CITY OF PALMDALE

Palmdale Safety Plan

May 2023

Prepared by:
Kimley»Horn

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Executive Summary

The City of Palmdale Safety Plan identifies emphasis areas to inform and guide further safety evaluation of the City's transportation network. The emphasis areas include type of crash, certain locations, and notable relationships between current efforts and crash history. The plan analyzes crash data on an aggregate basis as well as at specific locations to identify high-crash locations, high-risk locations, as well as city-wide trends and patterns. The analysis of crash history throughout the City's transportation network allows for opportunities to:

1. Identify factors in the transportation network that inhibit safety for all roadway users;
2. Improve safety at specific high-crash locations, and reduce serious injury and fatal collisions; and,
3. Develop safety measures using the four E's of safety: Engineering, Enforcement, Education, and Emergency Response to encourage safer driver behavior and lower severity outcomes.

With this plan, the City continues its safety efforts by identifying areas of emphasis and systemic recommendations to enhance safety.

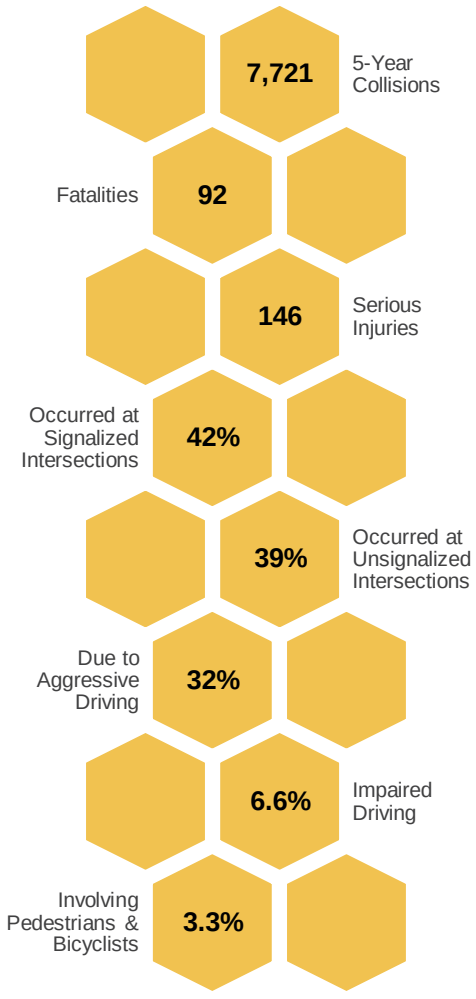
The City's vision is to enhance the transportation network and reduce traffic fatalities and serious injury related crashes, and the goals for the City of Palmdale are in support of General Plan Goal CM-1:

- Build and maintain a transportation system that is safe and comfortable for travelers of all modes regardless of age or ability.

As well as its sub-goals:

- **CM-1.1 Roadway design.** Design and maintain the public right-of-way through a complete streets approach that facilitates safe, comfortable, and efficient travel for all roadway users.
- **CM-1.2 Modal conflicts.** Use a systemic safety approach to proactively identify opportunities to improve safety where conflicts between users exist.
- **CM-1.3 Network gaps.** Identify and program mitigation measures for gaps and deficiencies in the transportation system to accommodate each major transportation mode.
- **CM-1.4 Speed management.** Include speed reducing elements along local and connector roadways and within all new private development projects.

City of Palmdale Collision Summary (2017-2021)



Source: Crossroads Database (2017-2021)

- **CM-1.5 Railroad crossings.** Implement grade separation at railroad crossings where feasible.

The General Plan Goal CM-1 are furthered by this plan through these targeted objectives:

Objective #1: Identify areas with a high risk for crashes.

Objective #2: Illustrate the value of a comprehensive safety program and the systemic process.

Objective #3: Plan future safety improvements for near-, mid- and long-term.

Objective #4: Define safety projects for HSIP and other program funding consideration.

This plan analyzes the most recent range of crash data (January 1, 2017 – December 31, 2021) and roadway characteristics to assess historic trends, patterns, and areas of increasing concern. While the COVID-19 pandemic altered traffic conditions and collision patterns in 2020 and 2021, these years were ultimately included to understand recent trends.

Further, the collision history was analyzed to identify locations with elevated risk of collisions either through collision histories or their similarities to other locations with more active collision patterns. Using a network screening process, locations were identified within the City that will most likely benefit from safety enhancements. Additionally, collision risk factors for the entire network were derived. The outcomes informed the identification and prioritization of engineering and non-infrastructure safety measures to address certain roadway characteristics and related behaviors that contribute to motor vehicle collisions with active transportation users.

Emphasis areas were developed by revisiting the vision and goals developed at the onset of the planning process and comparing them with the trends and patterns identified in the crash analysis.

Emphasis Area #1: Intersection Improvements

Emphasis Area #2: Vulnerable Road Users (Pedestrians & Bicyclists)

Emphasis Area #3: Aging Drivers (65+)

The following 10 case study locations were chosen to be representative of the corridor and intersection configurations throughout the City.

1. Signalized Intersection: 47th Street East and Avenue R
2. Unsignalized Intersection: 45th Street East and Avenue R-8
3. Segment: Avenue R-8 from 30th Street East to 35th Street East
4. Unsignalized Intersection: 25th Street East and Olive Drive
5. Unsignalized Intersection: 3rd Street East and Technology Drive
6. Signalized Intersection: 10th Street West and Rancho Vista Boulevard
7. Segment: Rancho Vista Blvd from 30th Street West to Seville Avenue
8. Signalized Intersection: 10th Street West and Avenue O-8
9. Segment: Sierra Highway (Avenue M to Rancho Vista Bl)
10. Signalized Intersection: 20th Street East and Avenue M

These locations were identified through the analysis process based on crash histories, stakeholder engagement, the observed crash patterns, and differing characteristics to provide the most insight into potential systemic safety countermeasures that the City can employ to achieve the most cost-effective safety benefits. While not necessarily the locations with the most crashes, the analysis team needed locations with a variety of characteristics to create a broad toolbox of solutions that would be applicable for most locations throughout the City. The findings of the case studies are not intended to serve as a priority project list, but instead represent opportunities for systemic safety enhancements throughout the City. These countermeasures were developed by referring to both the California Local Roadway Safety Manual (LRSM) and the Caltrans Proven Safety Countermeasures, and adhering to the Safe Systems Approach. Countermeasures were evaluated for their potential benefit/cost. The potential benefit of these countermeasures at locations with similar design characteristics can then be extrapolated regardless of crash history, allowing for proactive safety enhancements that can prevent future safety challenges from developing. Additionally, this information can be used to help the City apply for grants and other funding opportunities to implement safety improvements. These opportunities were assembled into the “countermeasure toolbox” as outlined on the next page. The opportunities identified in this Plan align with Statewide Plans such as the Caltrans California Transportation Plan (CTP) 2050, the Caltrans Strategic Management Plan 2020-2024, the Caltrans Climate Action Plan for Transportation Infrastructure (CAPTI), the California High Speed Rail Business Plan, the Caltrans Rail Plan, the Caltrans Transit Plan, and the Caltrans Bicycle and Pedestrian Plan. The STP also aligns with Regional Guidance Documents such as the Los Angeles North County Transportation Coalition Guidance, LA Metro 2020 Long Range Plan, and the Antelope Valley Transit Authority (AVTA) Strategic Plan.

Citywide Countermeasure Toolbox

ID	Potential Countermeasures	Where to apply?	CRF	Per Unit Cost (20-year estimate)*	Unit
NS04	Convert intersection to roundabout (from all way stop)	Where warranted by an intersection control evaluation	Varies	Varies	Varies
NS07	Upgrade intersection pavement markings (to make more visible)	Intersections where outdated or degraded striping and pavement markings exist	25%	$38,400	per intersection
NS20PB	Install pedestrian crossing at uncontrolled locations (new signs and markings only)	Where speed limits are less than 35 mph	25%	$22,000	per intersection
NS22PB	Install Rectangular Rapid Flashing Beacon (RRFB)	Unsignalized locations with significant pedestrian demand where speed limit is up to 35 mph	35%	$30,000	per intersection
R01	Add segment lighting	At locations that are currently unlit where likely traffic conflict exists	35%	$900,000	per mile
R08	Install raised median	Higher speed, undivided roadways with 4+ lanes	25%	$840	per LF for a 10' wide median
R14	Road Diet	Roadway segments with high number of sideswipe collisions	35%	$50,000	per mile
R17	Improve horizontal alignment (flatten curves)	Locations with excessive lane departure crashes due to roadway geometry	50%	Varies	Varies
R27	Install delineators, reflectors and/or object markers	Locations with a high number of fixed object collisions and collisions on curved segments	50%	Varies	Varies
R30	Install centerline rumble strips/stripes	Where travel speeds are greater than 45 mph and either curvature or traffic volumes warrant	20%	$50,000	per mile
R31	Install edgeline rumble strips/stripes	Where travel speeds are greater than 45 mph and either curvature or traffic volumes warrant	15%	$50,000	per mile

ID	Potential Countermeasures	Where to apply?	CRF	Per Unit Cost (20-year estimate)*	Unit
R33PB	Install Separated Bike Lanes	Locations where existing lane widths allow	45%	$50,000	per mile
R35PB	Install/Upgrade pedestrian crossing (with enhanced safety features)	Locations with no controlled crossing for significant distances	35%	$30,000	per crossing
R37PB	Install Rectangular Rapid Flashing Beacon (RRFB)	Midblock locations 1500+ feet away from an existing signal with significant pedestrian demand where speed limit is up to 35 mph	35%	$30,000	per crossing
R34PB	Install sidewalk/pathway (to avoid walking along roadway)	Along roadways where sidewalks currently do not exist	80%	$300	per LF for 4' sidewalk
S02	Improve signal hardware; lenses, back plate with retroreflective borders, mounting, size, and number	Signalized intersections where signals heads to do not meet current standards	15%	$26,400	per intersection
S03	Improve signal timing (coordination, phasing, red, yellow, operation)	Signalized intersections where there is insufficient clearance time with current timing plans or where signals placed closely enough to impact free flowing operations of the street	15%	$25,000	per intersection
S06	Install left-turn lane and add turn phase (signal has no left turn lane or phase before)	Locations that have significant left-turn volumes and no left-turn lane with sufficient right-of-way	55%	$80,000 (simple) to $350,000 (raised median and signal modification	per intersection
S16	Convert intersection to roundabout (from signal)	Signalized intersections with a significant collisions due to complex lane configurations	Varies	Varies	Varies
S18PB	Install crosswalk at signalized intersection	Signalized intersection that do not have crosswalks and have significant pedestrian volumes	25%	$32,000	per intersection

ID	Potential Countermeasures	Where to apply?	CRF	Per Unit Cost (20-year estimate)*	Unit
S19PB	Pedestrian Scramble (diagonal all-way crossing at a signal)	High volume locations with significant volumes on all intersection legs	40%	$122,000	per intersection
S21PB	Modify signal phasing to implement a Leading Pedestrian Interval (LPI) with new controller	Signalized Intersections – especially those with high pedestrian activity	60%	$15,000	per intersection
-**	Restrict uncontrolled left turn	Unsignalized intersections with alternative access opportunities where turning volumes are low	5%	Varies	Varies
-**	Curb Extension/Bulb-Out	Intersections with high pedestrian activity	5%	Varies	Varies
-**	Make wayfinding signs bilingual	Citywide	5%	Varies	Varies
-**	Apply for funding to Safe Routes to School (Active Transportation Program)	Citywide	5%	Varies	Varies
-**	Mark pavement with supplementary warning messages	Locations with right turn pockets	30%	Varies	Varies
-**	Improve pavement (dips)	Where water pools consistently at a level to create driving hazards or where the general speed of traffic is too high for the level of dip	5%	Varies	Varies

*Cost estimates were calculated in 2021 dollars using Caltrans costing formulas and other recent project bids. Recent and ongoing inflation could have significant cost impacts.

**There were not approved countermeasures for these improvements in the Local Roadway Safety Manual, so a conservative Crash Reduction Factor (CRF) was assumed.

Near-term action items were identified to accelerate the City's achievement of the goals and vision of this plan. The City will:

- Actively seek other funding opportunities to improve safety for all modal users,
- Collaborate with established safety partners & neighboring municipalities as improvements are made to create a cohesive transportation network, and
- Iteratively evaluate existing and proposed transportation safety programs and capital improvements to design a safer transportation network in Palmdale.

The City will regularly monitor and update the analysis performed in this plan. A full plan update will be required five years from the City Council's adoption of this plan which will maintain eligibility for HSIP funding.

1. Introduction

Located in the southern region of Antelope Valley, the City of Palmdale is a growing city with a population of over 160,000, making it the largest city in the High Desert area of Southern California. Palmdale is a thriving community with employment bases in aerospace, retail, and healthcare. It is located along the State Route-14 freeway with connections to Los Angeles and cities in the High Desert. The City's location and transportation network provide multiple challenges and opportunities. With a limited number of routes in and out of the City, bottlenecks can exacerbate congestion and air quality issues, but at the same time, the City has the infrastructure and population base to grow and diversity it's own employment, services and housing stock to increase the proportion of the population that lives, works and plays locally, reducing its reliance on connections with neighboring Cities. The University of California Berkeley's Transportation Injury Mapping System (TIMS) and California Department of Transportation (Caltrans) Vehicle Operation Cost Parameters, Palmdale's economic losses due to traffic injuries amounted to over $1.1 billion from 2017 to 2021. This report identifies factors associated with the most vehicle crashes particular to the City and proposes matching countermeasures to reduce or eliminate those crashes.

The Safety Plan section identifies emphasis areas to inform and guide further safety evaluation of the City's transportation network. The emphasis areas include the type of crash, certain locations, and notable relationships between current efforts and crash history. The plan analyzes crash data on an aggregate basis as well as at specific locations to identify high-crash locations, high-risk locations, and city-wide trends and patterns. The analysis of crash history throughout the City's transportation network allows for the following opportunities:

1. Identify factors in the transportation network that reduce safety for all roadway users;
2. Improve safety at specific high-crash locations; and,
3. Develop safety measures using the four E's of safety (Engineering, Enforcement, Education, and Emergency Response) to encourage safer driver behavior and lower severity outcomes.

Palmdale has taken steps to enhance all modal safety throughout the City and with this plan, Palmdale is continuing to prioritize safety in its planning processes. The Office of Traffic Safety (OTS) most recently ranked Palmdale 14th of 59 peer cities for total fatal and injured crashes after normalizing for population and Vehicle Miles Travelled (VMT) in 2019. With number one in the OTS crash rankings considered the highest, or "worst," this indicates that Palmdale is more severely impacted by traffic injuries than many of its peers throughout the state. This plan analyzes the most recent range of Crossroads crash data collected by the Cities police department from January 1, 2017 – December 31, 2021 and roadway conditions to assess historic trends, patterns, and areas of increasing concern.

2. Vision and Goals

This section evaluates the transportation network as well as non-infrastructure programs and policies within the City. Mitigation measures are evaluated using criteria to analyze the safety of road users (drivers, bicyclist, and pedestrians), the interaction of modes, the influences on the roadway network from adjacent municipalities, and the potential benefits of safety countermeasures. Through historical data and trends, proactive identification and safety opportunities can be identified and implemented without relying solely on a reaction and response to crashes as they occur.

As cities across the country have implemented Safety Plans and systemically addressed the conditions leading to fatal and severe-injury crashes, the Federal Highway Administration (FHWA) has found that Safety Plans effectively improve safety. Safety Plans provide a locally developed and customized roadmap to directly address the most common safety challenges in the given jurisdiction. This project's vision, goals, and objectives have been established to reflect discussions with Palmdale staff, various stakeholders identified by City staff, and a review of existing plans/policies in the area.

Goal #1: Identify areas with a high risk for crashes.
Objectives:

- Identify intersections and segments that would most benefit from mitigation.
- Identify areas of interest with respect to safety concerns for vulnerable users (pedestrians and bicyclists).

Goal #2: Illustrate the value of a comprehensive safety program and the systemic process.
Objectives:

- Demonstrate the systemic process' ability to identify locations with higher risk for crashes based on present characteristics closely associated with severe crashes.
- Demonstrate, through the systemic process, the gaps and data collection activities that can be improved upon.

Goal #3: Plan future safety improvements for near-, mid- and long-term.
Objectives:

- Identify safety countermeasures for specific locations (case studies).
- Identify safety countermeasures that can be applied city-wide.

Goal #4: Define safety projects for future Highway Safety Improvement Plan (HSIP) and other program funding consideration.
Objectives:

- Create the outline for a prioritization process that can be used in this and forth-coming cycles to apply for funding.
- Use the systemic process to create Project Case Studies.
- Use Case Studies and the countermeasure toolbox to apply for Highway Safety Improvement Plan (HSIP) and other funding consideration.

- Demonstrate the correlation between the proposed safety countermeasures with the Vision Zero Initiative and the California State Highway Safety Plan.

3. Process

Through the development and implementation of this Safety Plan, the City will continue its collaboration with safety partners to identify and discuss safety issues within the community.

Guidance on the Safety Plan process is provided at both the national (FHWA) and state (Caltrans) level, and both agencies have developed a general framework of data and recommendations for a Safety Plan.

FHWA encourages the following:

- The establishment of a working group (stakeholders) to participate in developing a Safety Plan;
- A review of crash, traffic, and roadway data to identify areas of concern; and,
- The identification of goals, priorities, and countermeasures to recommend improvements at spot locations, systemically, and comprehensively.

Caltrans guidance follows a similar outline with the following steps:

- Establish leadership;
- Analyze the safety data;
- Determine emphasis areas;
- Identify strategies;
- Prioritize and incorporate strategies; and,
- Evaluate and update the Safety Plan.

3.1 Guiding Manuals

This section describes the analysis process undertaken to evaluate safety within Palmdale at a systemic level. This report identifies specific locations within the City that will benefit from safety enhancements and derives crash risk factors based on historic crash data using a network screening process. The outcome will inform the identification and prioritization of engineering and non-infrastructure safety measures by addressing certain roadway characteristics and related driving behaviors contributing to crashes. This process uses the latest national and state best practices for statistical roadway analysis described.

3.1.1 Local Roadway Safety Manual

The *Local Roadway Safety Manual: A Manual for California's Local Road Owners* (Version 1.5, April 2020) encourages local agencies to pursue a proactive approach when identifying and analyzing safety issues and preparing to compete for project funding opportunities. A proactive

approach is the analyzation of safety in an entire roadway network through either a one-time network-wide analysis or a routine analysis of the roadway network.[1]

According to the *Local Roadway Safety Manual* (LRSM), "the California Department of Transportation (Caltrans) – Division of Local Assistance is responsible for administering California's federal safety funding intended for local safety improvements."

To provide the most beneficial and competitive funding approach, the analysis leading to countermeasure selection should focus on both intersections and roadway segments and maintain consideration of roadway characteristics and traffic volumes. The result should reflect a list of locations that are most likely to benefit from cost-effective countermeasures, preferably prioritized by a benefit/cost ratio. The manual suggests using a mixture of quantitative and qualitative measures to identify locations using both crash frequency and crash rates. These findings should then be screened for crash type and severity patterns to determine the cause of crashes and the potential effective countermeasures. Qualitative analysis should include field visits and a review of existing roadway characteristics and devices. This analysis also includes the assessing the causes of collisions, where possible. The specific roadway context can then be used to assess conditions that may decrease safety at the site and at systemic levels.

Countermeasure selection should be supported using Crash Modification Factors (CMFs). These factors are a peer reviewed product of research quantifying the expected rate of crash reduction expected from a given countermeasure. If more than one countermeasure is under consideration, the LRSM provides guidance on appropriate application of CMFs.

3.1.2 Highway Safety Manual

The *Local Roadway Safety Manual: A Manual for California's Local Road Owners* (Version 1.5, April 2020) encourages local agencies to pursue a proactive approach when identifying and analyzing safety issues and preparing to compete for project funding opportunities. A proactive approach is the analyzation of safety in an entire roadway network through either a one-time network wide analysis or a routine analysis of the roadway network.[2]

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[1] Local Roadway Safety Manual (Version 1.5) 2020. Page 5.

[2] Local Roadway Safety Manual (Version 1.5) 2020. Page 5.

findings should then be screened for crash type and severity patterns to determine the cause of crashes and the potential effective countermeasures. Qualitative analysis should include field visits and a review of existing roadway characteristics and devices. The specific roadway context can then be used to assess conditions that may decrease safety at the site and at systematic levels.

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3.1.3 Additional Guidance

The Palmdale Safety Plan is guided by general State guidance documents such as the Caltrans California Transportation Plan (CTP) 2050, the Caltrans Strategic Management Plan (2020-2024), the Caltrans Climate Action Plan for Transportation Infrastructure (CAPTI), and the California High Speed Rail Business Plan. The Plan is also guided by regional guidance documents such as the Los Angeles North County Transportation Coalition guidance, the LA Metro 2020 Long Range Plan, and the Antelope Valley Transit Authority (AVTA) Strategic Plan for Integrated Transportation in the Antelope Valley. Other plans and guidance such as the Caltrans Rail Plan, Caltrans Transit Plan, Caltrans Bicycle and Pedestrian Plan, and Caltrans Safe Systems Approach informed the development of the Plan.

3.2 Analysis Techniques

3.2.1 Collision Analysis

Intersections and roadways were analyzed using four collision metrics:

- Number of Collisions
- Critical Crash Rate (HSM Ch. 4)
- Probability of Specific Crash Types Exceeding Threshold Proportion (HSM Ch. 4)
- Equivalent Property Damage Only (HSM Ch. 4)

The initial steps of the collision analysis established sub-populations of roadway segments and intersections that have similar characteristics. For this study, intersections were grouped by their control type (Signalized or Non-signalized) and segments by their roadway category (Regional, Crosstown, Connector, Neighborhood). Individual collision rates were calculated for each sub-population. The population level crash rates were then used to assess whether a specific location has more or fewer crashes than expected. These sub-populations were also used to determine typical crash patterns to help identify locations where unusual numbers of specific crash types are seen.

The network screening process identifies intersections and roadway segments by the number of crashes that occurred at each one over the analysis period, and then identifies areas that had more of a given type of crash than would be expected for that type of location. These crash type factors were:

- collision injury (fatal, serious injury, other visible injury, complaint of pain, property damage only;
- collision type (broadside, rear-end, sideswipe, head-on, hit object, overturned, bicycle, pedestrian, other);
- environmental factors (lighting, wet roads);
- driver behavior (aggressive); and,
- driver impairment.

From the results of the network screening analyses, a short-list of locations was chosen based on crash activity, crash severity, crash patterns, location type, and area of Palmdale to provide the greatest variety of locations covering the widest range of safety opportunities for safety toolbox development. The intent is to populate the safety toolbox with mitigation measures that will be applicable to most of the crash activity in the City.

3.2.2 Statistical Performance Measures

Critical Crash Rate (CCR)

Analyzing the number of collisions at a location is a method used to understand the cost to society incurred at the local level; however, it does not give a complete indication of the level of risk for those who use that intersection or roadway segment daily. The HSM describes the Critical Crash Rate method, which provides a statistical review of locations to determine where risk is higher than that experienced by other similar locations. It is also the first step in analyzing patterns that may suggest systemic issues that can be addressed at that location, and proactively at others to prevent new safety challenges from emerging.

The CCR compares the observed crash rate to the expected crash rate at a location based on facility type and volume using a locally calculated average crash rate for the specific type of intersection or roadway segment being analyzed. Based on traffic volumes and a weighted citywide crash rate for each facility type, a critical crash rate threshold is established at the 95% confidence level to determine locations with higher crash rates that are unlikely to be random. The threshold is calculated for each location individually based on traffic volume and the crash profile of similar facilities.

Figure 1: Critical Crash Rate Formula

$$R_{c,i} = R_a + \left[P \times \sqrt{\frac{R_a}{MEV_i}}\right] + \left[\frac{1}{(2 \times (MEV_i))}\right]$$

Where,
$R_{c,i}$ = Critical crash rate for intersection i
R_a=Weighted average crash rate for reference population
P = P-value for corresponding confidence level
MEV_i = Million entering vehicles for intersection i
Source: Highway Safety Manual

DATA NEEDS

CCR can be calculated using:

- Daily entering volume for intersections or ADT for roadway segments;
- Intersection control types to separate them into like populations;
- Roadway functional classification to separate them into like populations; and,
- Collision records in Geographic Information System (GIS) or tabular form including coordinates or linear measures.

STRENGTHS

- Reduces low volume exaggeration;
- Considers variance; and,
- Establishes comparison threshold.

The process of analyzing the CCR and comparing locations (separately by intersections and segments) is a multi-step process. The following is a high-level description of the process undertaken to develop the initial analysis.

The first step in the process was to establish a city-wide crash rate for each facility population. These populations are broken into two categories with sub-categories:

- Intersection:
  - Signalized
  - Non-signalized
- Roadway Classification:
  - Regional
  - Crosstown
  - Connector
  - Neighborhood

The individual crash rate for each location was then calculated based on the associated traffic volume. This volume was either collected through data count resources or calculated based on the roadway classification. The next step was to establish a Significance Threshold. This Threshold was used to determine what level of exceedance (how much the crash rate exceeded the critical crash rate) a location must have based on traffic volume to provide a high level of confidence that the collision occurring at the location is not random. For this study, a confidence level of 95% was used. The local crash rates were then compared to the Significance Threshold to see if each location exceeded the expected CCR and if so, by how much. After this analysis was completed, the locations were analyzed by their categories according to that level of exceedance.

Equivalent Property Damage Only (EPDO)

The equivalent property damage only (EPDO) method is described in the Highway Safety Manual. This method assigns weighting factors to crashes based on injury level (severe, injury, property damage only) to develop a property damage only score. In this analysis, the injury crash costs were calculated for each location (based on the latest Caltrans injury costs). This figure is then divided by the injury cost for a property damage only crash. The resulting number is the equivalent number of property damage only crashes at each site. This figure allows all locations to be compared based on injury crash costs. (Highway Safety Manual, Chapter 4).

Probability

The HSM describes the methodology for determining the probability that crash type is greater than an identified threshold proportion. This helps to identify locations where a crash type is more likely to occur.

DATA NEEDS

The probability of a specific crash type can be determined using collisions records with location data, and classifications of the locations (intersections or segments) studied.

STRENGTHS

- Can be used as a diagnostic tool;
- Considers variance in data; and,
- Not affected by selection bias.

The HSM methodology first determines the frequency of a specific collision type at an individual location, then determines the observed proportion of that collision type relative to all collision types at that location. A threshold proportion is then determined for the specific collision type; HSM suggests utilizing the proportion of the collision type observed in the entire reference population (e.g. throughout the entire City of Palmdale).

