.2**, five roadway segments were selected for analysis, and recommendations were developed for each segment.

<u>Calabasas Road Between Mureau Road and Parkway Calabasas</u> – This 0.80-mile segment on Calabasas Road spans from Mureau Road on the west to Parkway Calabasas to the east. At approximately the mid-point of the segment, Calabasas Road provides on- and off-ramp access to US-101 South via unsignalized "hook" ramps. West of the ramps, the traveled way consists of a two-lane highway with a variety of center median treatments, including painted centerline, two-way left turn lane, and striped median. East of the ramps, the traveled way widens to a four-lane divided highway, separated by a combination of striped centerline, two-way left turn lane, striped median, and raised median at Parkway Calabasas. The existing posted speed limit is 40 miles per hour. On-street parking is permitted on some sections of the roadway. The major traffic collision patterns on this segment consist of the following:

- Rear-end crashes in the eastbound direction between Mureau Road and US-101 Ramps (due to unsafe speeds and following too closely)
- Broadside crashes between eastbound left-turning traffic and westbound through traffic (due to left-turn right of way violations); and
- Rear-end crashes in the eastbound direction between the US-101 ramps and Parkway Calabasas (due to following too closely)

Suggested roadway segment countermeasures include:

- Provide targeted law enforcement of the 40 mph posted speed limit
- Install radar speed feedback sign(s), i.e., dynamic speed warning sign at periodic intervals in the eastbound direction
- Provide dedicated left-turn pockets in the center median area for driveways, and where they can be accommodated by the existing roadway width and lane geometry.

<u>Las Virgenes Road between Mureau Road and Agoura Road</u> – This 0.60-mile segment on Las Virgenes Road spans from the signalized intersection at Mureau Road on the north to the signalized intersection at Agoura Road to the south. There are two intermediate traffic signals on the segments at each of the US-101 North and South ramp junctions where the Las Virgenes Road crosses over the freeway. The traveled way consists of a four-lane divided highway with raised and striped center medians. The existing posted speed limit is 35 miles per hour. On-street parking is prohibited on the street. The major traffic collision

patterns on this segment consist of the following:

- Rear-end crashes in the northbound direction between Agoura Road and the US-101 North ramps (due to following too closely);
- Rear-end crashes in the southbound direction between Mureau Road and Agoura Road (due to following too closely and unsafe speeds); and
- Run-off road crashes near Agoura Road (due to unsafe speeds, right-of-way violations and DUIs)

Suggested roadway segment countermeasures include:

- Provide pavement rehabilitation (or slurry) for roadway surfaces and refresh lane striping to improve contrast and visibility of the travel lanes and pavement markings during all times of the day.
- Install curve advisory signs (with reduced speed, if justified) to provide earlier notice to motorists of the horizontal and vertical curvature over the interchange, and the appropriate speed to select the navigate through the interchange area.

<u>Las Virgenes Road between Lost Hills Road and City</u> Boundary –
This 1.4-mile segment on Las Virgenes Road spans from the signalized intersection at Lost Hills Road on the north to the City's southerly limit. The traveled way consists of a two-lane undivided highway with paved shoulders. four-lane divided highway with raised and striped center medians. The existing posted speed limit is 45 miles per hour. On-street parking is prohibited on the street. The major traffic collision patterns on this segment consist of the following:

- Rear-end crashes in the southbound direction (due to following too closely and unsafe speeds); and
- Rear-end crashes in the northbound direction (due to following too closely and unsafe speeds); and

Suggested roadway segment countermeasures include:

- Provide targeted law enforcement of the 45 mph posted speed limit
- Install guardrail in the northbound direction to protect errant vehicles from striking utility poles and equipment adjacent to the edge of the shoulder pavement
- Install radar speed feedback sign(s), i.e., dynamic speed warning sign at periodic intervals in the southbound direction

<u>Agoura Road between Lost Hills Road and Las Virgenes Road</u> –
This 0.7-mile segment on Agoura Road spans from the signalized intersection at Lost Hills Road on the west to the signalized intersection at Las Virgenes Road on the east. The traveled way consists of a four-lane highway divided by two-way left-turn center lane, a Class 2 bikeway (on-street bike lanes), and a parking lane. The existing posted speed limit is 45 miles per hour. On-street parking is prohibited on the street. KOA noted a variety of different crashes across the segment; however, no major crash patterns emerged as significantly prominent. Broadside crashes (10) and side swipe (6) crashes were of the most frequent crash types. There were also 3 wrong-side-of-road crashes that occurred east of Lost Hills during the early evening. Suggested roadway segment countermeasures include:

- Evaluate and replace portions of the existing two-way left turn lane with a dedicated (directional) left-turn pocket where opposing traffic is not expected or permitted to use the center lane area for turns.
- Evaluate driveway sight distance for left-turns onto Agoura Road, and consider replacing short sections of the existing two-way left-turn lane with an acceleration lane to improve the ability for outbound driveway movements to merge with major roadway traffic;
- Convert existing on-street parking lane to a buffered Class 2 bike lane (or Class 4 protected bikeway)

- Consider removal of on-street parking lanes and reconfigure roadway cross-section to provide a raised median with left-turn pockets.

Calabasas Road between Park Granada and City Boundary –
This 0.25-mile segment on Calabasas Road spans from the signalized intersection at Park Granada on the west to the City's easterly limit (at El Canon Avenue). The traveled way consists of a two-lane roadway divided by a combination of raised landscaped median and flush concrete paved median (delineated by reflective pavement markers and decorate pavement). This stretch of Calabasas Road traverses through "Old Town Calabasas", which provides a variety of retail shops, offices and storefront which experience above average levels of pedestrian travel during certain times of the day. There are several unsignalized mid-block pedestrian crossings, and on-street parking lanes with extended sidewalk parking bays. The existing posted speed limit is 25 miles per hour, and the eastbound travel lanes narrow from two lanes to one lane at the west end of the segment. The traffic collision pattern on this segment consists mainly of rear-end crashes approaching El Canon Avenue, during both the day and night, resulting from unsafe speeds and DUI activity. Suggested roadway segment countermeasures include the following:

- Targeted law enforcement of the 25 mph posted speed limit
- Install edgeline and parking lane lines to create a visual narrowing of the travel lane and reduce speeds
- Install radar speed feedback sign(s), i.e., dynamic speed warning sign in the eastbound direction

Figure 6.1 Top Roadway Segments Map (EPDO)

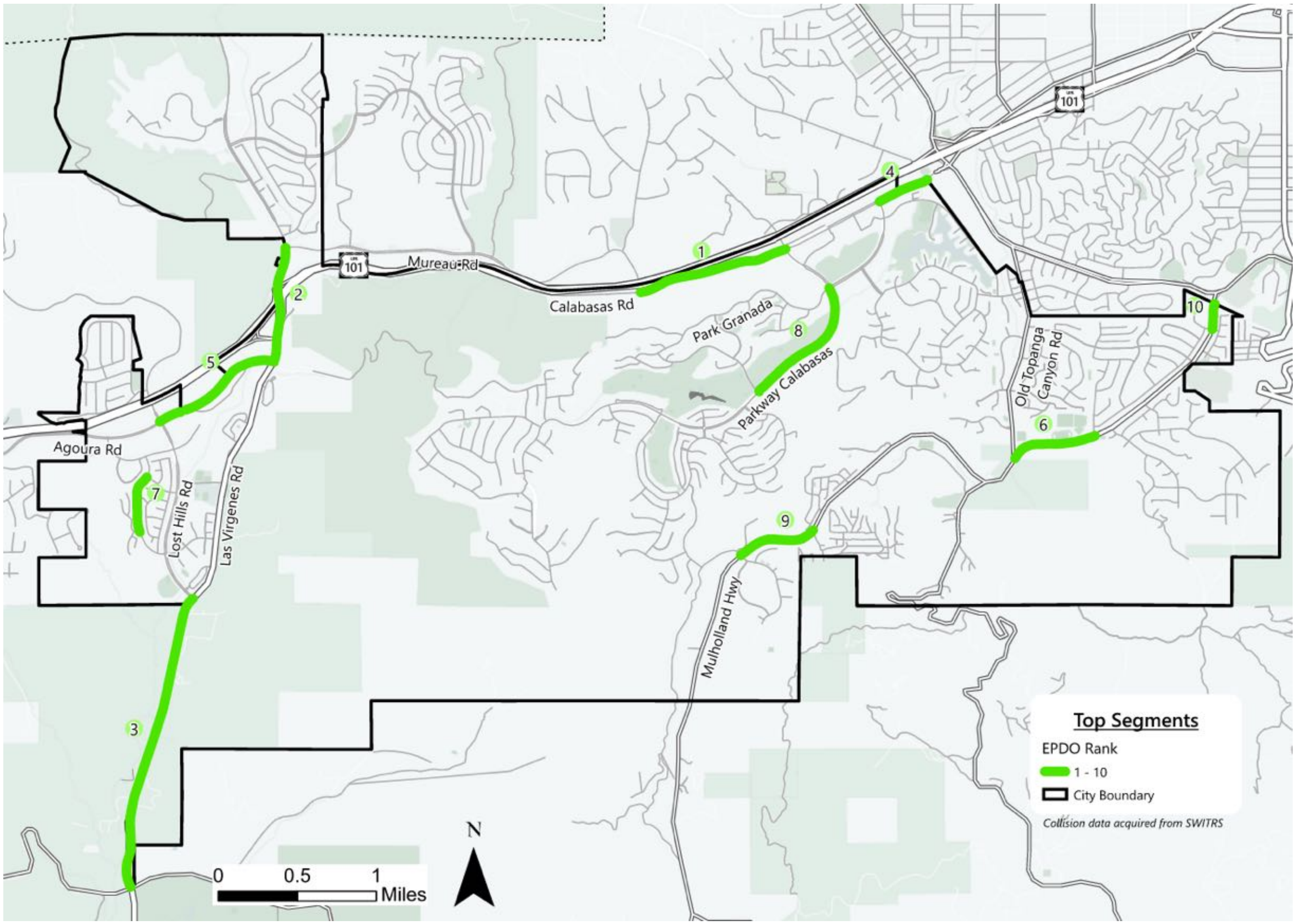
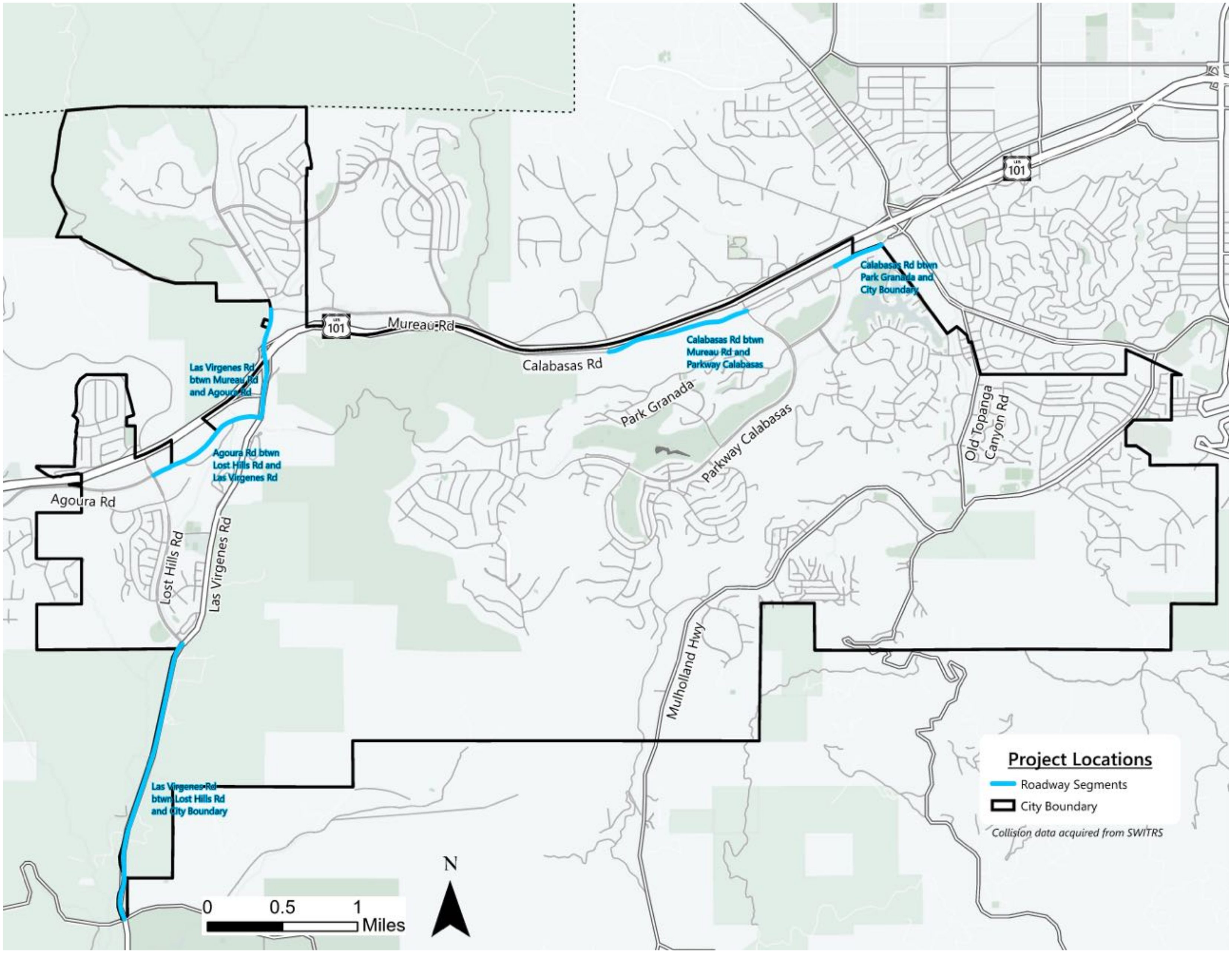


Figure 6.2 Proposed Roadway Segment Countermeasures

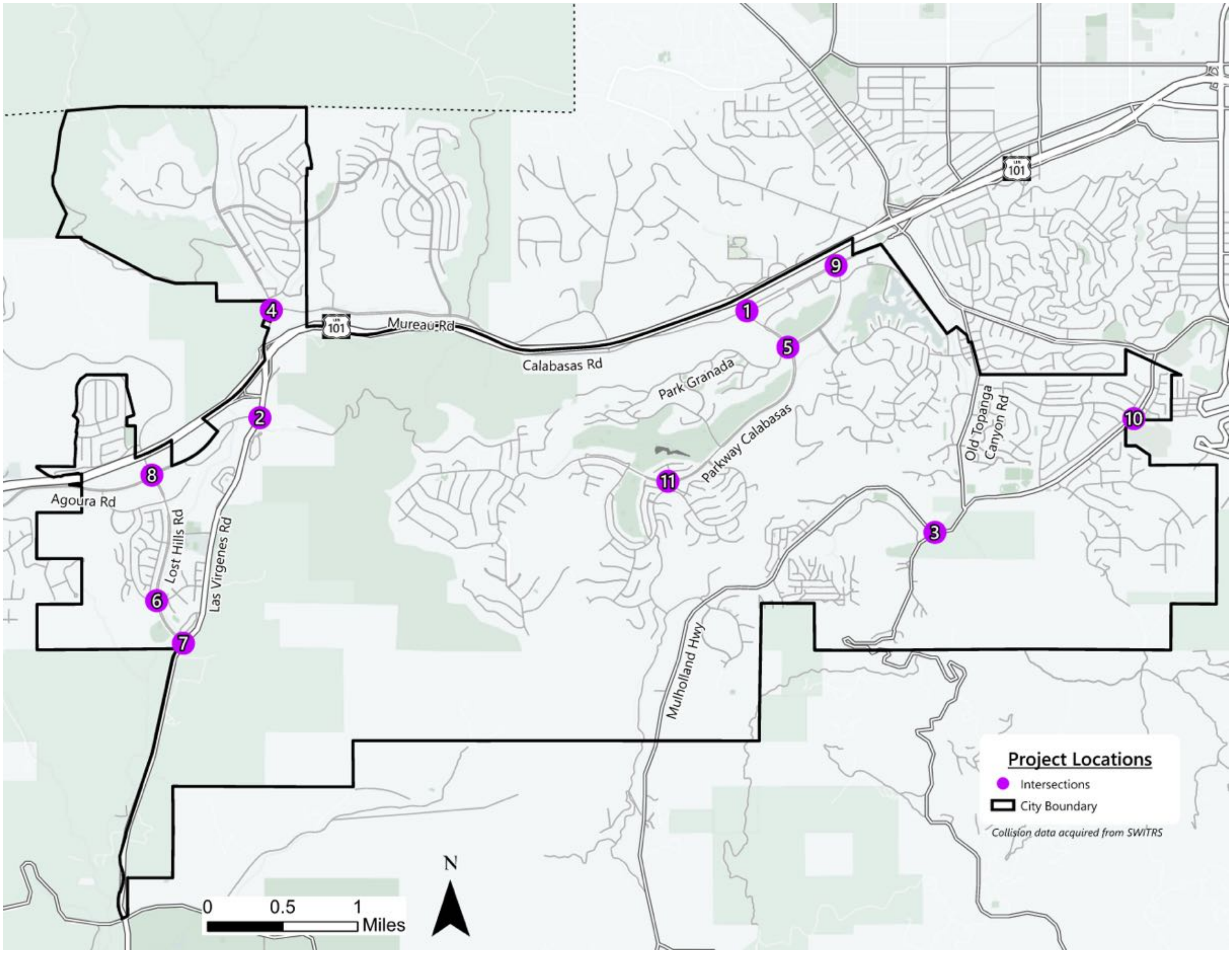


6.1.2 IDENTIFIED INTERSECTIONS

All the intersections of City-owned public streets were reviewed based on the crash frequency and EPDO methods. A total of 11 intersections were chosen for potential countermeasure implementation. **Figure 6.3** illustrates the locations of the proposed intersection countermeasures, and the list is shown below:

1. Calabasas Road and Parkway Calabasas
2. Las Virgenes Road and Agoura Road
3. Mulholland Highway and Old Topanga Canyon Road
4. Las Virgenes Road and Mureau Road
5. Parkway Calabasas and Park Granada
6. Lost Hills Road and Calabasas Hills Road
7. Las Virgenes Road and Lost Hills Road
8. Lost Hills Road and Agoura Road
9. Calabasas Road and Park Granada
10. Mulholland Highway and Paul Revere Drive
11. Parkway Calabasas and Camino Portal

Figure 6.3 Proposed Intersections Countermeasures



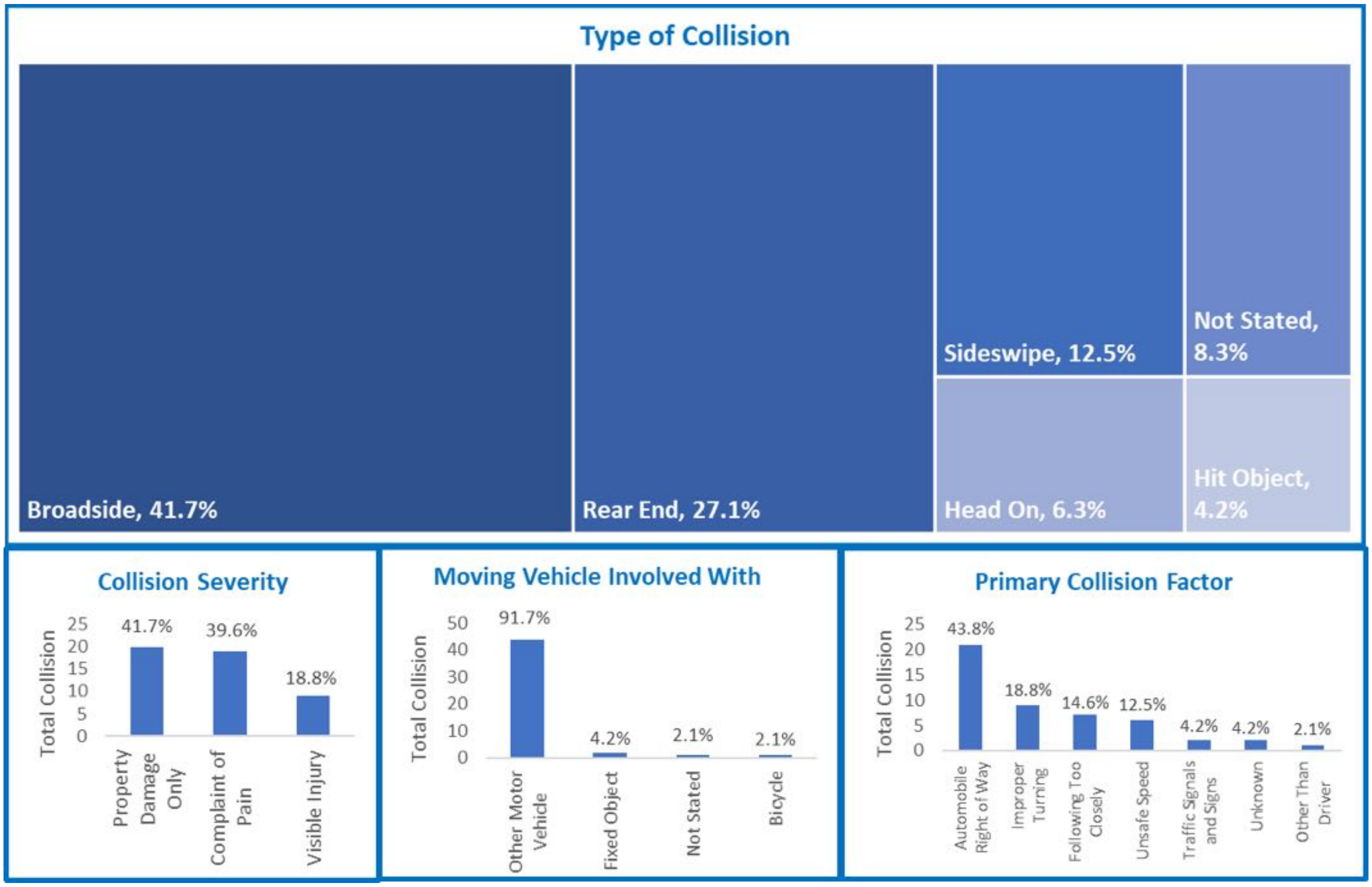
6.2 ROADWAY SEGMENT RECOMMENDATIONS

6.2.1 Calabasas Road between Mureau Road and Parkway Calabasas

From Mureau Road to Parkway Calabasas, Calabasas Road is a four-lane roadway between Parkway Calabasas and 101 ramp exist. The roadway segment between the 101 northbound ramp to Mureau Road the roadway is two-lane with painted median. Calabasas Road is classified as an Arterial Road under the Calabasas General Plan 2030. The roadway curb-to-curb width ranges from 58 to 72 feet, and the posted speed limit is 40 mph. Left-turn lanes with protected-permissive left-turn phasing is provided at minor intersections and protected left-turn phasing is provided at major intersection. Currently, a bicycle facility is provided along on different sections of Calabasas Road.