These proportions are then utilized to determine the probability that the proportion of a specific crash type is greater than the long-term expected proportion of that crash type.

Figure 2: Probability of Specific Crash Types Exceeding Threshold Proportion

$$P\left(p_i > \frac{p_i^*}{N_{observed,i}}, N_{observed,i(TOTAL)}\right) = 1 - betadist(p*_i, a + N_{observed,i}, \beta + N_{observed,i(TOTAL)} - N_{observed,i})$$

Where:
p_i^* = Threshold proportion
p_i = Observed proportion
$N_{observed,i}$ = Observed target crashes for a site i

$N_{observed,i(TOTAL)}$ = Total number of crashes for site i

Source: Highway Safety Manual

3.3 Future Analysis

The City plans to conduct regular collision monitoring as described in Section 10.2. The City will then refresh the analysis and update the Safety Plan as needed to maintain eligibility for HSIP funding, as described in Section 10.1**.** A key subsequent effort will be the development of a Local Road Safety Plan that conforms to the Federal Highway Administration's Safe Systems Approach and program guidelines under the Bipartisan Infrastructure Bill and Infrastructure and Jobs Act It will also be structured to meet Caltrans eligibility requirements for Highway Safety Improvement Program funding. The Local Roadway Safety Plan is expected to be complete by the end of 2023 and will build off of the analysis presented in this report. The Local Roadway Safety Plan will provide an ongoing program for citywide safety improvement with the goal of eliminating traffic fatalities and injuries in Palmdale.

4. Safety Partners

Local stakeholders were included in the development of this report to ensure the local perspective was maintained at the forefront of planning efforts. A stakeholder group of City staff and external partners consisted of representatives from the Los Angeles County Sheriff's Office (LACSO), Los Angeles County Fire Department, California Highway Patrol, Antelope Valley Transit Authority, City Planning Department, City Neighborhood Services, Palmdale Unified School District, and local Bicycle and Pedestrian Advocates. Members of the public were also engaged through a 'Social Pinpoint' website, where they were asked to highlight specific issues areas within the City with respect to transportation safety. The City has subscribed access to this site to provide ongoing two-way communication with the public.

The local stakeholders were called together to offer insight on the safety issues present in the City's transportation network. After the initial network screening and safety analysis, the stakeholder group met to discuss potential countermeasures and challenge areas through a field visit. The summaries of the field visit meeting is outlined below.

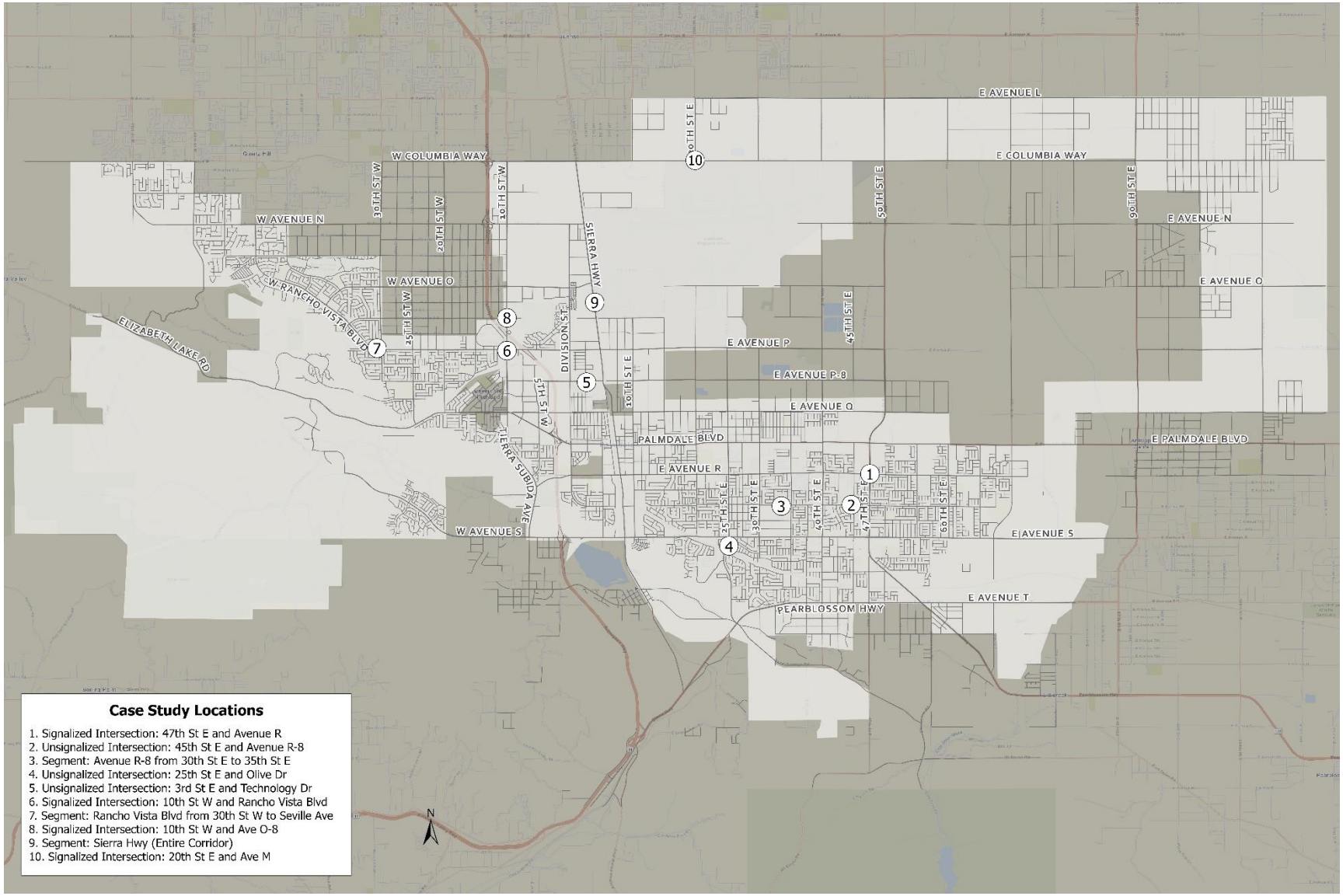
4.1 Field Visit Meeting

The field visit was conducted on August 15, 2022. At the meeting, stakeholders, including City officials and the Los Angeles County Sheriff's Department (LASD) were introduced to the project and provided an overview of the data used, the required outputs, and the potential outcomes of the study.

Stakeholders were asked to provide local insight and knowledge at 10 "case study" locations that were identified after the initial network screening and crash analysis process as well as transportation needs around several of the City's schools. Potential countermeasures were recommended, and emphasis/challenge areas were discussed, specifically speeding as a major factor in collisions throughout the City.

Stakeholder feedback was reviewed and incorporated into the study process for the development of the Safety Plan.

Figure 3: Case Study Locations



5. Existing Efforts

Existing plans, policies, and projects that were recently completed, planned, or on-going as part of the City's General Plan were compiled at the start of the Safety Plan process to gain perspective on the existing efforts for transportation-related improvements within the City. High-level key points regarding transportation improvements and safety-related topics were identified to inform decision making in this Safety Plan.

Table 1 outlines the relevant existing City plans and their improvements and funding sources. Table 2 outlines the relevant existing City projects and their timelines.

Table 1: Review of Existing City Plans

Document Name	Document Status	Agency	Document Description	Transportation Policies/Improvements	Funding Sources
General Plan	Adopted 1993	City of Palmdale	Long-Term Planning	• Serves as a foundation for making land use decisions based on goals and policies related to transportation routes, population growth, development, open space, resource preservation, air and water quality, noise impacts, safety issues and other related development factors.	• City of Palmdale
Transportation + Mobility Spring 2020 Report (General Plan Update)	Adopted 2020	City of Palmdale	Long-Term Planning	• Summarizes the existing transportation conditions in the City, such as the local roadway system, transit system, bicycle facilities, goods movement infrastructure, parking availability, and air transport facilities	• City of Palmdale (General Fund, Prop C, Prop A Gas Tax, SB 821, etc.) • Measure R • Measure M • Article 3 • Article 8
Palmdale Transit Area Specific Plan	Adopted 2020	City of Palmdale	Specific Area Plan	• Proposes a development strategy for a pedestrian-oriented mixed-use district surrounding the City of Palmdale's Transportation Center and the future high-speed rail station.	• City of Palmdale • Measure M • Traffic Congestion Relief Program (TCRP) • Los Angeles County Transportation Authority (LACMTA)

Document Name	Document Status	Agency	Document Description	Transportation Policies/Improvements	Funding Sources
Palmdale High-Speed Rail Station Area Plan	Adopted 2016	City of Palmdale	Specific Area Plan	• Overviews the planning around a future High-Speed Rail Multi-Modal Station near the vicinity of downtown Palmdale. • Develops urban design recommendations, establish a mobility strategy, and identify economic development opportunities	• City of Palmdale • California High-Speed Rail Authority (CHSRA) • U.S. Department of Transportation's Rebuilding American Infrastructure with Sustainability and Equity (RAISE) grant
Strategic Plan for Integrated Transportation in the Antelope Valley	Adopted 2021	City of Palmdale	Long-Term Planning	• This document is used to position the Antelope Valley area as a sustainable, attractive, and forward-looking community by shifting land use and transportation planning away from singe occupancy vehicle (SOV) use and sprawling developments • Develops attractive and useful public transportation services while leveraging shifts in transportation technologies	• Congestion Mitigation and Air Quality (CMAQ) • Sustainable Communities Program (SCAG) • City of Palmdale • Measure R • Prop A and C Integrated Mobility Innovation • SB-1 • S310, S307

Table 2: Review of Existing City Projects

Project Name	Timeline	Transportation Policies/Improvements	Funding Sources
Avenue Q Complete Streets Project	Fall 2020 – Summer 2022	• Improvements to walking and biking conditions for all ages and abilities; improve comfort and safety of active transportation in desert weather.	• Southern California Association of Governments (SCAG)
Avenue R Complete Streets & Safe Routes to School	Summer 2022 – Spring 2024	• Construction of sidewalks, adding bike lanes, widening the road, and improving signalized intersections.	• California Transportation Commission • Active Transportation Program (ATP) • Federal funds
Avenue M Safety Study	October 2020 – Ongoing	• Signal timing adjustment, speed enforcement and education efforts, only right-turn in and right-turn out, new signal poles and mast arms, mobile Radar Speed Feedback message boards, high-visibility retroreflective back-plates.	• California Transportation Commission • Active Transportation Program (ATP) • Federal funds
Rancho Vista Grade Separation	Ongoing	• Palmdale will be experiencing dynamic job growth around Air Force Plant 42 in the coming decade; the main access point to these facilities is Rancho Vista Blvd; the City is proposing to construct an overhead bridge carrying Rancho Vista Blvd over Sierra Highway and the railroad tracks.	• Federal Fund
Speed Management for Safety Summary	July 14th – 15th, 2021	• This workshop overviews the themes around speed safety raised by the community and recommendations for further speed management planning and actions.	• General Fund
Palmdale Transportation Center Transit & Infrastructure Design Project	March 2021 – November 2023	• This project will include an analysis of the existing and future planned infrastructure systems necessary to support the future Palmdale multi-modal high-speed rail station.	• Measure M

6. Data Summary

This section describes the data sources used for the analysis process of this safety assessment.

6.1 Roadway Network

The Caltrans California Road System (CRS) GIS database was used to build the base roadway network used for this analysis. Intersections and roadway segments were divided into control and classification categories so that each set could have its own crash rates and be compared with similar facilities or control type. Functional Classifications were imported from the City's General Plan and confirmed by City Staff. Information on intersection traffic control was provided by the City and included in the analysis network. The collision analysis requires each intersection to be classified by type: Signalized or Unsignalized. Figure 4 illustrates City of Palmdale's roadway functional classification and intersection control type as used for this study.

6.2 Count Data

Vehicular count data is used as part of the analysis process to evaluate the impact of traffic and understand the natural hierarchy of the roadway network. Count data utilized for this project was pulled from various studies and elements. For locations without volume or count data, other resources were utilized to identify a reasonable assumption for individual corridors and classification types. The traffic volume information allowed the team to assess locations for risk as well as reviewing locations with the highest number of collisions.

6.3 Collision Data

Collision data was collected from Crossroads software for the period from January 1, 2017 through December 31, 2021. Analysis of the raw collision data is the first step in understanding the specific and systemic challenges faced throughout the City. Analyzing the five years of data provided insight on the collision trends and patterns detailed in Section 7. The locations of fatal and severe injury collisions are displayed in Figure 5.

Figure 4: Functional Classification

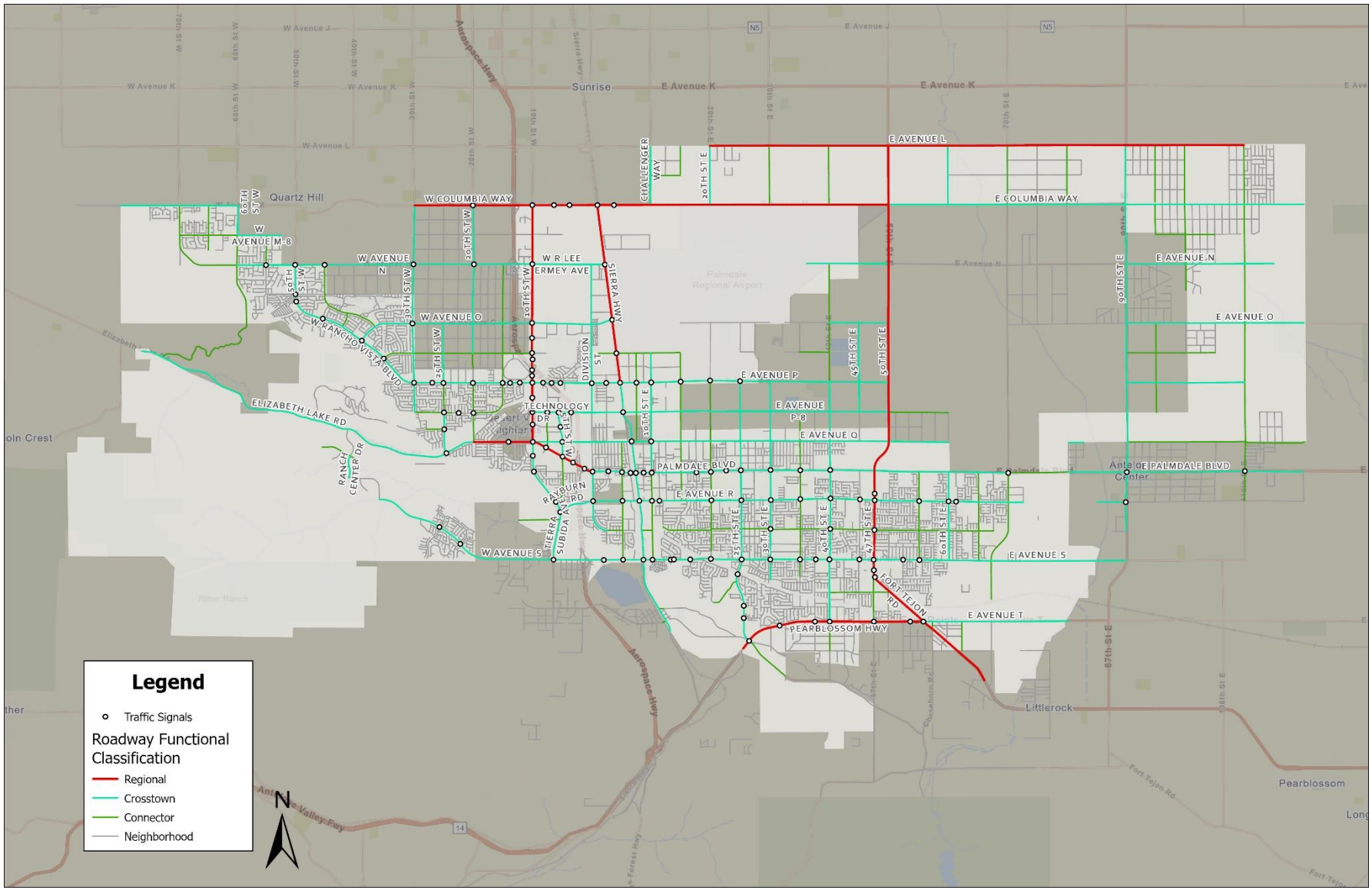


Figure 5: Fatal and Severe Injury Collisions (2017-2021)

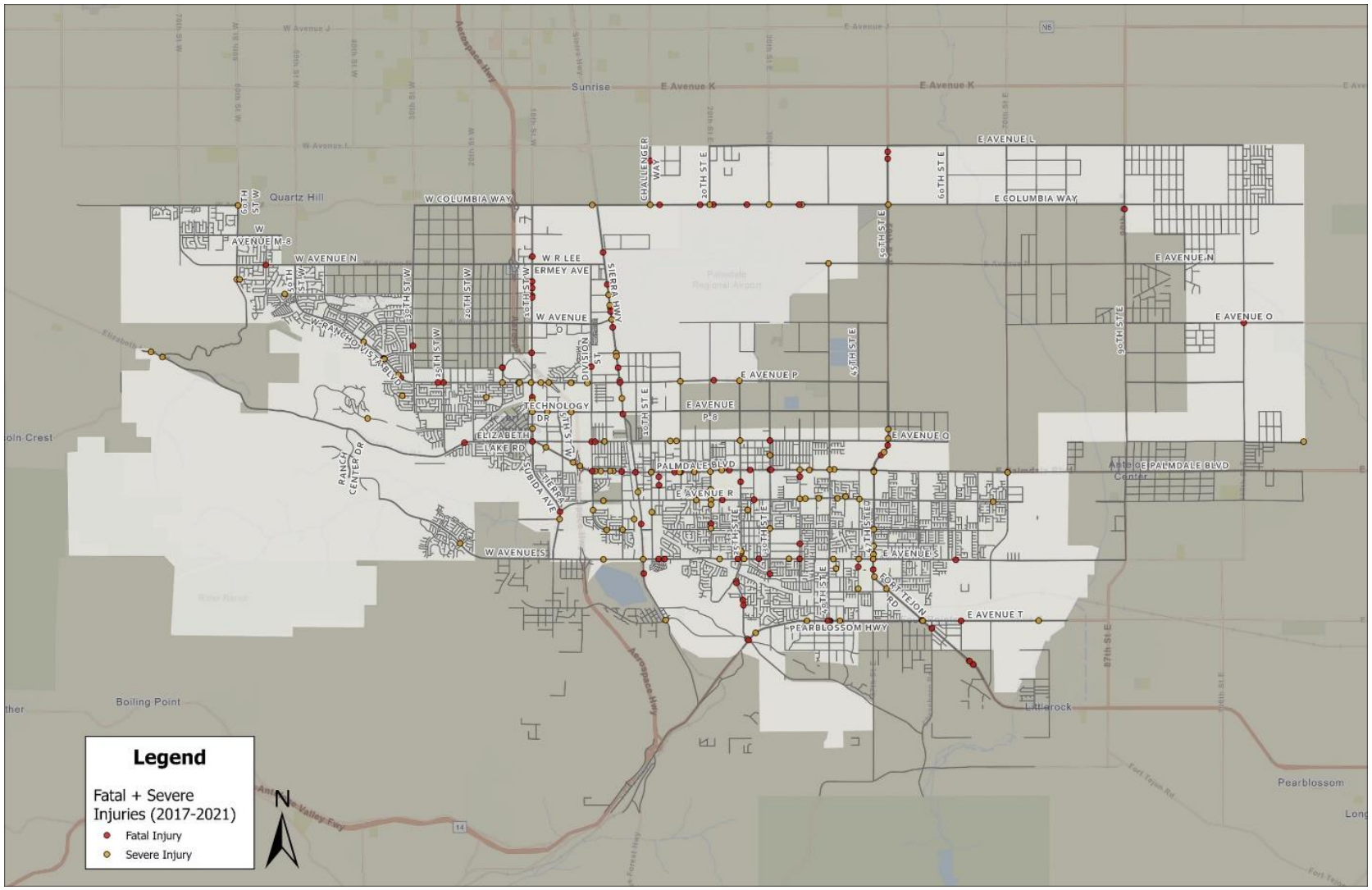
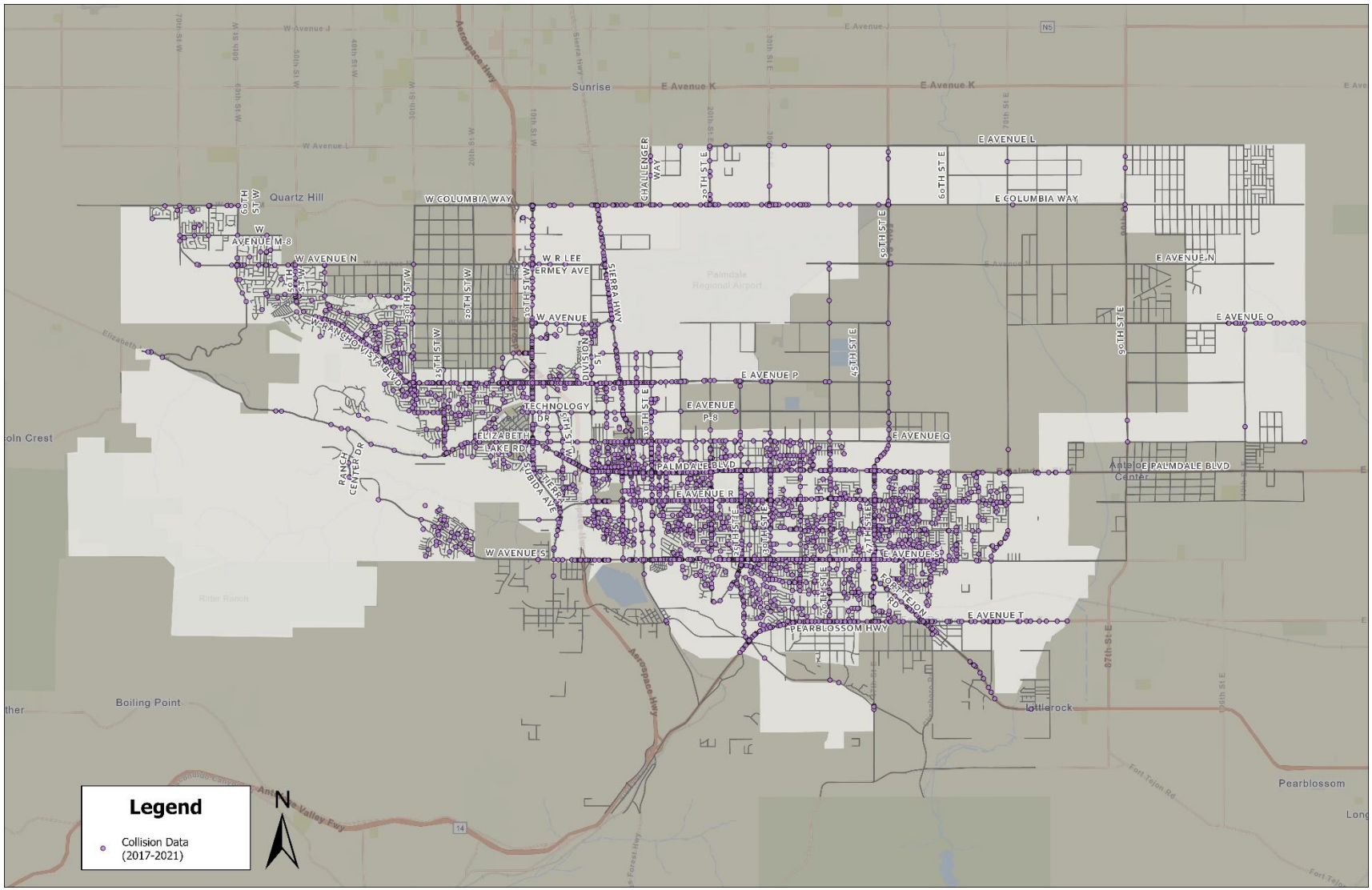


Figure 6: All Collisions (2017-2021)



7. Collision Safety Trends

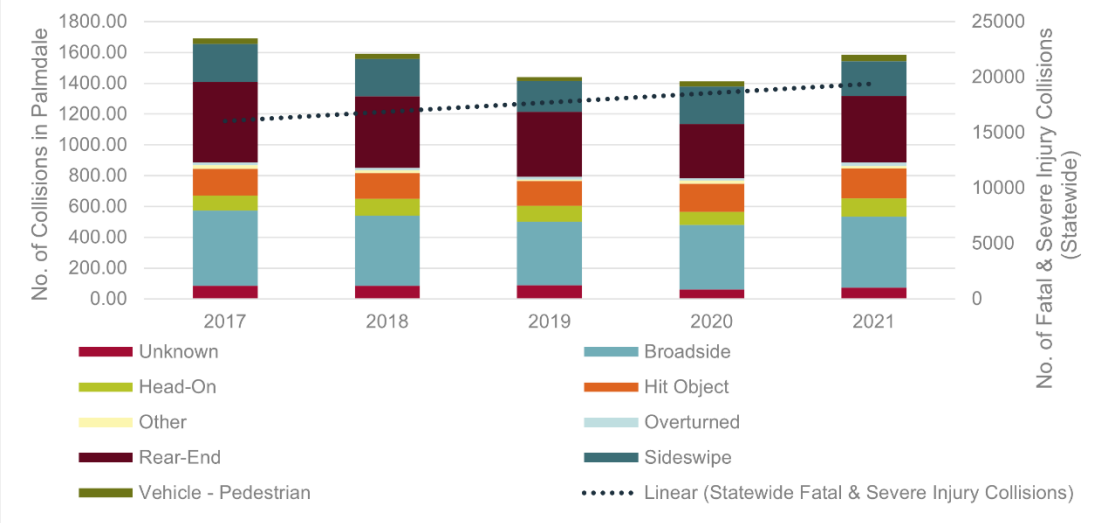
The analysis was conducted using a network screening process for the surface roadway system. This section contains the results of the analysis, which included the evaluation of Palmdale's fatal and serious injury collisions, statewide fatal and serious injury collisions, pedestrian collisions, bicycle collisions, collision severity levels, and collision causes.

7.1 All Collisions

This report utilized collision data for a five-year period to provide a better understanding of trends and to reflect the patterns in crashes that have occurred on City streets. Data used for this report was extracted from Crossroads Software. Collision data from January 1, 2017 through December 31, 2021 as reported to Crossroads from the local enforcement indicated that during this time there were 7,721 collisions recorded within Palmdale.