A total of 48 crashes occurred on this segment from January 2015 to December 2020. The common primary crash factors were automobile right of way (43.8%), improper turning (18.8%), following too closely (14.6%). Broadside, rear end, and sideswipes were the most common crash types. Approximately 70 percent of the broadside crashes were caused by automobile right of way. **Figure 6.4** illustrates the crash statistics for this intersection.

Figure 6.4 Crash Statistics – Calabasas Road

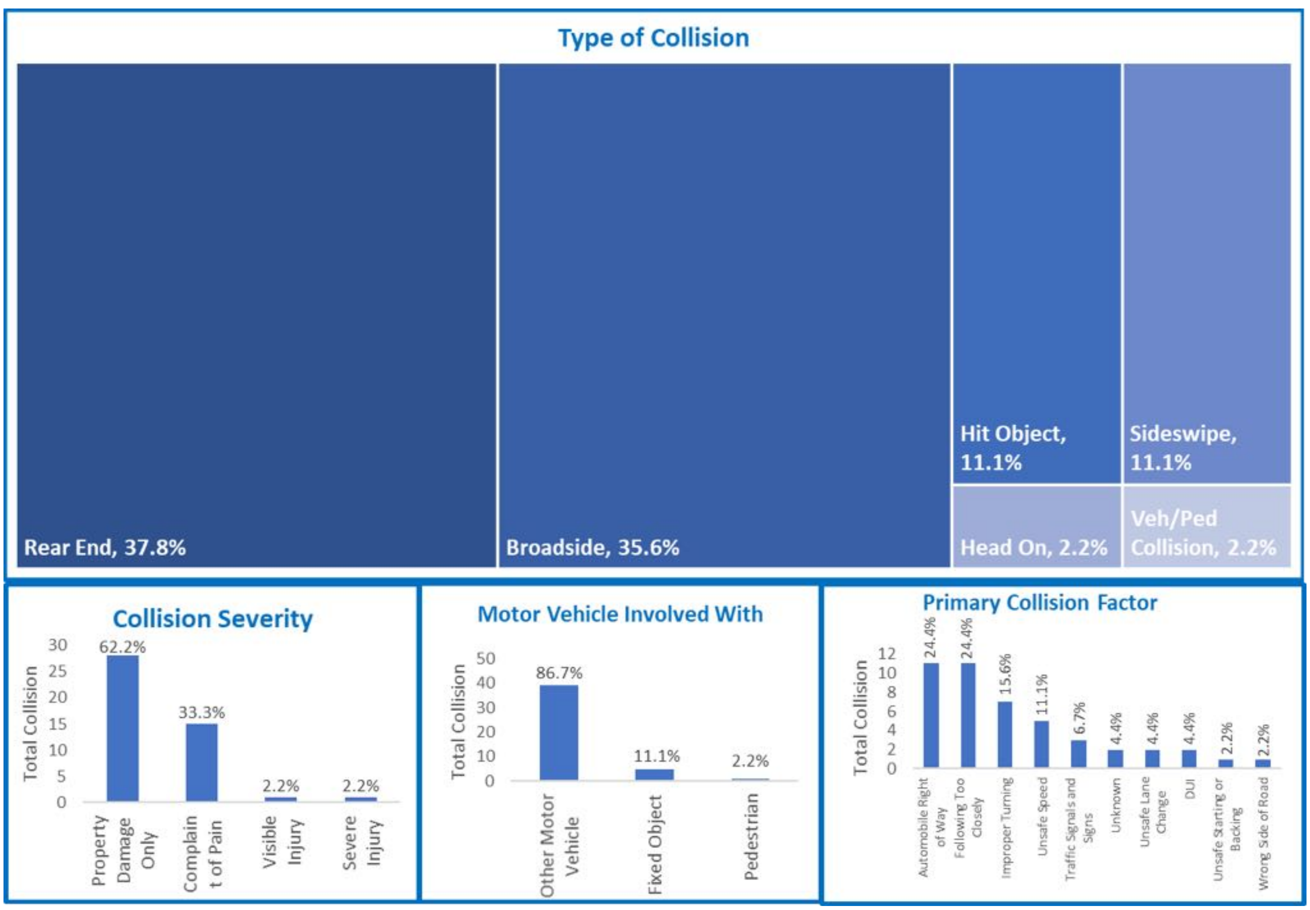


6.2.2 Las Virgenes Road between Agoura Road and Mureau Road

Las Virgenes Road from Agoura Road to Mureau Road is a four-lane roadway with Class II bike lanes from Rondell Street to Mureau Road. Calabasas has all kinds of raised median treatments throughout the City, such as raised medians are provided along the corridor from the Mureau Road to Rondell Street. A two-way left-turn lane is provided from Agoura Road to Rondell Street. Las Virgenes Road between Agoura Road to Mureau Road is classified as an Arterial under the Calabasas General Plan 2030. The roadway curb-to-curb width ranges from 60 to 82 feet, and the posted speed limit range between 35-45 mph. Left-turn lanes with protected-permissive left-turn phasing are provided at major intersections.

A total of 45 crashes occurred on this segment from January 2015 to December 2020. The common primary crash factors were automobile right-of-way (24%), following too closely (24%), and improper turning (16%). Rear-end, broadside, and hit object were the most common crash types. Approximately 65 percent of the rear end crashes were caused by following too closely. **Figure 6.5** illustrates the crash statistics for this intersection.

Figure 6.5 Crash Statistics – Las Virgenes Road

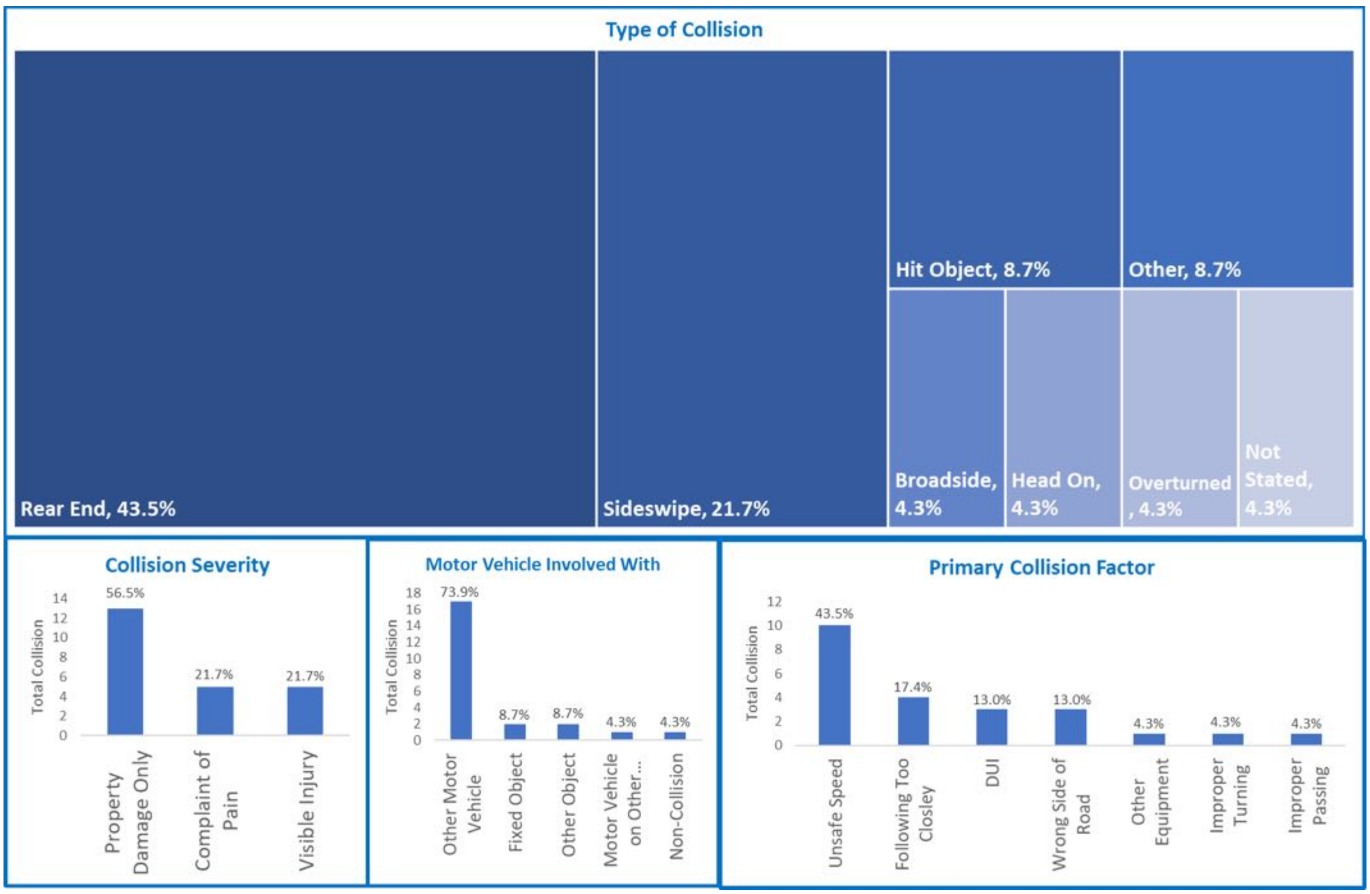


6.2.3 Las Virgenes Road between Lost Hills Road and City Boundary

Las Virgenes Road from Lost Hills Road to City Boundary is a two-lane roadway from South City Boundary to Lost Hills Road with a painted median. Las Virgenes Road is classified as an Arterial under the Calabasas General Plan 2030. The roadway curb-to-curb width 24 feet throughout the roadway segment, it is different at the intersection of Las Virgenes Road and Lost Hills Road, and the posted limit is 50 mph. Left-turn lanes with protected left-turn phasing are provided at major intersections.

A total of 23 crashes occurred on this segment from January 2015 to December 2020. The common primary crash factors were unsafe speed (43%), following too closely (17%), and DUI (13%). Rear-end, sideswipes, and hit object were the most common crash types. **Figure 6.6** illustrates the crash statistics for this intersection.

Figure 6.6 Crash Statistics – Las Virgenes Road

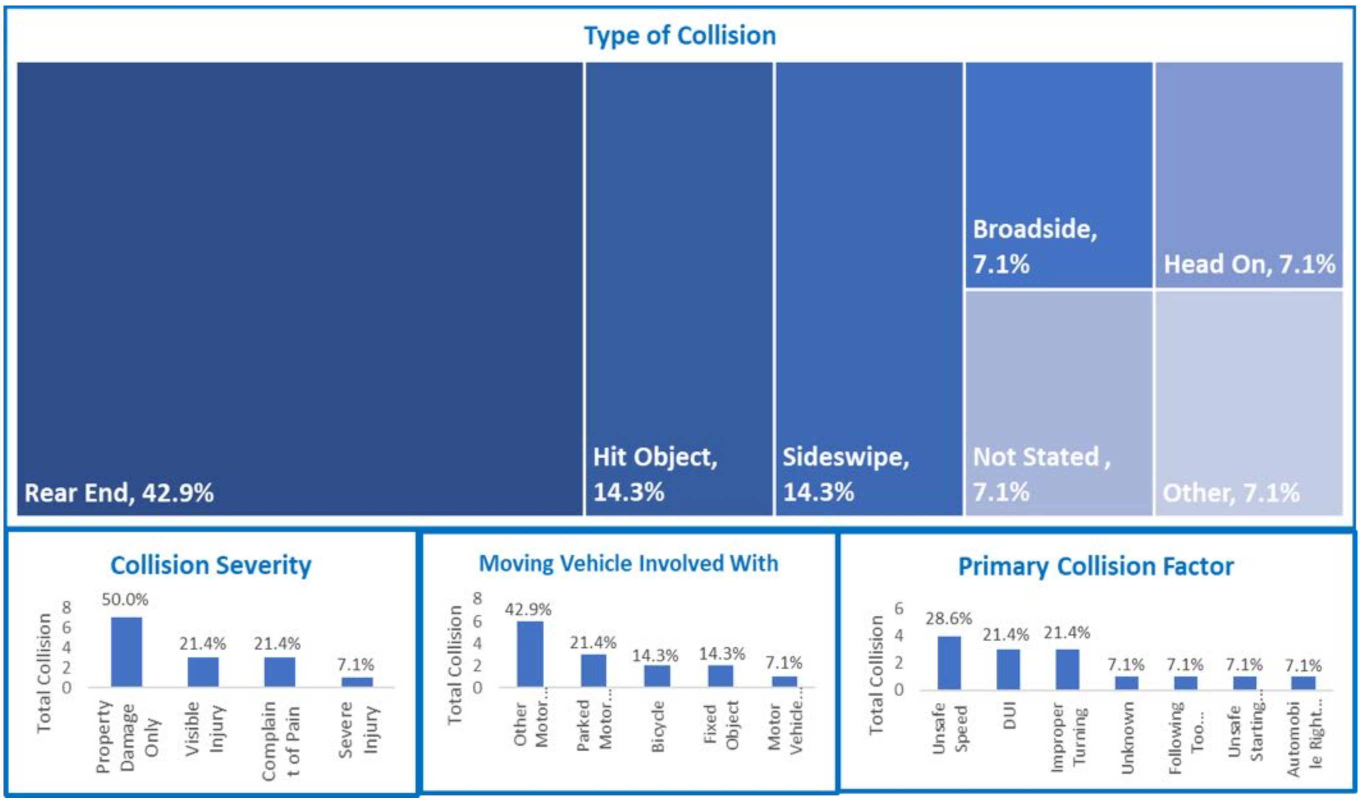


6.2.4 Calabasas Road between Park Granada and City Boundary

Calabasas Road from Park Granada to City Boundary is a four-lane roadway from Park Granada and Calabasas Road intersection to east City Boundary with a raised median. Calabasas Road is classified as an arterial road under the Calabasas General Plan 2030. The roadway curb-to-curb width range from 48 to 80 feet, and the posted limit is 25 mph. Left-turn lanes with protected left-turn phasing are provided at Calabasas Road and Park Granada.

A total of 14 crashes occurred on this segment from January 2015 to December 2020. The common primary crash factors were unsafe speed (29%), DUI (21%), and improper turning (21%). Rear-end, sideswipes, and hit object were the most common crash types. **Figure 6.7** illustrates the crash statistics for this intersection.

Figure 6.7 Crash Statistics – Calabasas Road

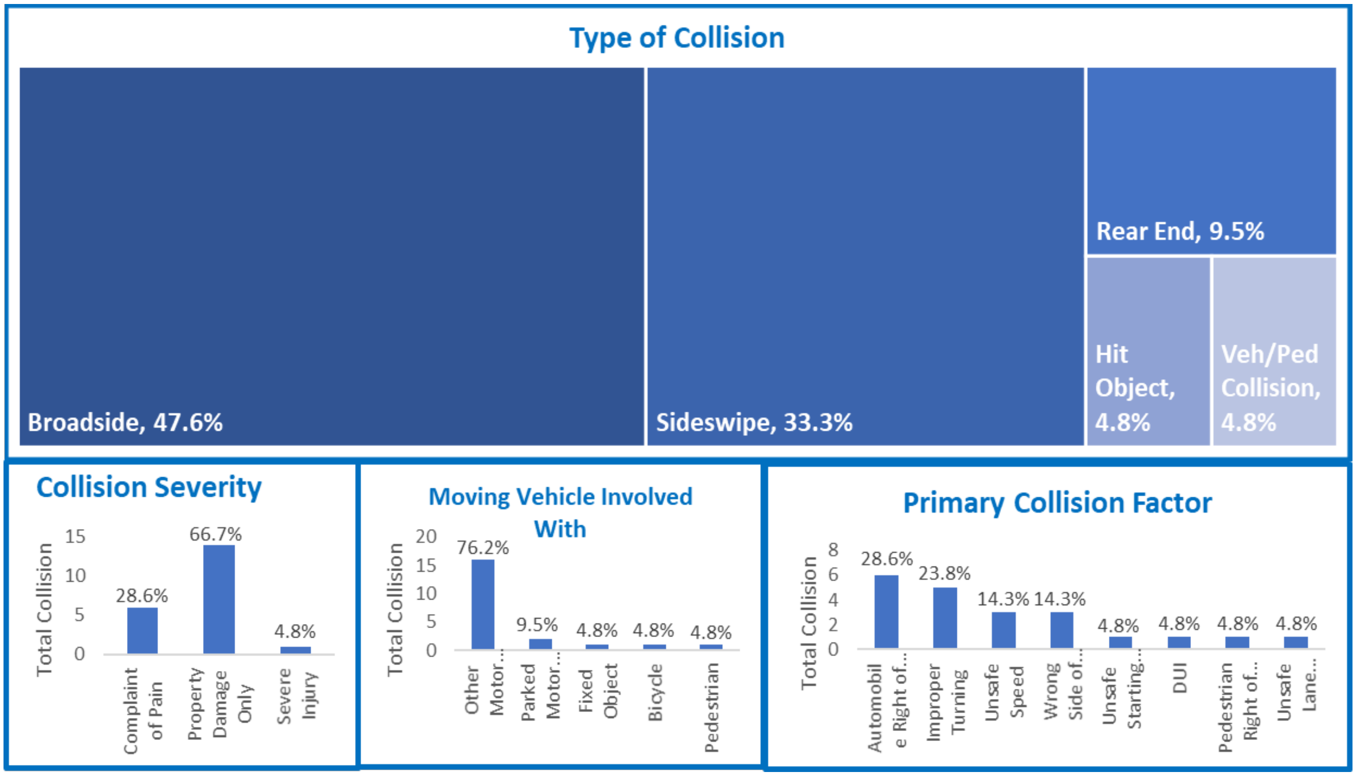


6.2.5 Agoura Road between Lost Hills Road and Las Virgenes Road

Agoura Road from Lost Hills Road to Las Virgenes Road is a four-lane roadway with Class II bike lanes throughout the segment. Calabasas has all kinds of raised median treatments throughout the City, such as raised median is provided at Lost Hills Road and Agoura Road intersection and rest of the segment has two way left turn painted median. Agoura Road from Lost Hills Road to Las Virgenes Road is classified as an arterial road under the Calabasas General Plan 2030. The roadway curb-to-curb width is 82 feet, and the posted speed limit 45 mph. Left-turn lanes with protected left-turn phasing are provided at major intersections.

A total of 21 crashes occurred on this segment from January 2015 to December 2020. The common primary crash factors were automobile right of way (29%), improper turning (24%), and unsafe speed (14%). Broadside, sideswipe and rear end were the most common crash types. **Figure 6.8** illustrates the crash statistics for this intersection.

Figure 6.8 Crash Statistics – Agoura Road



6.3 INTERSECTION RECOMMENDATIONS

All intersections on City-owned public streets were included in the crash analysis. The Top 10 signalized intersections that ranked highest on the basis of crash frequency, crash severity and EPDO scoring were selected for further investigation of safety countermeasures. Caltrans recommends that only thoroughly researched countermeasures with a readiness to be applied by local agencies on a statewide basis should be utilized. Therefore, the list of countermeasures discussed in this section includes, to a predominant degree, only those improvements which are available for application and reimbursement through the Caltrans' Highway Safety Program (HSIP), and its Call For Projects.

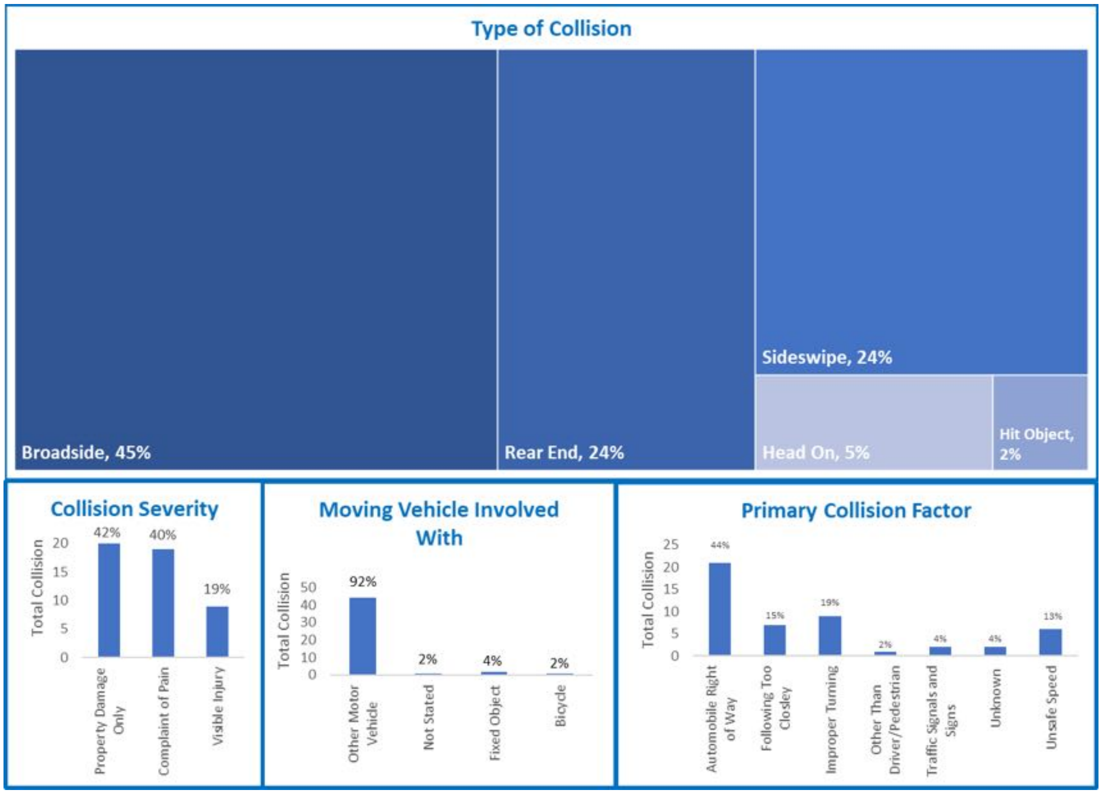
To the extent possible, the safety countermeasures were developed in coordination with ongoing City efforts to improve, enhance, repair and maintain its existing roadways and traffic safety infrastructure, as well future plans for other capital roadway improvements. For example, Calabasas has recently upgraded a number of incandescent signal indications to LED, and has updated the clearance intervals at several existing signalized intersections. The City should ensure that these locations are periodically monitored with respect to collision patterns to assess whether these changes have affected the driving conditions and collision frequency and patterns

6.3.1 Calabasas Road and Parkway Calabasas

This signalized intersection has two through travel lanes, a right-turn lane and a left-turn lane in each direction on Calabasas Road and Parkway Calabasas. On both streets, a left-turn lane with protected left-turn phasing is provided. The speed limit is 40 mph on both streets. A buffered bike lane is provided in the southbound, westbound, and eastbound directions. Standard crosswalks and curb ramps are provided at the intersection.

A total of 45 crashes occurred at the Calabasas Road and Parkway Calabasas intersection from January 2015 to December 2020. The intersection ranked 1st according to EPDO (Equivalent Property Damage Only). Crash type include rear end (68%), sideswipe (24%), broadside (45%), and hit-object (2%). The common primary crash factors were automobile right of way (44%) and improper turning (19%). Primarily, the broadside crashes were associated with automobile right of way and improper turning. **Figure 6.9** illustrates the crash statistics for this intersection.

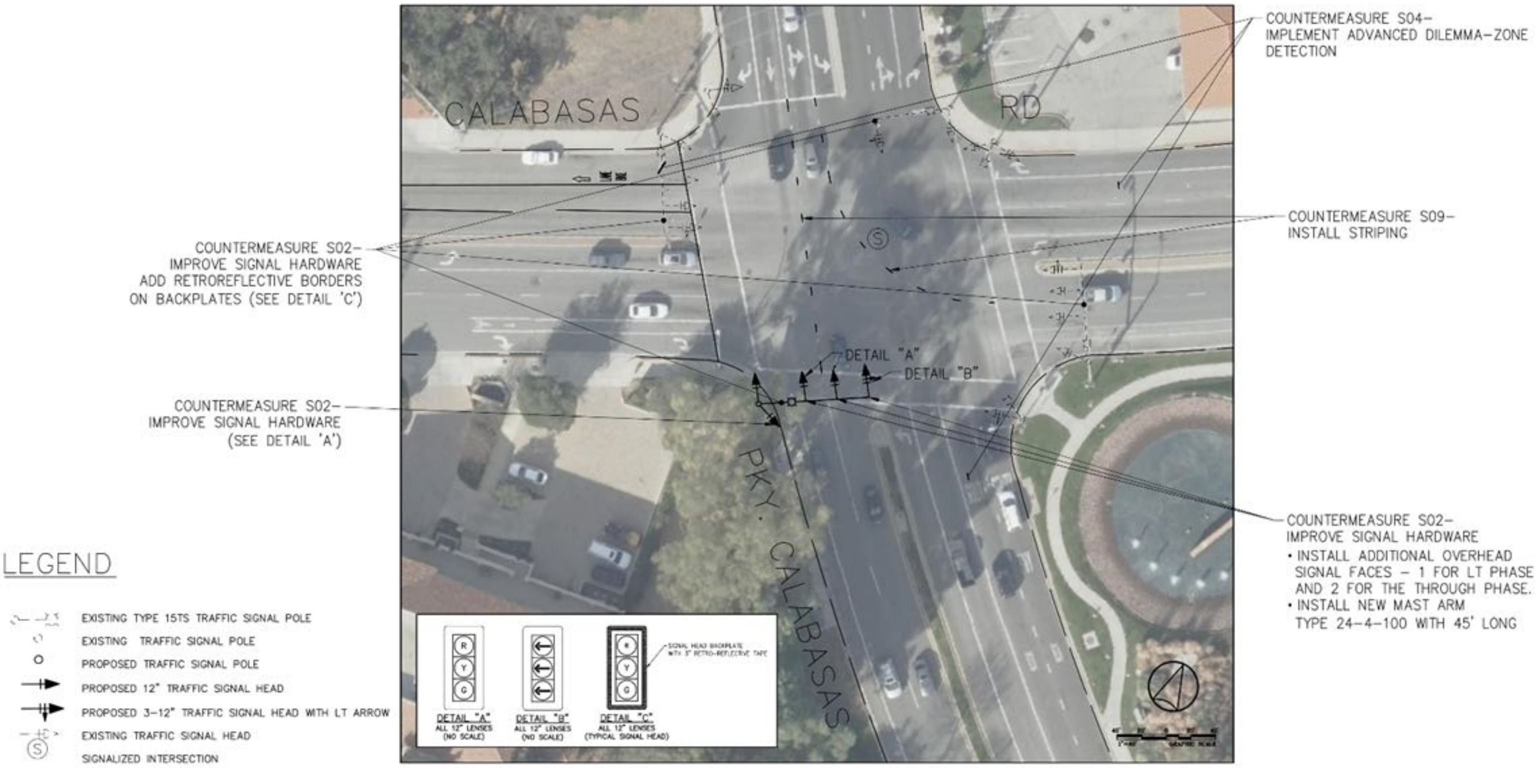
Figure 6.9 Crash Statistics – Calabasas Road & Parkway Calabasas



The following safety countermeasures could be considered at this intersection and are shown in **Figure 6.10**.

- S04 – Advance dilemma zone detection may address the frequency of red-light violations, reducing the frequency of crashes associated with the traffic signal phase change. Consider providing advanced dilemma zone detection at this intersection on Calabasas Road.
- S09 – Consider re-striping the standard crosswalks to high-visibility crosswalks at the intersection.
- S02 – Improve traffic signal hardware, including: signal head back-plates with retroreflective borders (all approaches), and additional overhead signal faces for the southbound traffic approaching from the Highway 101 interchange direction (requires new pole and mast arm equipment). These countermeasures will provide better visibility of the signal indications, improve drivers' advance perception of the signal, and serve to reduce rear-end crashes.

Figure 6.10 Recommended Improvements – Calabasas Road & Parkway Calabasas

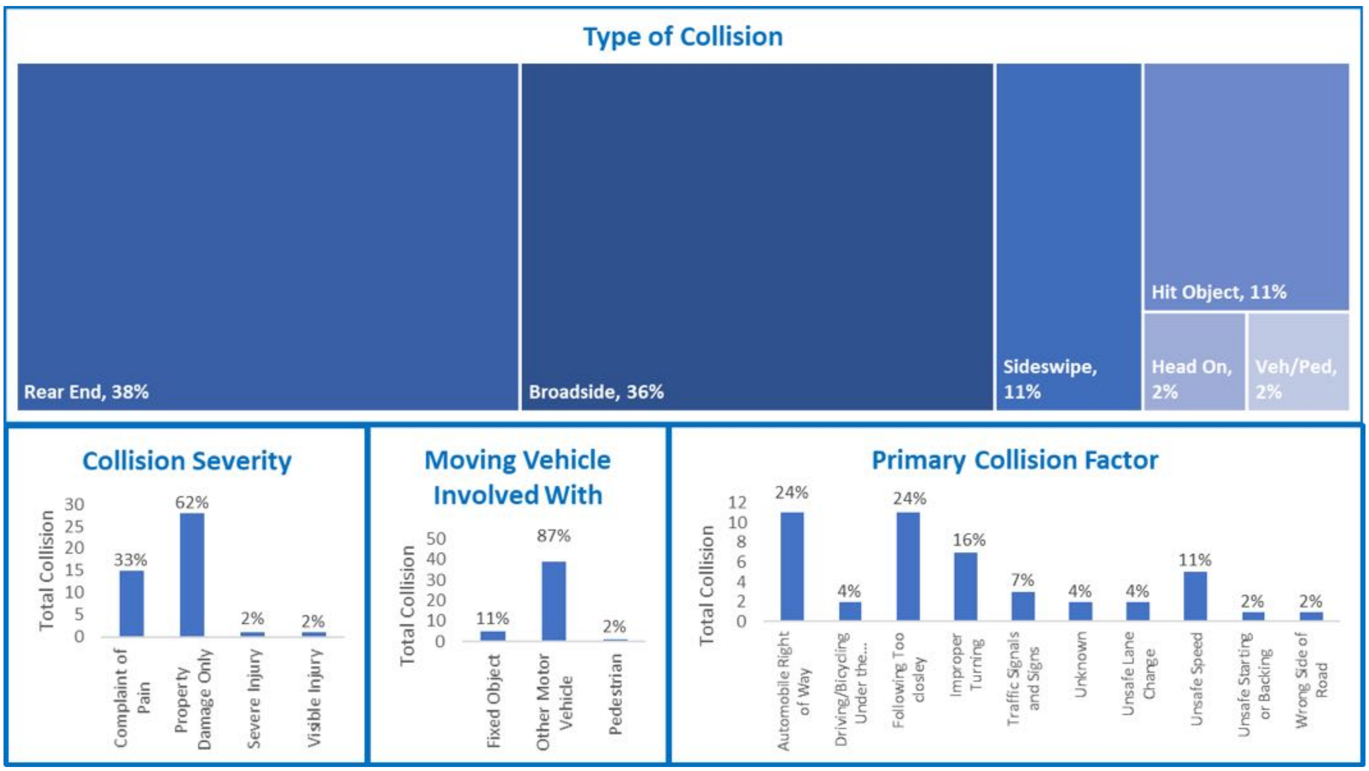


6.3.2 Las Virgenes Road and Agoura Road

The signalized intersection has two travel lanes with a right-turn lane with dual left-turn lanes Agoura Road and two through lanes on Las Virgenes Road. Also, Class II bike lanes are provided on Agoura Road. The posted speed limit 35 mph and 45mph on Las Virgenes Road and 45 mph on Agoura Road. Standard crosswalks and ADA-compliant curb ramps are provided at the intersection. At the Agoura Road, the two travel lanes go into Northbound and one travel lane into Southbound.

A total of 45 crashes occurred at the Las Virgenes Road and Agoura Road intersection from January 2015 to December 2020. The intersection ranked 2nd according to EPDO (Equivalent Property Damage Only). The primary crash types include rear end (38%) and sideswipe (11%). The common primary crash factors were automobile right of way (24%), following too closely (24%), improper turning (16%), and unsafe speed (11%). At this intersection, 62 percent of the crashes were associated with property damage only. **Figure 6.11** illustrates the crash statistics for this intersection.

Figure 6.11 Crash Statistics – Las Virgenes Road and Agoura Road



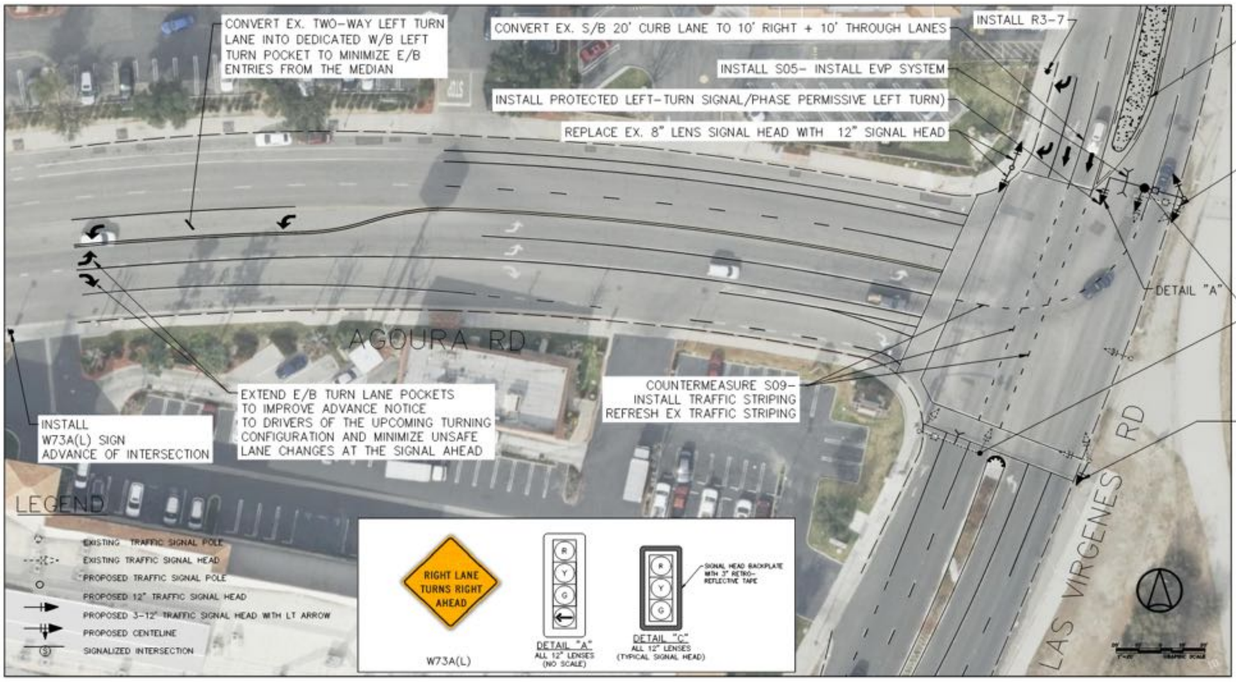
The following safety countermeasures could be considered in this intersection.

- S02 – Improve signal hardware such as back-plates with retroreflective borders and additional lenses for left turn and through phase on northbound approach, lenses etc. providing better visibility of intersection signals aids the drivers' advance perception of the upcoming intersection. Consider providing the retroreflective back-plates (N/B and S/B approaches) at the intersection.
- S09 – Consider re-striping the standard crosswalks to high-visibility crosswalks at the intersection.

- S12 – Consider raised median which prohibits left turn into and out of driveways that may be located too close to the functional area of the intersection.
- Install traffic signs and striping improvement on each approaches such as pavement markings and advance warning signs as shown in Figure 6.12.

Figure 6.12 illustrates the safety countermeasures that could be considered at this intersection.

Figure 6.12 Recommended Improvements – Las Virgenes Road and Agoura Road

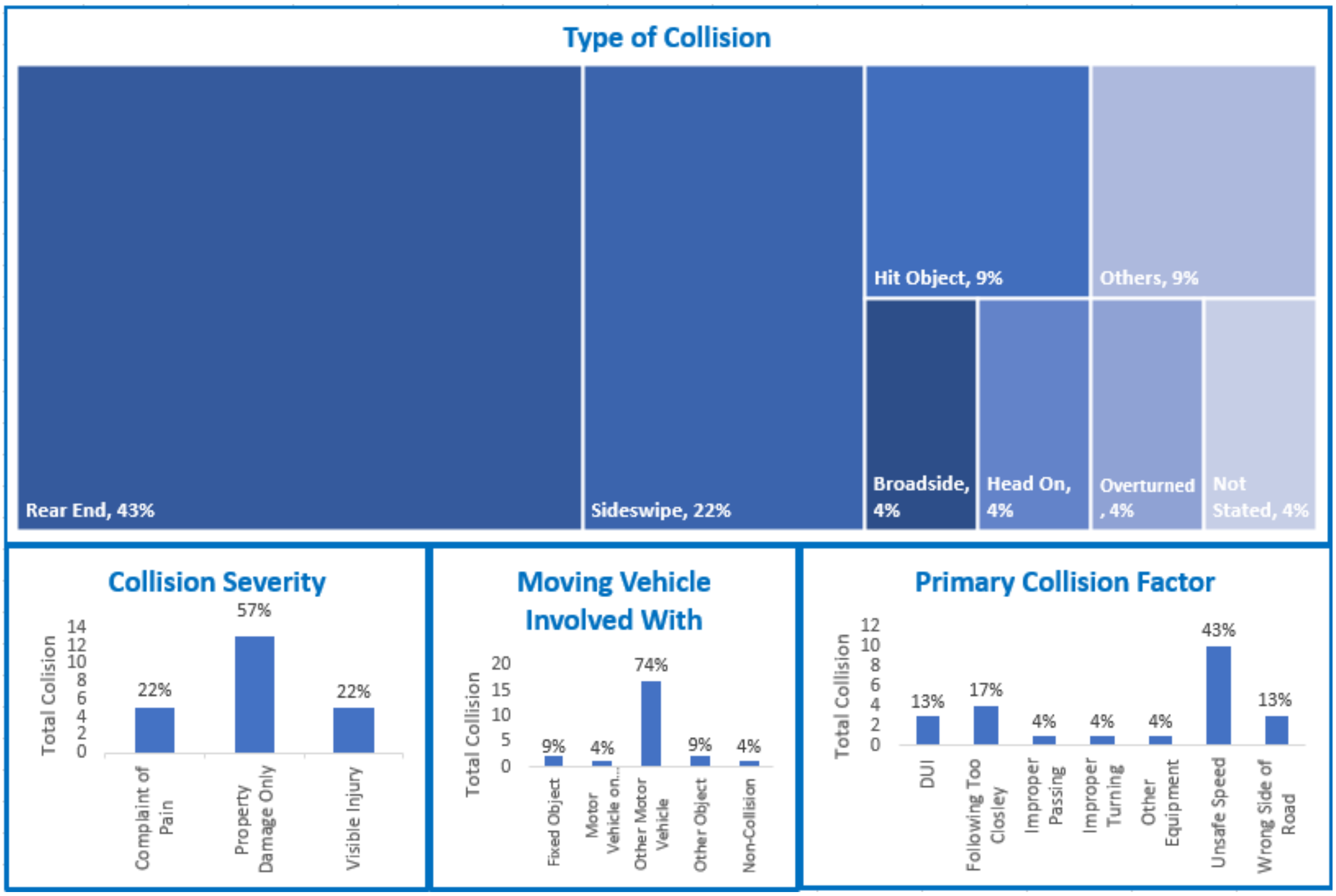


6.3.3 Mulholland Highway and Old Topanga Canyon Road

The non-signalized intersection with stop control on Northbound has one lane with a left-turn lane on Westbound direction on Mulholland Highway and Old Topanga Canyon Road. The posted speed limit on Mulholland Highway is 45 mph with a yellow-painted median. City of Calabasas in the design phase of installing a traffic signal at this intersection.