The most common occurring collision types were Broadsides (29%) and Rear-ends (28%), as shown in Figure 7. The figure also shows the trendline for fatal & severe collisions statewide. While there was an increase in these types of collisions statewide, the number of collisions in Palmdale generally decreased over the same period. While collisions decreased from 2017-2020, they increased again in 2021. The increase in collisions is reflective of statewide and national trends related to the reduction in COVID-19 restrictions and associated driver behavior changes following reopening of schools, workplaces, and social spaces.

Figure 7: Collision Type by Year (2017-2021)



Source: Palmdale Crossroads Database (2017-2021)

7.2 Fatalities

During the study period, 92 fatal collisions and 146 severe injury collisions occurred, as seen in Figure 7.

Table 3 outlines the fatal collisions categorized by modes involved.

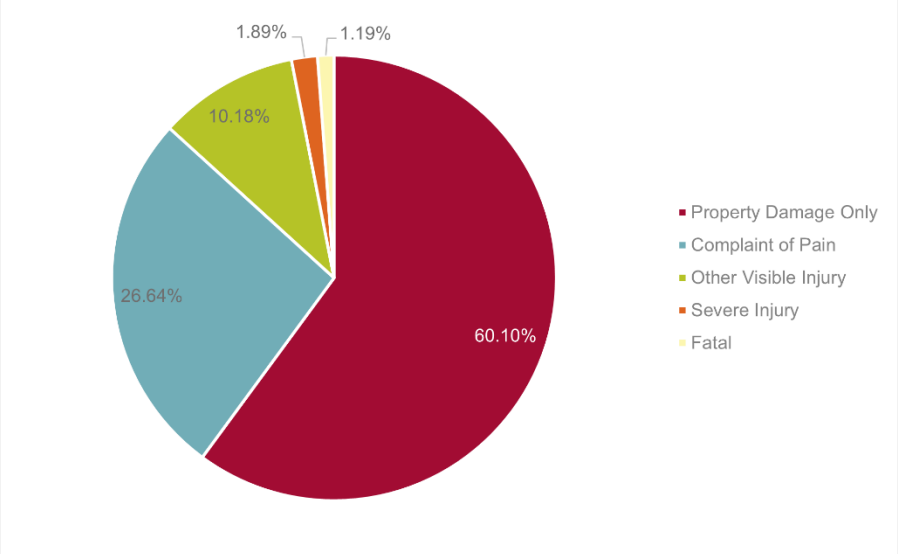
Table 3: Fatal Collisions Categorized by Modes Involved (2017-2021)

Involved With	# of Fatal Collisions	# of Severe Injury Collisions	# of Total Collisions
Other Motor Vehicle	48	83	5252
Fixed Object	14	19	935
Parked Motor Vehicle	0	1	630
Pedestrian	28	25	185
Other Object	0	2	93
express	1	5	87
Bicycle	0	9	74
Motor Vehicle on Other Roadway	1	2	69

7.3 Injury Levels

As shown in Figure 8, 60.1% of the collisions reported during the time-period resulted in property damage only. Fatalities and severe injuries totaled 3.08% of all collisions.

Figure 8: Collisions by Injury Level (2017-2021)

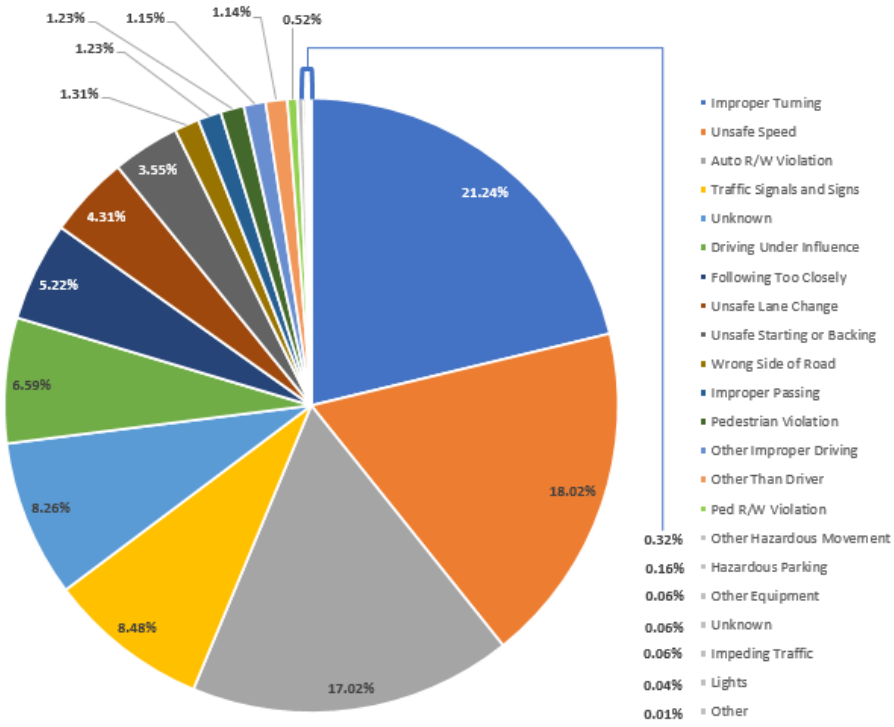


Source: Palmdale Crossroads Database (2017 – 2021)

7.4 Cause of Collision

The highest recorded cause of collisions in Palmdale during this time period is Improper Turning at 21.24%, followed by Unsafe Speed at 18.02% and Automobile Right-of-Way Violation at 17.02% as well as Ignoring Traffic Signals and Signs at 8.48%.

Figure 9: Cause of Collisions (2017-2021)



Source: Palmdale Crossroads Database (2017 – 2021)

7.5 Vulnerable Users

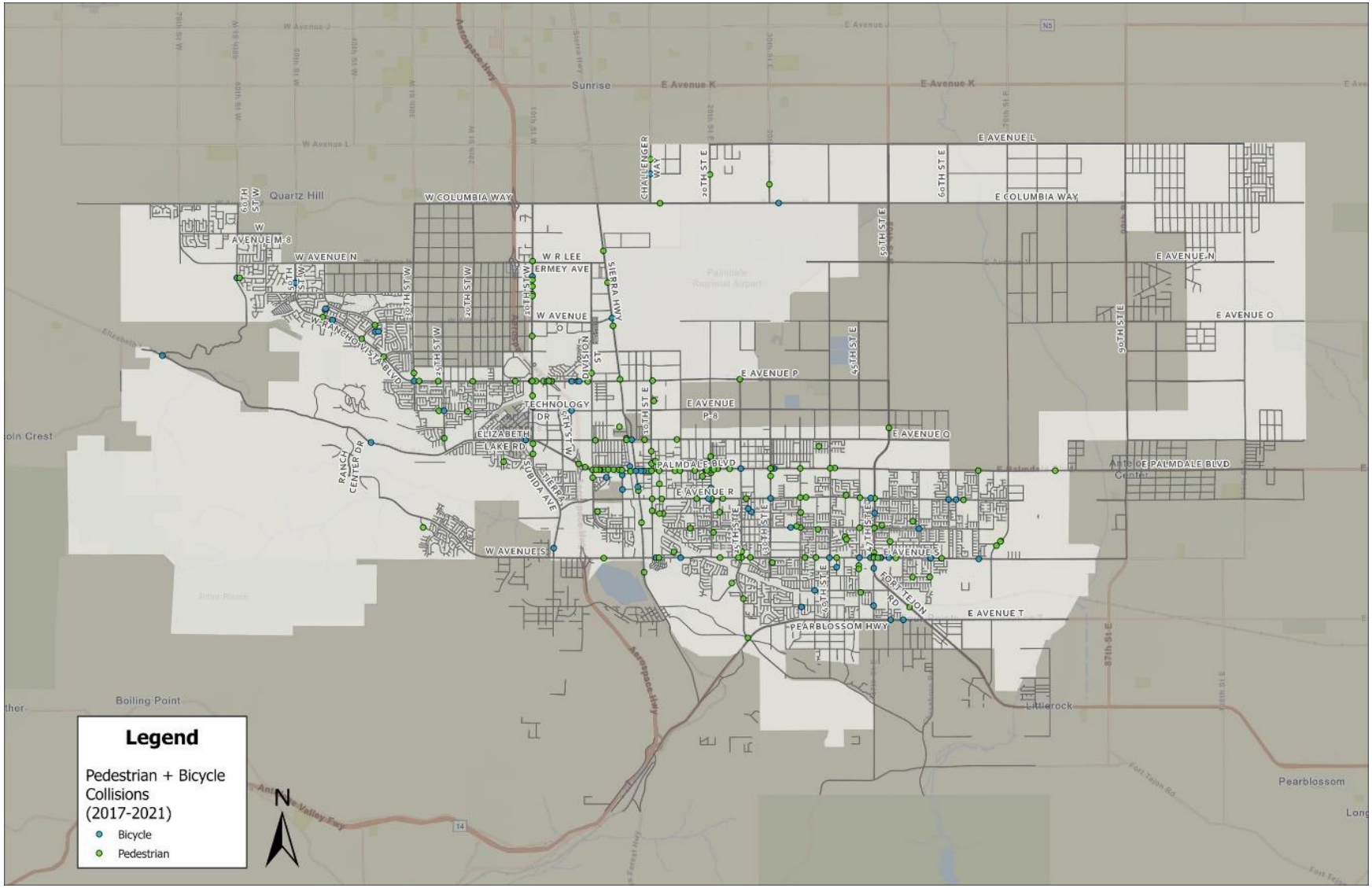
7.5.1 Pedestrian Collisions

185 pedestrian-involved collisions occurred during the study period, resulting in 28 fatal collisions, 25 severe injury, and 126 collisions with some form of reported injury or pain. 78.6% of the pedestrian involved collisions occurred at night. Figure 10 shows the locations of pedestrian collisions during the study period.

7.5.2 Bicycle Collisions

During the study period, 74 collisions involving bicycles were reported. Of these, none were fatal, and 9 resulted in severe injuries. The collision history shows 62% of the collisions occurred during daylight, 20% of these collisions were attributed to automobile right-of-way violations. Figure 10 shows the location of bicycle collisions during the study period.

Figure 10: Pedestrian and Bicycle Collisions



7.6 Other Data Trends

These figures highlight significant trends that outline potential emphasis areas for collision reduction. These trends are significant as they can be addressed by infrastructure and non-infrastructure countermeasures.

- 36 percent of collisions occurred either at night or during the dusk/dawn hours, these collisions may be reduced through additional lighting, reflective markings, and patrols for impaired and reckless driving. 79 percent of the pedestrian/bicycle fatalities occurred at night or during dusk/dawn hours. As pedestrians and bicycle collisions are particularly vulnerable at night, it is important that the City identify these issues areas.
- 52 percent of crashes happened between the hours of 12 PM to 6 PM. This is typically the busiest time of day for traffic and the most likely to be congested. Crashes during this time of day may be lessened through improvements to signal timing coordination and responsiveness as well as patrols for speed enforcement.
- 7 percent of crashes involved DUIs (Driving Under the Influence). These crashes can best be prevented through enforcement and educational programming. 31.2% of fatal and serious collisions involved impaired driving, compared to 25.3% of the fatal and serious collisions statewide. Roadway improvements such as increased lighting and roadway infrastructure that reduces vehicle speeds can reduce the likelihood of these crashes leading to serious or fatal injuries.
- Drivers aged between 15 and 20 years old were found to be at fault in 8.9 percent of collisions. Additionally, 16.1% of fatal and serious injury collisions in Palmdale involved young drivers, compared to 13.1% statewide. These crashes can be reduced through enforcement patrols for speed and reckless driving as well as routine reminders of roadway rules and regulations. Infrastructure that reduces vehicle speed is also beneficial for developing good driving habits.
- Drivers aged 60 and over were found to be at fault in 9 percent of all collisions. Lighting, retroreflective markings and signs, advance warning signage, and responsive signal timing can all assist drivers that may have slower reaction times due to age or other disabilities. Adding resiliency to the roadway system will enhance independence for seniors and drivers with disabilities.

7.7 Project Prioritization

7.7.1 Analysis Methodology

Developing the High Collision Network

The methodology to develop the high collision network for the City of Palmdale was based on industry best practices and tailored to the City. The following section outlines the process from the development of the network to its preparation for future analysis.

Required Base Data

The data analysis process begins with the development of an ArcGIS base map containing the following information: 1) the existing roadway network which contains roadway names, number of lanes, and speed data as available and 2) the Crossroads/SWITRS collision data from January 2017 – December 2021 that contains the year, injury level, and cause of each collision. Fatal and severe injury collisions are also analyzed while developing the collision injury network.

Building the High Collision Network
Within ArcGIS, the required base data were spatially joined together so that the collisions were assigned to their appropriate roadway segments. This collision data can be queried into the following groups:

1. Aggressive driving collisions (collisions due to speeding, following too closely, or running lights or stop signs)
2. Broadside collisions
3. Head-on collisions
4. Rear-end collisions
5. Pedestrian-involved collisions
6. Dark collisions (collisions occurring at night or during dusk/dawn hours)

The total crash count for each segment was summed by group. Based on this, the segment's crashes per mile were calculated. These crash rates per segment were used in the next steps.

Defining Thresholds
Thresholds were defined to indicate what designates a "high collision" segment. Currently, there are a variety of ways that agencies define High collision Thresholds. For example, some HINS represent the most concentrated 50% of collisions while others represent as much as 80% of the total collisions. For the City of Palmdale HINs by mode, a 50% threshold was used.

Base High Injury Network
Based on the threshold defined above, a map for each collision type was developed to visually represent the high collision network. The segments were defined between major intersections to capture high collisions along roadway segments.

Preparing for Future Analysis and Project Prioritization
The High Collision Network (HCN) can be operationalized to help prioritize larger safety investments in concert with lower cost systemic countermeasures that are implemented city-wide. The high injury networks identified here can be used to prioritized different implementations around the City. Project prioritization using the high collision networks is discussed in Section 9.3.

7.7.2 High Injury Network (HIN) and High Collision Networks (HCN)s

The collision data used to develop the network was pulled from Crossroads/SWITRS for January 1, 2017 to December 31, 2021, for the City of Palmdale's roadway network. During this period, there were 7,721 collisions, including 238 fatal & severe injury collisions,(92 fatal collisions and 146 severe injury collisions). The following pages shows the high injury networks created for all collisions and for each collision type.

High Injury Network

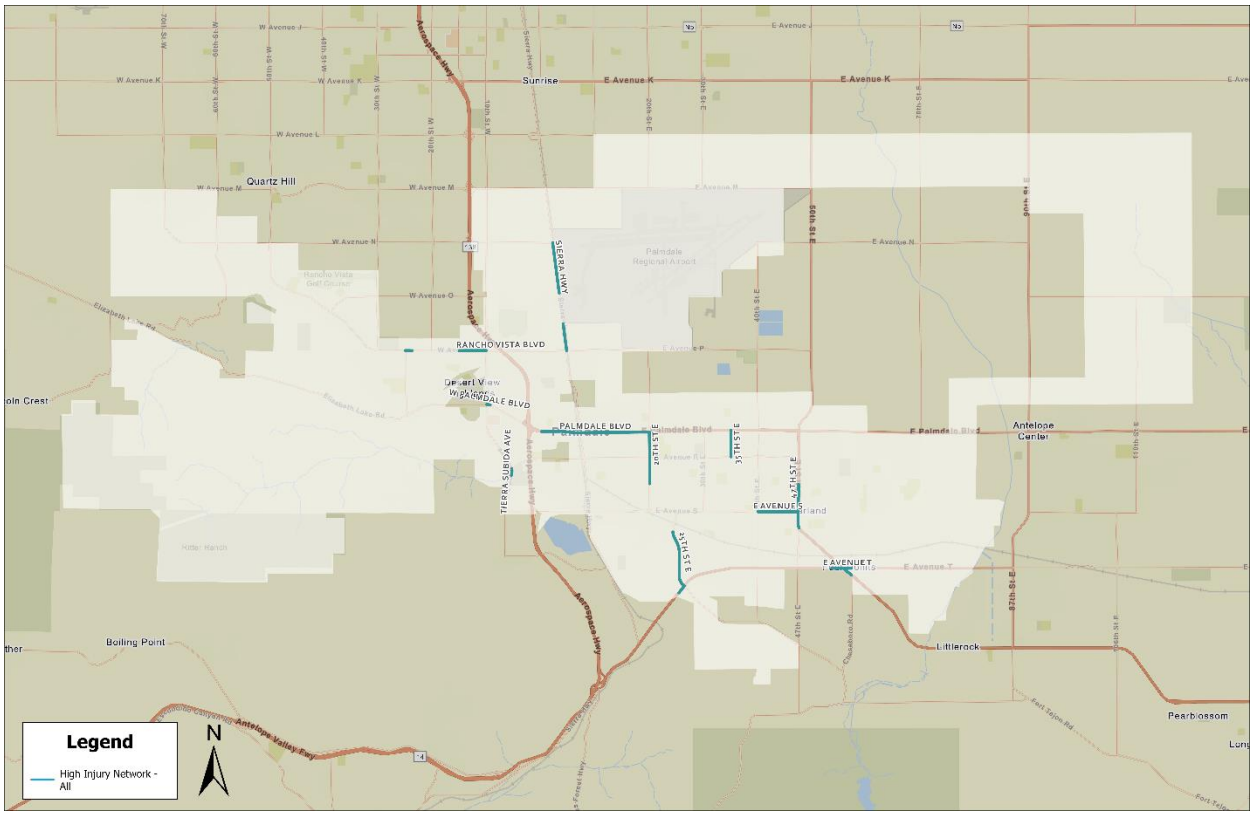
The following section summarizes the high injury network for all fatal and severe injuries collisions

The network for all collisions for just 1.5% of the total collisions in the City (119 collisions / 7,721 total collisions), but accounts for 50% of all fatalities and severe injuries (119 fatal or severe injury-causing collisions / 238 total fatal or severe injury-causing collisions).

The HIN for all modes accounts for 1.4% of the City's entire transportation network (8.8 HIN miles / 642.8 total miles). These segments also carry some of the highest traffic volumes in the City, making them poor candidates for countermeasures that would reduce roadway capacity.

Figure 11 shows the high injury network for all modes identified for the City of Palmdale.

Figure 11: High Injury Network



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Aggressive Driving

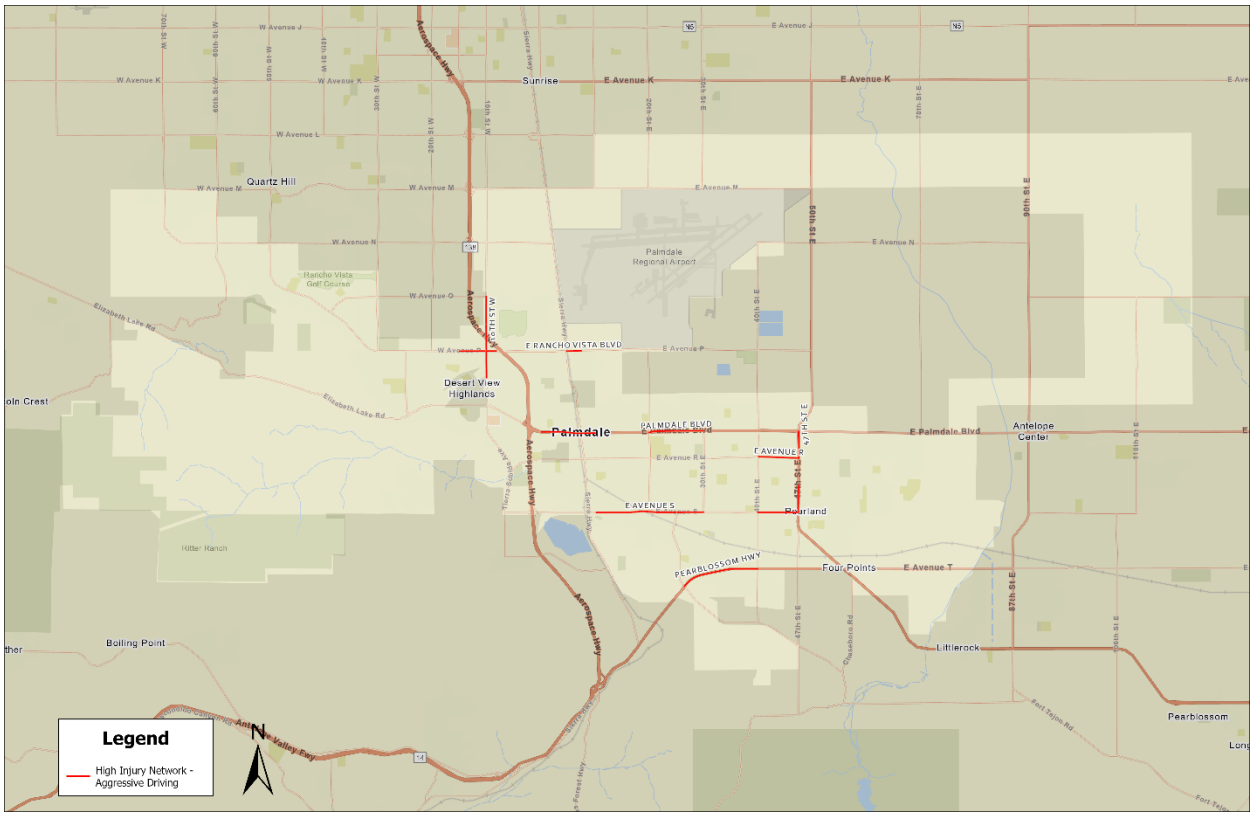
The following section summarizes the collision network for aggressive driving (collisions caused by speeding, tailgating, and reckless driving). During this period, there were 2,318 aggressive driving collisions along the network.

The network for aggressive driving accounts for 30.0% of the total collisions in the City (2,318 collisions / 7,721 total collisions). Furthermore, it accounts for 25.6% of all fatalities and severe injuries (61 fatal or severe injury-causing collisions / 238 total fatal or severe injury-causing collisions).

The HCN for aggressive driving collisions accounts for 1.6% of the City's entire transportation network (10.5 aggressive miles / 642.8 total miles). These segments also carry some of the highest traffic volumes in the City, making them poor candidates for countermeasures that would reduce roadway capacity.

Figure 12 shows the aggressive collision network for all modes identified for the City of Palmdale.

Figure 12: Aggressive Collision Network



This network can be prioritized for enforcement activities, as well as infrastructure improvements that discourage high speeds. Signal timing, narrower travel lanes, and other similar techniques can be employed to address these collisions without impacting vehicle capacity.

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Broadside Collisions

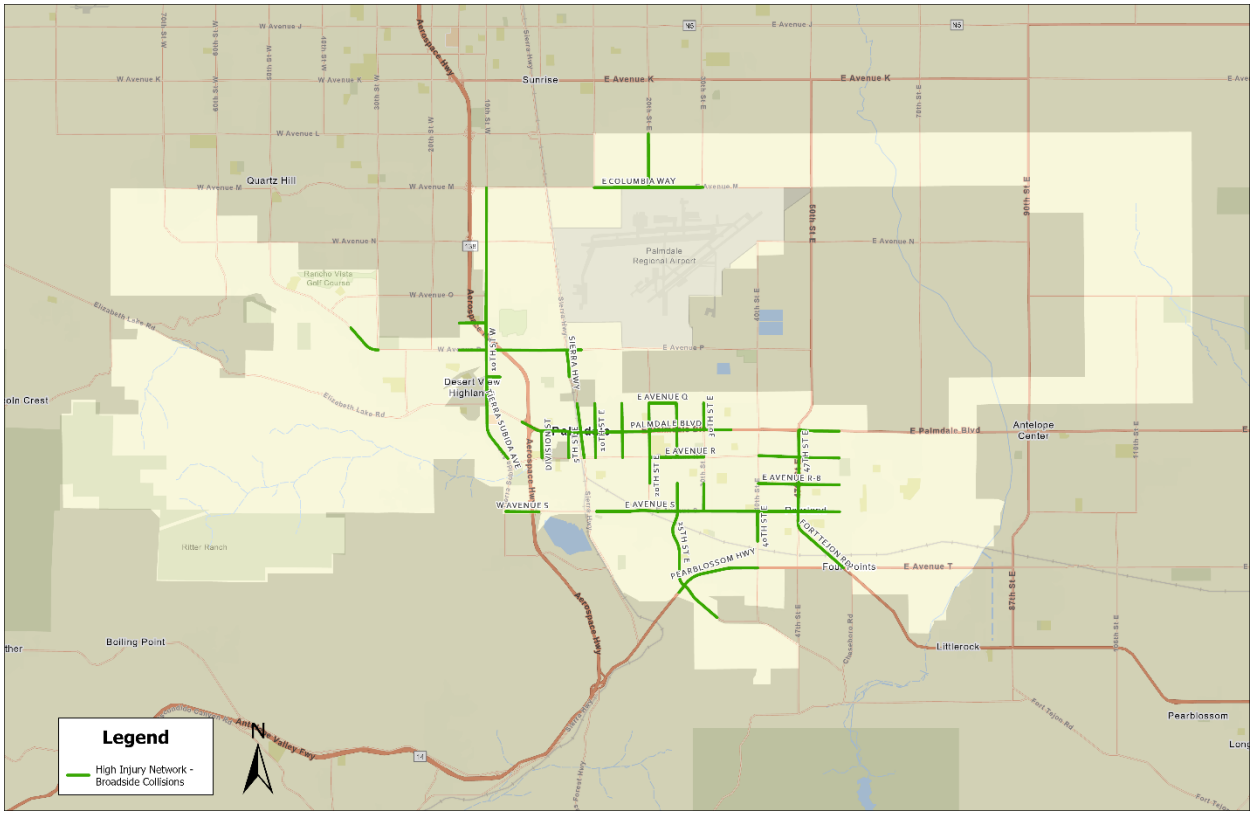
The following section summarizes the collision network for broadside collisions (collisions resulting in a broadside). During this period, there were 4,318 collisions along the network.

The network for broadside accounts for 55.9% of the total collisions in the City (4,318 collisions / 7,721 total collisions). Furthermore, it accounts for 54.2% of all fatalities and severe injuries (129 fatal or severe injury-causing collisions / 238 total fatal or severe injury-causing collisions)

The broadside network for all modes accounts for 6.6% of the City's entire transportation network (42.3 broadside miles / 642.8 total miles)

Figure 13 shows broadside network for all modes identified for the City of Palmdale.

Figure 13: Broadside Collision Network



These collisions typically occur at intersections and driveways. Countermeasures that improve intersection visibility, reduce vehicle speeds, and improve traffic control responsiveness are most effective for reducing these collisions.