A total of 23 crashes occurred at the Mulholland Highway and Old Topanga Canyon Road intersection from January 2015 to December 2020. The intersection ranked 3rd according to EPDO (Equivalent Property Damage Only). The primary crash types include rear end (43%) and sideswipe (22%). The common primary crash factors were unsafe speed (43%) and following too closely (17%). At this intersection, 57 percent of the crashes were associated with property damage only. **Figure 6.13** illustrates the crash statistics for this intersection.

Figure 6.13 Crash Statistics – Mulholland Highway and Old Topanga Canyon Road

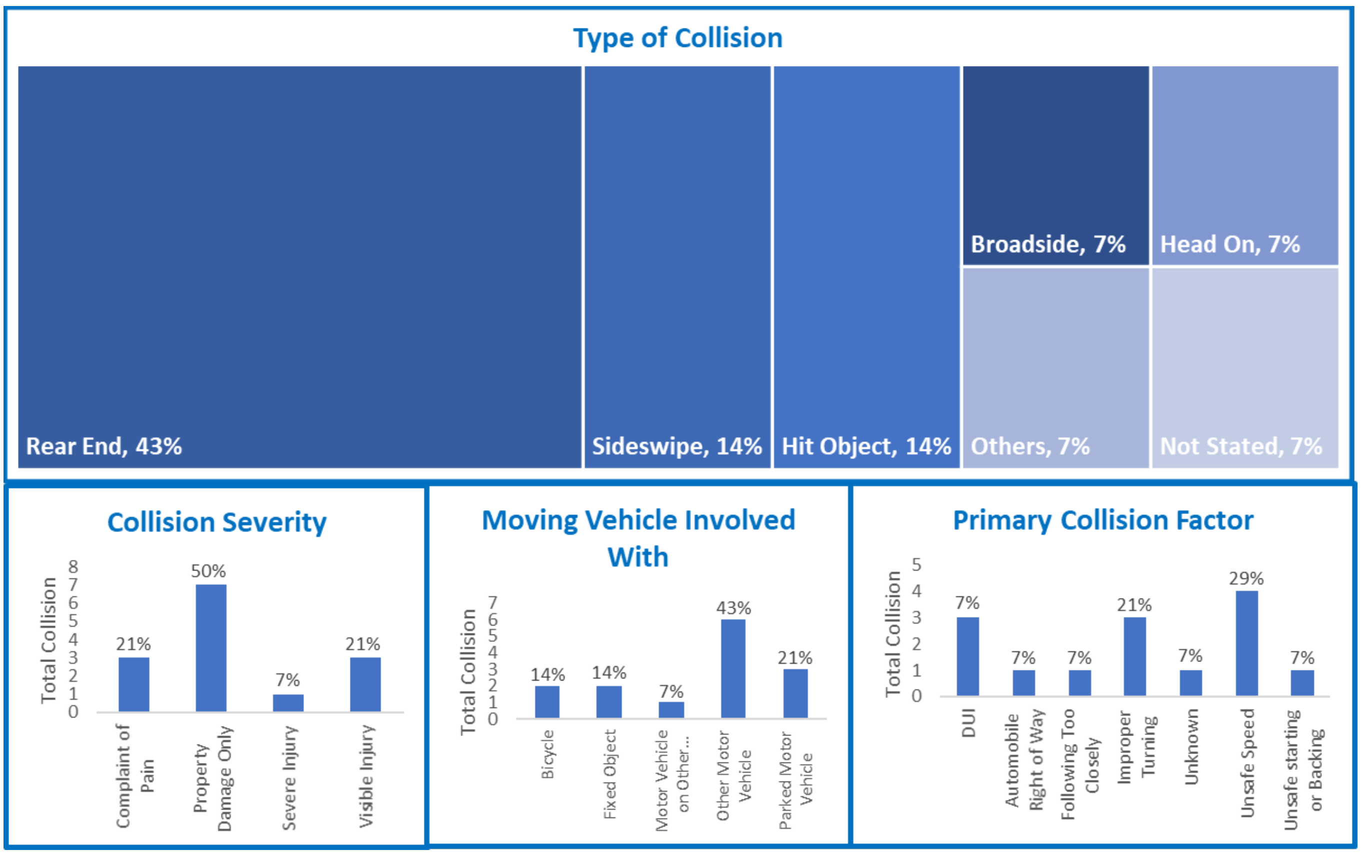


6.3.4 Las Virgenes Road and Mureau Road

The signalized intersection at Las Virgenes Road and Mureau Road has two through lanes with a left-turn lane on Eastbound direction on Mureau Road and Southbound direction on Las Virgenes Road. The posted speed limit on Las Virgenes Road is 45 mph and 40 mph on Mureau Road. The left-turn lane has protected left-turn phasing on both the lanes, and the northbound & southbound approaches have a buffered bike lane. Standard crosswalks and ADA-compliant curb ramps are provided at the intersection.

A total of 14 crashes occurred at the Las Virgenes Road and Mureau Road intersection from January 2015 to December 2020. The intersection ranked 4th by EPDO score. A total of four pedestrian-related crashes occurred at this intersection, and one of the crashes was fatal. The primary crash types include rear end (43%) and sideswipe/hit-object (14%). Also, the primary crash factors were unsafe speed (29%) and improper turning (21%). **Figure 6.14** illustrates the crash statistics for this intersection.

Figure 6.14 Crash Statistics – Las Virgenes Road and Mureau Road

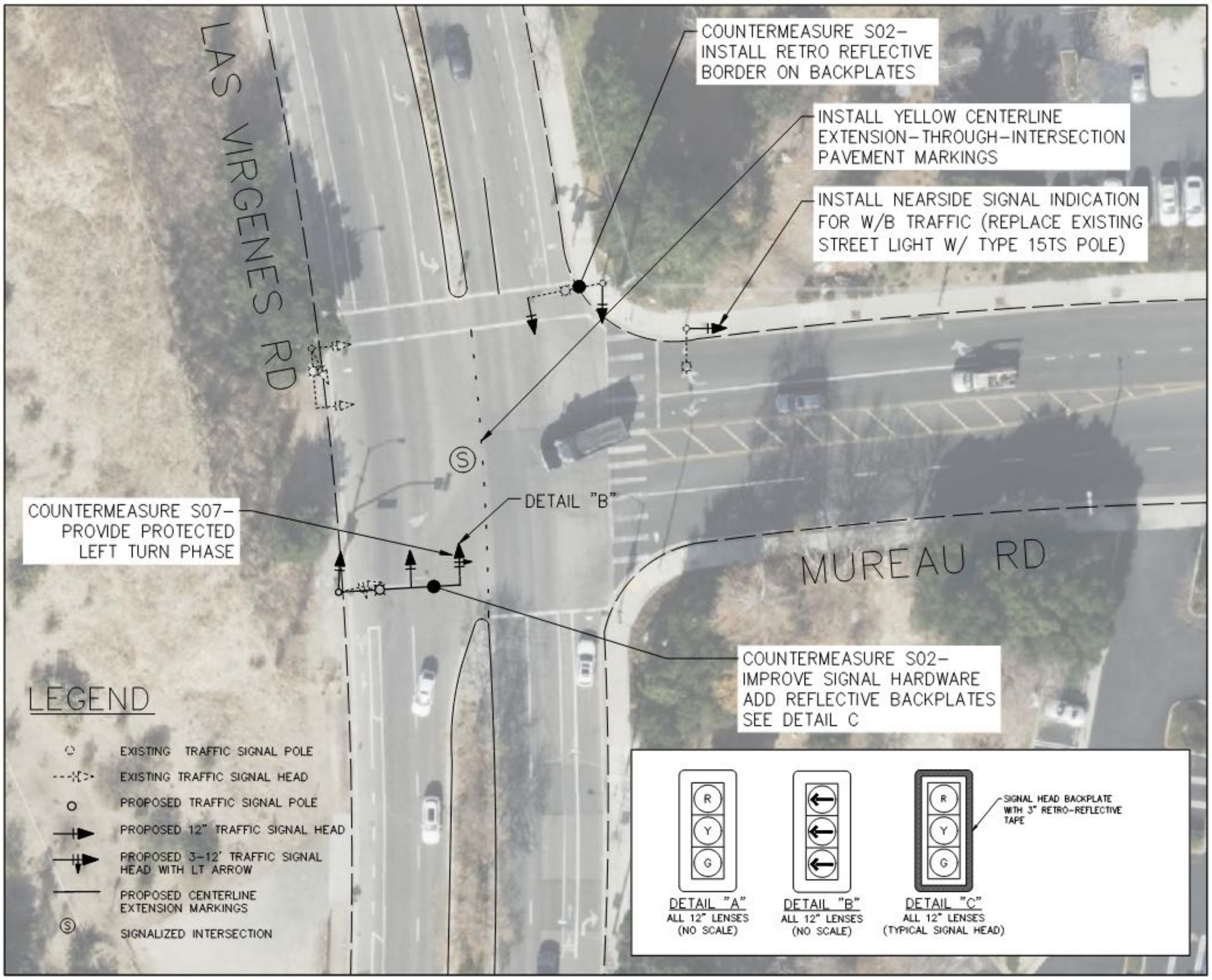


The following safety countermeasures could be considered in this intersection and are shown in **Figure 6.15**.

- S02 – Improve signal hardware such as back-plates with retroreflective borders, lenses etc. providing better visibility of intersection signals aids the drivers' advance perception of the upcoming intersection. Consider providing the retroreflective back-plates (N/B and S/B approaches) at the intersection.

- S07 – Consider the installation of protected left-turn phase on southbound direction.
- Consider yellow centerline lane line extension through intersection.

Figure 6.15 Recommended Improvements – Las Virgenes Road and Mureau Road

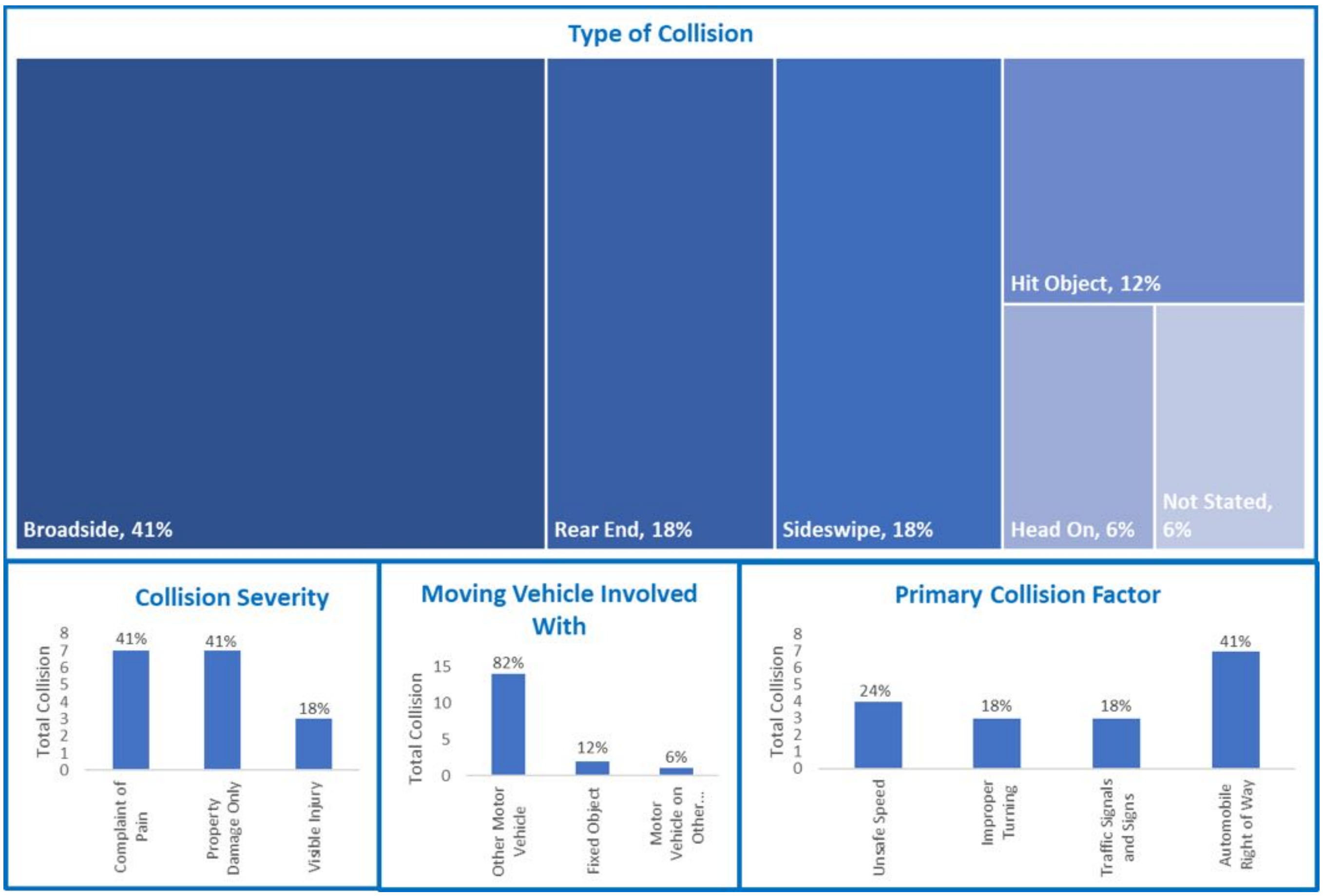


6.3.5 Parkway Calabasas and Park Granada

The signalized intersection at Parkway Calabasas and Park Granada has two travel lanes with a left-turn lane on Parkway Calabasas, while Park Granada has a left-turn lane, a shared-through-left lane, and a right travel lane. A raised median is provided along on both the streets, and the left-turn lanes have protected left-turn phasing at this intersection. Also, Class II bike lanes are provided on Parkway Calabasas. The posted speed limit is 45 mph on Parkway Calabasas and 40 mph on Park Granada. Standard crosswalks and ADA-compliant curb ramps are provided at the intersection.

A total of 17 crashes occurred at the Parkway Calabasas and Park Granada intersection from January 2015 to December 2020. The intersection ranked 5th by EPDO score. The primary crash type includes broadside (41%), sideswipe (18%), and include rear end (18%). Also, the primary crash factors were complaint of pain (41%), property damage only (41%), and visible injury (18%). The broadside crashes were primarily associated with complaint of pain and property damage only, and approximately 41 percent of total crashes were caused by automobile right of way. **Figure 6.16** illustrates the crash statistics for this intersection.

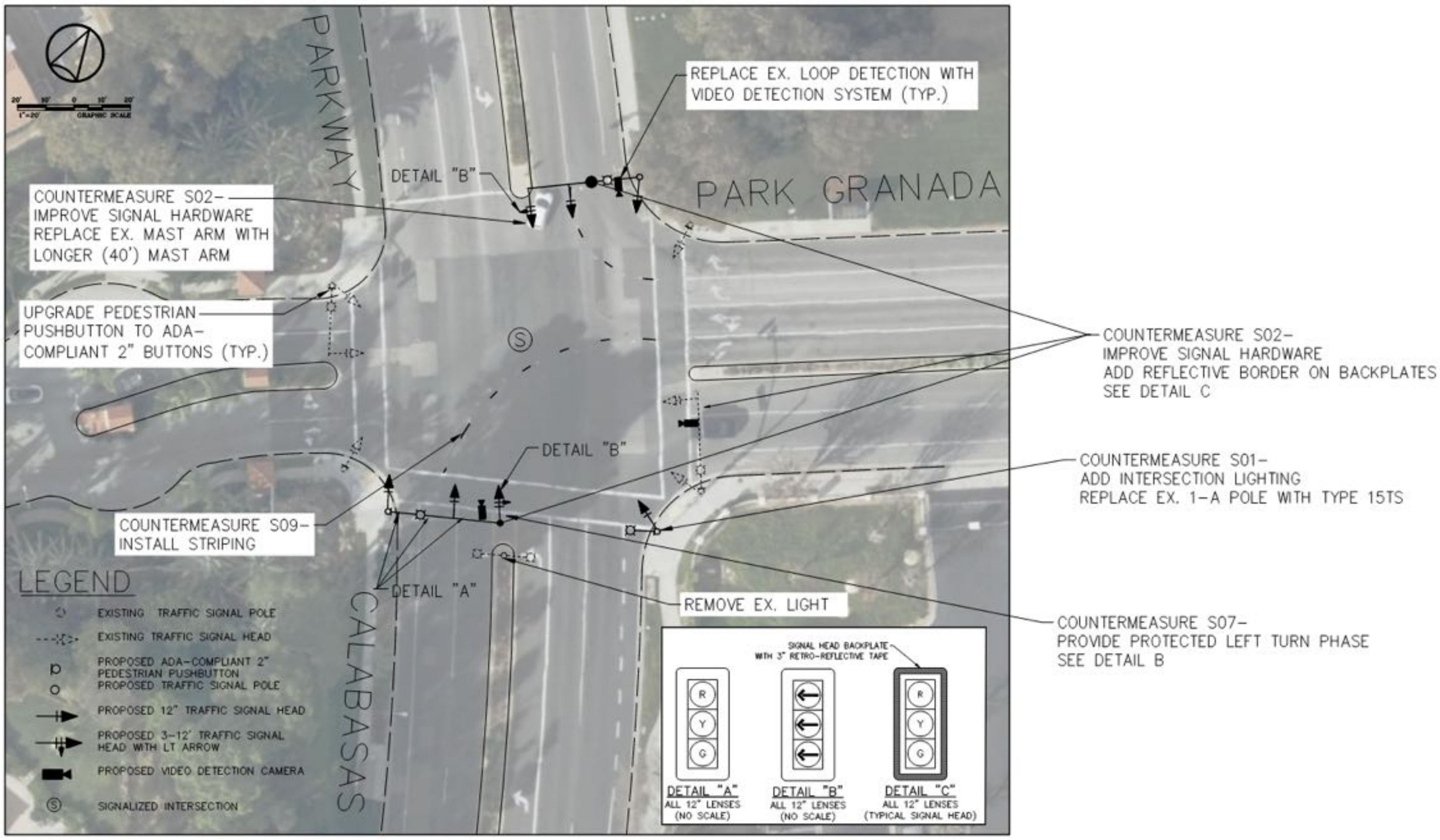
Figure 6.16 Recommended Improvements – Parkway Calabasas and Park Granada



The following safety countermeasures could be considered in this intersection and are shown in **Figure 6.17**.

- S02 – Improve signal hardware such as back-plates with retroreflective borders and additional lenses on northbound approach, providing better visibility of intersection signals aids the drivers' advance perception of the upcoming intersection. Consider providing the retroreflective back-plates (N/B and S/B approaches) at the intersection.
- S07 – Consider adding protected left-turn phase for the southbound direction.
- Upgrade pedestrian push button to ADA compliant hardware.

Figure 6.17 Recommended Improvements – Parkway Calabasas and Park Granada

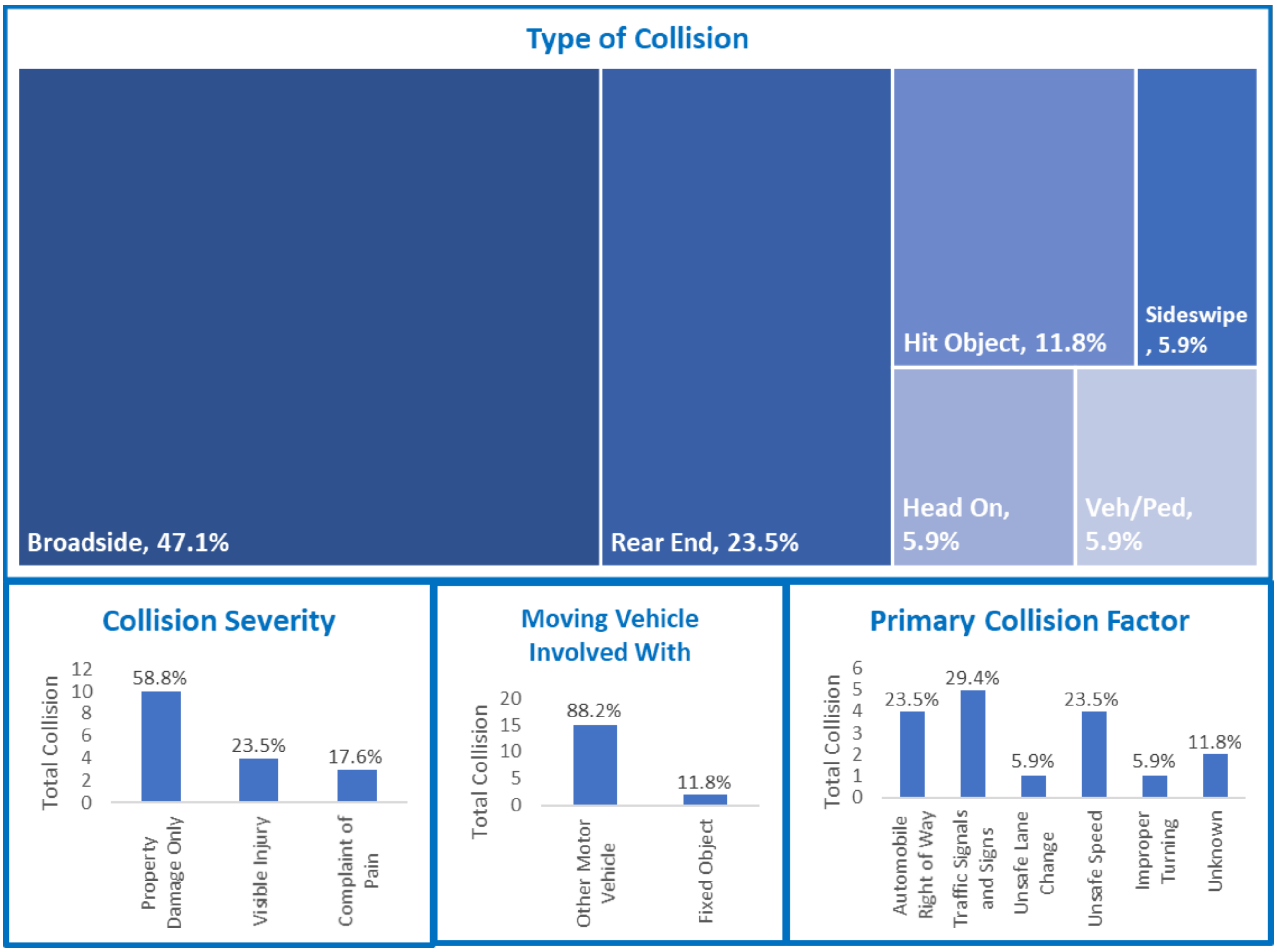


6.3.6 Lost Hills Road and Calabasas Hills Road

The unsignalized intersection at Lost Hills Road and Calabasas Hills Road has two travel lanes with a left-turn lane on Lost Hills Road, while Calabasas Hills Road has a one shared travel lane. A raised median is provided on the north and south leg of the intersection, and the left-turn lane has protected left-turn phasing at this intersection. The posted speed limit ranges between 35 mph and 45 mph on Calabasas Hills Road and Lost Hills Road. Standard crosswalks and ADA-compliant curb ramps are provided at the intersection.

A total of 17 crashes occurred at the Lost Hills Road and Calabasas Hills Road intersection from January 2015 to December 2020. The intersection ranked 6th by EPDO score. The primary crash types include broadside (47%), rear end (24%), and hit object (12%). Also, the primary crash factors were traffic signals and signs (29%), unsafe speed (23%), and automobile right of way (23%). **Figure 6.18** illustrates the crash statistics for this intersection.

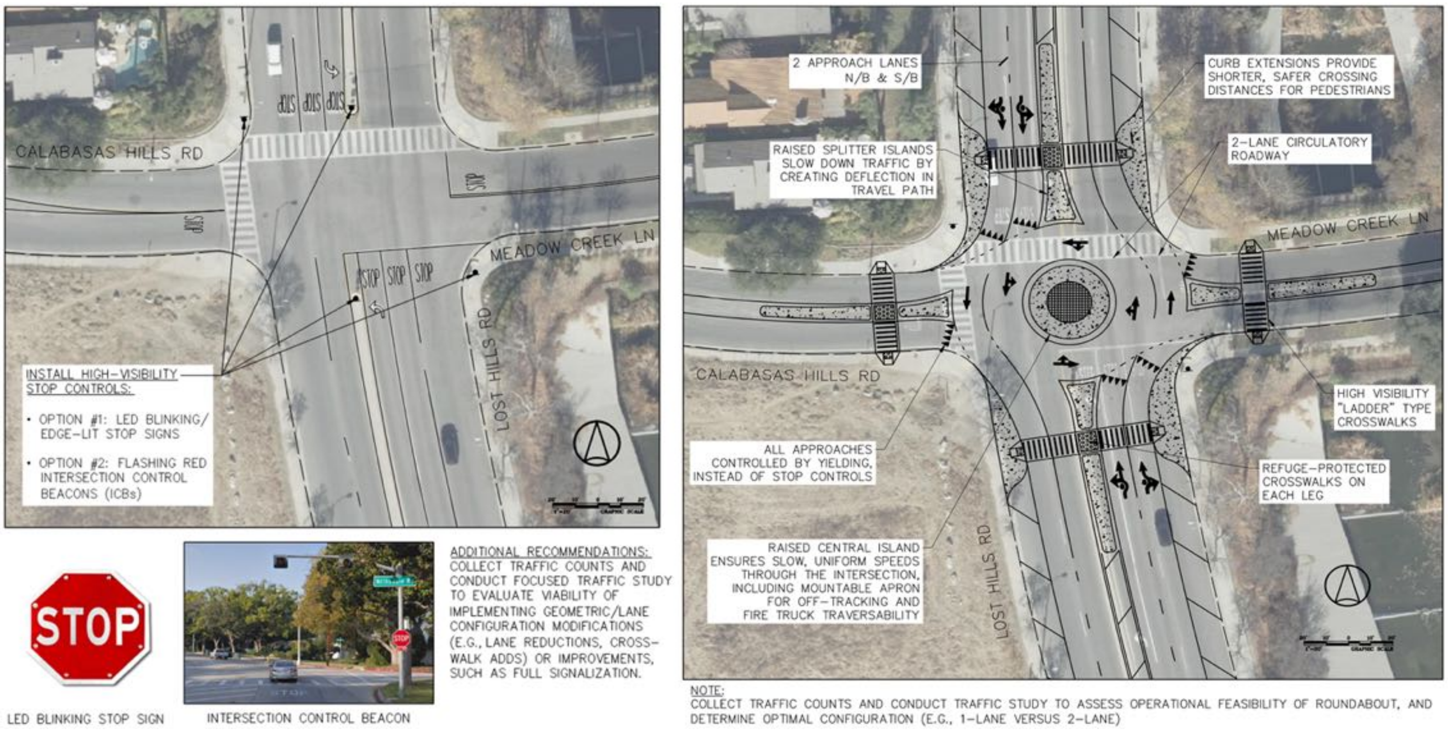
Figure 6.18 Crash Statistics – Lost Hills Road and Calabasas Hills Road



The following safety countermeasures that could be considered in this intersection are shown in **Figure 6.29**.

- Install high visibility stop controls at the existing multi-way stop controlled intersection.
- Consider converting the stop control intersection into roundabout
  - High visibility ladder type crosswalk
  - Approaches control by Yielding
  - Raised central island

Figure 6.19 Recommended Improvements – Lost Hills Road and Calabasas Hills Road



6.3.6.1 Lost Hills Road and Cold Spring Street

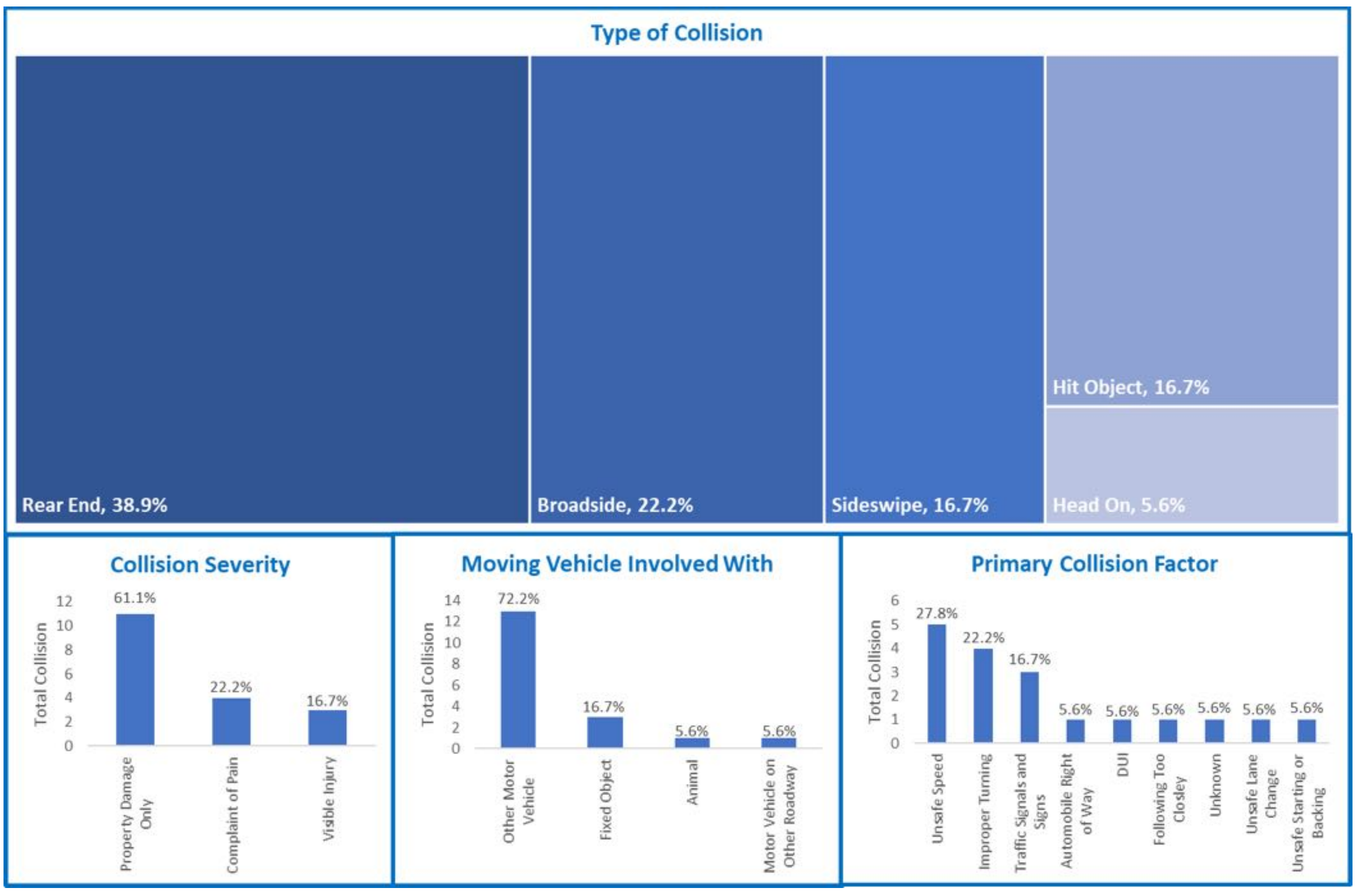
The unsignalized, 3-way stop controlled intersection at Lost Hills Road and Cold Spring street provides two travel lanes and a left-turn lane on Lost Hills Road, and one shared travel lane on the eastbound approach on Cold Spring Street. This intersection, located 1,750 feet north of the existing intersection of Lost Hills Road and Calabasas Hills Road, is not included in the EPDO Top 10 intersection ranking list; however, as the nearby Lost Hills Road and Cold Spring Street intersection's safety measures were discussed in the Traffic and Transportation Commission (TTC) meeting, the City now wishes to address safety issues at this location. The City recently upgraded the intersection with edge-lit stop signs, in-roadway warning lights (in-pavement flashers), and curb extensions to reduce the pedestrian crossing distance and improve sight distance and visibility between pedestrians and motorists.

6.3.7 Las Virgenes Road and Lost Hills Road

The signalized intersection at Las Virgenes Road and Lost Hills Road has two travel lanes with a left-turn lane on Las Virgenes Road, while Lost Hills Road has left-turn, a through lane, and a dedicated right-turn lane on north-west side and all three in combine one lane on south-east side of the intersection. A raised median is provided on Lost Hills Road, and the left-turn lane has protected left-turn phasing for the north-eastbound and south-westbound approaches. The posted speed limit is 50 mph on Las Virgenes Road and 45 mph on Lost Hills Road. Standard crosswalks and ADA-compliant curb ramps are provided at the intersection.

A total of 18 crashes occurred at the Las Virgenes Road and Lost Hills Road intersection from January 2015 to December 2020. The intersection ranked 7th by EPDO score. The primary crash types include rear end (40%), broadside (22%), and sideswipe (17%). Also, the primary crash factors were unsafe speed (28%) and improper turning (22%). **Figure 6.20** illustrates the crash statistics for this intersection.

Figure 6.20 Crash Statistics – Las Virgenes Road and Lost Hills Road

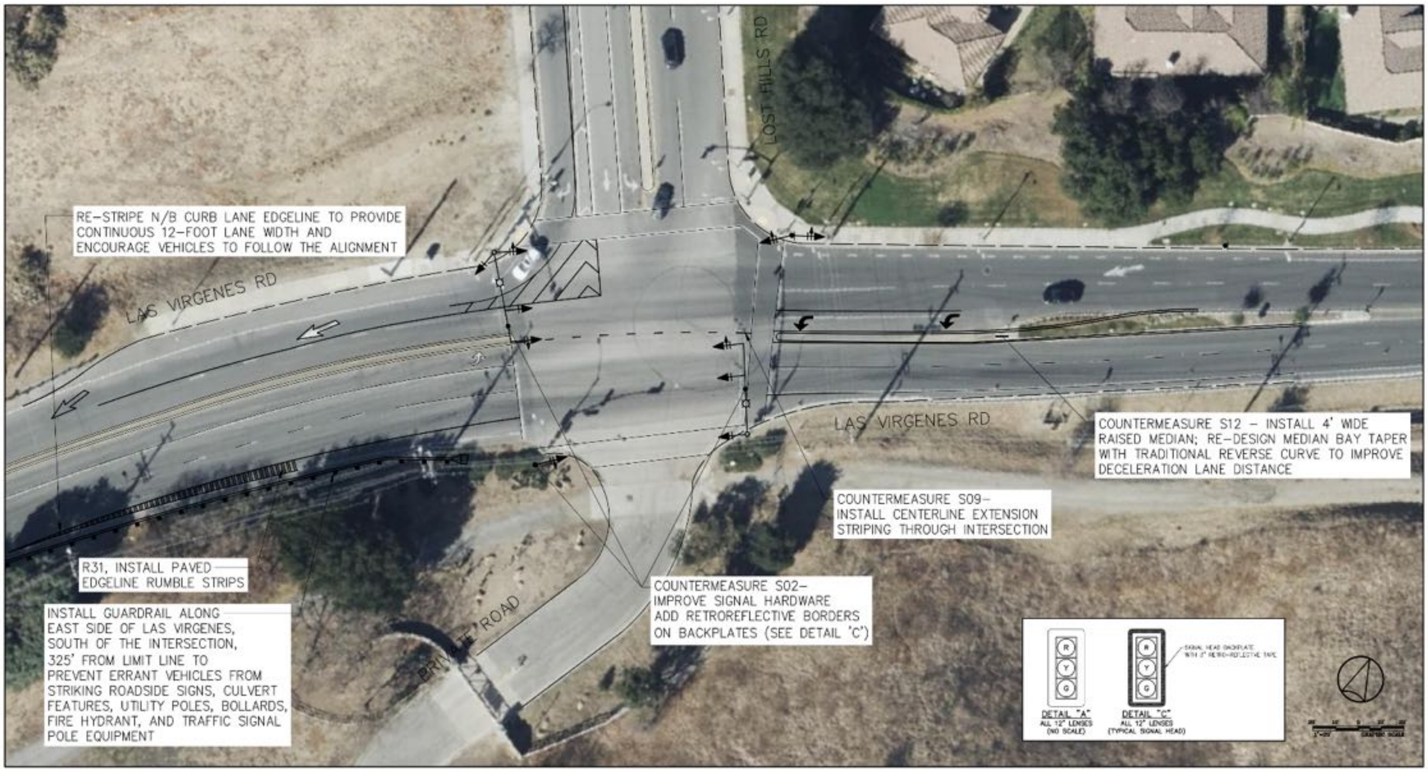


The following safety countermeasure that could be considered in this intersection is shown in **Figure 6.21**.

- S02 – Improve signal hardware: Add retroreflective borders on backplates on both the side of Las Virgenes Road.

- S09 – Install centerline extension striping through intersection and re-strip southbound approach to fully merge traffic before the intersection.
- S12 – Install wide raise median on northbound. Re-design median bay taper with traditional reverse curve to improve deceleration lane distance.

Figure 6.21 Recommended Improvements – Las Virgenes Road and Lost Hills Road

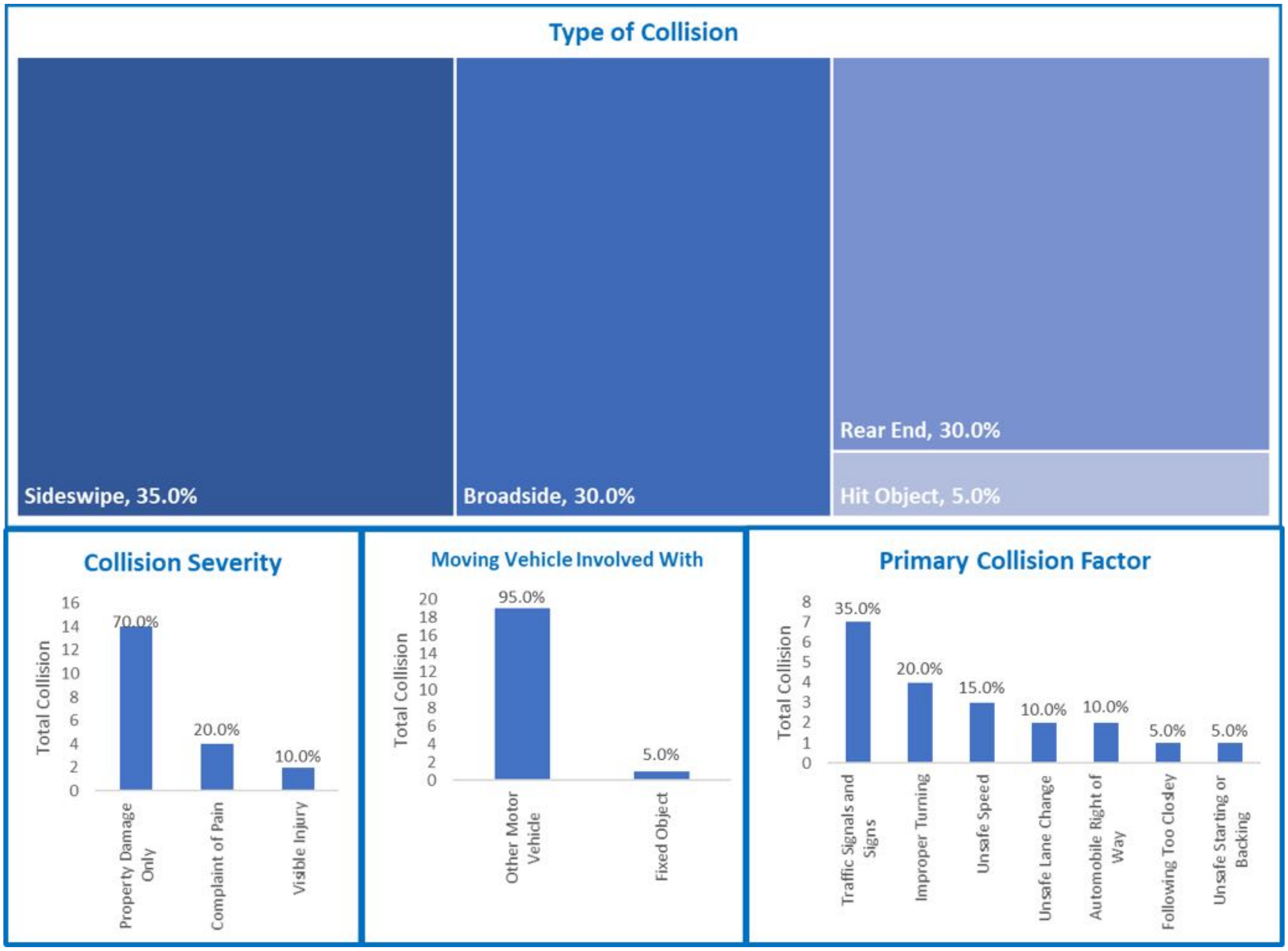


6.3.8 Lost Hills Road and Agoura Road

The signalized intersection at Lost Hills Road and Agoura Road has two travel lanes with a left-turn lane in all directions. Also, a dedicated right-turn lane is provided in northbound. Class II bike lanes are provided on Agoura Road and on westbound. The posted speed is 45 mph on Lost Hills Road and 45 mph on Agoura Road. Standard crosswalks and ADA-compliant curb ramps are provided at the intersection.