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Dark Collisions

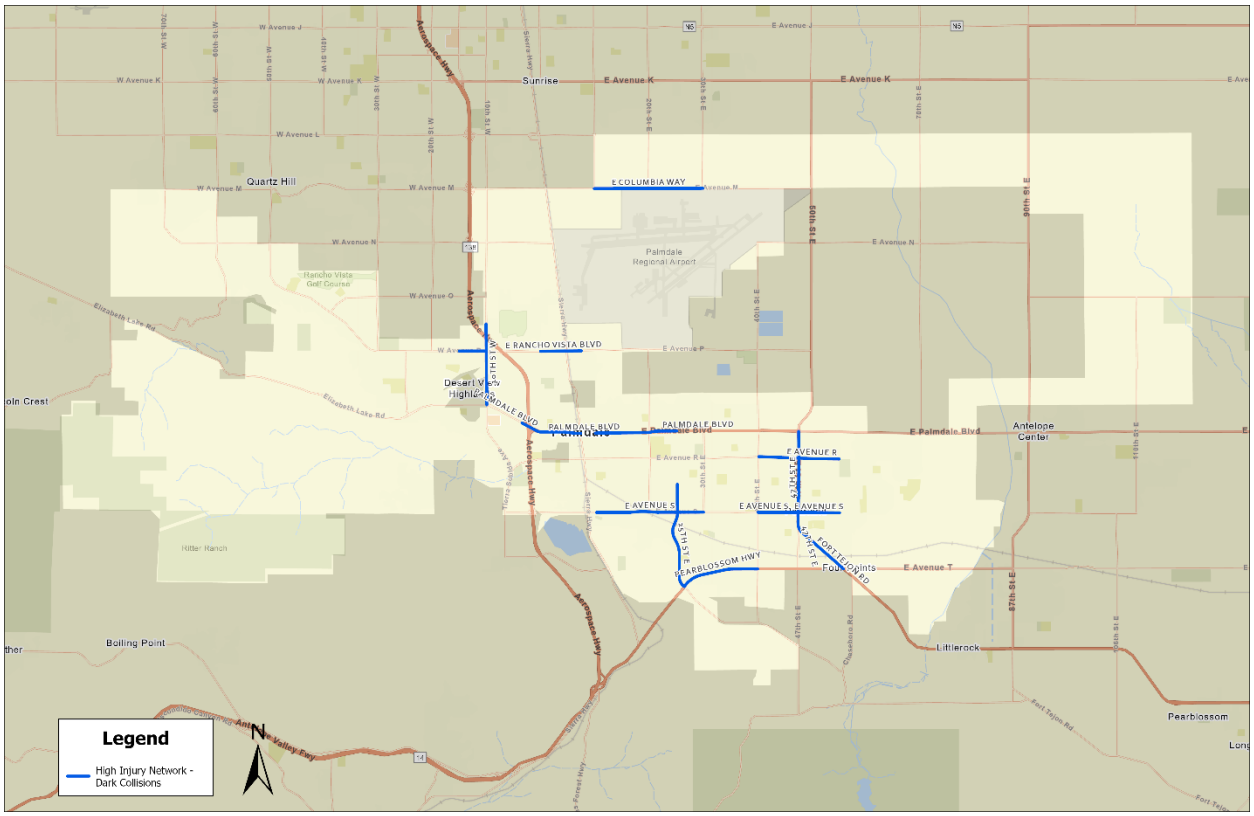
The following section summarizes the collision network for dark collisions (collisions occurring at night). During this period, there were 2,984 collisions along the network.

The network for dark collisions accounts for 38.6% of the total number in the City (2,984 collisions / 7,721 total collisions). Furthermore, it accounts for 39.1% of all fatalities and severe injuries (93 fatal or severe injury-causing collisions / 238 total fatal or severe injury-causing collisions). Compared to peer municipalities around the state, Palmdale ranks 11 out of 61 in terms of nighttime fatal and injury crashes (with 1 being the worst, and 61 being the best).

The broadside network for all modes accounts for 2.9% of the City's entire transportation network (18.9 broadside miles / 642.8 total miles)

Figure 14 shows broadside network for all modes identified for the City of Palmdale.

Figure 14: Dark Collision Network



These areas may be targeted for lighting improvements, impaired driving enforcement, and additional retroreflective markings and signage to improve overall nighttime visibility and discourage impaired driving.

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Head-On Collisions

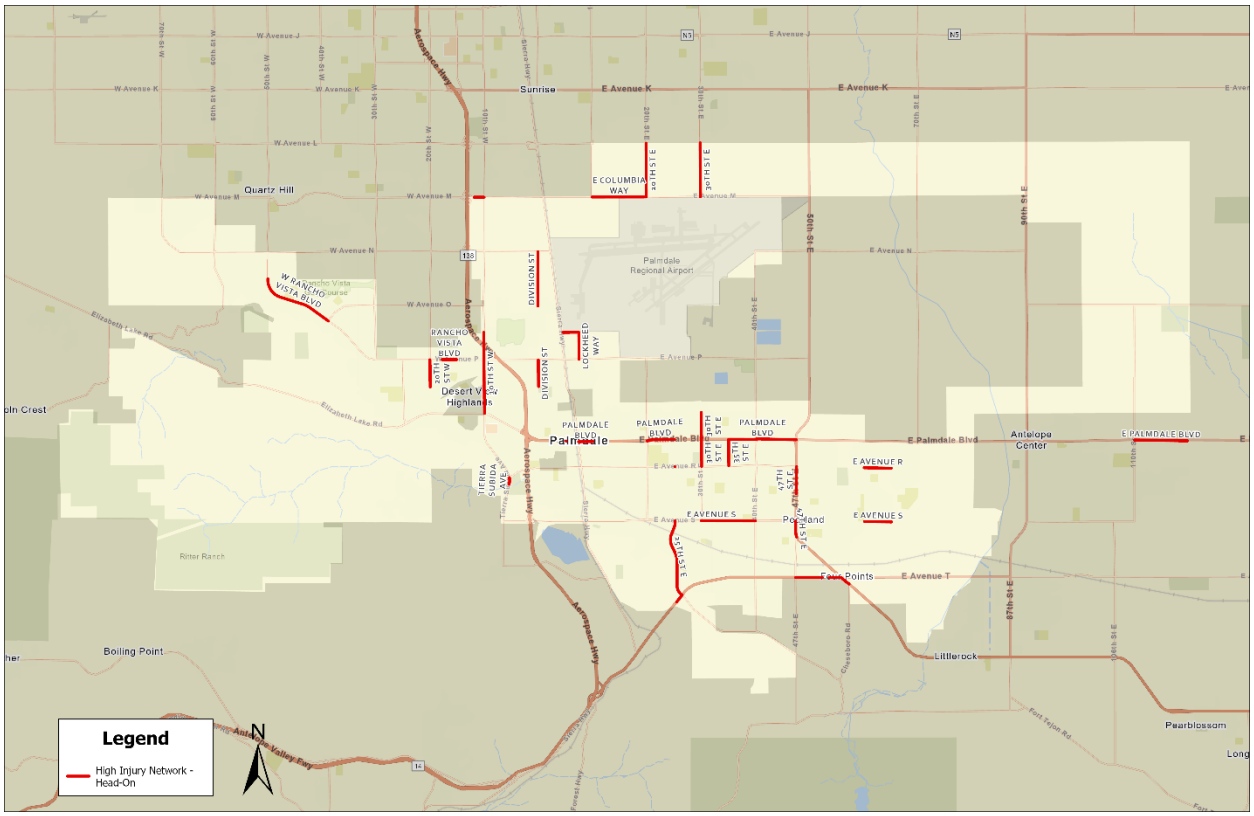
The following section summarizes the collision network for head-on collisions. During this period, there were 2,221 collisions along the network.

The network for head-on collisions accounts for 28.8% of the total collisions in the City (2,221 collisions / 7,721 total collisions). Furthermore, it accounts for 27.3% of all fatalities and severe injuries (65 fatal or severe injury-causing collisions / 238 total fatal or severe injury-causing collisions)

The head-on network for all modes accounts for 3.0% of the City's entire transportation network (19.4 broadside miles / 642.8 total miles)

Figure 15 shows the head-on network for all modes identified for the City of Palmdale.

Figure 15: Head-On Collision Network



Head on collisions typically occur when vehicles either cross the centerline, or a driver misjudges a turn through an intersection. Emphasis should be given to these collisions as they often result in fatal or severe injuries. Raised medians, buffered centerlines, turn tracking in intersections (particularly where there are multiple turn lanes or wide intersections) can help address these crashes. On narrower two-lane roadways, centerline rumble strips can also be an effective countermeasure.

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Pedestrian Collisions

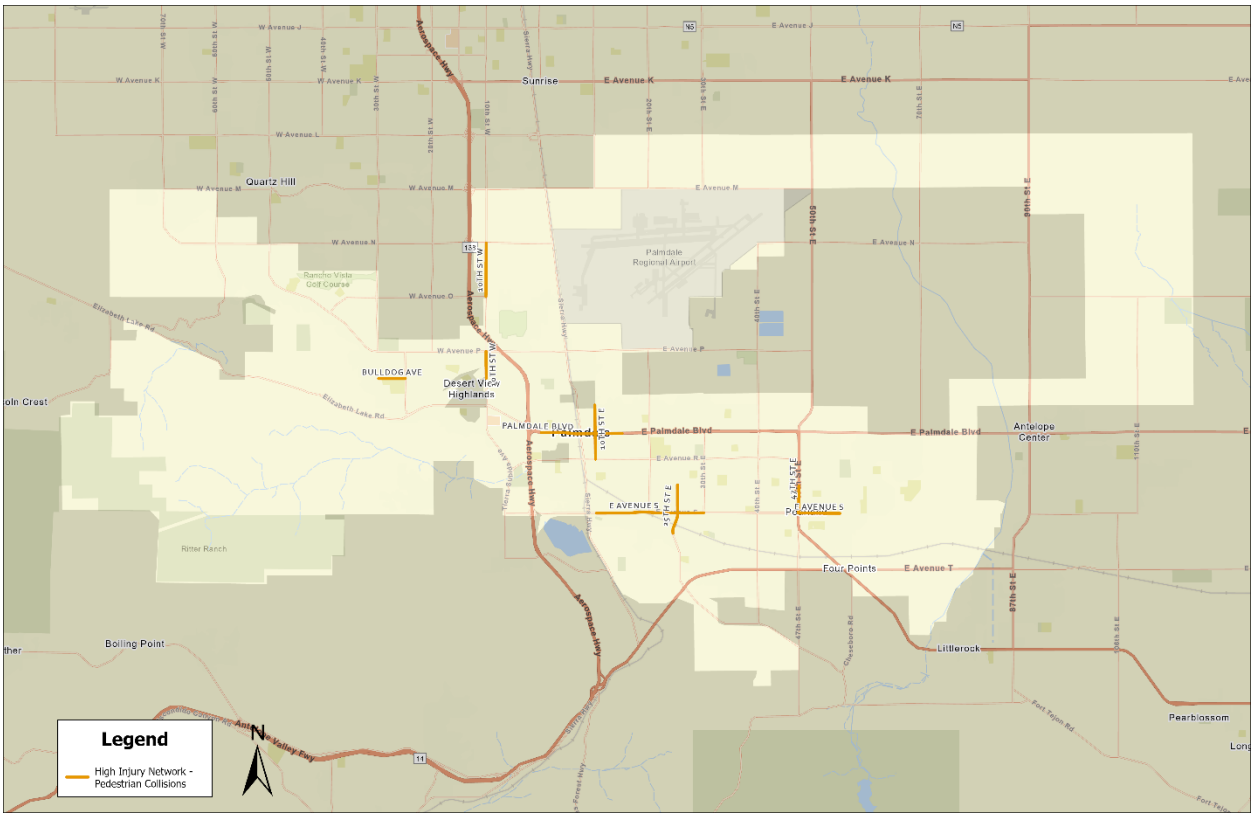
The following section summarizes the collision network for pedestrian collisions. During this period, there were 1,513 collisions along the network.

The network for pedestrian collisions accounts for 19.6% of the total collisions in the City (1,513 collisions / 7,721 total collisions). Furthermore, it accounts for 17.6% of all fatalities and severe injuries (42 fatal or severe injury-causing collisions / 238 total fatal or severe injury-causing collisions). Compared to peer municipalities around the state, Palmdale ranks 36 out of 61 in terms of pedestrian fatal and injury crashes (with 1 being the worst, and 61 being the best).

The pedestrian network for all modes accounts for 1.4% of the City's entire transportation network (8.7 broadside miles / 642.8 total miles)

Figure 16 shows the pedestrian network for all modes identified for the City of Palmdale.

Figure 16: Pedestrian Collision Network



Areas with higher concentrations of pedestrian crashes can be prioritized for treatments that reduce vehicle speed, provide protected crossings, allow pedestrian priority (such as leading pedestrian intervals) and closure of any gaps in the sidewalk, crosswalk network.

`

Rear-end Collisions

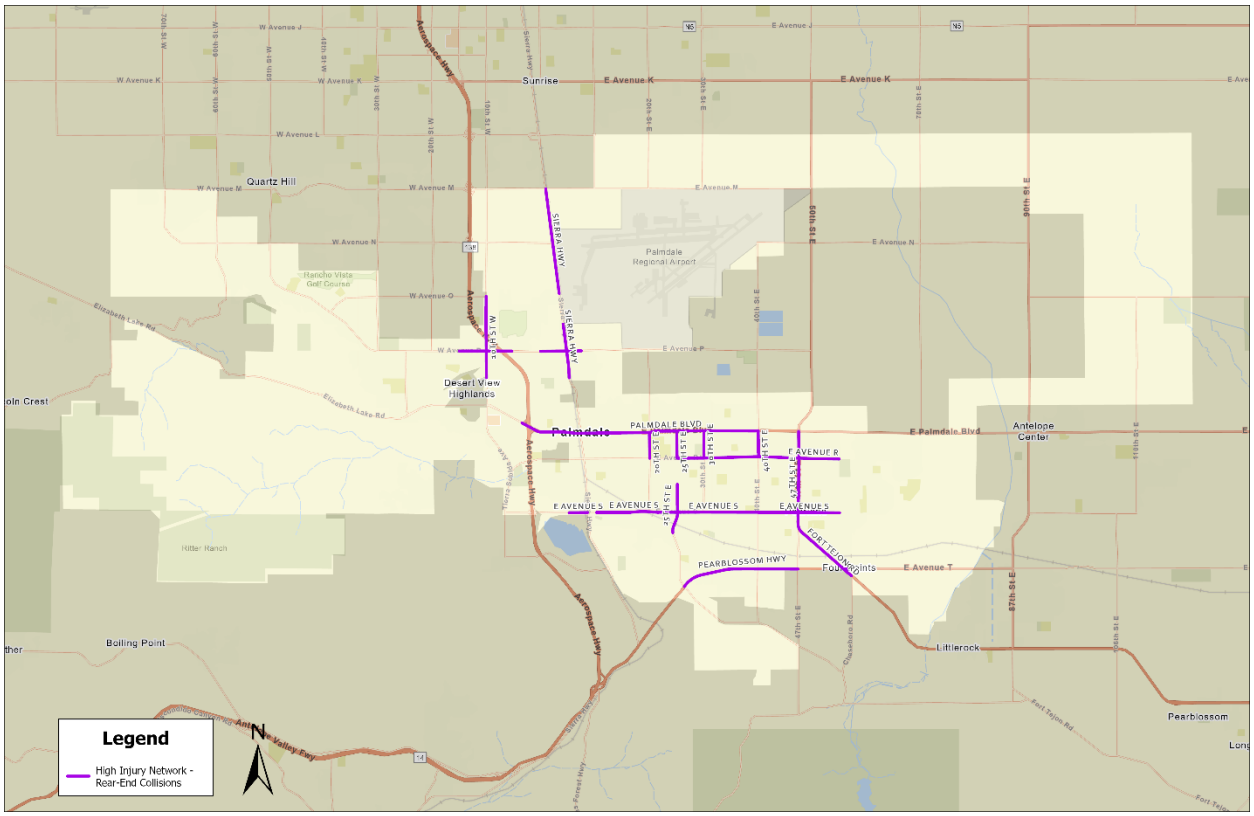
The following section summarizes the collision network for rear-end collisions. During this period, there were 3,755 collisions along the network.

The network for rear-end collisions accounts for 48.6% of the total collisions in the City (3,755 collisions / 7,721 total collisions). Furthermore, it accounts for 46.6% of all fatalities and severe injuries (111 fatal or severe injury-causing collisions / 238 total fatal or severe injury-causing collisions).

The rear-end network for all modes accounts for 4.2% of the City's entire transportation network (27.1 broadside miles / 642.8 total miles)

Figure 17 shows the rear-end network for all modes identified for the City of Palmdale.

Figure 17: Rear-End Collision Network



The primary factor behind rear end collisions is speed, followed by inattention. Treatments that reduce vehicle speed and that increase the visibility of driveways and intersections are effective for these types of collisions.

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7.8 Collision Network Screening Analysis Results

Figure 18 and Figure 19 and below show the results of the collision network screening analysis, with the number of collisions at both intersections and mid-block roadway segments.

Figure 18: Collision Network Screening Analysis Results: Intersection Network (2017-2021)

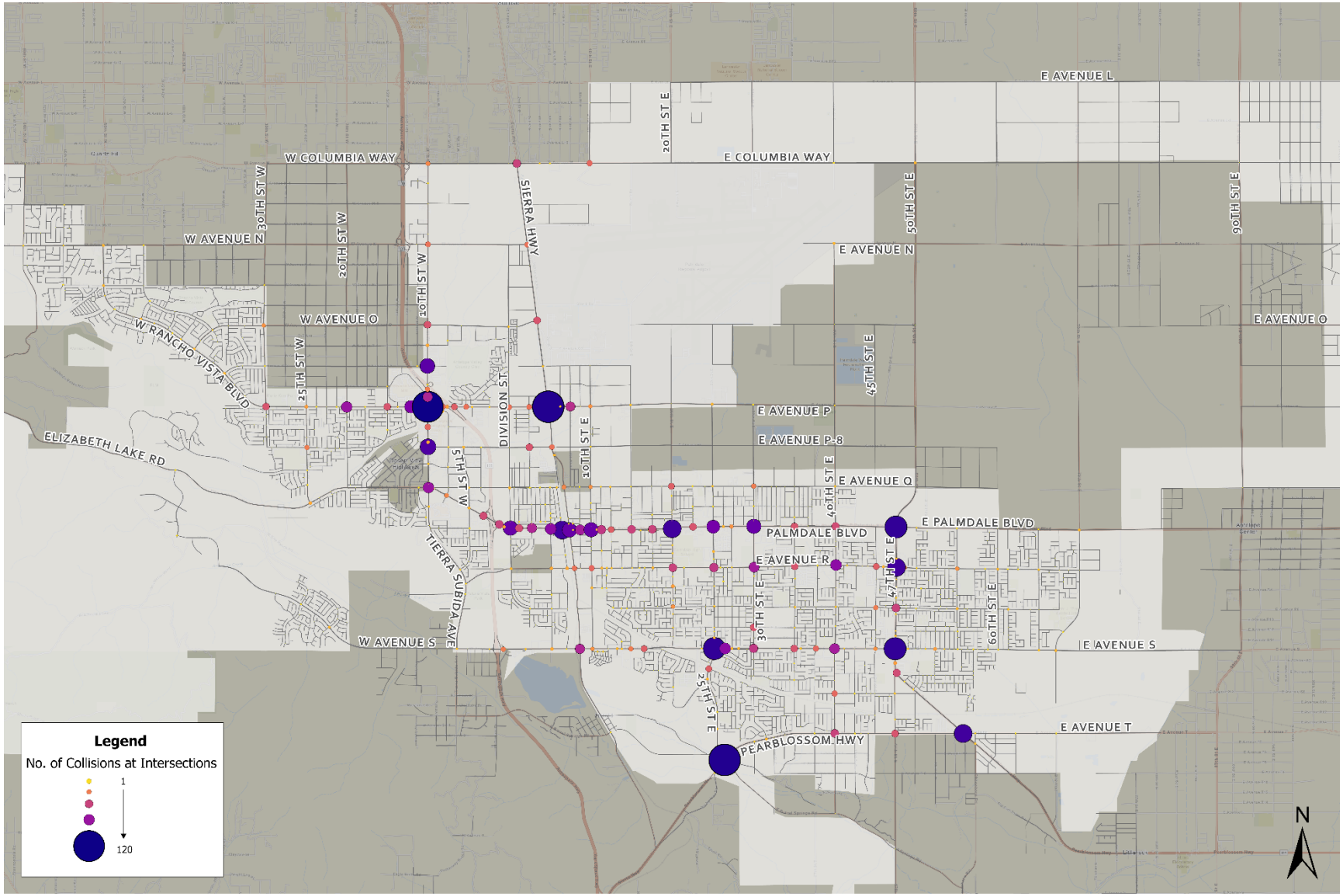


Figure 19: Collision Network Screening Analysis Results: Intersections Network (2017-2021)

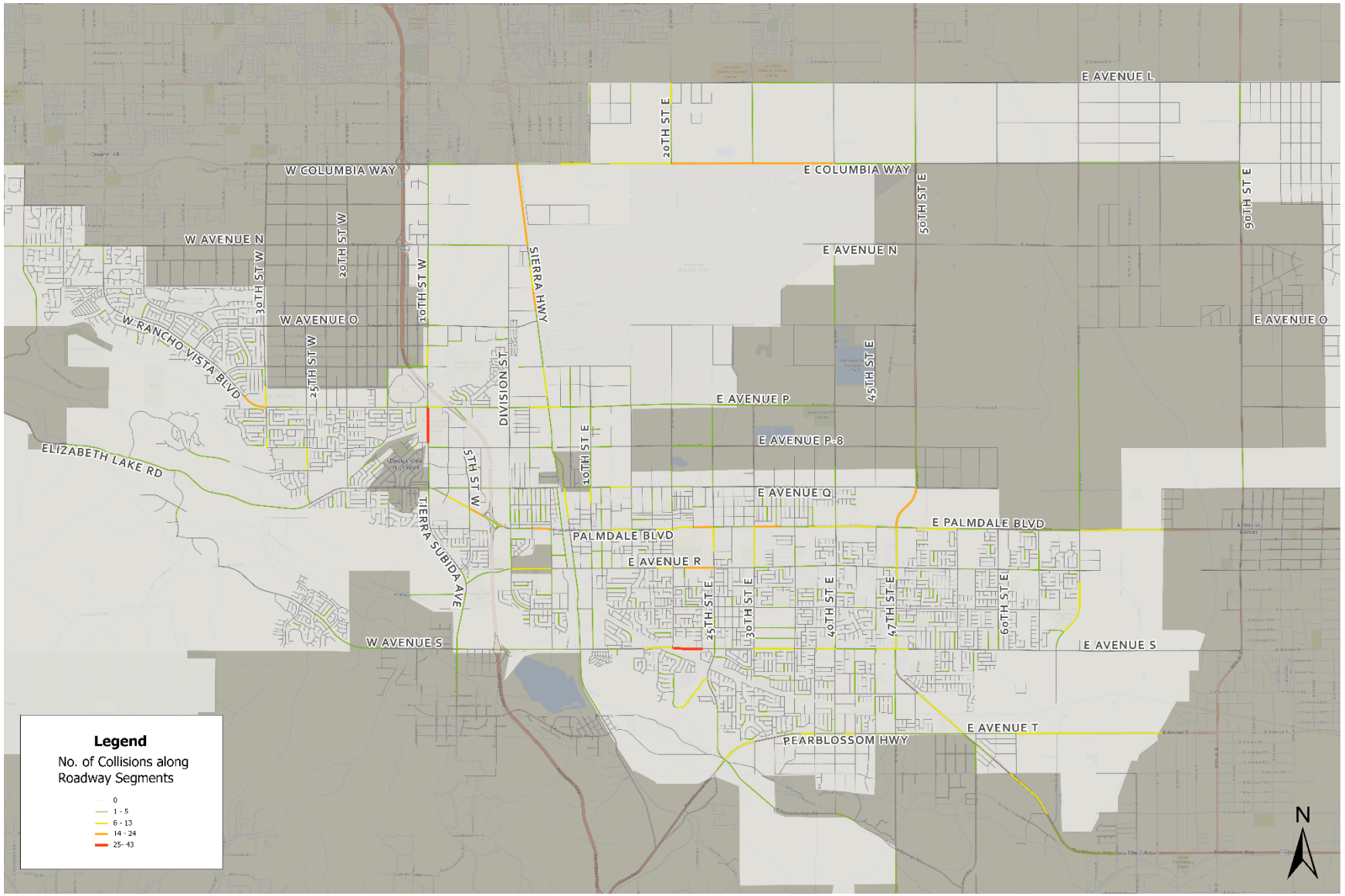


Table 4 and Table 5 how the number of crashes occurring at the top ten locations in Palmdale by crash type for the locations that will be studied further in the Report, and highlights locations in which the probability of those crash types exceeding the threshold proportion is greater than 33%.

The tables are ordered by the number of collisions that occurred at that segment or intersection. To be statistically significant, only locations where more than two collisions occurred are represented. At locations with two or less collisions, random chance can account for crash history as much or more than specific roadway characteristics.

The tables are separated into sub-sections visible by the blue gradient. The first two columns, Collisions and CCR, represent the level of crash activity in absolute terms, and as relative to other similar locations, respectively.

Per guidance from the Local Roadway Safety Manual (LRSM) each sub-population of locations was shown according to the number of collisions. The second column shows the CCR, which highlights whether or not the collision activity was higher or lower than the average for the sub-population based on the individual segment or intersection volume. This volume was either collected through data count resources or calculated based on the roadway classification. All averages used in the CCR calculation were established based on City of Palmdale crash data to determine what locations might be best to prioritize at the local level. This process highlights locations of collisions that are unusual for the City to determine Palmdale's challenge areas, and not problems faced by peer cities that do not apply in Palmdale. The remaining columns total collisions by type, to evaluate each sub-population and understand what proportion of crashes in the City are of a particular type. The citywide proportion was compared with the local intersection or segment specific proportion to determine which locations have more of a given crash type than would be expected when considering the City average. A confidence level of 95% was used for the CCR Calculations. For this study, two categories of ranges were highlighted:

After this analysis was completed, the locations were compared against other similar locations within the City by their categories according to the expected proportion of that crash type within Palmdale. Locations with higher-than-expected crashes of that type were identified by the probability that random chance would not account for exceedances.

Additionally, it should be noted that the columns for Collision Severity, Type, Involved With, and Behavior are additional characteristics of the collisions and should not be counted as a separate collision.

The following provides an example of how to read Tables 4 and 5.

Table Definitions:

- Total Collisions: Number of collisions observed at the intersection or segment from January of 2017 through December of 2021.
- Critical Crash Rate (CCR): The CCR specific to the intersection or segment.

- Severity: The number of severe injury and fatal collisions that occurred at this location in the study period.
- Fatality: The number of fatal collisions that occurred at this location in the study period.
- Broadside, Sideswipe, Rear-End, Head-On, Hit Object, Overturned, Other, Pedestrian, Bicycle: The number of these types of collisions that occurred at this location in the study period.
- Other: The number of miscellaneous collision types (mostly single vehicle) that occurred at this location in the study period.
- Aggressive, Dark, Wet: The number of the collisions with this factor identified as the cause of collision.

Table 4: Analysis Rankings: Intersections (Top 10 Per Type)

Intersection	Crashes	Local CCR Differential[1]	EPDO[2]	*Fatal*	*Serious Injury*	*Other Visible Injury*	*Complaint of Pain*	*PDO*	Broadside	Sideswipe	Rear End	Head On	Hit Object	Overturned	Other	Pedestrian	Bicycle	Aggressive	Distracted	Impaired	Dark	Wet
Signalized Intersections																						
10TH ST W & W RANCHO VISTA BLVD	120	0.23	491	0	1	3	35	81	18	23	53	6	2	1	0	3	1	56	5	7	0	6
SIERRA HWY & E RANCHO VISTA BLVD	103	0.51	805	1	2	6	30	64	22	27	37	4	4	0	3	1	0	39	4	8	0	7
PEARBLOSSOM HWY & BARREL SPRINGS RD	97	0.59	1163	2	3	14	22	56	29	13	28	11	4	3	1	1	0	39	1	2	2	5
25TH ST E & E AVENUE S	86	0.41	379	0	1	6	14	65	18	13	32	7	4	0	1	4	0	35	3	5	0	2
47TH ST E & E AVENUE S	80	0.31	1043	1	4	6	17	52	17	14	31	2	3	0	0	4	1	32	0	7	1	3
6TH ST E & PALMDALE BLVD	69	0.59	209	0	0	4	20	45	25	10	20	4	3	0	1	1	1	31	0	5	0	2
56TH ST E & FORT TEJON RD	66	0.22	687	0	3	5	16	42	21	5	29	4	3	0	0	0	0	34	2	2	2	4
47TH ST E & E AVENUE R	66	0.11	201	0	0	4	19	43	10	10	31	2	3	0	2	2	0	30	1	2	0	3
20TH ST E & PALMDALE BLVD	65	0.36	523	0	2	4	18	41	19	10	22	2	2	0	1	2	1	24	4	1	0	3
10TH ST W & TECHNOLOGY DR	62	0.47	490	0	1	11	31	19	43	4	2	10	2	0	0	0	0	6	0	1	0	2
Unsignalized Intersections																						
50TH ST E & E PALMDALE BLVD	84	1.60	530	0	2	7	10	65	13	28	14	1	14	3	1	0	0	17	2	8	1	0
26TH ST E & E AVENUE S	44	0.74	191	0	0	11	8	25	17	7	8	5	2	1	1	1	0	3	0	2	0	1
11TH ST E & PALMDALE BLVD	34	0.41	134	0	0	3	14	17	22	4	1	2	2	0	1	2	0	2	0	2	0	0
15TH ST E & PALMDALE BLVD	32	0.40	626	1	2	8	5	16	21	1	3	1	5	0	0	1	0	8	1	2	0	4
25TH ST E & OLIVE DR	31	0.51	81	0	0	1	8	22	15	7	1	3	1	0	2	0	0	2	0	1	0	2
2ND ST E & PALMDALE BLVD	30	0.45	269	0	1	2	11	16	16	5	5	0	0	0	0	3	0	3	0	4	1	2
30TH ST E & E AVENUE R-12	28	1.39	131	0	0	7	7	14	21	1	3	0	3	0	0	0	0	5	0	1	0	0
BELA ST & E AVENUE S	26	0.28	264	1	0	4	7	14	14	3	4	1	3	0	0	1	0	2	0	0	0	0

Intersection	Crashes	Local CCR Differential[1]	EPDO[2]	*Fatal*	*Serious Injury*	*Other Visible Injury*	*Complaint of Pain*	*PDO*	Broadside	Sideswipe	Rear End	Head On	Hit Object	Overturned	Other	Pedestrian	Bicycle	Aggressive	Distracted	Impaired	Dark	Wet
3RD ST E & TECHNOLOGY DR	26	0.99	77	0	0	0	10	16	15	2	2	1	1	0	1	0	0	12	1	0	1	3
12TH ST E & PALMDALE BLVD	24	0.25	90	0	0	1	11	12	7	2	9	2	2	0	1	0	0	13	1	0	0	0

1. Local Critical Crash Rate Differential
2. Equivalent Property Damage Only Crashes

= Local CCR Differential > 1.0

= Local CCR Differential 0.33-1.0

= Local CCR Differential < 0.33

= 90-100% probability that crash type if over-represented

= 80-90% probability that crash type is over-represented

= 70-80% probability that crash type is over-represented

[1]Local Critical Crash Rate Differential

[2]Equivalent Property Damage Only Crashes

Table 5: Analysis Rankings: Segments (Top 10 Per Type)

Facility	Limits	Crashes	Local CCR Differential[1]	EPDO[2]	*Fatal*	*Serious Injury*	*Other Visible Injury*	*Complaint of Pain*	*PDO*	Broadside	Sideswipe	Rear End	Head On	Hit Object	Overturned	Other	Pedestrian	Bicycle	Aggressive	Distracted	Impaired	Dark	Wet
Regional																							
50TH ST E	E PALMDALE BLVD - AVE Q	**16**	0.81	571	2	1	4	5	4	1	1	2	3	3	4	2	0	0	3	0	2	4	0
50TH ST E	AVE M - AVE L	**3**	-0.21	330	2	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	2	1
10TH ST W	BEECHDALE DR - AVE P	**31**	0.78	398	0	2	2	4	23	9	11	8	1	2	0	0	0	0	6	0	1	0	3
SIERRA HWY	AVE M - AVE N	**24**	0.16	262	1	0	4	7	12	0	1	11	1	6	3	1	1	0	11	2	3	1	2
W PALMDALE BLVD	5TH S W - SR-14 SB RAMP	**22**	1.66	63	0	0	0	8	14	6	8	5	1	2	0	0	0	0	5	0	4	0	0
E COLUMBIA WAY	40TH ST E - 30TH ST E	**19**	0.86	411	1	1	3	7	7	4	3	4	1	7	0	0	0	1	8	2	1	3	2
E COLUMBIA WAY	20TH ST E - 30TH ST E	**15**	0.15	358	2	0	0	3	10	3	1	3	3	4	1	0	0	0	6	1	0	3	1
SIERRA HWY	AVE N - AVE O	**14**	0.37	719	2	2	2	6	2	1	2	4	2	5	0	0	0	0	3	0	3	4	1
47TH ST E	E AVENUE R - 47TH ST PAVILION ENTRANCE	**13**	0.37	23	0	0	0	2	11	1	2	9	0	1	0	0	0	0	6	2	2	0	0
FORT TEJON RD	PEARBLOSSOM HWY - AVE S-8	**11**	-0.08	60	0	0	3	4	4	5	1	1	0	3	0	0	1	0	1	0	0	4	0
PEARBLOSSOM HWY	30TH ST E - 25TH ST E	**11**	-0.02	219	0	1	3	3	4	2	1	4	1	1	1	1	0	0	6	1	0	4	2
E COLUMBIA WAY	20TH ST E - 10TH ST E	**11**	0.10	185	1	0	0	2	8	5	3	2	0	1	0	0	0	0	3	0	1	4	0
Crosstown																							
E AVENUE S	20TH ST E - HALFMOON DR	**43**	1.66	307	0	1	3	14	25	7	8	17	5	3	0	0	1	0	23	1	4	0	2
PALMDALE BLVD	3RD ST E - 5TH ST E	**22**	1.52	275	0	1	4	10	7	13	1	5	3	0	0	0	2	0	3	0	0	1	3
E AVENUE R	HASTINGS ST - 25TH ST E	**20**	1.32	234	1	0	0	10	9	9	4	3	0	3	0	0	1	0	3	1	1	0	3
W RANCHO VISTA BLVD	30TH ST W - SEVILLE AVE	**19**	1.67	416	2	0	4	6	7	16	1	0	0	2	0	0	0	0	0	0	0	0	0
PALMDALE BLVD	25TH ST E - 22ND ST E	**17**	1.07	215	1	0	2	3	11	5	1	6	1	3	0	0	1	0	6	3	1	0	0
PALMDALE BLVD	POND AVE - 30TH ST E	**14**	1.35	44	0	0	2	2	10	3	4	5	1	1	0	0	0	1	2	1	1	0	0

Facility	Limits	Crashes	Local CCR Differential[1]	EPDO[2]	*Fatal*	*Serious Injury*	*Other Visible Injury*	*Complaint of Pain*	*PDO*	Broadside	Sideswipe	Rear End	Head On	Hit Object	Overturned	Other	Pedestrian	Bicycle	Aggressive	Distracted	Impaired	Dark	Wet
PALMDALE BLVD	22ND ST E - 20TH ST E	**13**	0.66	212	0	1	0	7	5	5	1	3	1	2	0	0	2	0	2	0	2	0	0
AVE P	10TH ST W - LOWES DR	**13**	0.45	38	0	0	1	3	9	0	3	8	0	1	0	0	1	0	6	1	0	0	1
30TH ST E	E AVENUE R - HWY 138	**13**	2.19	72	0	0	4	4	5	1	0	7	1	3	0	0	1	0	6	0	0	0	0
E AVENUE T	70TH ST E - 80TH ST E	**12**	-0.01	201	0	1	1	3	7	4	0	4	1	1	1	1	0	0	5	0	1	4	1
Connector																							
70TH ST E	EDDY LN - AVE R-12	**11**	0.78	36	0	0	0	5	6	2	2	1	0	4	0	0	2	0	1	1	0	0	1
E PALMDALE BLVD	80TH ST E - 70TH ST E	**8**	-0.13	28	0	0	0	4	4	0	2	4	1	0	0	0	1	0	2	0	1	3	0
OLD HAROLD RD	25TH ST E - FIRETHORN ST	**8**	5.64	38	0	0	2	2	4	1	3	2	0	1	0	0	1	0	1	0	0	0	0
47TH ST E	E AVENUE S-8 - STARGAZER PL	**5**	0.57	15	0	0	0	2	3	0	2	0	0	3	0	0	0	1	0	0	0	0	2
E AVENUE R-8	SAN YSIDRO WAY - LEMSFORD AVE	**4**	1.09	9	0	0	0	1	3	0	1	1	0	1	0	0	0	1	0	0	0	0	0
5TH ST E	AVE R - AVE R-4	**4**	0.76	9	0	0	0	1	3	1	1	2	0	0	0	0	0	0	1	0	0	0	0
AVE P-8	BOLTE WAY - 25TH ST E	**3**	0.60	8	0	0	0	1	2	1	1	0	0	0	0	0	1	0	0	0	0	0	1
47TH ST E	FORT TEJON RD - AVE S-8	**3**	0.10	18	0	0	1	1	1	0	1	2	0	0	0	0	0	0	2	2	0	0	0
15TH ST E	BLACKBIRD DR - AVE Q-12	**3**	7.61	18	0	0	1	1	1	0	0	0	2	1	0	0	0	0	2	0	0	2	1
Neighborhood																							
11TH ST E	E AVENUE Q-4 - HWY 138	**5**	2.84	5	0	0	0	0	5	1	1	2	1	0	0	0	0	0	1	0	1	0	0
11TH ST E	AVE R - AVE Q-12	**5**	4.15	5	0	0	0	0	5	2	3	0	0	0	0	0	0	0	0	0	0	0	0
4TH ST E	E AVENUE Q-7 - AVE Q-3	**4**	3.72	4	0	0	0	0	4	0	1	1	1	0	0	1	0	0	1	0	0	0	0
JODY LN	AVE Q-4 - ST ANDREWS WY	**4**	14.29	4	0	0	0	0	4	0	0	0	0	4	0	0	0	0	1	0	0	1	0
FIRETHORN AVE	SHAMROCK AVE - OLD HAROLD RD	**4**	3.60	4	0	0	0	0	4	0	0	1	1	0	0	0	0	0	0	0	0	0	0
E AVENUE R-12	30TH ST E - 35TH ST E	**4**	2.13	9	0	0	0	1	3	2	1	0	0	1	0	0	0	0	0	0	2	0	0

Facility	Limits	Crashes	Local CCR Differential[1]	EPDO[2]	*Fatal*	*Serious Injury*	*Other Visible Injury*	*Complaint of Pain*	*PDO*	Broadside	Sideswipe	Rear End	Head On	Hit Object	Overturned	Other	Pedestrian	Bicycle	Aggressive	Distracted	Impaired	Dark	Wet
OLIVE DR	VISTA LEON - 25TH ST E	**4**	4.00	4	0	0	0	0	4	3	1	0	0	0	0	0	0	0	1	0	0	0	0
E AVENUE Q-9	RITA ST - 20TH ST E	**4**	5.66	14	0	0	1	0	3	0	1	0	0	1	0	1	1	0	0	0	1	0	1
PEARBLOSSOM HWY	75TH ST E - 70TH ST E	**3**	0.29	8	0	0	0	1	2	0	1	0	0	1	1	0	0	0	0	0	0	1	0
37TH ST E	FRONTAGE RD - AVE Q-4	**3**	2.16	3	0	0	0	0	3	1	2	0	0	0	0	0	0	0	0	0	0	0	1

1. Local Critical Crash Rate Differential

2. Equivalent Property Damage Only Crashes

= Local CCR Differential > 1.0

= Local CCR Differential 0.33-1.0

= Local CCR Differential < 0.33

= 90-100% probability that crash type if over-represented

= 80-90% probability that crash type is over-represented

= 70-80% probability that crash type is over-represented

[1]Local Critical Crash Rate Differential

[2]Equivalent Property Damage Only Crashes

7.9 Statewide Comparison

A comparison of fatal & severe injury collision data to the State averages were conducted for data from 2010-2019 (the most recent statewide data available). These numbers may vary slightly from those mentioned previously, due to the differences in the years of the study period. The following are areas where collisions within Palmdale relate more to specific factors than elsewhere in the State. These numbers specifically compare the proportion of fatal and serious injury crashes that have the characteristics listed in Table 6. Of the most severe crashes in Palmdale during the study period, crashes at intersection, crashes involving impaired drivers and crashes involving young drivers were over-represented relative to state-wide averages. Intersection collisions likely have a higher percentage compared to statewide as Palmdale is more urban than the state. Crashes involving lane departures, motorcycles, bicycles, and aging drivers were under-represented.

Table 6: Comparison of Statewide and Palmdale Fatal & Severe Injury Crashes (2010-2019)

California SHSP Challenge Area	Statewide %	Palmdale %	Percentage Difference
Palmdale has a Higher Percentage of F&SI Crashes			
Intersections	23.6%	51.1%	27.5%
Impaired Driving	25.3%	31.2%	5.9%
Young Drivers	13.1%	16.1%	3.0%
Driver Licensing	24.7%	25.6%	0.9%
Pedestrians	19.2%	19.9%	0.7%
Distracted Driving	5.0%	5.2%	0.2%
Work Zones	1.4%	1.6%	0.2%

California SHSP Challenge Area	Statewide %	Palmdale %	Percentage Difference
Palmdale has a Lower Percentage of F&SI Crashes			
Commercial Vehicles	6.4%	5.9%	- 0.5%
Aggressive Driving	33.1%	31.9%	- 1.2%
Occupant Protection	14.2%	12.7%	- 1.5%
Aging Drivers	12.4%	9.3%	- 3.1%
Bicyclists	8.3%	4.5%	- 3.8%
Motorcyclists	21.0%	16.5%	- 4.5%
Lane Departure	43.3%	34.6%	- 8.7%

*Available for Fatal Only.

8. Best Practices Evaluation and Emphasis Areas

8.1 Emphasis Areas

Emphasis areas represent crash factors that are common in the City and provide the opportunity to reduce the largest number of traffic injuries with strategic investment. Emphasis areas were developed by revisiting the vision and goals of this planning process and comparing them with the trends and patterns identified in the crash analysis.

8.1.1 Emphasis Area #1: Intersection Improvements

Intersection collisions, as defined by the SHSP, are those identified as those occurring at an intersection. For the purposes of this analysis, those that occurred within 250 feet of an intersection were also included. Intersection collisions accounted for about 51.1% of all fatal and severe injury collisions and 82% of all collisions. 59 of the 92 fatal injury collisions occurred at intersections, and 112 of the 146 severe injury collisions occurred at intersections.

Goals for Emphasis Area #1:

- Reduce the number of collisions at intersections;
- Identify hot spots for intersection collisions; and,
- Apply for funding and implement countermeasures at City intersections.

Strategies for Emphasis Area #1:

- Address intersection collisions by implementing proven countermeasures ;
- Identify priority corridors for intersections collisions and implement countermeasures on these corridors;
- Install or upgrade pedestrian crossings with enhanced features to improve visibility;
- Implement curb extensions or bulb outs at intersections with high pedestrian traffic;
- Consider converting four-way stops to roundabouts if warranted by an intersection control evaluation; and,
- Install flexible delineators, reflectors, and/or new lane striping at intersections.

These strategies will be implemented by the City, while partnering with Caltrans, Southern California Association of Governments (SCAG), Los Angeles County Sheriff's Department, and other community partners. Funding sources for these strategies may include HSIP, Active Transportation Program (ATP), OTS, SB 1, and SS4A grant programs.

8.1.2 Emphasis Area #2: Impaired Drivers

Impaired driving crashes are a high priority challenge area within the Caltrans SHSP. Caltrans defines these as crashes where any evidence of drug or alcohol use by the driver is present, even if the driver was not over the legal limit. 507 crashes (6.6%) were reported as the driver being under the influence of alcohol or drugs. Forty-five of these crashes resulted in a fatality and 84 in a severe injury. 89% of these crashes (452) resulted in Property Damage Only. 12% of these collisions. Broadside and head-on collisions were 30% of impaired driving collisions, but 90% of fatal collisions and 71% of severe injury collisions.

Goals for Emphasis Area #2:

- Reduce the number of crashes attributed to impaired driving;
- Identify hot spots and priority corridors for countermeasures to reduce impaired driving; and,
- Apply for funding to implement countermeasures to reduce impaired driving crashes.

Strategies for Emphasis Area #2:

- Authorize, publicize, and conduct sobriety checkpoints programs;
- Implement an impaired driving education campaign;
- Develop educational programs targeting specific audiences based on age group;
- Additional enforcement presence;
- Create effective media campaigns in both visual and print media;
- Consider converting four-way stops to roundabouts if warranted by an intersection control evaluation;
- Install improved segment lighting to improve visibility along darker segments;
  Restripe road to include narrower lanes to lower vehicles speeds; and,
- Install reflective markings that delineate direction and make lane striping more visible at night.

These strategies will be implemented by the City, law enforcement, and community organizations. Funding sources for these strategies may include OTS, NHTSA, and SB1 grant programs.

8.1.3 Emphasis Area #3: Young and Inexperienced Drivers

Young drivers, as defined by the Caltrans SHSP, are drivers between 15 and 20 years of age. Young drivers were involved in 687 crashes, about 8.9% of total crashes. Eight resulted in fatal injury and 16 resulted in severe injury. 78% of these crashes resulted in property damage only.

Goals for Emphasis Area #3:

- Reduce the number and severity of collisions attributed to young drivers;
- Identify hot spots and priority corridors for young driver collisions;

Strategies for Emphasis Area #3:

- Implement driver's education courses, implementing technology in young driver's vehicles, and education campaigns to target drivers with messages regarding road safety, common mistakes, and challenges that young drivers face;
- Increase enforcement to address young driver behaviors that will mainly focus on education, encouragement, and enforcement; and,
- Increase enforcement near hotspots of young driver collisions and increased coordination with community organizations
- Apply for funding and implement countermeasures to address young drivers;
- Install warning signs that are more visible than standard signage, such as flashing beacons or those with Retroreflectivity;
  Install advanced warning signs: including those for intersections, curves, schools, and services;
- Install speed feedback signs with HAWK beacons; and,
- Repurpose unused pavement into medians, bike lanes, parking, blub-out and curb extensions, or bus stops.

These strategies will be implemented by the City, law enforcement, and local community organizations. Funding sources for these strategies may include NHTSA, OTS, and SB1 grant programs.

9. Countermeasure Toolbox

This section provides information on general identified issues, crash reduction factors, improvements, and countermeasures identified for the City of Palmdale, as well as for specific project locations identified as part of this analysis. Countermeasures for each of the Safety Project Case Studies are based on data analysis, stakeholder input, and site visits.

9.1 Infrastructure Improvements

9.1.1 Countermeasure Selection Process

Part D of the HSM provides information on CMFs for roadway segments, intersections, interchanges, special facilities, and road networks. CMFs are used to estimate the safety effects

of highway improvements, specifically to compare and select highway safety improvements. A CMF less than 1.0 indicates that a treatment has the potential to reduce crashes. A CMF greater than 1.0 indicates that a treatment has the potential to increase crashes. A Crash Reduction Factor (CRF) is directly connected to the CMF and is "mathematically defined as (1 – CMF) (the higher the CRF, the greater the expected reduction in crashes)[3]." CMFs can help decision makers weigh potential alternative projects but are only one measure of a project's value and should be considered part of a larger decision-making process. Furthermore, it is important to note that not all CMFs are as reliable as others. The FHWA maintains a federal depository of CMFs and includes a star rating system to help users determine which CMFs are bolstered by the best and most thorough research. Key factors to consider when applying CMFs include:

1. Selection of an appropriate CMF;
2. Estimation of crashes without treatment;
3. Application of CMFs by type and severity; and,
4. Estimation of the combined effect for multiple treatments.

Examples of Safety Countermeasures can be found through several sources. This Report utilizes the countermeasures found in the California LRSM and the CMF Clearinghouse (CMF CH) website. The Caltrans Proven Safety Countermeasures guidance also informed the selection of these countermeasures. Countermeasures for each of the Safety Project Case Studies are based on the data analysis and site visits. Additional countermeasures were identified for the high-level issues on a city-wide level and are discussed in Section 9.2.

9.1.2 Safety Project Case Studies

From the city-wide analysis, ten project case study locations were selected for further evaluation and countermeasure development. For each of these locations, Safety Project Case Studies were developed to provide a balanced understanding of common safety patterns at a variety of location types that can be used to associate countermeasures with specific roadway configurations and conditions. These locations were identified through the analysis process based on their crash histories, stakeholder engagement, the observed crash patterns, and differing characteristics to provide the most insight into potential systemic safety countermeasures that the City can employ to achieve the most cost-effective safety benefits.

A Safety Project Case Study was developed for each of the following locations:

5. Signalized Intersection: 47th Street East and Avenue R
6. Unsignalized Intersection: 45th Street East and Avenue R-8
7. Segment: Avenue R-8 from 30th Street East to 35th Street East
8. Unsignalized Intersection: 25th Street East and Olive Drive
9. Unsignalized Intersection: 3rd Street East and Technology Drive
10. Signalized Intersection: 10th Street West and Rancho Vista Boulevard
11. Segment: Rancho Vista Blvd from 30th Street West to Seville Avenue
12. Signalized Intersection: 10th Street West and Avenue O-8
13. Segment: Sierra Highway (Avenue M to Rancho Vista Bl)

[3] Local Roadway Safety Manual (Version 1.5) 2020. Page 27.

14. Signalized Intersection: 20th Street East and Avenue M

The following pages summarize conditions at each location, and potentially beneficial countermeasures. Countermeasures were subjected to a benefit/cost assessment and scored according to their potential return on investment. These case studies can be used to select the most appropriate countermeasure, and to potentially phase improvements over the longer-term. The potential benefit of these countermeasures at locations with similar design characteristics can then be extrapolated regardless of crash history, allowing for proactive safety enhancements that can prevent future safety challenges from developing. These case study sheets can also be used to position the City for future grant funding opportunities.