A total of 20 crashes occurred at the Lost Hills Road and Agoura Road intersection from January 2015 to December 2020. The intersection ranked 8th by EPDO score. The primary crash types include sideswipe (35%), broadside (30%), and rear end (30%). Also, the primary crash factors were traffic signals and signs (35%), improper turning (20%), and unsafe speed (15%). **Figure 6.22** illustrates the crash statistics for this intersection.

Figure 6.22 Crash Statistics – Lost Hills Road and Agoura Road

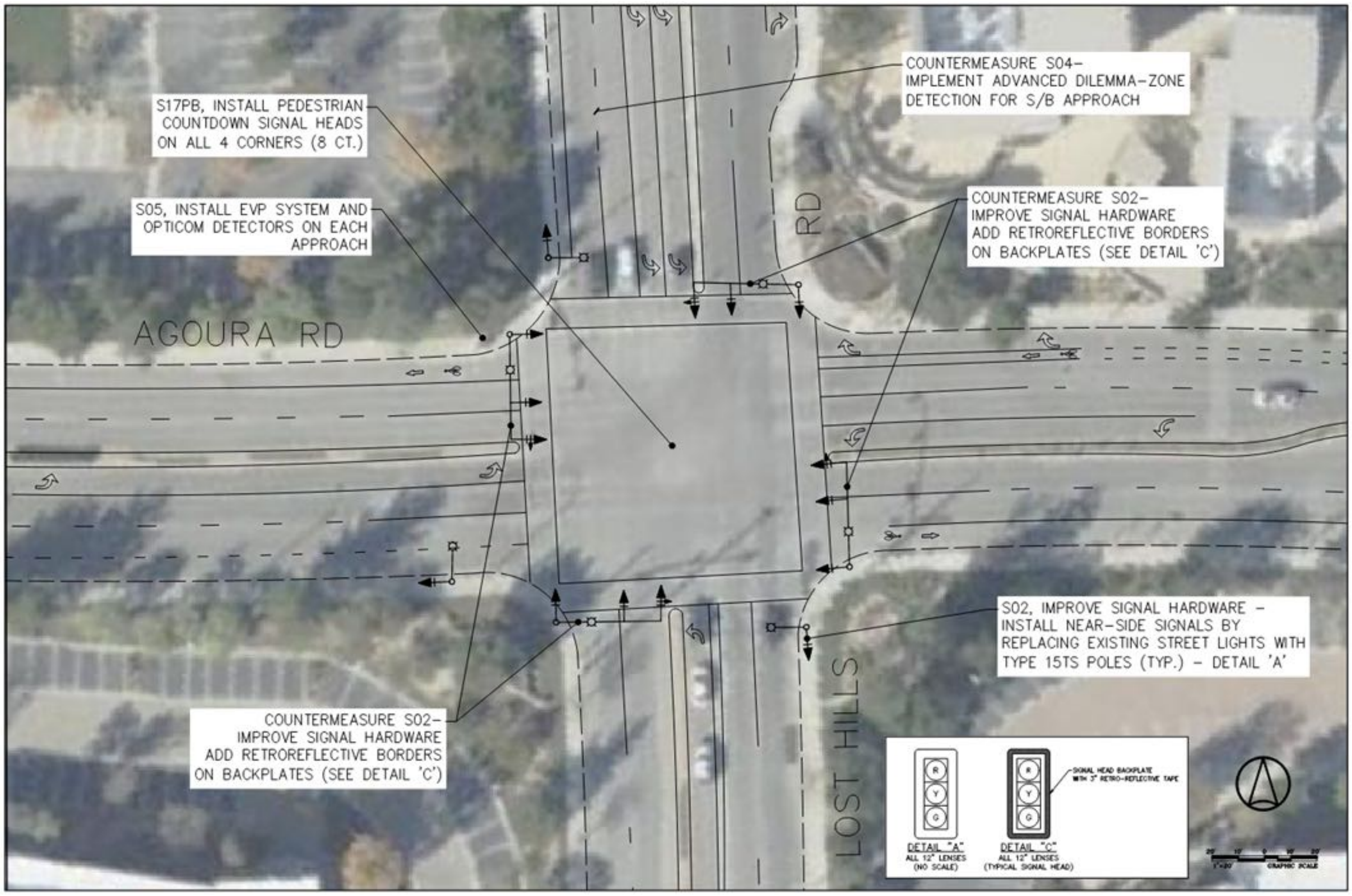


The following safety countermeasures could be considered in this intersection and are shown in **Figure 6.23**.

- S02 – Nearside traffic signals may provide better visibility of intersection signals. Consider providing the nearside supplemental signals on Lost Hills Road (southbound approach).

- S04 - Advance dilemma zone detection may address the frequency of red-light violations, reducing the frequency of crashes associated with the traffic signal phase change. Consider providing the advanced dilemma zone detection at this intersection on Lost Hills Road (northbound approaches).
- S05 – Install EVP system opticom detectors on each approaches.

Figure 6.23 Recommended Improvements – Lost Hills Road and Agoura Road

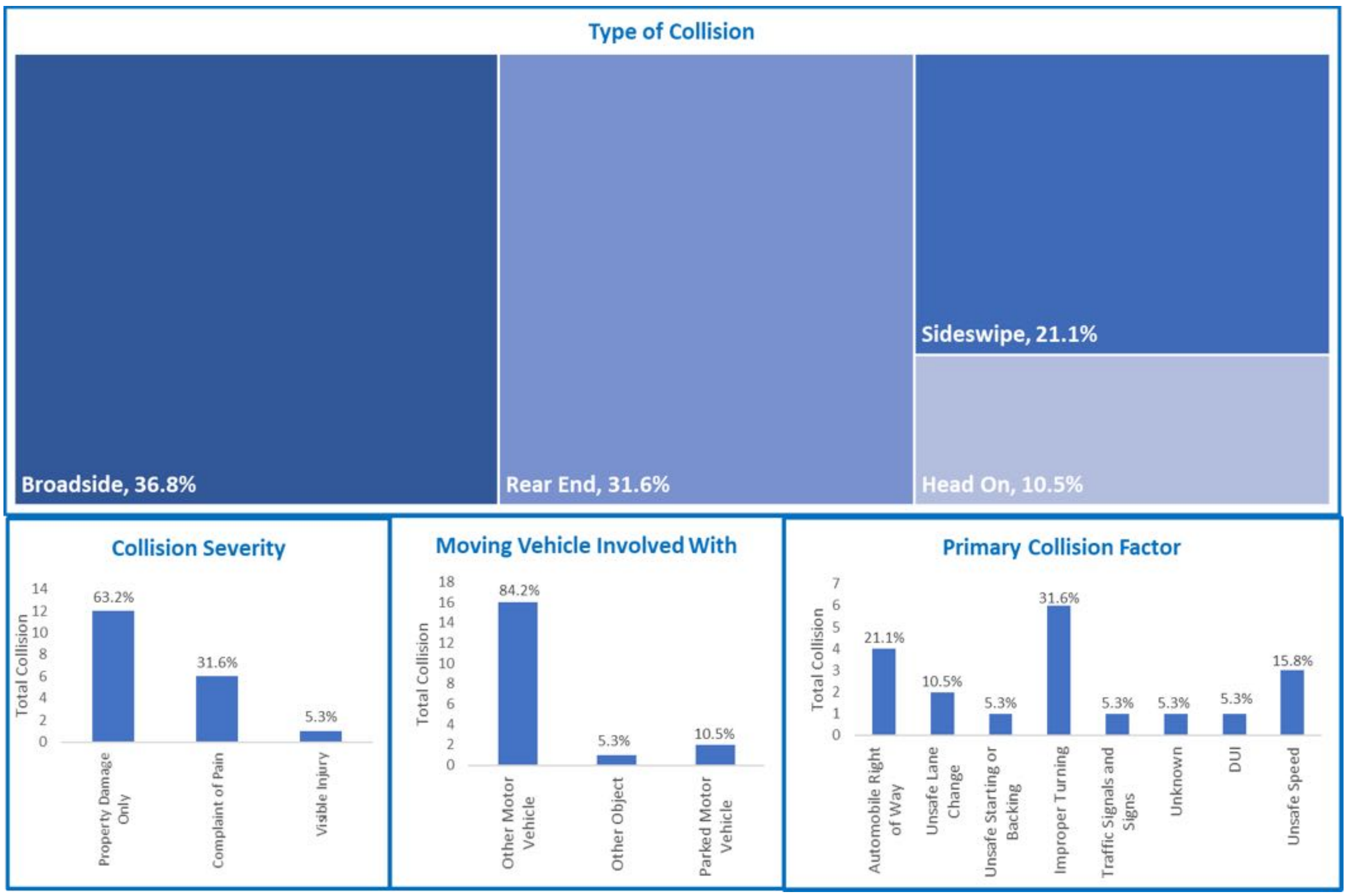


6.3.9 Calabasas Road and Park Granada

The signalized intersection at Calabasas Road and Park Granada has two travel lanes with dual left-turn lanes on westbound and northbound of the intersection, while eastbound has two travel lanes and separate left-turn and right turn lanes in same direction. Protected left-turn phasing is provided at this intersection. The posted speed limit is 40 mph on Calabasas Road and 40 mph on Park Granada. Pedestrian crosswalks and ADA-compliant curb ramps are provided at the intersection.

A total of 19 crashes occurred at the Calabasas Road and Park Granada intersection from January 2015 to December 2020. The intersection ranked 9th by EPDO score. The primary crash types include broadside (37%), rear end (31%), and sideswipe (21%). Also, the primary crash factors were improper turning (31%), automobile right of way (21%), and unsafe speed (15%). **Figure 6.24** illustrates the crash statistics for this intersection.

Figure 6.24 Crash Statistics – Calabasas Road and Park Granada

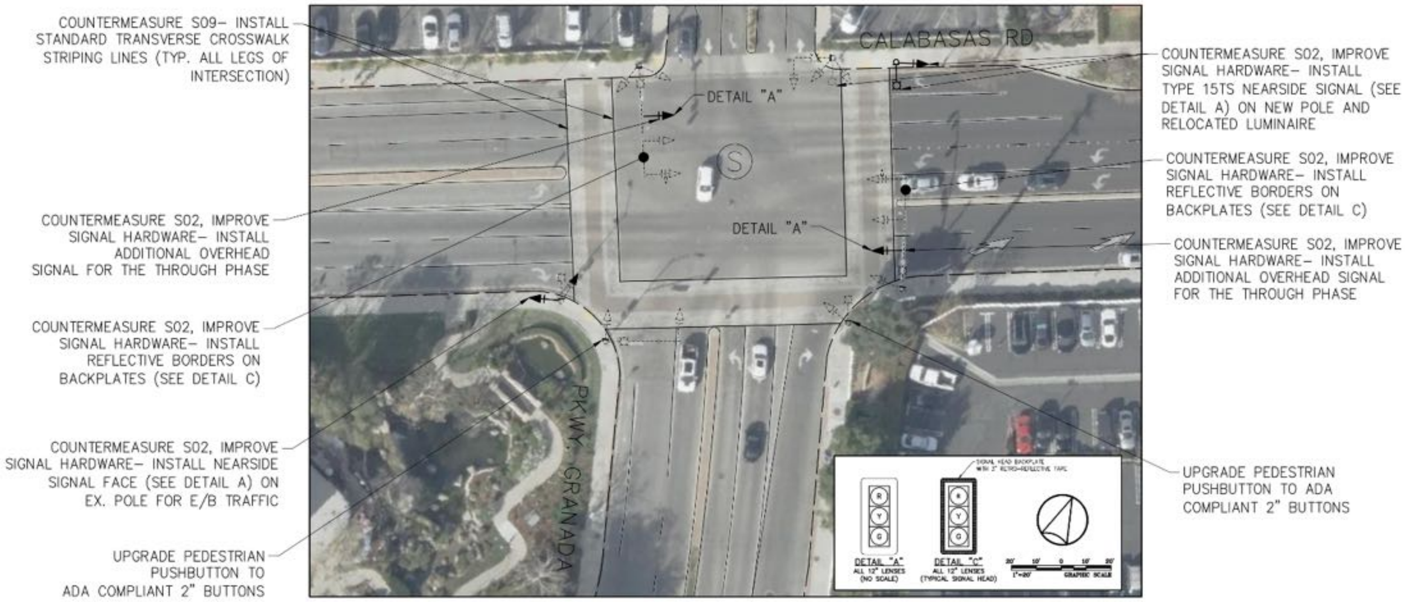


The following safety countermeasures could be considered in this intersection and are shown in **Figure 6.25**.

- S02 – Nearside traffic signals may provide better visibility of intersection signals. Consider providing nearside supplemental signals on Calabasas Road and Park Granada (all approaches expect southbound)

- Consider upgrading pedestrian push button to ADA compliant hardware.
- S09 – Considering refreshing striping to install standard traverse crosswalk on all approaches.

Figure 6.25 Recommended Improvements – Calabasas Road and Park Granada

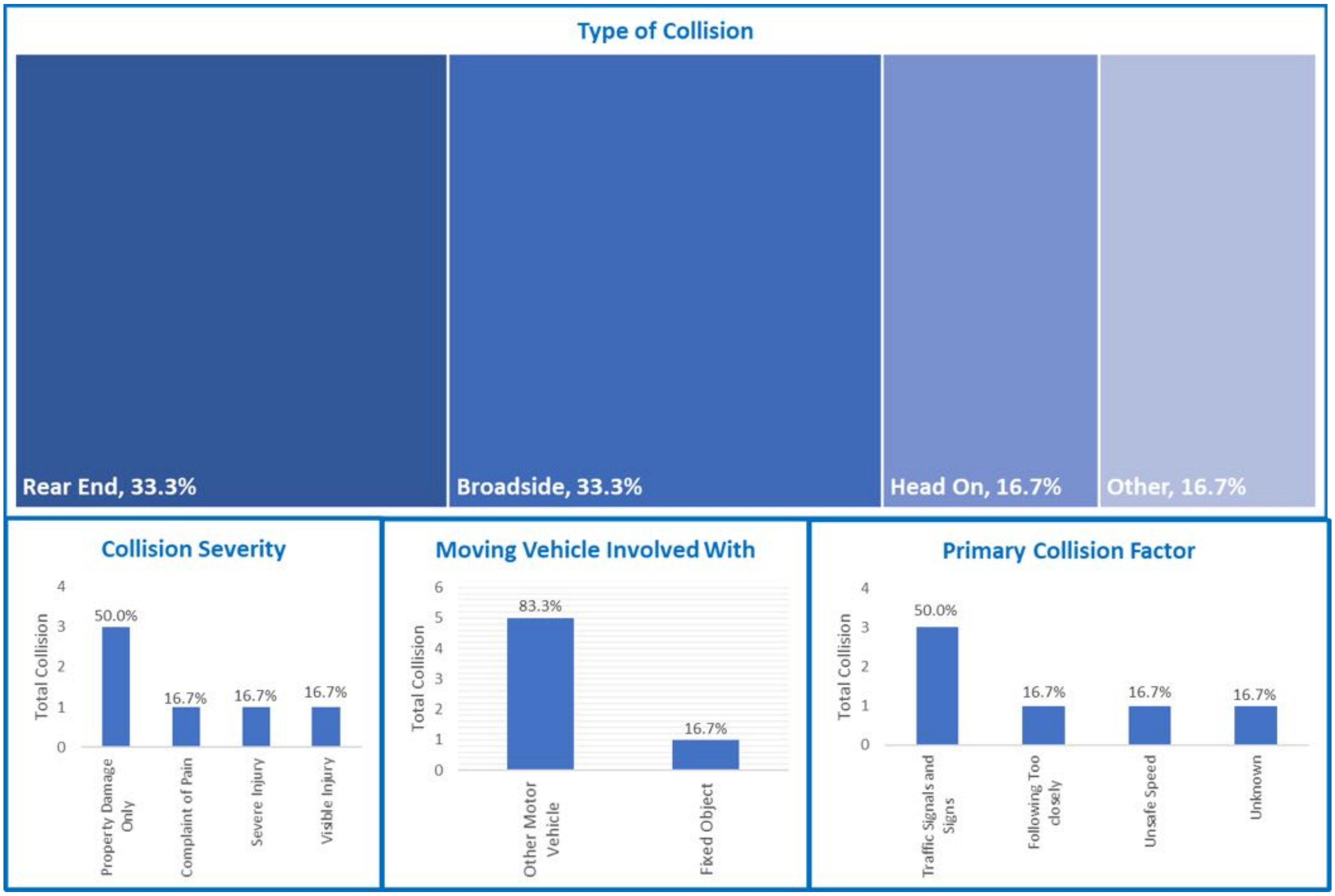


6.3.10 Mulholland Highway and Paul Revere Drive

The signalized intersection at Mulholland Highway and Paul Revere Drive has two travel lanes with a left-turn lane on Mulholland Highway (Westbound approach), while Paul Revere Drive has only one lane, that combine both left and right turns. There is no through lane on Paul Revere Drive. Raised medians are provided in on east direction. The westbound approach has protected phasing. The posted speed limit is 40 mph on Mulholland Highway. Standard crosswalks and ADA-compliant curb ramps are provided at the intersection.

A total of 6 crashes occurred at the Mulholland Highway and Paul Revere Drive intersection from January 2015 to December 2020. The intersection ranked 10th by EPDO score. The primary crash types include broadside (33%) and rear end (33%). Also, the primary crash factor was traffic signals and signs (50%). **Figure 6.26** illustrates the crash statistics for this intersection.

Figure 6.26 Crash Statistics – Mulholland Highway and Paul Revere Drive

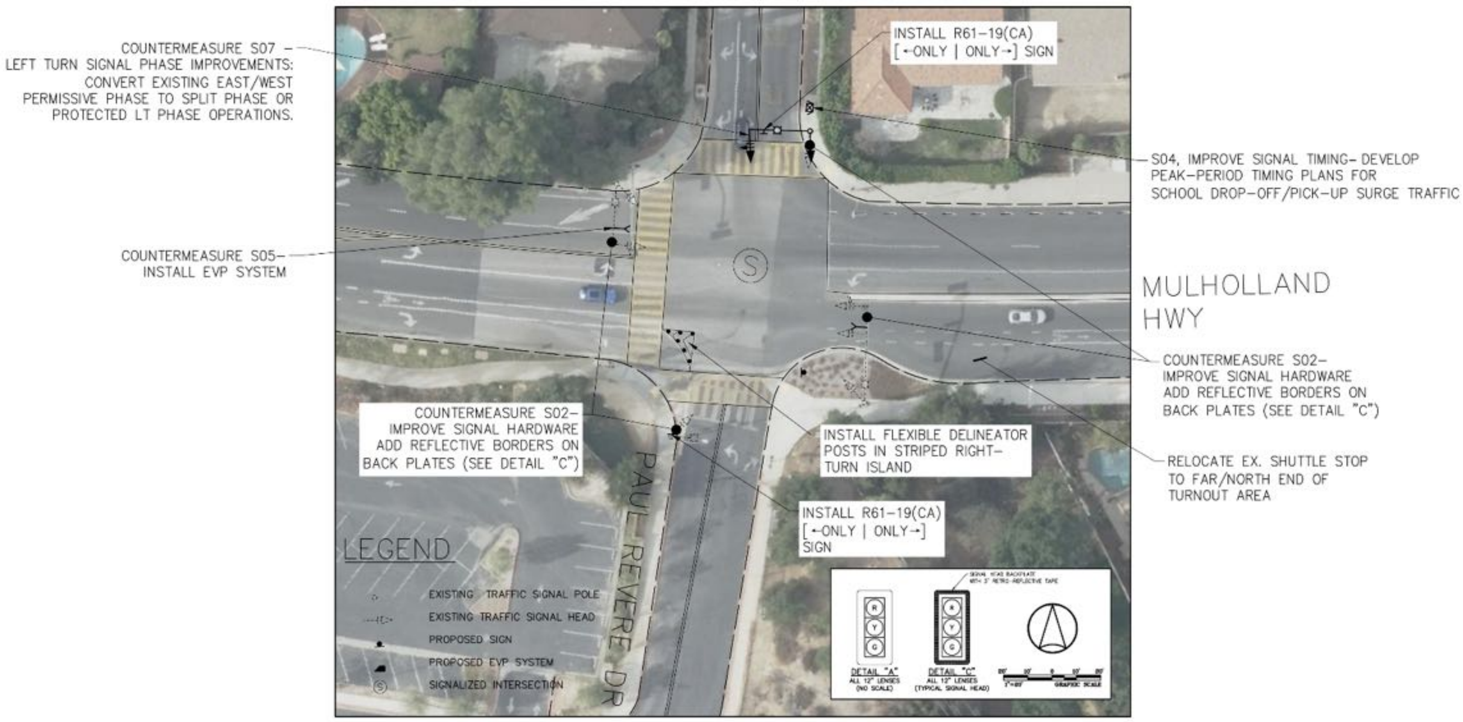


The following safety countermeasures could be considered in this intersection are shown in **Figure 6.27**.

- S05 – Consider installing EVP system along Mulholland Hwy.
- S07 - Separate left turn lane from single lane and consider providing new protected left turn signal heads.

- S09 - Consider re-striping the standard crosswalks to high-visibility crosswalks on all approaches.
- Remove conflicting white crosswalk marking on the northbound approach to reduce confusion..

Figure 6.27 Recommended Improvements – Mulholland Highway and Paul Revere Drive

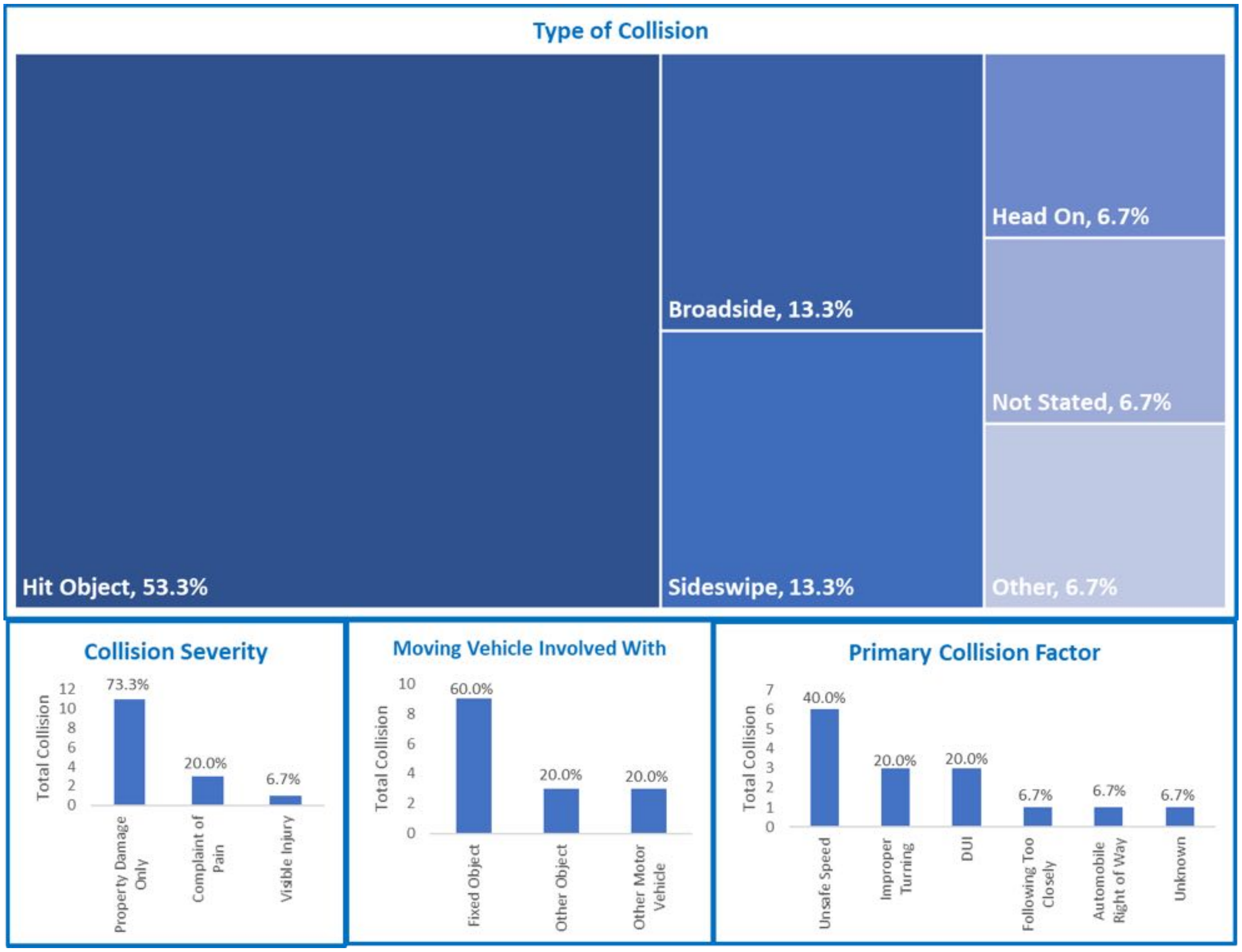


6.3.11 Parkway Calabasas and Camino Portal

The roundabout with yield control at Parkway Calabasas and Camino Portal has one travel lane on both the streets. Lemon Avenue has one travel lane, also with dual left-turn lanes (southbound). Standard crosswalks and ADA-compliant curb ramps are provided at the intersection.

A total of 15 crashes occurred at the Parkway Calabasas and Camino Portal intersection from January 2015 to December 2020. The intersection ranked 11th by EPDO score. The primary crash types include hit object (53%), broadside (13%), and sideswipe (13%). Also, the primary crash factor was unsafe speed (40%) and improper turning (20%). **Figure 6.28** illustrates the crash statistics for this intersection.

Figure 6.28 Crash Statistics – Parkway Calabasas and Camino Portal



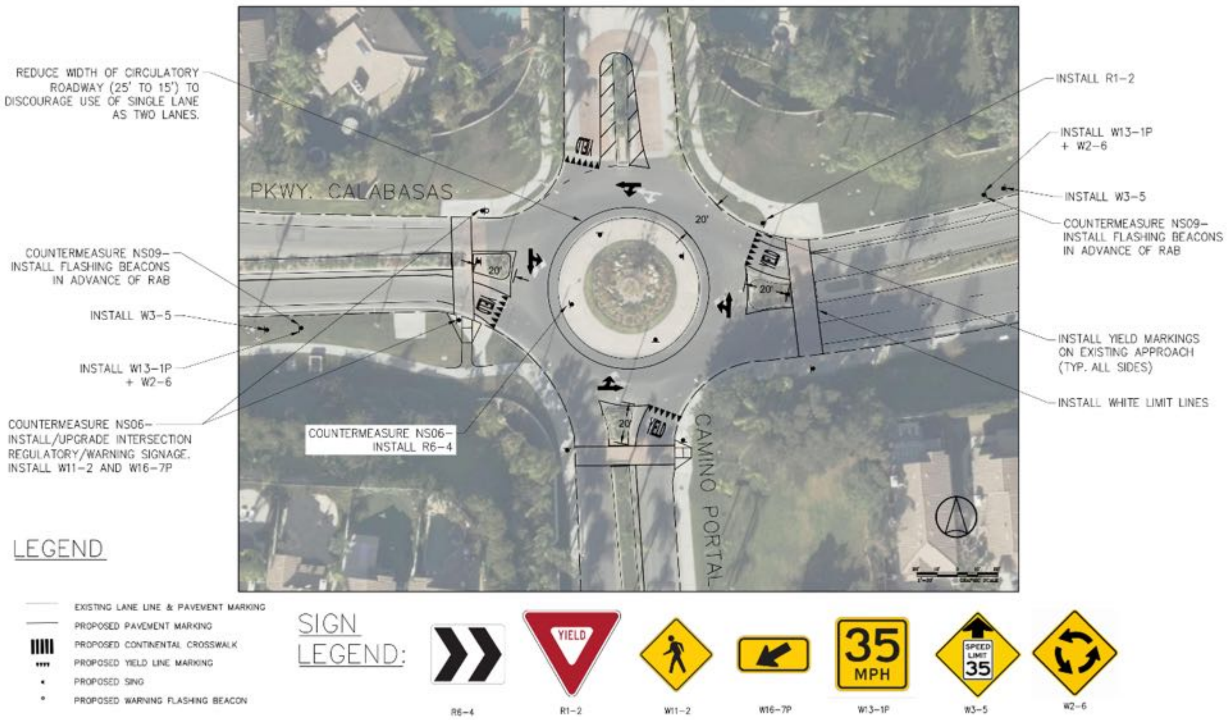
The following safety countermeasures could be considered in this intersection and are shown in **Figure 6.29**.

- NS07 - Consider adding white limit lines to the existing decorative crosswalks on all approaches.

- Consider adding intersection lighting – Reassess night item conditions and optimize street lighting layout.

- NS06 – Install/Upgrade intersection regulatory/warning signage. The City has already started this upgrade and many of the signs were recently replaced.

Figure 6.29 Recommended Improvements – Parkway Calabasas and Camino Portal



7.0 NON-ENGINEERING SAFETY MEASURES

This section presents the non-infrastructure solutions to Calabasas roadway safety needs. The programs will promote safe behavior in each plan's identified transportation safety emphasis areas through education, law enforcement, and encouragement.

7.1 FUNDING SOURCES

Several state and federal grant programs offer to fund non-engineering roadway safety projects. The California Department of Transportation's (Caltrans) Active Transportation Program (ATP) encourages bicycle and pedestrian use in the state by funding programs that increase bike or pedestrian mode share or improve bicycle or pedestrian safety. Caltrans also administers the Sustainable Communities Grant Program, which awards grants to municipal projects that reduce Greenhouse Gas Emissions and support multi-modal transportation. The Sustainable Communities Program prioritizes projects that solicit stakeholder and community engagement and support state policies like the 2040 California Transportation Plan. The California Office of Traffic Safety awards grants for projects addressing any one or more of ten priority areas, including Driving Under the Influence, Distracted Driving, Pedestrian and Bicycle Safety, Police Enforcement, Safety Data Collection, and Marketing/Publicity Campaigns.

At the federal level, the Advanced Transportation and Congestion Management Technologies Deployment Program funds technology to promote safety and efficiency in the transportation system. The Highway Safety Improvement Program (HSIP) funds roadway improvements on any public roadway. **Table 7.1** provides a list of eligible programs and the funding sources for related to transportation safety.

Table 7.1 Transportation Safety Funding Sources Summary

Agency	Source	Eligible Programs	Areas Addressed
Federal Highway Administration (FHWA)	Highway Safety Improvement Program (HSIP)	Any work on public roads, bikeways and pedestrian paths/trails. For the most part, only engineering projects are eligible but the FAST act permits funding for data collection by law enforcement[1,2].	Data Collection
Federal Highway Administration (FHWA)	Advanced Transportation and Congestion Management Technologies Deployment Program	Funds advanced transportation and congestion management technologies to improve safety, efficiency and performance. Examples of funded project types include advanced traveler information systems and data collection and analysis efforts[3].	Digital Enforcement; Technology Partnerships

Agency	Source	Eligible Programs	Areas Addressed
California Department of Transportation (Caltrans)	Active Transportation Program (ATP)	Local government projects that improve the safety or increase the mode share of bicycling and walking. Additional program objectives include reducing emissions and enhancing public health[4].	Bicycle and Pedestrian Education and Enforcement
California Department of Transportation (Caltrans)	Sustainable Communities Grant Program	The program awards "Competitive Grants" to local governments. These grants prioritize projects that reduce Greenhouse Gas Emissions, support multi-modal transportation, involve stakeholder/ community engagement and support related plans like the California Transportation Plan and California Complete Streets Framework[5] .	Active Transportation
			Speed and Education
California Office of Traffic Safety	Office of Traffic Safety (OTS) Grants	Programs should address one of ten priority areas (six relevant ones listed to the right). Grant recipients should expect to wait up to 90 days before being reimbursed/funded, and should be able to provide traffic safety data to justify funded programs[6].	Driving under the Influence of Drugs/Alcohol (DUI)
			Distracted Driving
			Ped/Bike Safety
			Police Enforcement
			Roadway Safety and Data Collection
			Social Media/Marketing

Sources:

1. *Highway Safety Improvement Program Guidelines, April 2016*
2. *Highway safety improvement program, Pub. L. No. 148, 23 US Code (2015). https://www.law.cornell.edu/uscode/text/23/148.*
3. *Advanced Transportation and Congestion Management Technologies Deployment. February 2016. https://www.fhwa.dot.gov/fastact/factsheets/advtranscongmgmtfs.cfm.*
4. *2021 Active Transportation Program Guidelines. March 25, 2020. Resolution G-20-31.*
5. *California Department of Transportation. Sustainable Transportation Planning Grant Program. December 2019.*
6. *California Office of Traffic Safety Grant Manual for Federal Fiscal Year 2020. December 2019.*

7.2 YOUNG DRIVERS

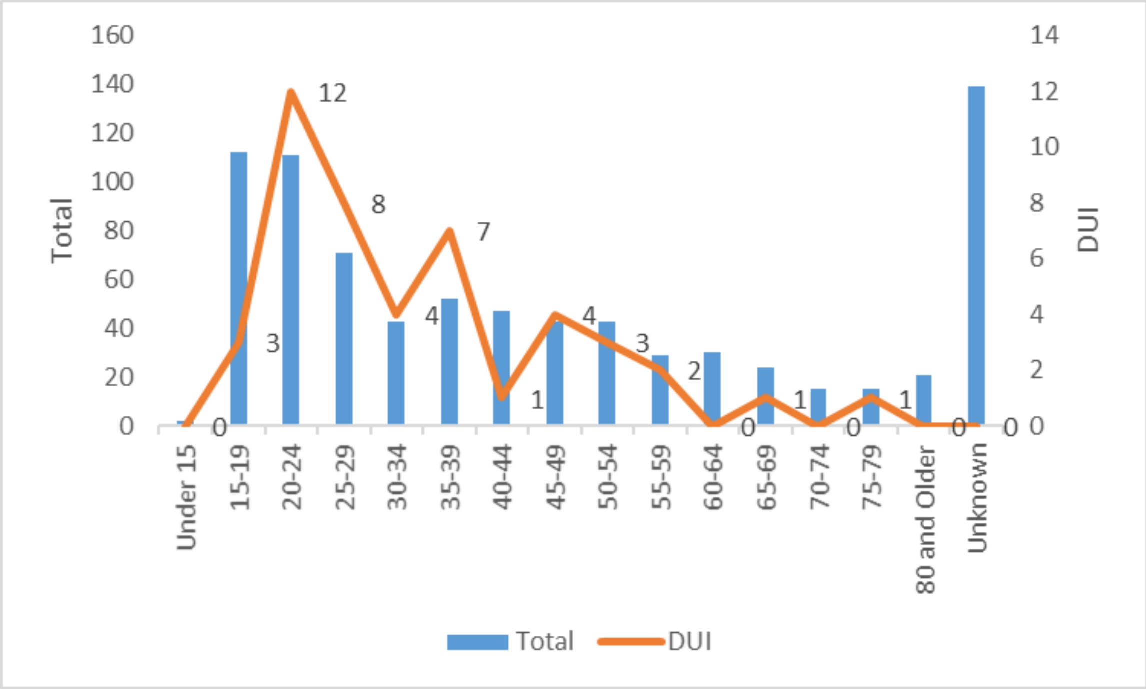
The crash analysis revealed that drivers under the age of 25 were at fault was 66 percent of total crashes in Calabasas. Younger drivers' relative lack of experience and judgment[2] makes them more likely to engage in risky behaviors, such as speeding or distracted driving. In Calabasas, nearly 99 percent of households own at least one vehicle, and motorists are more inclined to acquire licenses at an earlier age. Therefore, educating young drivers on the importance of safe driving practices is a key pillar of the city's LRSP.

Youth drunk driving is a problem worth examining on its own. The crash data indicated that drivers under

[2] *Johnson, "Why Is 18 the Age of Adulthood If the Brain Can Take 30 Years to Mature?" https://bigthink.com/mind-brain/adult-brain*

25 were associated with 32 percent of DUI crashes in Calabasas. Drivers younger than 21, the minimum legal drinking age in California, were associated with 11 percent of DUI crashes. The City may consider implementing programs warning youth about the dangers of drinking and driving. See **Figure 7.1** for age breakdown of DUI crashes.

Figure 7.1 – DUI Crashes as per Age Group



The following safety (non-engineering) programs or program elements can be considered to address young drivers' safety risks.

7.2.1 EDUCATION

- Consider incorporating the Start Smart Program[3] into the high school curriculum. Move the class location from the sheriff's office to the school campus and allow students to take elective unit classes.
- Expand the school safety program, which brings police officers to Elementary School (K-5) classes, to include Middle and High Schools.
- Establish an interactive simulation program for high school students – Every 15 Minutes[4]. The interactive simulation program aims to challenge high school juniors and seniors about drinking, driving, and mature decision-making. Every 15 Minutes program is funded through the California Office of Traffic Safety, and the California Highway Patrol provides mini-grants to schools to implement every 15 Minutes program. Every 15 Minutes program is a two-day program focusing on high school juniors and seniors. The program challenges them to think about drinking, driving, personal safety, the responsibility of making decisions, and the impact their decisions have on their family, friends, and community.

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[3] *Start Smart Program, https://www.chp.ca.gov/programs-services/programs/youth-programs/start-smart-driving-smart-to-stay-safe*

[4] *https://www.chp.ca.gov/programs-services/programs/youth-programs/every-15-minutes*

- Start a social media campaign at local middle and high schools, encouraging students to post videos on the danger of using their phones while driving. One possible concept might be "Save the Snap": a student gets out their phone just after putting the key into ignition only to get a comic reminder to "save the snap" for later.

7.2.2 ENFORCEMENT

- Monitor local liquor stores and bars suspected of selling alcohol to minors.
- Set up police checkpoints at night to enforce DUI and California's Graduated Licensing Law. The Graduated Licensing Law prohibits children under age 18 from driving with someone under the age of 21 or between 11 pm and 5 am without an adult (25 years old) supervision and catches drunk drivers.
- Provide training to sheriffs for finding DUIs and other driving behaviors

7.2.3 FUNDING SOURCES

Table 7.2 presents potential funding sources for programs addressing safety challenges faced by young drivers.

Table 7.2 Young Driver Program Funding Sources

DESCRIPTION	RESPONSIBLE AGENCY	FUNDING SOURCE
EDUCATION		
Incorporate the Start Smart Program into the high school curriculum. Move the class location from the sheriff's office to the school campus and allow students to take elective unit classes..	Los Angeles County Sheriff's Department, California Highway Patrol, Las Virgenes Unified School District	OTS Grants
Expand the School Safety Program, which brings police officers to include Middle and High Schools.	Los Angeles County Sheriff's Department, Las Virgenes Unified School District	OTS Grants
Establish the stage an interactive simulation program for high school students – Every 15 Minutes. The interactive simulation program aims to challenge high school juniors and seniors about drinking, driving, and mature decision-making.	Las Virgenes Unified School District	OTS Grants
Start a Social Media Campaign at local middle and high schools, encouraging students to post videos on the danger of using their phones while driving.	Las Virgenes Unified School District	OTS Grants
ENFORCEMENT		
Monitor local liquor stores and bars suspected of selling alcohol to minors.	City of Calabasas, Los Angeles County Sheriff's Department	OTS Grants
Set up police checkpoints at night to enforce California's Graduated Licensing Law.	Los Angeles County Sheriff's Department	OTS Grants

7.3 REAR-ENDS AND SPEEDING

Speeding contributes significantly to crash frequency and severity. For instance, a car hitting a pedestrian is eight times more likely to kill that pedestrian when moving at 40 miles per hour than when moving at 20 miles per hour. In the local context, speeding is the second-most common primary crash factor and the most frequent cause of rear-end crashes. Driving at unsafe speeds causes 39 percent of total rear-end crashes and 38 percent of rear-end crashes at signalized intersections.

The following safety (non-engineering) programs or program elements can be considered to address rear ends and speeding-related crashes.

7.3.1 EDUCATION

- Create a social media campaign

7.3.2 ENCOURAGEMENT/EMERGING TECHNOLOGY

- Partner with navigation technology companies like Google and Waze to improve in-app messaging, notifying drivers of approaching intersections.

7.3.3 ENFORCEMENT

- Install radar speed feedback signs at periodic intervals along arterials with reported speeding. These technologies display passing drivers' travel speed below a sign with the posted speed limit, thus showing whether drivers are traveling over the speed limit[5,6].
- Deploy police officers equipped with radar or LIDAR technology at strategic locations to ticket speeding drivers.

7.5.4 FUNDING SOURCES

Table 7.3 presents potential funding sources for the programs addressing Rear-ends and Speeding. Regarding the program on partnering with navigation platforms, the Waze mobile app has a history of helping cities for no charge[7]. The company expects cities to reciprocate with data helpful to Waze (e.g. traffic signal or road closure information).