Case Study Sheet: Location #1

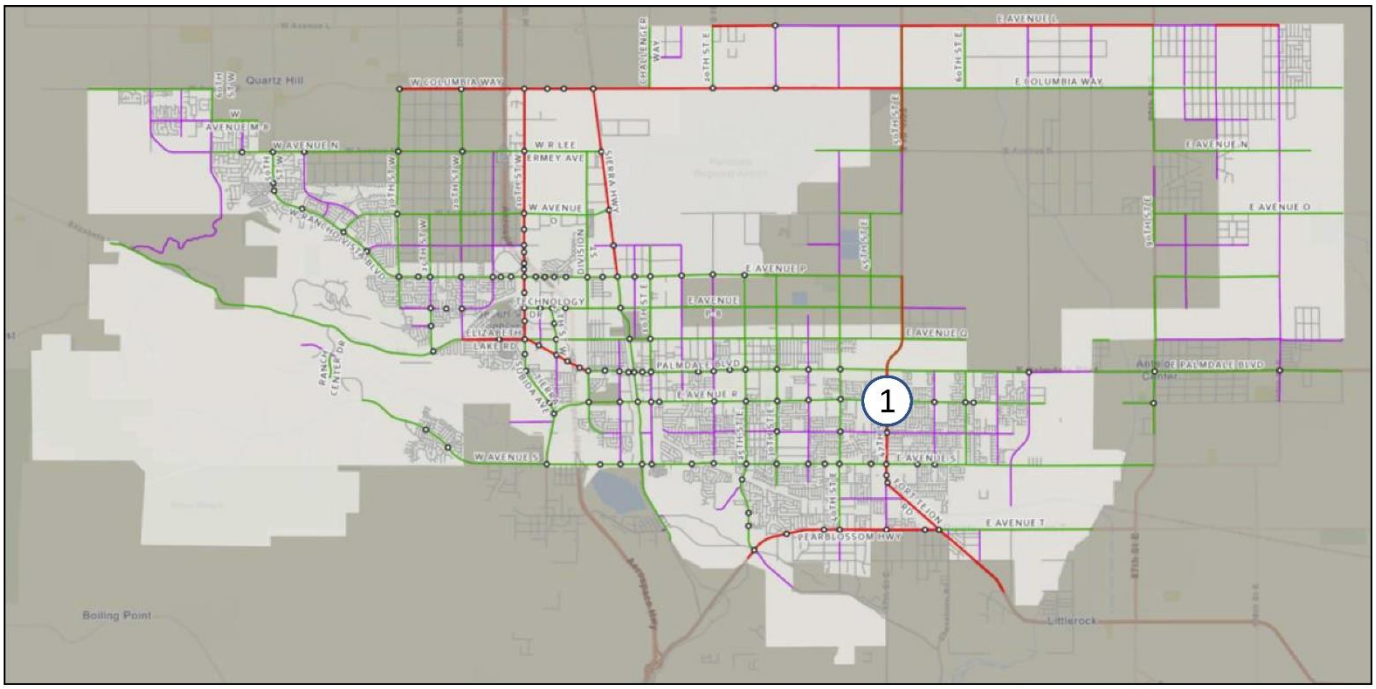
Project Name: Palmdale STP
Agency Name: City of Palmdale
Prepared by: Kimley-Horn
Date: March 2023

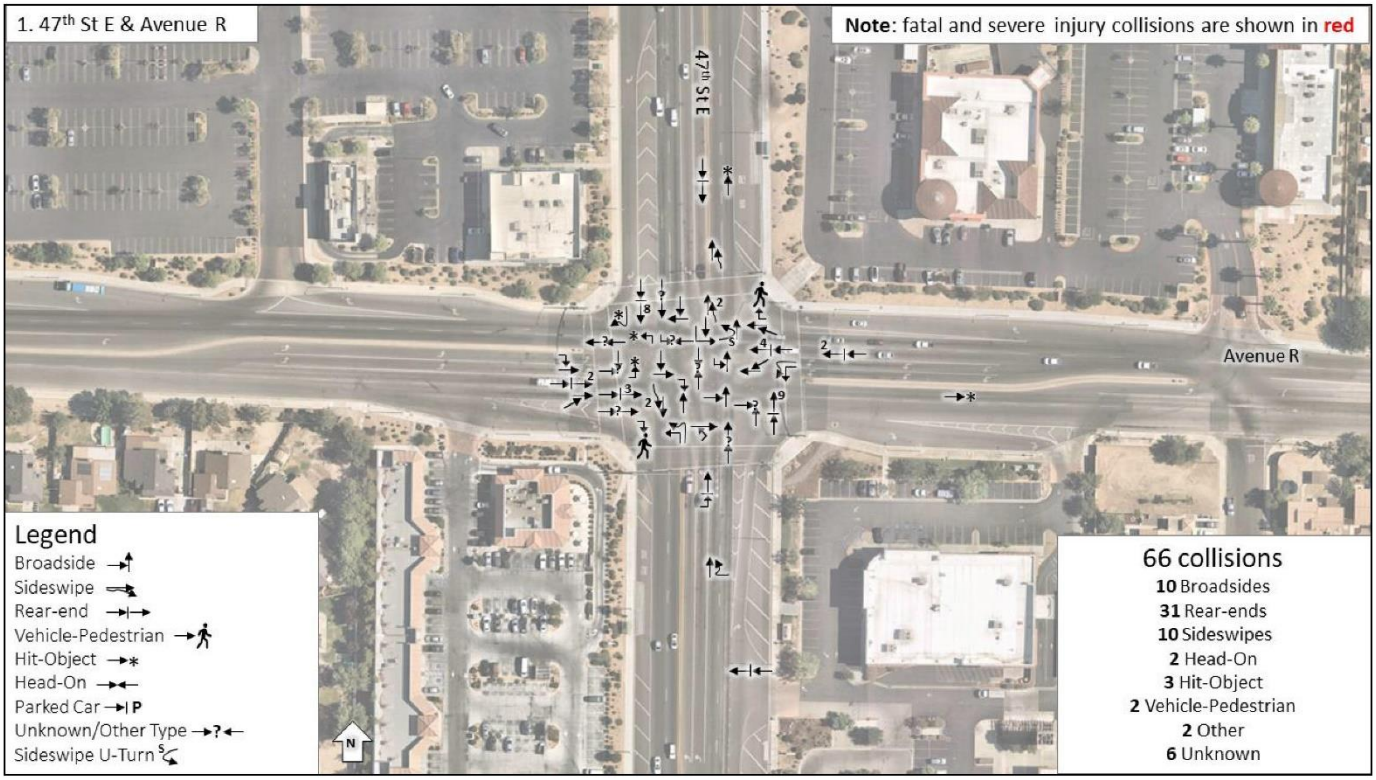
SIGNALIZED INTERSECTION

Project Location, Description & Maps

Intersection: 47th St E and Avenue R

Example of Similar Intersections: 47th St E and Avenue S; 25th St E and Avenue S





Case Study Sheet: Location #1

Project Location, Description & Maps

Collision Data	
Total Collisions	66
Fatal and Severe Injury Collisions	0
Top 3 Collision Types (%)	Broadside (47%) Rear-End/Sideswipe (15%)
Dark Collisions	28
Impaired Collisions	2

Collision Data	
Number of Approaches	4
Total Entering Vehicles	48,000
Crosswalk Condition	Crosswalk on all approaches
Control Type	Signalized Intersection
Lighting	Yes
Highest Posted Speed Limit	55 MPH

Collisions Involved With		
Vehicular	**Pedestrian**	**Bicycle**
53	2	0

Field Visit Notes

- This intersection is owned by Caltrans.
- There have been 5 collisions in 2022 at this location
- There is no signal coordination at this location
- Potential for lane markings or call-outs on turns

Countermeasure Evaluation

Potential Countermeasures	Crash Reduction Factor (LRSM/CMF ID)	20 Year Safety Benefit	Total 20-Year Costs (Installation and Maintenance)*	Safety Related B/C Ratio
Road Diet	30%	$3,213,840	$237,600	13.53
Improve signal hardware (back plates with retroreflective borders)	15%	$1,606,920	$26,400	60.87
Implement signal coordination here	15%	$1,606,920	$4,000	401.73

*Cost estimates were calculated in 2021 dollars using Caltrans costing formulas and other recent project bids. Recent and ongoing inflation could have significant cost impacts.

Case Study Sheet: Location #2

Project Name: Palmdale STP
Agency Name: City of Palmdale

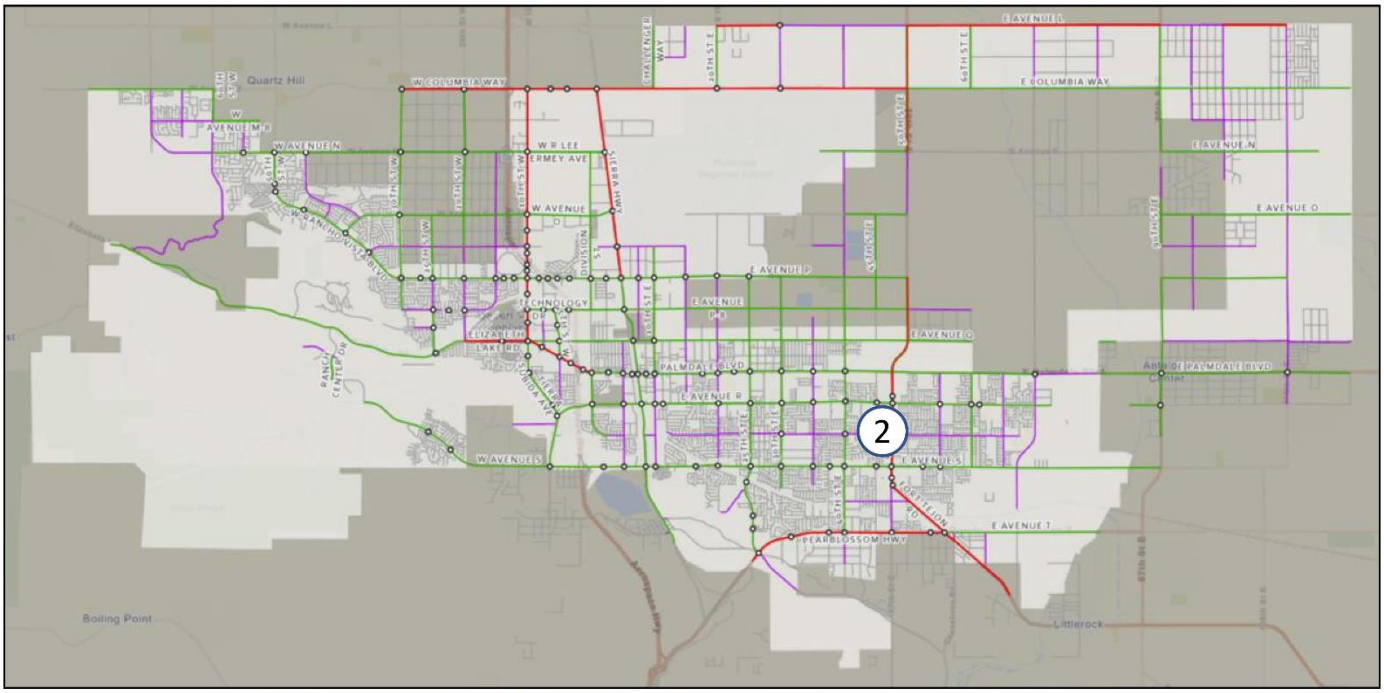
Prepared by: Kimley-Horn
Date: March 2023

FOUR-WAY-STOP INTERSECTION

Project Location, Description & Maps

Intersection: 45th St E and Avenue R-8

Example of Similar Intersections: 35th St E and Avenue R-8



Case Study Sheet: Location #2

Project Location, Description & Maps

Collision Data	
Total Collisions	19
Fatal and Severe Injury Collisions	0
Top 3 Collision Types (%)	Broadside (74%) Rear-End (21%)
Dark Collisions	9
Impaired Collisions	1

Collision Data	
Number of Approaches	4
Total Entering Vehicles	8,588
Crosswalk Condition	Crosswalk on E/S approaches
Control Type	Unsignalized Intersection (4-Way Stop)
Lighting	Yes
Highest Posted Speed Limit	55 MPH

Collisions Involved With		
Vehicular	**Pedestrian**	**Bicycle**
17	1	0

Field Visit Notes

- Potential for safe routes to school implementations here
- Potential for sidewalk expansion on north side – issues with right-of-way and ADA ramps

Countermeasure Evaluation

*As of February 2023, the City is modifying striping and adding bicycle lanes on Ave R-8 which will improve this intersection. Based on these improvements, the City should monitor these improvements and reevaluate the intersection 6 months after the striping modifications. The City could consider the countermeasures below at that time.

Potential Countermeasures	Crash Reduction Factor (LRSM/CMF ID)	20 Year Safety Benefit	Total 20-Year Costs (Installation and Maintenance)*	Safety Related B/C Ratio
Install sidewalk/pathway (to avoid walking along roadway)	80%	$258,880	$101,400	2.55
Add segment lighting	35%	$1,110,900	$138,864	8.00
Install Rectangular Rapid Flashing Beacon (RRFB)	35%	$113,260	$30,000	3.77

*Cost estimates were calculated in 2021 dollars using Caltrans costing formulas and other recent project bids. Recent and ongoing inflation could have significant cost impacts.

Case Study Sheet: Location #3

Project Name: Palmdale STP
Agency Name: City of Palmdale

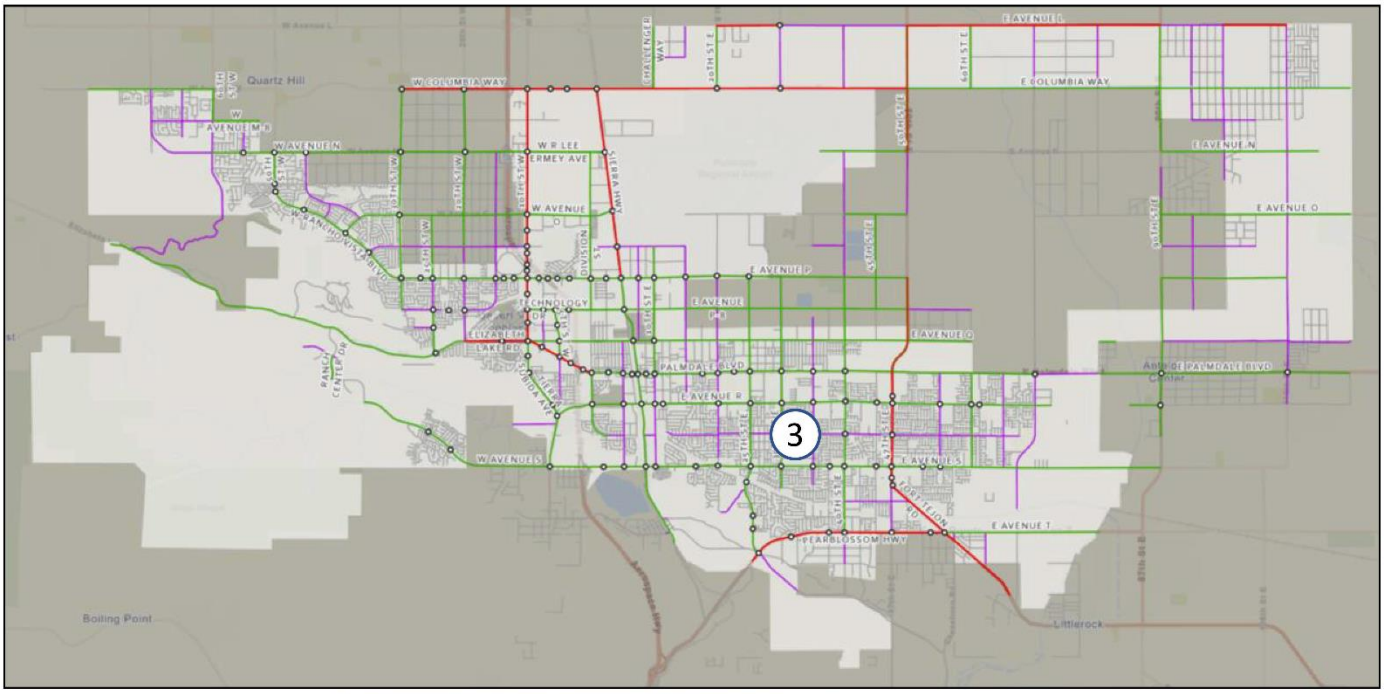
Prepared by: Kimley-Horn
Date: March 2023

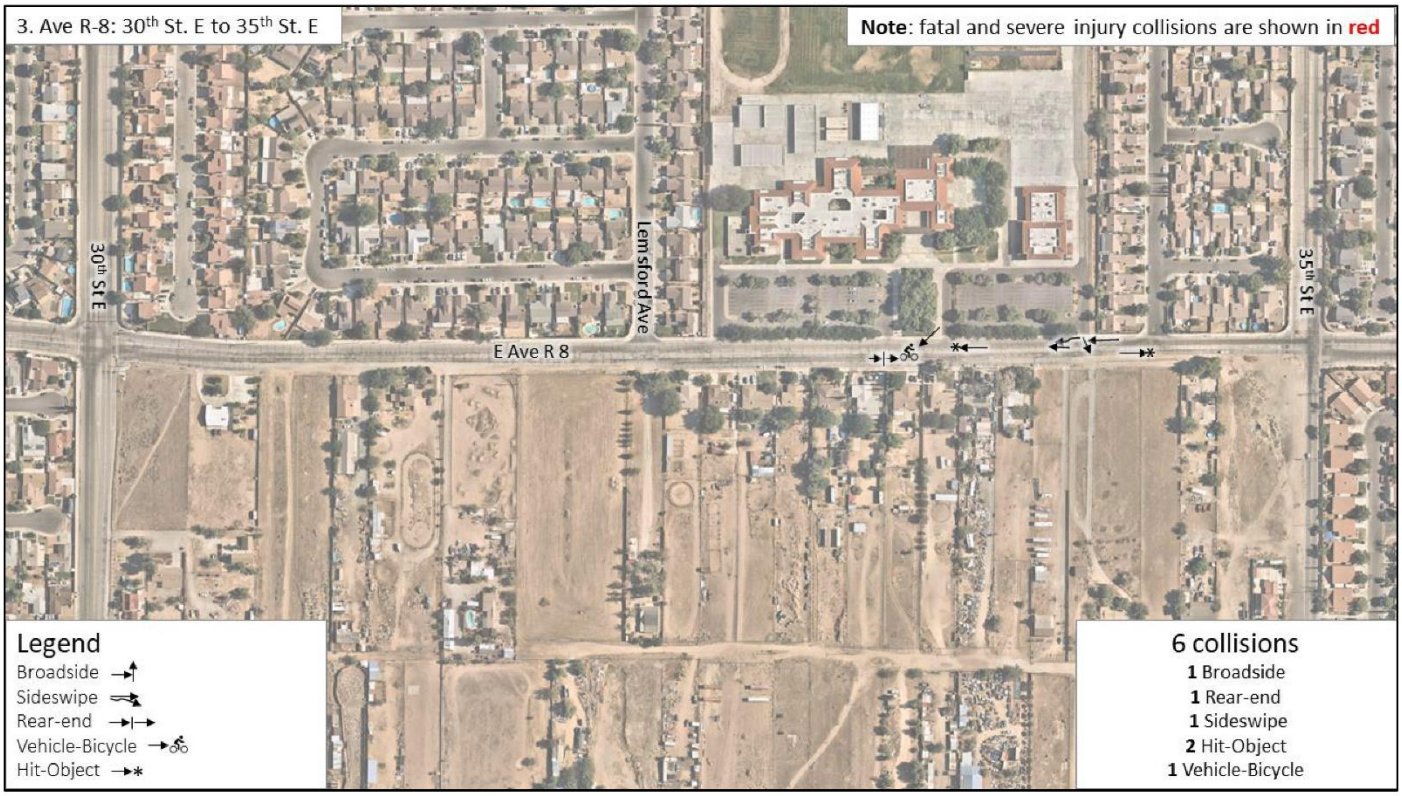
ROADWAY SEGMENT

Project Location, Description & Maps

Segment: Avenue R-8: 30th St E to 35th St E

Example of Similar Intersections: Avenue R-8: 45th St E to 47th E; Avenue S-8: 42nd St E to 45th St E





Case Study Sheet: Location #3

Project Location, Description & Maps

Collision Data	
Total Collisions	6
Fatal and Severe Injury Collisions	0
Top 3 Collision Types (%)	Hit-Object (33%) Rear-End/ Vehicle – Pedestrian/Broadside/Side swipe (17%)
Dark Collisions	2
Impaired Collisions	1

Collision Data	
Average Daily Traffic (ADT)	4,489
Lighting	On westbound portion only
Median	Double yellow line
Highest Posted Speed Limit	45 MPH

Collisions Involved With		
Vehicular	**Pedestrian**	**Bicycle**
13	2	0

Field Visit Notes

- Avenue R-8 has been a priority corridor for safety
- Cactus Middle School is along this corridor
- This location is a potential safe routes to school corridor

Countermeasure Evaluation

Potential Countermeasures	Crash Reduction Factor (LRSM/CMF ID)	20 Year Safety Benefit	Total 20-Year Costs (Installation and Maintenance)*	Safety Related B/C Ration
Install Separated Bike Lanes	45%	$145,620	$43,750	3.33

*Cost estimates were calculated in 2021 dollars using Caltrans costing formulas and other recent project bids. Recent and ongoing inflation could have significant cost impacts.

Case Study Sheet: Location #4

Project Name: Palmdale STP
Agency Name: City of Palmdale

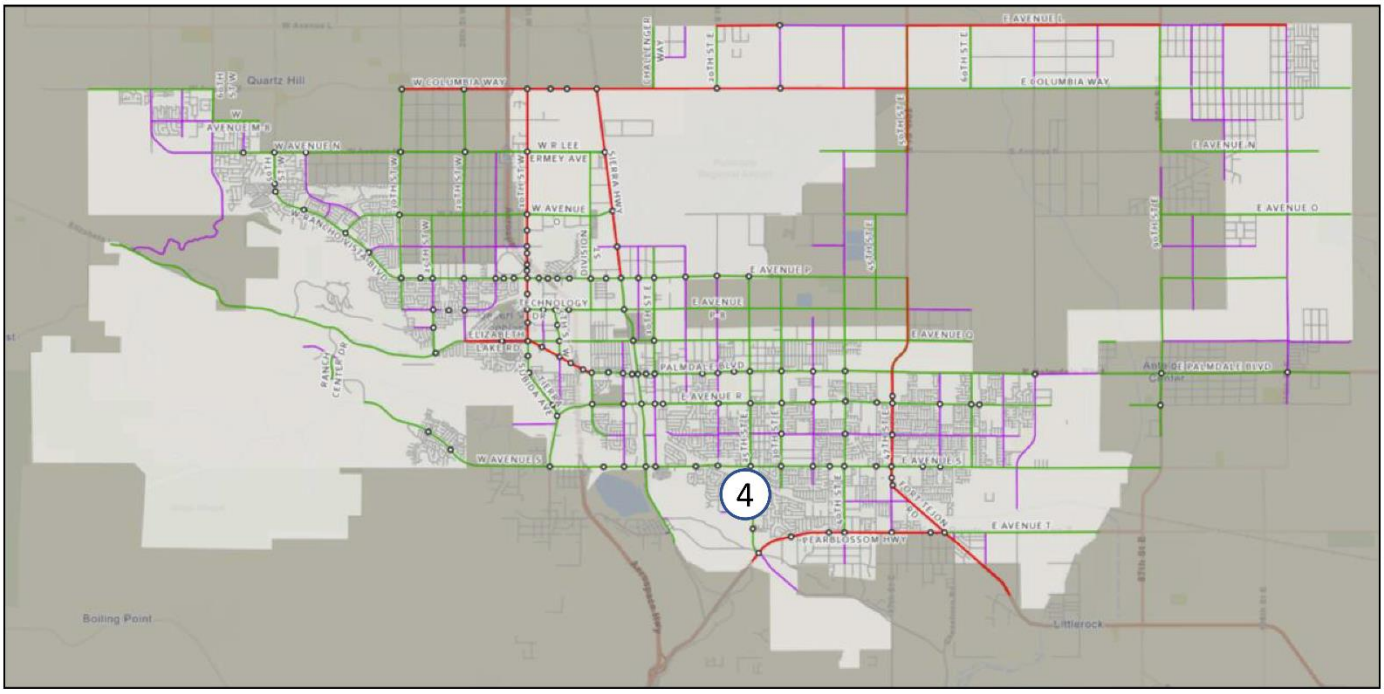
Prepared by: Kimley-Horn
Date: March 2023

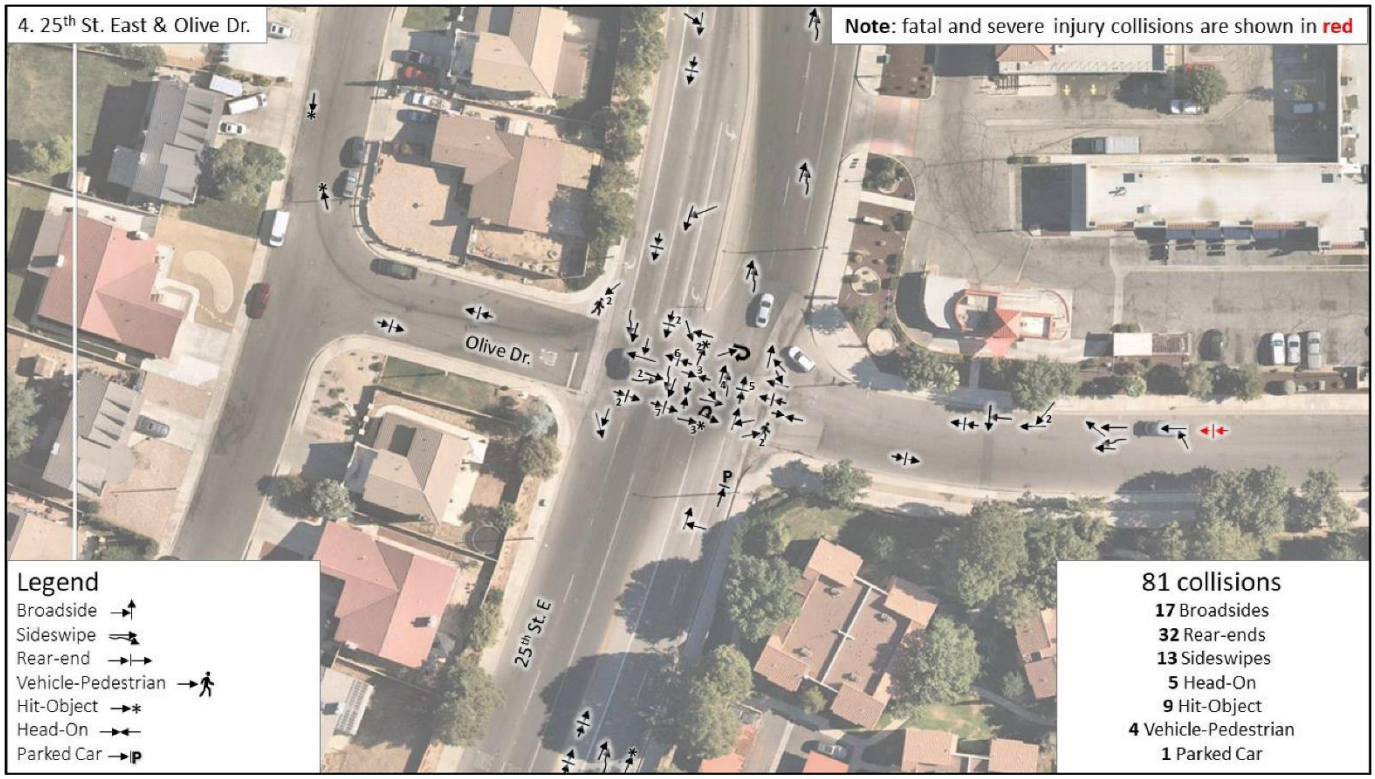
TWO-WAY-STOP INTERSECTION

Project Location, Description & Maps

Intersection: 25th St E and Olive Dr

Example of Similar Intersections: 25th St E and Avenue R-14





Case Study Sheet: Location #4

Project Location, Description & Maps

Collision Data	
Total Collisions	89
Fatal and Severe Injury Collisions	1
Top 3 Collision Types (%)	Rear-End (36%) Broadside (20%) Sideswipe (15%)
Dark Collisions	37
Impaired Collisions	5

Collision Data	
Number of Approaches	4
Total Entering Vehicles	24,683
Crosswalk Condition	Crosswalk on all approaches
Control Type	Unsignalized Intersection (Two – way Stop)
Lighting	Yes
Highest Posted Speed Limit	50 MPH

Collisions Involved With		
Vehicular	**Pedestrian**	**Bicycle**
68	4	0

Field Visit Notes

- There are dips in the pavement at this intersection
- Sight distance issues along east-bound left turn (from Olive Dr onto NB 25th St E)

Countermeasure Evaluation

Potential Countermeasures	Crash Reduction Factor (LRSM/CMF ID)	20 Year Safety Benefit	Total 20-Year Costs (Installation and Maintenance)*	Safety Related B/C Ratio
Restrict uncontrolled left turn (including a raised median)	5%	$1,016,160	Varies	Varies
Mark pavement with supplementary warning messages	5%	$1,016,160	Varies	Varies
Install drainage to capture water in the intersection and remove cross gutter	5%	$1,016,160	Varies	Varies
Modify striping on NB lanes to improve WB sight visibility entering the intersection	5%	$1,016,160	$5,000	203.23

*Cost estimates were calculated in 2021 dollars using Caltrans costing formulas and other recent project bids. Recent and ongoing inflation could have significant cost impacts.