[5] SRTS Guide: Active Speed Monitors. (2015, July). http://guide.saferoutesinfo.org/enforcement/active_speed_monitor.cfm

[6] *SRTS Guide: Speed Trailers*. (2015, July). http://guide.saferoutesinfo.org/enforcement/speed_trailer.cfm

[7] *Ungerleider, N., & Ungerleider, N. (2015, April 15). Waze Is Driving Into City Hall. Fast Company. https://www.fastcompany.com/3045080/waze-is-driving-into-city-hall*

Table 7.3 Rear-end and Speeding Program Funding Sources

DESCRIPTION	RESPONSIBLE AGENCY	FUNDING SOURCE
EDUCATION		
Create a social media campaign.	City of Calabasas	OTS Grants
ENCOURAGEMENT		
Partner with navigation technology companies like Google and Waze to improve in-app messaging, notifying drivers of approaching intersections.	City of Calabasas, Google	Advanced Transportation and Congestion Management Technologies Deployment Program
ENFORCEMENT		
Install Active Speed Monitors or Speed Trailers at periodic intervals along arterials with reported speeding.	Los Angeles County Sheriff's Department	OTS Grants, Advanced Transportation and Congestion Management Technologies Deployment Program
Deploy police officers equipped with radar or LIDAR technology at strategic locations to ticket speeding drivers.	Los Angeles County Sheriff's Department	OTS Grants

Note: May be able to obtain for free in exchange for providing Waze with city data

7.4 IMPROPER TURNING/HIT-OBJECT/SIDESWIPE CRASHES

From 2015 to 2020, improper turning was one of the most common Primary Crash Factor (PCF) for crashes in Calabasas, constituting 16 percent of total crashes. There are various violations that fall under the improper turning category, such as improper turn at a traffic light, improper left or right turn, and improper U-turn. An example of improper turning may include making an improper left or right turn at a traffic signal when the driver fails to yield to a pedestrian. Another example may include making a right turn on a red light at an intersection with a "no right turn on red" sign.

Sideswipe and hit-object crashes were the two types of crashes, most often associated with improper turning. Sideswipe crashes related to Improper turning constitute 28 percent of sideswipe crashes. Of all fatal crashes, none of the fatalities was related to hit-object due to improper turning.

The following safety (non-engineering) programs or program elements can be considered.

7.7.2 ENCOURAGEMENT/EMERGING TECHNOLOGY

- Team up with Google to enhance safety features on Google Maps and Waze navigation apps to reduce improper turning and sideswipe crashes. For example, Waze app settings in Los Angeles direct drivers away from intersections requiring high-risk un-signalized left-turn movements[8]. An app function warning drivers when to change lanes could address sideswipe crashes.

7.7.3 ENFORCEMENT

- Install speed trailers at periodic intervals along arterials with reported speeding. These technologies display passing drivers' travel speed below a sign with the posted speed limit, thus showing whether drivers travel over the speed limit.
- Deploy police officers equipped with radar or LIDAR technology at strategic locations to ticket speeding drivers.

7.7.4 FUNDING SOURCE

Table 7.4 presents potential funding sources for the programs that address Improper turning, hit object, and sideswipe crashes. Waze has a history of helping cities for no charge[9], as the company expects cities to reciprocate with data helpful to Waze (e.g., traffic signal or road closure information).

Table 7.4 Improper Turning/Hit Object/Sideswipe Crash Program Funding Sources

DESCRIPTION	RESPONSIBLE AGENCY	FUNDING SOURCE
ENCOURAGEMENT		
Team up with Google to enhance safety features on Google Maps and Waze navigation apps to reduce improper turning and sideswipe crashes. For example, Waze app settings in Los Angeles direct drivers away from intersections requiring dangerous un-signalized left-turn movements.	City of Calabasas, Google	Advanced Transportation and Congestion Management Technologies Deployment Program
ENFORCEMENT		
Install speed trailers at periodic intervals along arterials with reported speeding. These technologies display passing drivers' travel speed below a sign with the posted speed limit, thus showing whether drivers travel over the speed limit.	Los Angeles County Sheriff's Department	OTS Grants, Advanced Transportation and Congestion Management Technologies Deployment Program
Deploy police officers equipped with radar or LIDAR technology at strategic locations to ticket speeding drivers.	Los Angeles County Sheriff's Department	OTS Grants

[8] Poon, L. (n.d.). In L.A., Waze Minimizes Left Turns, Putting Safety Over Speed. CityLab. Retrieved April 16, 2020, from http://www.citylab.com/tech/2016/06/waze-puts-safety-over-speed-by-minimizing-left-turns-in-la/487577/

[9] Ungerleider, N., & Ungerleider, N. (2015, April 15). Waze Is Driving Into City Hall. *Fast Company*. https://www.fastcompany.com/3045080/waze-is-driving-into-city-hall

8.0 SAFETY PROJECTS

This section provides the project scope, crash reduction benefits calculation, cost estimation, and Benefit to Cost (B/C) ratio analysis. This section also discusses and summarizes the project prioritization for the HSIP application.

8.1 PROJECT SCOPES AND BENEFIT CALCULATIONS

The development of project scopes involves identifying one or more specific countermeasures at potential locations for safety improvements. Expected benefits are derived by applying the proposed countermeasures and corresponding Crash Reduction Factors (CRFs) to the expected crashes. This involves:

- Identifying the current number of crashes without treatment
- Applying CRFs by type and severity
- Applying a benefit value by crash severity
- Calculating the annual crash reduction benefits and multiplying by the project life in years

Caltrans has established some key requirements and procedures for its calls-for-projects to allow agencies maximum flexibility in combining countermeasures and locations into a single project while ensuring all projects can be consistently ranked on a statewide basis. These include:

- Only a maximum of three individual countermeasures can be utilized in the B/C ratio for a project.
- For a countermeasure to be utilized in the B/C ratio calculations, it must represent a minimum of 15 percent of the project's total construction cost. This is intended to ensure that minor and insignificant project elements are not misrepresented to the agency's major safety effort.

An engineer determining the benefits of newly installed infrastructure first determines the number of crashes with the potential to be prevented by the improvement. The engineer then applies the CRF, which gives the rough percentage of crashes that would be prevented. The next step in estimating the overall benefit of a proposed improvement project is multiplying the expected reduction in crashes by a generally accepted value for the "cost" of crashes. The expected "benefit" value for a project is the expected "reduction in costs" value from reducing future crashes. The source for the costs by crash severity level was taken from Appendix D of the Caltrans Local Roadway Safety Manual:

- Fatal and Severe Injury Combined (KA[10])- Signalized Intersection - $1,590,000
- Fatal and Severe Injury Combined (KA[10])- Non-Signalized Intersection - $2,530,000
- Fatal and Severe Injury Combined (KA[10])- Roadway - $2,190,000
- Evident - $142,300
- Possible Injury- Complaint of Pain (C[10]) - $80,900
- Property Damage Only (O[10]) - $13,300

[10]K – Fatality
A – Severe
C – Complaint of Pain
O – Property Damage Only

The final step in calculating the total safety project benefits is to divide the benefits by the number of years the crash data was collected (five years for this project) and multiply this value by the project life in years.

For this LRSP, instead of calculating project benefits manually, project benefits were derived from entering crash data directly into the HSIP Analyzer tool. The tool auto-calculates project crash reduction benefits based on the method discussed above, and reduces benefits calculated if more than one project is included due to cumulative effects.

The safety project scopes are listed in **Table 8.1**, including the applicable countermeasure category for each improvement and benefits calculated according to the method above.

Table 8.1 Safety Project Scopes

Project 1: Calabasas Road and Parkway Calabasas

CM #	Countermeasure Names	Description	Crash Type	CRF	Project Life (Years)	No. of Preventable Crashes
S02	Improve signal hardware	• Add retroreflective borders on backplates • Install additional overhead signal faces and new mast arms on northbound face	All	15%	10	45
S04	Provide advance dilemma-zone detection for high speed approaches	• Install advance dilemma zone detection on w/b approach	All	40%	10	13
S09	Install raised pavement markers and striping	• Install intersection striping	All	10%	10	45

Project 2: Las Virgenes Road and Agoura Road

CM #	Countermeasure Names	Description	Crash Type	CRF	Project Life (Years)	No. of Preventable Crashes
S02	Improve signal hardware	• Add retroreflective borders on backplates on La Virgenes Road	All	15%	10	42
S05	Install emergency vehicle pre-emption system	• Add EVP system	Emergency Vehicle	70%	10	42
S09	Install raised pavement markers and striping	• Install intersection striping	All	10%	10	42
S12	Install raised median on approaches	• Replace ex. TWLT lane on s/b approach with a raised median	All	25%	20	7

Project 3: Las Virgenes Road and Mureau Road

CM #	Countermeasure Names	Description	Crash Type	CRF	Project Life (Years)	No. of Preventable Crashes
S02	Improve signal hardware	• Add retroreflective borders on backplates on La Virgenes Road on N/S direction	All	15%	10	17
S07	Provide protected left turn phase	• Install protected left turn phase on s/b approach	All (SB)	30%	20	12

Project 4: Parkway Calabasas and Park Granada

CM #	Countermeasure Names	Description	Crash Type	CRF	Project Life (Years)	No. of Preventable Crashes
S01	Add intersection lighting	• Replace ex. 1-A pole with type 15TS	Night	40%	20	15
S02	Improve signal hardware	• Add retroreflective borders on backplates • Replace ex. Mast arm with longer mast arm	All	15%	10	17
S07	Provide protected left turn phase	• Install protected left turn phase on s/b approach	All	30%	20	15
S09	Install raised pavement markers and striping	• Install intersection striping	All	10%	10	17

Project 5: Lost Hills Road and Calabasas Hills Road

CM #	Countermeasure Names	Description	Crash Type	CRF	Project Life (Years)	No. of Preventable Crashes
NS06/ NS08	Install LED blinking sing & Flashing Beacon	• Install high visibility stop control • Convert intersection into Roundabout	All	15%	10	17

Project 6: Las Virgenes Road and Lost Hills Road

CM #	Countermeasure Names	Description	Crash Type	CRF	Project Life (Years)	No. of Preventable Crashes
S02	Improve signal hardware	• Add retroreflective borders on backplates on w/b approaches	All	15%	10	16
S09	Install raised pavement markers and striping	• Install centerline extension • Re-strip s/b approach to fully merge traffic before the intersection	All	10%	10	18
S12	Install raised median on approaches	• Install 4' wide raised median	All	25%	20	18

Project 7: Lost Hills Road and Agoura Road

CM #	Countermeasure Names	Description	Crash Type	CRF	Project Life (Years)	No. of Preventable Crashes
S02	Improve signal hardware	• Add retroreflective borders on backplates on all approaches	All	15%	10	20
S04	Provide advance dilemma-zone detection	• Implement advance dilemma zone detection for s/b approach	All	40%	10	13
S05	Install EVP system	• Add EVP system	Emergency Vehicle	70%	10	20
S17PB	Install pedestrian countdown signal heads	• Install pedestrian countdown signal heads on all corners	All	25%	20	20

Project 8: Calabasas Road and Park Granada

CM #	Countermeasure Names	Description	Crash Type	CRF	Project Life (Years)	No. of Preventable Crashes
S02	Improve Signal Hardware	• Add retroreflective borders on backplates on w/b approaches • Install nearside signal face for e/b traffic • Install additional overhead signal for E/W direction	All	15%	10	19
S09	Install raised pavement markers and striping	Install standard transverse crosswalk striping lines	All	10%	10	19

Project 9: Mulholland Highway and Paul Revere Drive

CM #	Countermeasure Names	Description	Crash Type	CRF	Project Life (Years)	No. of Preventable Crashes
S02	Nearside Supplemental Signal	• Add retroreflective borders on backplates	All	15%	10	6
S04	Install signal timing	• Improve signal timing	All	40%	10	6
S05	Install EVP system	• Add EVP system	Emergency Vehicle	70%	10	6
S07	Provide protected left turn phase	• Convert E/W permissive phase to protective phase	All	30%	20	1
S09	Install raised pavement markers and striping	• Refresh traffic striping on all crosswalk	All	10%	10	6

Project 10: Parkway Calabasas and Camino Portal

CM #	Countermeasure Names	Description	Crash Type	CRF	Project Life (Years)	No. of Preventable Crashes
NS06	Upgrade Signage and Markings	• Install regulatory/warning signage	All	15%	10	15
NS09	Install flashing beacon	• Install flashing beacon in advance of RAB on E/W direction	All	30%	10	8

8.2 COST ESTIMATE

Planning-level cost estimates were developed for each countermeasure. Cost estimates were prepared based on recent bid tabulations and estimates of current construction costs consisting of unit-based cost estimates and contingencies. The costs include construction costs and include engineering and administrative costs. A contingency is added to the construction cost of each project depending on the complexity of the scope. The engineering and administration cost is assumed to be 25 percent of the total construction cost, including the contingency.

8.3 BENEFIT/COST RATIO

A Benefit/Cost Ratio (BCR) is the ratio of a project's benefits relative to its costs, and both are expressed in monetary terms. The BCR is calculated by taking a project’s overall benefit and dividing it by the overall project cost. Projects with a higher BCR mean greater benefits relative to costs, while a lower BCR means fewer benefits than costs.

Based on Caltrans’s need for a fair, data-driven, statewide project selection process for HSIP call-for-projects, the benefit and cost calculations were completed using the same process shown in the HSIP Analyzer to calculate the B/C ratio of the project. The B/C ratios were used to identify the projects with high cost-effectiveness that may have a greater chance of receiving federal funding in Caltrans call-for-projects. **Table 8.2** summarizes the B/C ratio proposed safety projects. The benefit/cost ratio is calculated according to the HSIP Analyzer from the HSIP grant application.

Table 8.2 Benefits/Cost Ratio Analysis by Safety Project

ID	Location	CM #	Countermeasure	Crash Benefits	Cost ($)	Benefit/Cost Ratio	HSIP Max Share	HSIP Amount	Local Amount
1	Calabasas Road & Parkway Calabasas	S02	Upgrade signal hardware	$578,175	$40,749	14.19	100%	$40,749	$0
		S04	Provide advance dilemma-zone	$549,400	$73,320	7.49	100%	$73,320	$0
		S09	Install raised pavement markers and striping	$385,450	$564	683.42	100%	$564	$0
TOTAL				**$1,513,025**	**$114,633**	**13.20**		**$0**	**$0**
2	Las Virgenes and Agoura Road	S02	Upgrade signal hardware	$373,150	$41,595	8.97	100%	$41,595	$0
		S05	Install EVP	$1,741,367	$14,100	123.50	100%	$14,100	$0
		S09	Install raised pavement markers & striping	$248,767	$9,423	26.40	100%	$9,423	$0
		S12	Install raised median	$133,917	$62,130	2.16	90%	$55,917	$6,213
TOTAL				**$2,114,517**	**$127,248**	**16.62**		**$0**	**$6,213**
3	Las Virgenes Road & Mureau Road	S02	Upgrade signal hardware	$270,025	$11,915	22.66	100%	$11,915	$0
		S07	Provide protected left turn phase	$749,400	$60,207	12.45	100%	$60,207	$0
TOTAL				**$1,019,425**	**$72,122**	**14.13**		**$0**	**$0**

4	Parkway Calabasas & Park Granada	S01	Add intersection lighting	$1,150,800	$10,998	104.64	100%	$10,998	$0
		S02	Upgrade signal hardware	$271,575	$102,411	2.65	100%	$102,411	$0
		S07	Provide protected left turn phase	$863,100	$4,371	197.46	100%	$4,371	$0
		S09	Install raised pavement markers & striping	$181,050	$367	493.32	100%	$367	$0
TOTAL				**$2,466,525**	**$118,147**	**20.88**		**$0**	**$0**
5	Lost Hills Road & Calabasas Hills Road	NS06	LED blinking signs	$220,875	$17,202	12.84	100%	$17,202	$0
		NS08	Flashing Beacons	$220,875	$22,560	9.79	100%	$22,560	$0
TOTAL				**$441,750**	**$39,762**	**11.11**		**$0**	**$0**
6	Las Virgenes Road & Lost Hills Road	S02	Upgrade signal hardware	$200,650	$1,481	135.48	100%	$1,481	$0
		S09	Install raised pavement markers & striping	$149,467	$5,925	25.23	100%	$5,925	$0
		S12	Install raised median on approaches	$747,333	$262,965	2.84	90%	$236,669	$26,297
TOTAL				**$1,097,450**	**$270,371**	**4.06**		**$0**	**$26,297**
7		S02	Upgrade signal hardware	$198,600	$13,889	14.30	100%	$13,889	$0

	Lost Hills Road & Agoura Road	S04	Install Advance dilemma zone	$332,333	$73,320	4.53	100%	$73,320	0
		S05	Install EVP	$926,800	$28,200	32.87	100%	$28,200	$0
		S17PB	Install pedestrian countdown signal head	$662,000	$18,048	36.68	100%	$18,048	$0
TOTAL				**$2,119,733**	**$133,457**	**15.88**		**$0**	**$0**
8	Calabasas Road & Park Granada	S02	Upgrade signal hardware	$196,825	$20,868	9.43	100%	$20,868	$0
		S09	Install raised pavement markers & striping	$131,217	$14,890	8.81	100%	$14,890	$0
TOTAL				**$328,042**	**$35,758**	**9.17**		**$0**	**$0**
9	Mulholland Highway and Paul Revere	S02	Upgrade signal hardware	$463,275	$3,948	117.34	100%	$3,948	$0
		S04	Improve signal timing	$1,235,400	$4,230	292.06	40%	$1,692	$2,538
		S05	Install EVP	$2,161,950	$14,100	153.33	100%	$14,100	$0
		S07	Provide protected left turn phase	$13,300	$7,755	1.72	100%	$7,755	$0
		S09	Install raised pavement markers & striping	$308,850	$17,126	18.03	100%	$17,126	$0
TOTAL				**$4,182,775**	**$80,840**	**51.74**		**$0**	**$2,538**
10	Parkway Calabasas &	NS06	Install warning/regulatory signs	$121,300	$13,804	8.79	100%	$13,804	$0

	Camino Portal	NS09	Install flashing beacon as advance warning	$191,950	$21,150	9.08	100%	$21,150	$0
TOTAL				**$960,183**	**$33,500**	**28.66**		**$0**	**$0**

8.4 PROJECT PRIORITIZATION

A prioritized list of safety projects for the HSIP application was identified. The B/C ratios may be used as a guide to identifying the projects with high cost-effectiveness that have the greatest chance of receiving federal funding in Caltrans call-for-projects.

BCR is not the only guide to prioritize and implement a countermeasure. The safety project list will be used as a reference on which safety project to implement first. The implementation timeline will be dependent on the City's goals and funding eligibility. The City may choose to move forward with any of these safety projects in any order, depending on funding availability. If the applications are approved for funding, these projects should not be applied for future HSIP cycles. If the safety projects are not funded by the HSIP Cycle 11, then those projects could be considered for reapplying for funding in future cycles.

Because HSIP grants are competitive, it is typically appropriate to apply only for projects with an estimated BCR considered high. According to the HSIP grant application guidelines, a safety project needs to be at least $100,000 and a minimum of 3.5 BCR to submit an HSIP Cycle 10 application.

Taking the HSIP application into consideration, **Table 8.3** summarizes the BCR analysis for the safety project. The safety projects are categorized by countermeasure ID and are prioritized by BCR. The City may use the list from Table 8.3 to determine which will be implemented based on the City's goals and funding availability.

Table 8.3 Benefits/Cost Ratio Analysis by Safety Project

Location	CM #	Countermeasure	Crash Benefits	Cost ($) Estimate	BCR
Parkway Calabasas and Camino Portal	NS06	Install warning/regulatory signs	$121,300	$13,804	8.79
Parkway Calabasas and Camino Portal	NS09	Install flashing beacon as advance warning	$191,950	$21,150	9.08
Calabasas Road and Park Granada	S02	Upgrade signal hardware	$196,825	$20,868	9.43
Las Virgenes Road and Mureau Road	S07	Provide protected left turn phase	$749,400	$60,207	12.45
Lost Hills Road and Calabasas Hills Road	NS06	LED blinking signs	$220,875	$17,202	12.84
Calabasas Road and Parkway Calabasas	S02	Upgrade signal hardware	$578,175	$40,749	14.19

Mulholland Highway and Paul Revere	S09	Install raised pavement markers &striping	$308,850	$17,126	18.03
Lost Hills Road and Agoura Road	S05	Install EVP	$926,800	$28,200	32.87
Lost Hills Road and Agoura Road	S17PB	Install Pedestrian countdown signal head	$662,000	$18,048	36.68
Parkway Calabasas and Park Granada	S01	Add intersection lighting	$1,150,800	$10,998	104.64
Las Virgenes Road and Agoura Road	S05	Install EVP	$1,741,367	$14,100	123.50
Las Virgenes Road and Lost Hills Road	S02	Upgrade signal hardware	$200,650	$1,481	135.48
Mulholland Highway and Paul Revere	S05	Install EVP	$2,161,950	$14,100	153.33
Mulholland Highway and Paul Revere	S04	Improve signal timing	$1,235,400	$4,230	292.06
Parkway Calabasas and Park Granada	S09	Install raised pavement markers & striping	$181,050	$367	493.32
Calabasas Road and Parkway Calabasas	S09	Install raised pavement markers and striping	$385,450	$564	683.42

The average BCR of HSIP 9 selected projects is 17.7, depending on the minimum reimbursement amount and BCR of HSIP Cycle 11, the City can either select the eligible individual projects or group projects as a systemic improvement, as shown in Table 8.3, for the HSIP funding application. The City may also determine which project to be prioritized based on available funding sources, public support, and other factors.