Case Study Sheet: Location #5

Project Name: Palmdale STP
Agency Name: City of Palmdale

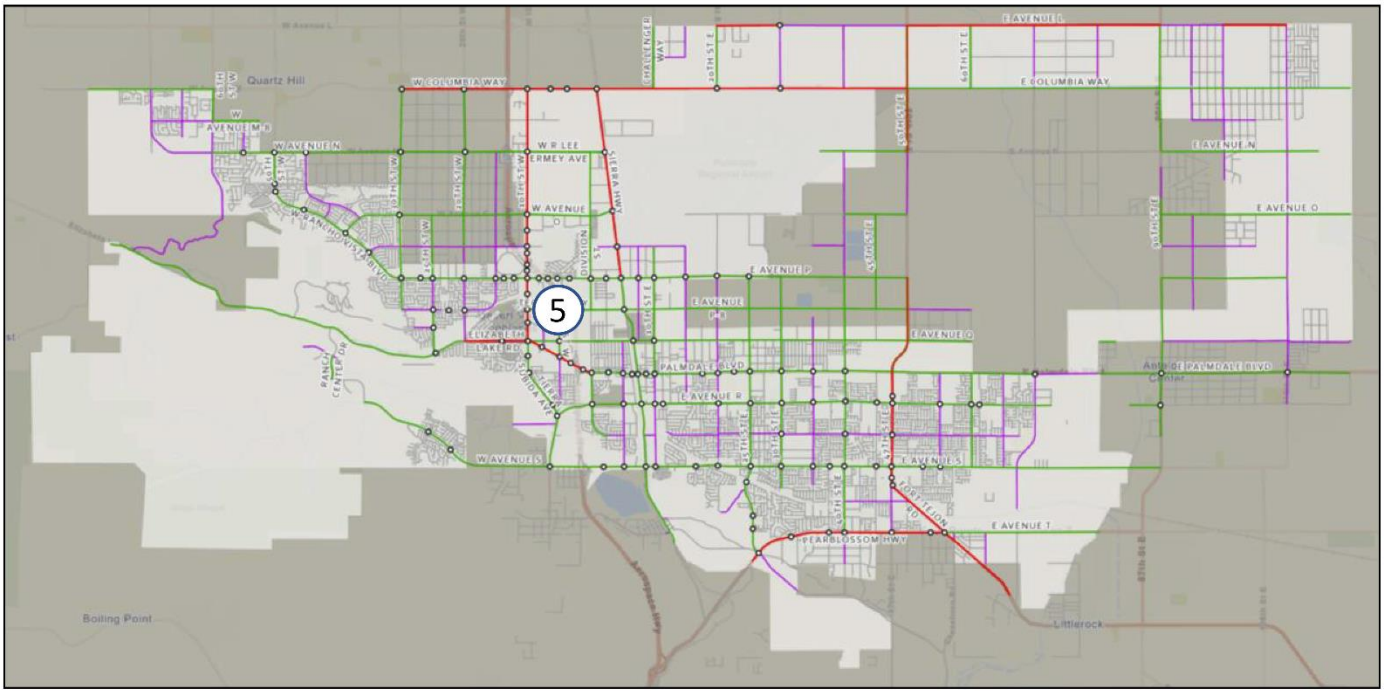
Prepared by: Kimley-Horn
Date: March 2023

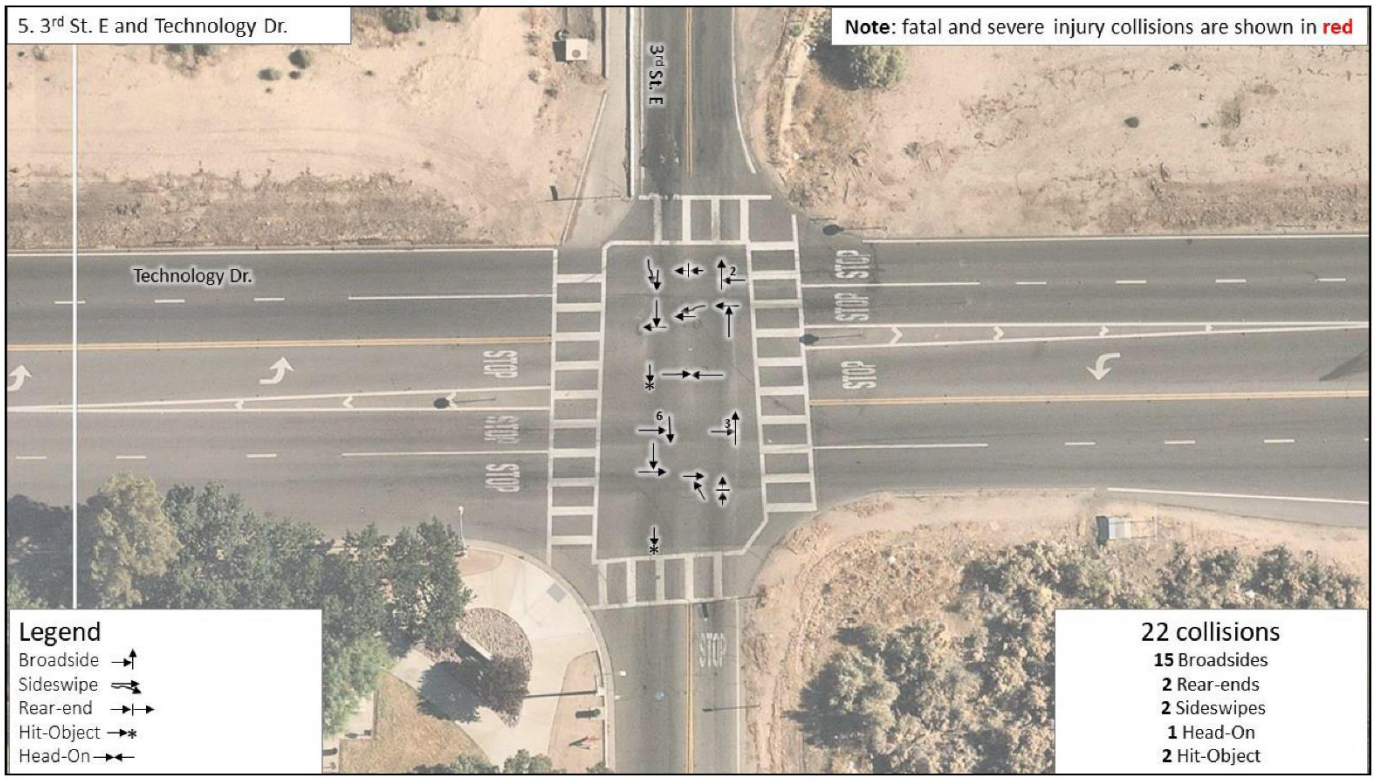
FOUR-WAY-STOP INTERSECTION

Project Location, Description & Maps

Intersection: 3rd St E and Technology Dr

Example of Similar Intersections: 45th St E and Avenue S-8; 60th St E and Avenue R-8





Case Study Sheet: Location #5

Project Location, Description & Maps

Collision Data	
Total Collisions	26
Fatal and Severe Injury Collisions	0
Top 3 Collision Types (%)	Broadside (58%) Rear-End/Sideswipe (8%)
Dark Collisions	9
Impaired Collisions	0

Collision Data	
Number of Approaches	4
Total Entering Vehicles	11,739
Crosswalk Condition	Crosswalk on all approaches
Control Type	Unsignalized Intersection (Four-way stop)
Lighting	Yes, can be improved
Highest Posted Speed Limit	55 MPH

Collisions Involved With		
Vehicular	**Pedestrian**	**Bicycle**
20	0	0

Field Visit Notes

- Conflicting vehicle movements are often unable to see each other at the intersection
- High speeds observed during field visit
- Lighting not present on NE and SE corner
- Number of lanes may be too high for a stop-controlled intersection

Countermeasure Evaluation

Potential Countermeasures	Crash Reduction Factor (LRSM/CMF ID)	20 Year Safety Benefit	Total 20-Year Costs (Installation and Maintenance)*	Safety Related B/C Ratio
Convert intersection to roundabout (from all way stop)	5%	$204,360	Varies	Varies
Reduce number of lanes coming into intersection	5%	$204,360	Varies	Varies
Curb Extension/Bulb-Out and striping modification	5%	$204,360	$120,000	1.70

*Cost estimates were calculated in 2021 dollars using Caltrans costing formulas and other recent project bids. Recent and ongoing inflation could have significant cost impacts.

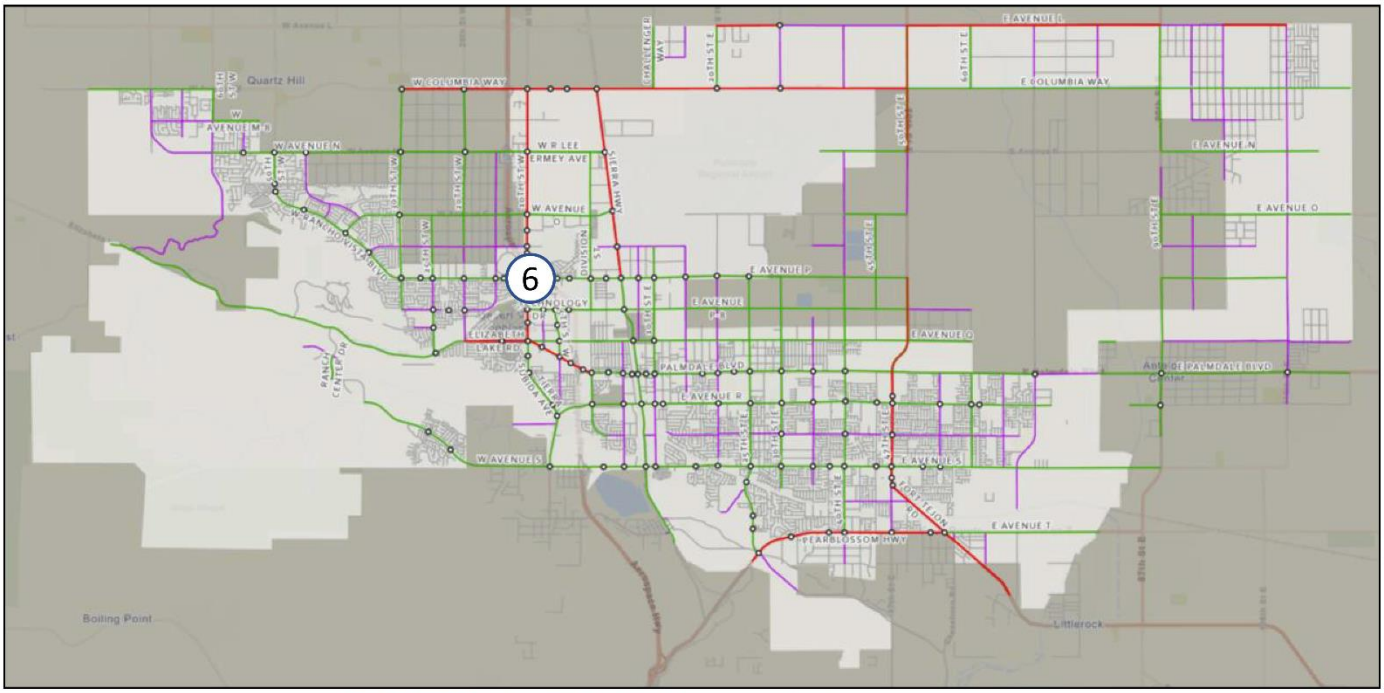
Case Study Sheet: Location #6

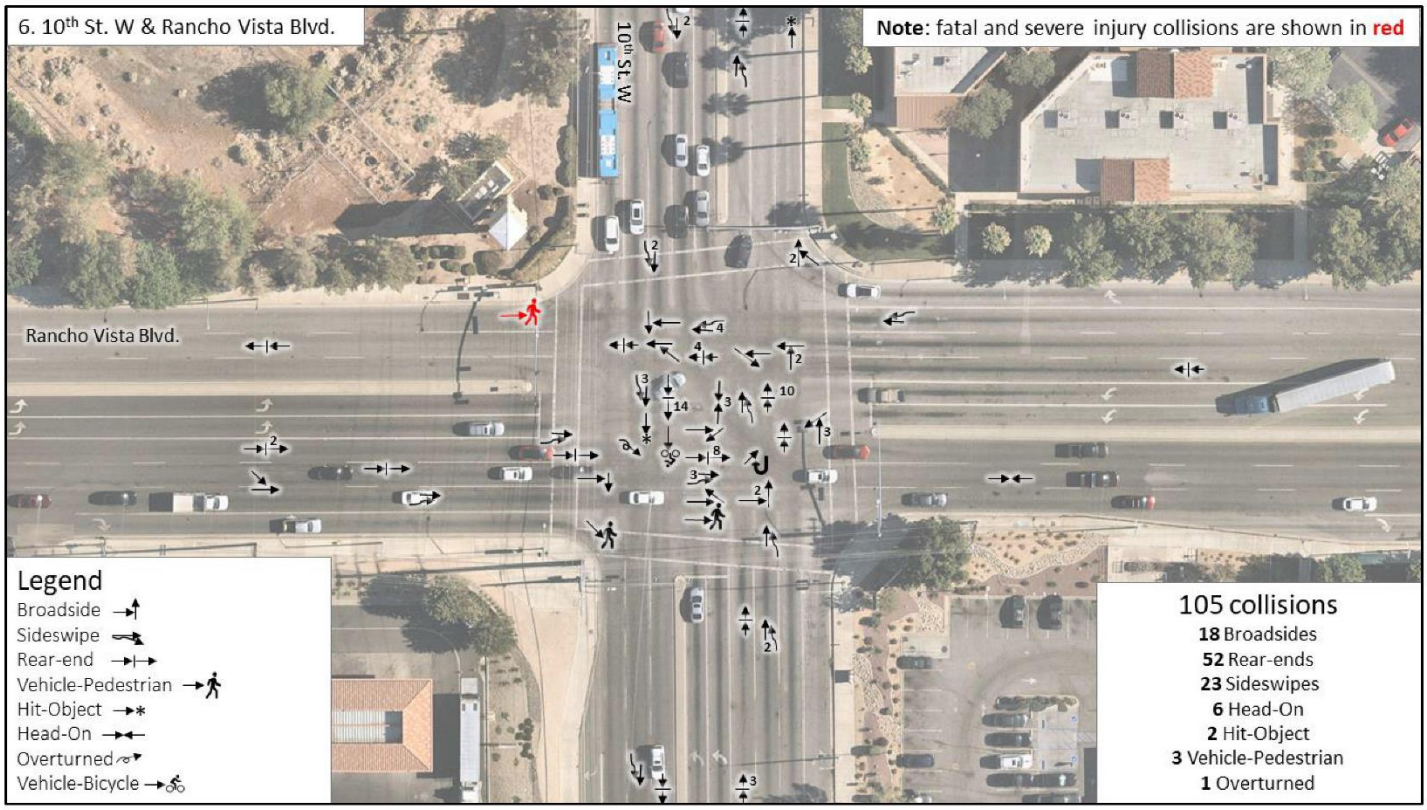
Project Name: Palmdale STP
Agency Name: City of Palmdale
Prepared by: Kimley-Horn
Date: March 2023

SIGNALIZED INTERSECTION

Project Location, Description & Maps

Intersection: 10th St W and Rancho Vista Blvd
Example of Similar Segment: 25th St E and Avenue S; 47th St E and Avenue R





Case Study Sheet: Location #6

Project Location, Description & Maps

Collision Data	
Total Collisions	119
Fatal and Severe Injury Collisions	1
Top 3 Collision Types (%)	Rear-End (44%) Sideswipe (19%) Broadside (15%)
Dark Collisions	26
Impaired Collisions	5

Collision Data	
Number of Approaches	4
Total Entering Vehicles	77,770
Crosswalk Condition	Crosswalk on all approaches
Control Type	Signalized Intersection
Lighting	Yes
Highest Posted Speed Limit	50 MPH

Collisions Involved With		
Vehicular	**Pedestrian**	**Bicycle**
99	3	1

Countermeasure Evaluation

Potential Countermeasures	Crash Reduction Factor (LRSM/CMF ID)	20 Year Safety Benefit	Total 20-Year Costs (Installation and Maintenance)*	Safety Related B/C Ratio
Modify signal phasing to implement signal coordination and a Leading Pedestrian Interval (LPI)	60%	$5,823,600	$15,000	388.24
Upgrade intersection pavement markings	25% (applies to all collisions)	$6,512,400	$110,000	59.20
Improve signal timing	15%	$1,628,520	$14,400	113.09

*Cost estimates were calculated in 2021 dollars using Caltrans costing formulas and other recent project bids. Recent and ongoing inflation could have significant cost impacts.

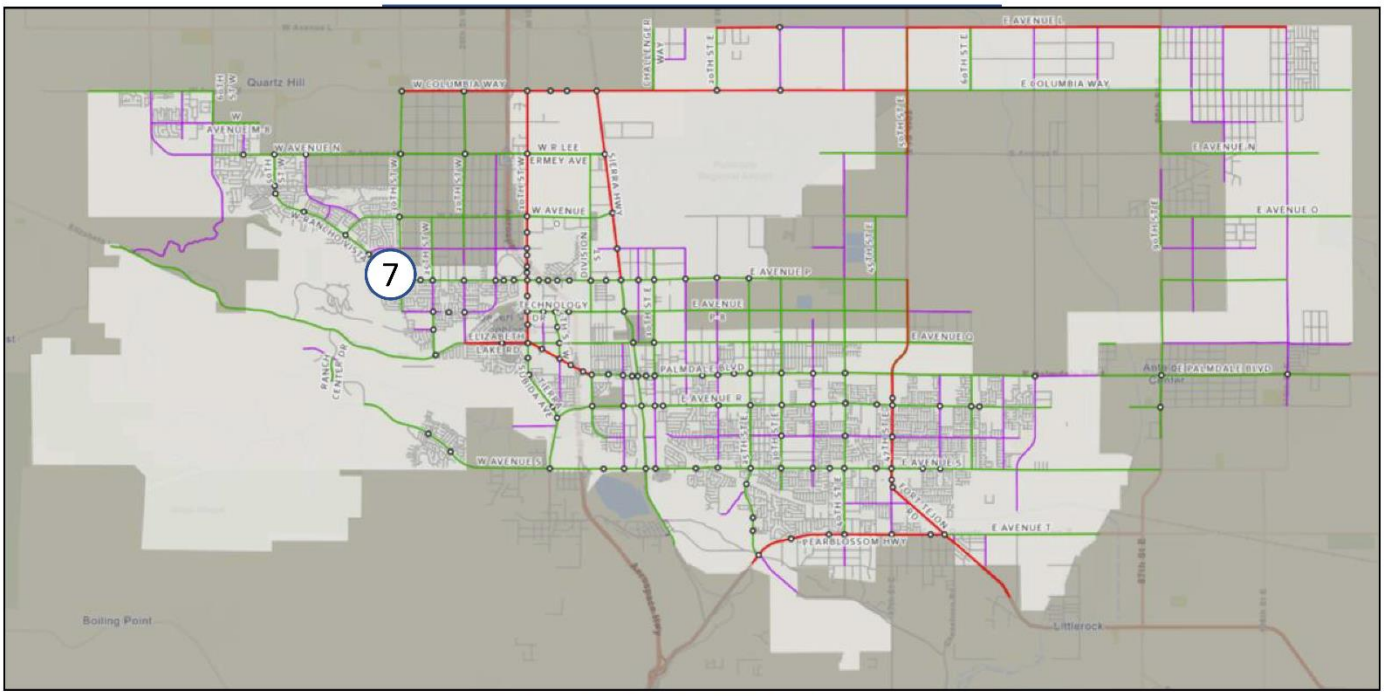
Case Study Sheet: Location #7

Project Name: Palmdale STP
Agency Name: City of Palmdale
Prepared by: Kimley-Horn
Date: March 2023

ROADWAY SEGMENT

Project Location, Description & Maps

Segment: Rancho Vista Blvd: 30th St W to Seville Ave
Example of Similar Segment: Elizabeth Lake Rd from Desert Flower Dr to Tierra Subida Ave



Case Study Sheet: Location #7

Project Location, Description & Maps

Collision Data	
Total Collisions	20
Fatal and Severe Injury Collisions	2
Top 3 Collision Types (%)	Broadside (80%) Hit Object (15%) Sideswipe (5%)
Dark Collisions	4
Impaired Collisions	0

Collision Data	
Average Daily Traffic (ADT)	N/A
Lighting	Yes
Median	Median on west side; double yellow line on east side
Highest Posted Speed Limit	55 MPH

Collisions Involved With		
Vehicular	**Pedestrian**	**Bicycle**
16	0	0

Countermeasure Evaluation

Potential Countermeasures	Crash Reduction Factor (LRSM/CMF ID)	20 Year Safety Benefit	Total 20-Year Costs (Installation and Maintenance)*	Safety Related B/C Ratio
Restrict uncontrolled left turn with locations for U-turn access upstream	5%	$1,526,240	Varies	Varies
Install raised median	25%	$5,541,000	$550,800	10.06

*Cost estimates were calculated in 2021 dollars using Caltrans costing formulas and other recent project bids. Recent and ongoing inflation could have significant cost impacts.

Case Study Sheet: Location #8

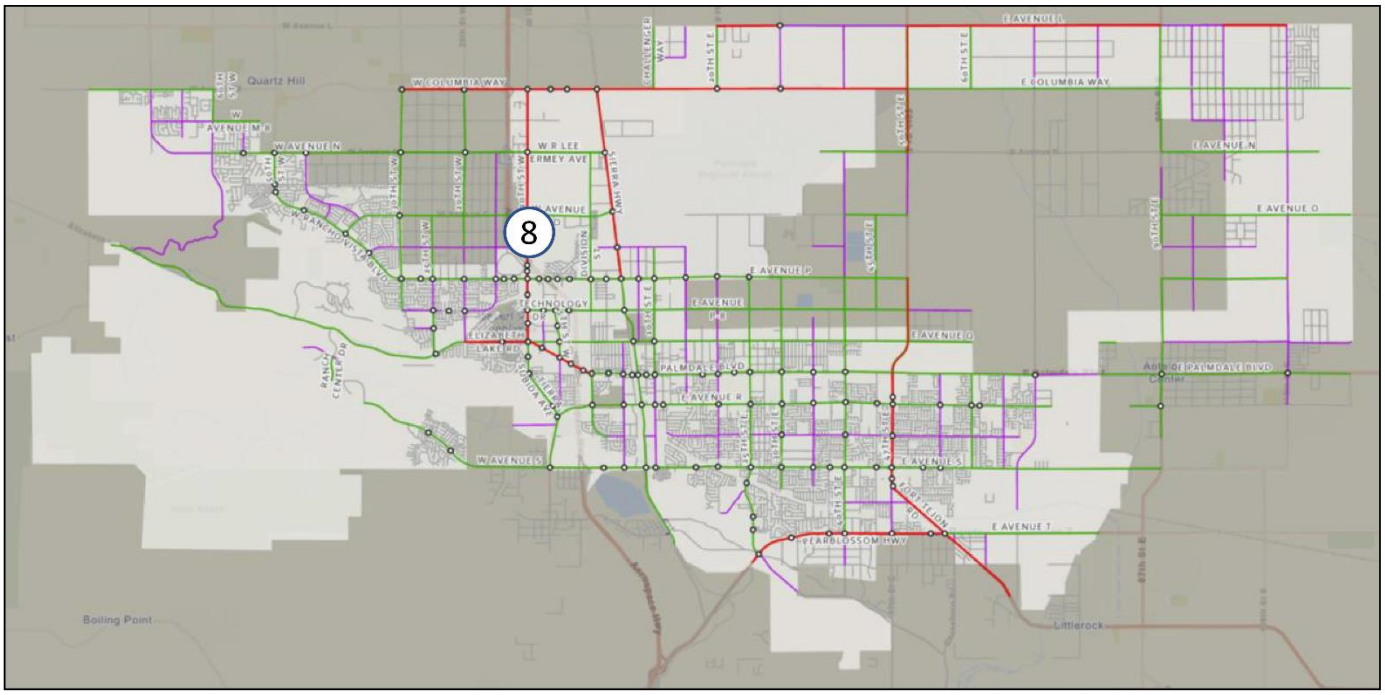
Project Name: Palmdale STP
Agency Name: City of Palmdale

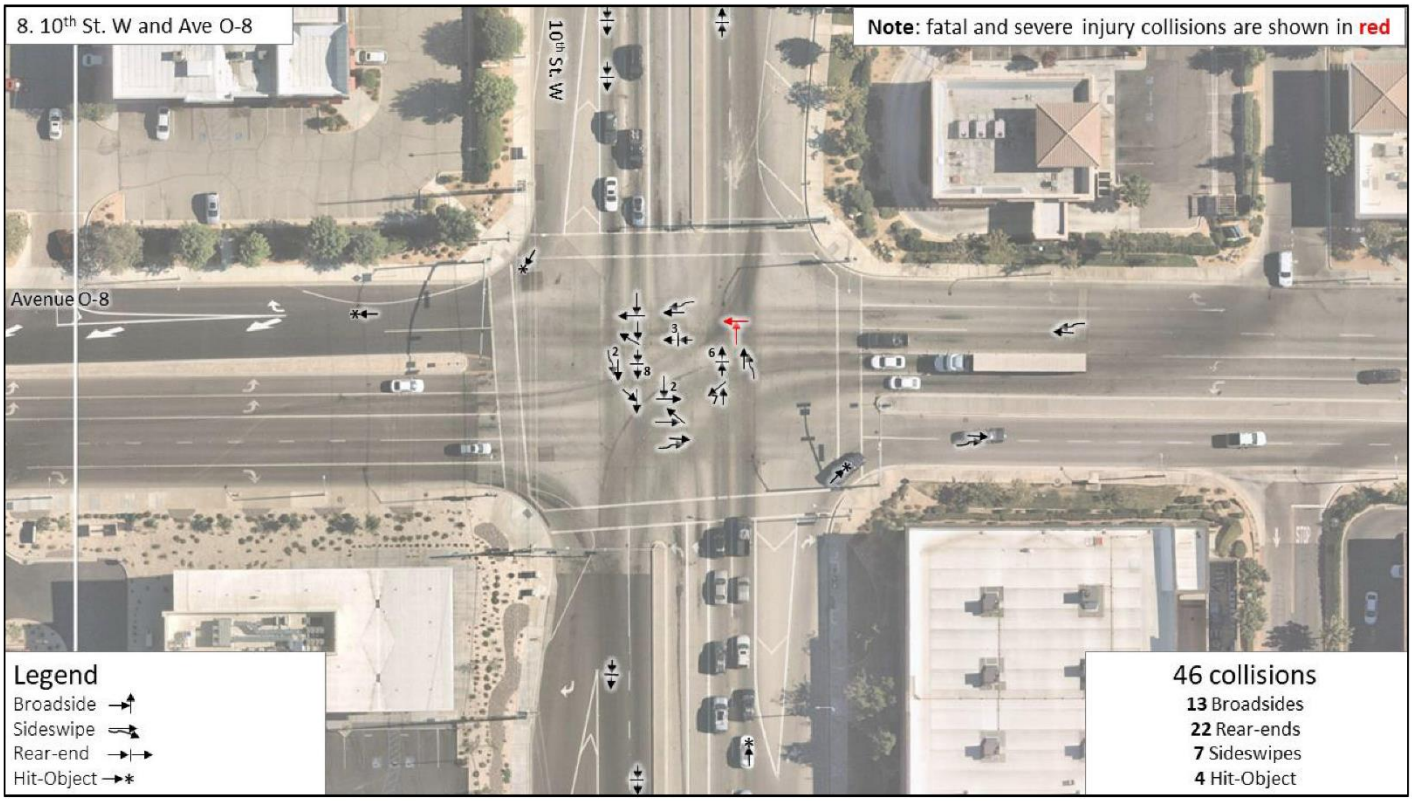
Prepared by: Kimley-Horn
Date: March 2023

SIGNALIZED INTERSECTION

Project Location, Description & Maps

Intersection: 10th St W and Ave O-8
Example of Similar Segment: 47th St E and Avenue S; 47th St E and Avenue R





Case Study Sheet: Location #8

Project Location, Description & Maps

Collision Data	
Total Collisions	57
Fatal and Severe Injury Collisions	1
Top 3 Collision Types (%)	Rear-End (39%) Broadside (23%) Sideswipe (12%)
Dark Collisions	12
Impaired Collisions	1

Collision Data	
Number of Approaches	4
Total Entering Vehicles	26,234
Crosswalk Condition	Crosswalk on all approaches
Control Type	Signalized Intersection
Lighting	Yes
Highest Posted Speed Limit	50 MPH

Collisions Involved With		
Vehicular	Pedestrian	Bicycle
20	0	0

Countermeasure Evaluation

Potential Countermeasures	Crash Reduction Factor (LRSM/CMF ID)	20 Year Safety Benefit	Total 20-Year Costs (Installation and Maintenance)*	Safety Related B/C Ratio
Improve signal hardware; lenses, back plate with retroreflective borders, mounting, size, and number	15%	$2,951,640	$26,400	111.80
Improve signal timing (coordination, phases, red, yellow, or operation)	15%	$2,951,640	$25,000	118.06

*Cost estimates were calculated in 2021 dollars using Caltrans costing formulas and other recent project bids. Recent and ongoing inflation could have significant cost impacts.

Project Location, Description & Maps

Project Location, Description & Maps

Project Location, Description & Maps

Case Study Sheet: Location #9

Project Location, Description & Maps

Case Study Sheet: Location #9

Project Location, Description & Maps

Collision Data	
Total Collisions	123
Fatal and Severe Injury Collisions	13
Top 3 Collision Types (%)	Rear-End (41%) Hit Object (20%) Sideswipe (15%)
Dark Collisions	47
Impaired Collisions	11

Collision Data	
Average Daily Traffic (ADT)	Average ~ 30,092
Lighting	None Present
Median	None Present
Highest Posted Speed Limit	65 MPH

Collisions Involved With		
Vehicular	**Pedestrian**	**Bicycle**
87	3	1

Countermeasure Evaluation

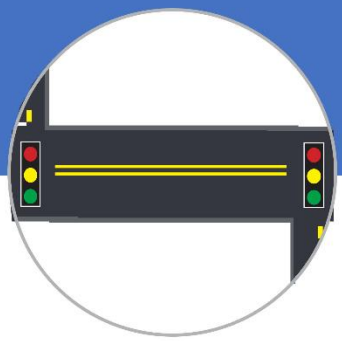
Potential Countermeasures	Crash Reduction Factor (LRSM/CMF ID)	20 Year Safety Benefit	Total 20-Year Costs (Installation and Maintenance)*	Safety Related B/C Ratio
Install raised median	25%	$34,043,600	$5,313,600	6.41
Install delineators, reflectors and/or object markers	15%	$20,426,160	$126,480	161.50
Add segment lighting	35%	$47,661,040	$3,496,800	13.63
Install centerline rumble strips/stripes	20%	$214,560	$238,080	0.90
Modify signal phasing to implement a Leading Pedestrian Interval (LPI)	60%	$16,109,520	$14,000	214.79
Install crosswalks at signalized intersections	25%	$6,712,300	$74,400	90.22

*Cost estimates were calculated in 2021 dollars using Caltrans costing formulas and other recent project bids. Recent and ongoing inflation could have significant cost impacts.

Case Study Sheet: Location #10

Project Name: Palmdale STP
Agency Name: City of Palmdale

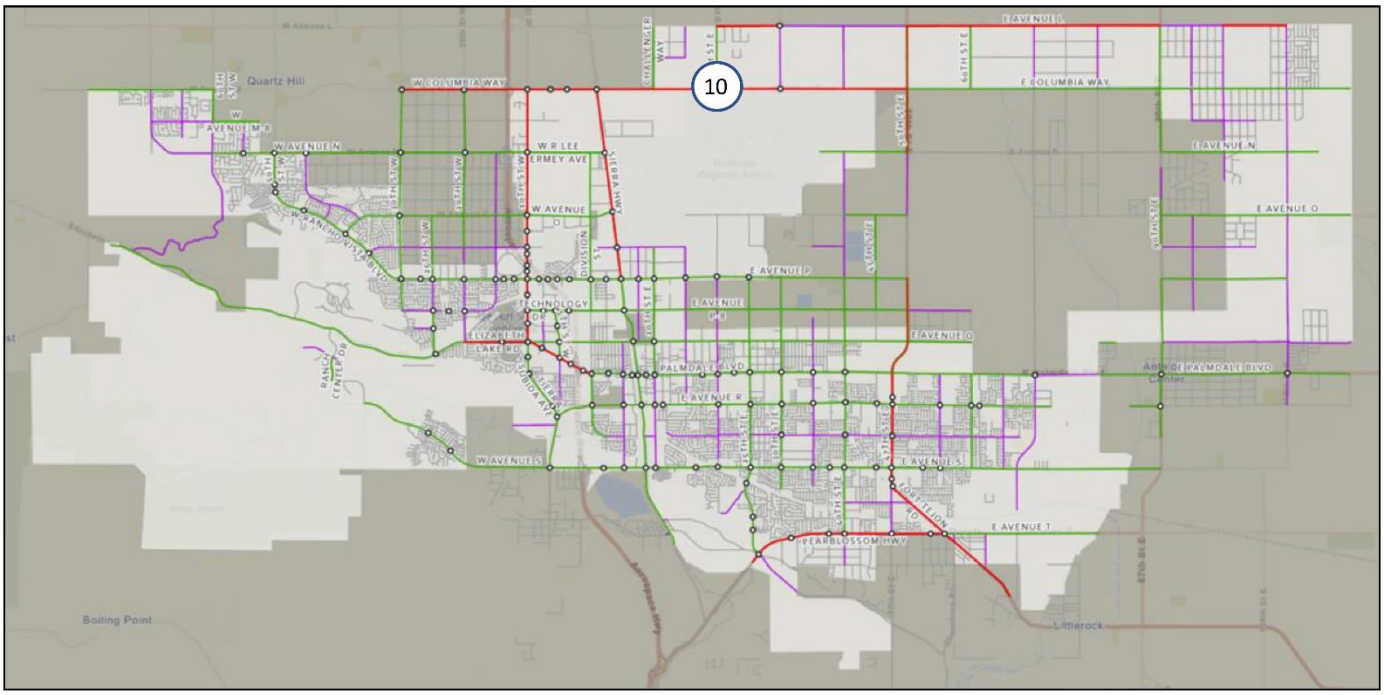
Prepared by: Kimley-Horn
Date: March 2023

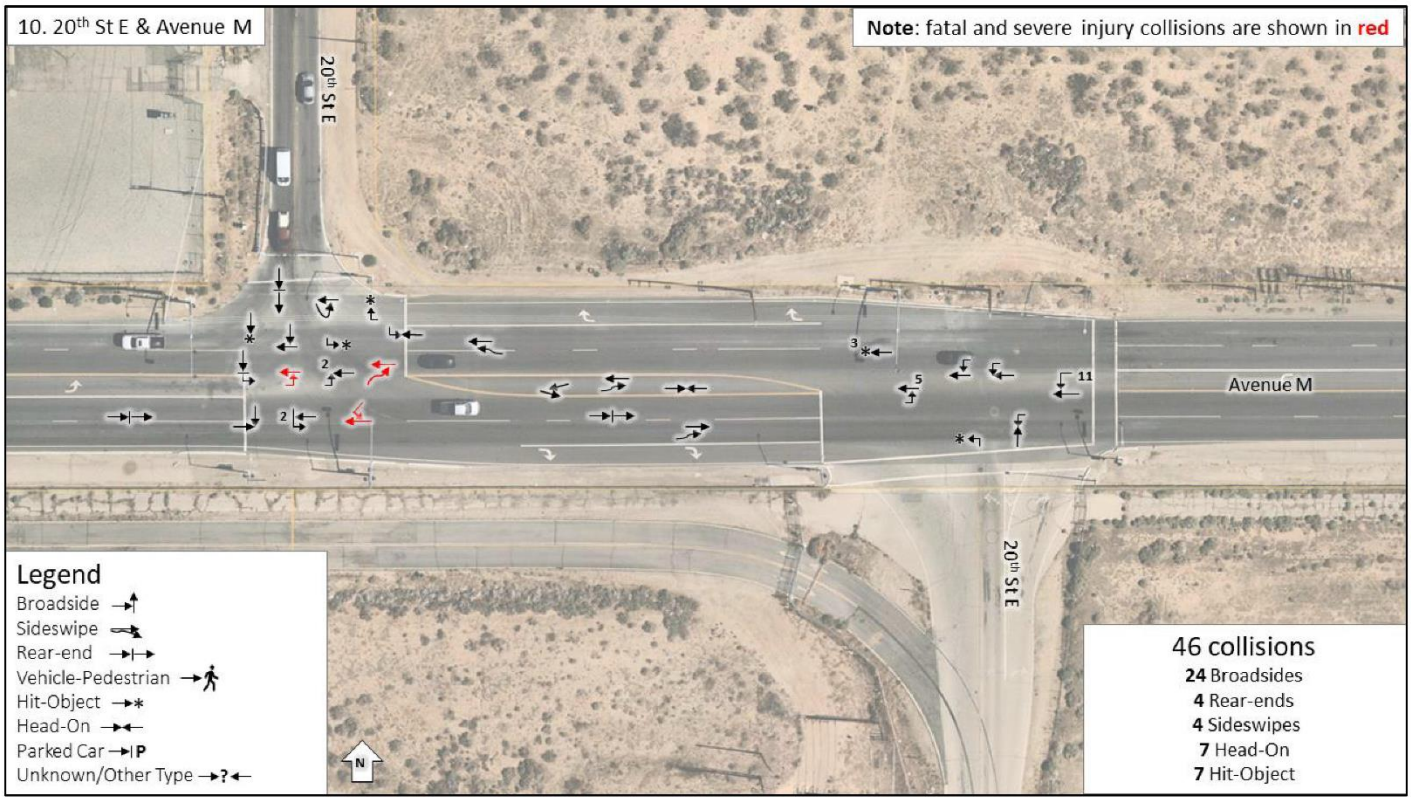


SIGNALIZED INTERSECTION

Project Location, Description & Maps

Intersection: 20th St E and Ave M
Example of Similar Intersections: 10th St W and Technology Dr/Beechdale Dr





Case Study Sheet: Location #10

Project Location, Description & Maps

Collision Data	
Total Collisions	46
Fatal and Severe Injury Collisions	3
Top 3 Collision Types (%)	Broadside (52%) Head-On (15%) Hit Object (15%)
Dark Collisions	16
Impaired Collisions	1

Collision Data		
Number of Approaches	4	
Total Entering Vehicles	15,944	
Crosswalk Condition	Crosswalk on N/E/S approaches	
Control Type	Signalized Intersection	
Lighting	Yes	
Highest Posted Speed Limit	60 MPH	
Collisions Involved With		
Vehicular	**Pedestrian**	**Bicycle**
21	0	0

Countermeasure Evaluation

Potential Countermeasures	Crash Reduction Factor (LRSM/CMF ID)	20 Year Safety Benefit	Total 20-Year Costs (Installation and Maintenance)*	Safety Related B/C Ration
Install delineators, reflectors and/or object markers	15%	$5,523,900	$163,200	33.85
Install edgeline rumble strips/stripes	15%	$5,523,900	$76,800	71.93

*Cost estimates were calculated in 2021 dollars using Caltrans costing formulas and other recent project bids. Recent and ongoing inflation could have significant cost impacts.

9.2 Citywide Countermeasure Toolbox

This evaluation considered citywide trends to identify countermeasures that would likely provide the most benefit with widespread implementation. Table 7 outlines the citywide safety project opportunities, which is also referred to as the "Countermeasure Toolbox". Within the toolbox, the description of the countermeasure along with its Local Roadway Safety Manual (LRSM) ID number is listed. The next column, Crash Reduction Factor (CRF), are "multiplicative factors used to estimate the expected reduction in number of crashes after implementing a given countermeasure at a specific site (the higher the CRF, the greater the expected reduction in crashes)." For each of these countermeasures, a planning level benefit/cost analysis was completed.

Applying the benefit/cost at the citywide level was estimated assuming some randomness in crash distribution. The location characteristics, such as whether there is a traffic signal, and the type of crashes, were used at the citywide level to calculate an average cost of crashes that the countermeasure might reduce. The benefit per location was then factored out to a 20-year lifecycle savings, with an Opinion of Project Probable Cost (OPCC) for the initial installation costs and a per-year maintenance cost estimate. The cost shown in Table 7 should be considered initial planning costs using 2022 dollars and not assumed final.

In order to prioritize the projects in the countermeasure toolbox, the following section highlights countermeasures that are appropriate for the networks shown in Section 7.7.2 High Injury Network (HIN) and High Collision Networks (HCN)s, a timeline of each countermeasure is also shown in the table. Near-term projects can be implemented within the next two years, mid-term projects within the next five years, and long term projects within the next ten years.

9.3 High Injury Networks and Project Prioritization

The High Injury Networks that were created in **Section 7.7.2** are useful for prioritizing the implementation of certain countermeasures in areas that have high concentration of fatal and severe injury collisions. The following section summarizes which countermeasures can be implemented along certain High Injury Networks.

9.3.1 Aggressive Driving Collisions

Figure 12 shows the High Injury Network for aggressive driving collisions. This network includes segments of 10th Street West, Rancho Vista Boulevard, Palmdale Boulevard, Avenue S, Avenue R, 47th Street, and Pearblossom Highway. The following countermeasures from the toolbox can be implemented in these locations to address aggressive driving collisions:

- Install raised median (R01)
- Implement Road Diet (R14)
- Install centerline rumble strips/striping – where appropriate (R30)
- Install edgeline rumble strips/striping – where appropriate (R31)
- Improve signal timing (S03)
- Install curb extension/bulb-outs
- Mark pavement with supplementary warning messages

9.3.2 Broadside Collisions

Figure 13 shows the High Injury Network for broadside collisions. This network includes segments of 10th Street West, Rancho Vista Boulevard, Palmdale Boulevard, Avenue S, Avenue R, Avenue Q, 47th Street, Columbia Way, and Pearblossom Highway. The following countermeasures from the toolbox can be implemented in these locations to address broadside collisions:

- Convert intersection to roundabout (NS04/S16)
- Upgrade intersection pavement markings (NS07)
- Add segment lighting (R01)
- Improve horizontal alignment/flatten curves (R17)
- Improve signal hardware (S02)
- Improve signal timing (S03)
- Restrict uncontrolled left turn

9.3.3 Dark Collisions

Figure 14 shows the High Injury Network for dark collisions. This network includes segments of 10th Street West, Palmdale Boulevard, Rancho Vista Boulevard, Avenue R, Avenue S, 47th Street East, and Pearblossom Highway. The following countermeasures from the toolbox can be implemented in these locations to dark collisions:

- Upgrade intersection pavement markings (NS07)
- Install additional lighting (R01)
- Install delineators, reflectors, or object markers (R27)
- Install centerline striping (R30)

9.3.3 Head-On Collisions

Figure 15 shows the High Injury Network for head-on collisions. This network includes segments of 10th Street West, Rancho Vista Boulevard, Avenue S, Avenue P, and 47th Street East. The following countermeasures from the toolbox can be implemented in these locations to address head-on collisions:

- Add segment lighting (R01)
- Install raised median (R08)
- Implement road diet (R14)
- Install delineators, reflectors, or object markers (R27)
- Install centerline rumble strips/striping (R30)
- Install edgeline rumble strips/striping (R31)
- Install left-turn lane (S06)
- Mark pavement with supplementary warning messages

9.3.4 Pedestrian Collisions

Figure 16 shows the High Injury Network for pedestrian collisions. This network includes segments of Avenue S, Palmdale Boulevard, 25th Street East, 47th Street East, and 10th Street West. The following countermeasures from the toolbox can be implemented in these locations to address pedestrian collisions:

- Install pedestrian crossing at uncontrolled locations (NS20PB)
- Install Rectangular Rapid Flashing Beacon (RRFB) (NS22PB/R37PB)
- Install upgraded pedestrian crossing (R35PB/S18PB)
- Install sidewalk/pathway (R34PB)
- Install pedestrian scramble (S19PB)
- Implement Leading Pedestrian Interval (LPI) timing (S21PB)
- Install curb extension/bulb out
- Install edgeline striping (R31)

9.3.5 Rear-End Collisions

Figure 17 shows the High Injury Network for rear-end collisions. This network includes segments of Palmdale Boulevard, Sierra Highway, 10th Street West, Avenue S, Avenue, and Pearblossom Highway. The following countermeasures from the toolbox can be implemented in these locations to address rear-end collisions:

- Upgrade intersection pavement markings (NS07)
- Add segment lighting (R01)
- Improve horizontal alignment/flatten curves (R17)
- Install upgraded pedestrian crossing (R35PB)
- Improve signal hardware (S02)
- Improve signal timing (S03)
- Mark pavement with supplementary warning messages
- Improve signal hardware (S02)

Table 7: Citywide Safety Countermeasure Toolbox

ID	Potential Countermeasures	Where to apply?	CRF	Per Unit Cost (20-year estimate) *	Unit	Timeline
NS04	Convert intersection to roundabout (from all way stop)	Where warranted by an intersection control evaluation	Varies	Varies	Varies	Long-term
NS07	Upgrade intersection pavement markings (to make more visible)	Intersections where outdated or degraded striping and pavement markings exist	25%	$38,400	per intersection	Near-term
NS20PB	Install pedestrian crossing at uncontrolled locations (new signs and markings only)	Where speed limits are less than 35 mph	25%	$22,000	per intersection	Mid-term
NS22PB	Install Rectangular Rapid Flashing Beacon (RRFB)	Midblock locations 1500+ feet away from an existing signal with significant pedestrian demand where speed limit is up to 35 mph	35%	$30,000	per intersection	Mid-term
R01	Add segment lighting	At locations that are currently unlit where likely traffic conflict exists	35%	$900,000	per mile	Mid-term
R08	Install raised median	Higher speed, undivided roadways with 4+ lanes	25%	$840	per LF for a 10' wide median	Long-term
R14	Road Diet	Roadway segments with high number of sideswipe collisions	35%	$50,000	per mile	Long-term
R17	Improve horizontal alignment (flatten curves)	Locations with excessive lane departure crashes due to roadway geometry	50%	Varies	Varies	Mid-term
R27	Install delineators, reflectors and/or object markers	Locations with a high number of fixed object collisions and collisions on curved segments	50%	Varies	Varies	Near-term
R30	Install centerline rumble strips/stripes	Where travel speeds are greater than 45 mph and either curvature or traffic volumes warrant	20%	$50,000	per mile	Near-term

ID	Potential Countermeasures	Where to apply?	CRF	Per Unit Cost (20-year estimate) *	Unit	Timeline
R31	Install edgeline rumble strips/stripes	Where travel speeds are greater than 45 mph and either curvature or traffic volumes warrant	15%	$50,000	per mile	Near-term
R33PB	Install Separated Bike Lanes	Locations where existing lane widths allow	45%	$50,000	per mile	Mid-term
R35PB	Install/Upgrade pedestrian crossing (with enhanced safety features)	Locations with no controlled crossing for significant distances	35%	$30,000	per crossing	Mid-term
R37PB	Install Rectangular Rapid Flashing Beacon (RRFB)	Midblock locations 1500+ feet away from an existing signal with significant pedestrian demand where speed limit is up to 35 mph	35%	$30,000	per crossing	Mid-term
R34PB	Install sidewalk/pathway (to avoid walking along roadway)	Along roadways where sidewalks currently do not exist	80%	$300	per LF for 4' sidewalk	Mid-term
S02	Improve signal hardware; lenses, back plate with retroreflective borders, mounting, size, and number	Signalized intersections where signals heads to do not meet current standards	15%	$26,400	per intersection	Mid-term
S03	Improve signal timing (coordination, phasing, red, yellow, operation)	Signalized intersections where there is insufficient clearance time with current timing plans or where signals placed closely enough to impact free flowing operations of the street	15%	$14,400	per intersection	Near-term
S06	Install left-turn lane and add turn phase (signal has no left turn lane or phase before)	Where warranted	55%	$16,000	per intersection	Mid-term
S16	Convert intersection to roundabout (from signal)	Signalized intersections with a significant collisions due to complex lane configurations	Varies	Varies	Varies	Long-term
S18PB	Install pedestrian crossing (S.I.)	Where warranted	25%	$32,000	per intersection	Long-term
S19PB	Pedestrian Scramble	High volume locations with significant volumes on all intersection legs	40%	$51,600	per intersection	Long-term

ID	Potential Countermeasures	Where to apply?	CRF	Per Unit Cost (20-year estimate) *	Unit	Timeline
S21PB	Modify signal phasing to implement a Leading Pedestrian Interval (LPI) with new controller	Signalized Intersections – especially those with high pedestrian activity	60%	$15,000	per intersection	Near-term
-**	Restrict uncontrolled left turn	Unsignalized intersections with alternative access opportunities where turning volumes are low	5%	Varies	Varies	Mid-term
-**	Curb Extension/Bulb-Out	Intersections with high pedestrian activity	5%	Varies	Varies	Mid-term
-**	Make wayfinding signs bilingual	Citywide	5%	Varies	Varies	Short-term
-**	Apply for funding to Safe Routes to School (Active Transportation Program)	Citywide	5%	Varies	Varies	Short-term
-**	Mark pavement with supplementary warning messages	Locations with right turn pockets	30%	Varies	Varies	Mid-term
-**	Improve pavement (dips)	Where water pools consistently at a level to create driving hazards or where the general speed of traffic is too high for the level of dip	5%	Varies	Varies	Long-term

*Cost estimates were calculated in 2021 dollars using Caltrans costing formulas and other recent project bids. Recent and ongoing inflation could have significant cost impacts.

**There were not approved countermeasures for these improvements in the Local Roadway Safety Manual, so a conservative Crash Reduction Factor (CRF) was assumed.

10. Funding Sources & Next Steps

10.1 Funding

Competitive funding resources are available to assist in the development and implementation of safety projects in Palmdale. The City should continue to seek available funding and grant opportunities from local, state, and federal resources to accelerate their ability to implement safety improvements throughout Palmdale. This section provides a high-level introduction to some of the main funding programs and grants for which the City can apply.

10.1.1 Highway Safety Improvement Program

The Highway Safety Improvement Program (HSIP) is a Federal program that apportions funding as a lump sum for each state, which is then divided among apportioned programs. These flexible funds can be used for projects to preserve or improve safety conditions and performance on any Federal-aid highway, bridge projects on any public road, facilities for non-motorized transportation, and other project types. Safety improvement projects eligible for this funding include:

- New or upgraded traffic signals
- Upgraded guard rails
- Pedestrian warning flashing beacons
- Marked high visibility crosswalks
- Other projects listed in the Caltrans Local Road Safety Manual

California's local HSIP focuses on infrastructure projects with national recognized crash reduction factors. Normally HSIP call-for-projects is made at an interval of one to two years. The applicant must be a city, a county, or a tribal government federally recognized within the State of California.

Additional information regarding this program at the Federal level can be found online at: https://safety.fhwa.dot.gov/hsip/. California specific HSIP information – including dates for upcoming call for projects - can be found at: Local Highway Safety Improvement Program (HSIP) | Caltrans. The locations and countermeasures discussed in this analysis can be used to develop a grant application to the next round of Highway Safety Improvement Program funding. The next round of funding is expected in fall 2024.

10.1.2 Caltrans Active Transportation Program

Caltrans Active Transportation Program (ATP) is a statewide funding program, created in 2013, consolidating several federal and state programs. The ATP funds projects that encourage increased mode share for walking and bicycling, improve mobility and safety for non-motorized users, enhance public health, and decrease greenhouse gas emissions. Projects eligible for this funding include:

- Bicycle and pedestrian infrastructure projects
- Bicycle and pedestrian planning projects (e.g., safe routes to school)
- Non-infrastructure programs (education and enforcement)

This program funding is provided annually. The ATP call for projects typically comes out in the spring. Information on this program and cycles can be found online at: Active Transportation Program (ATP) | Caltrans.

10.1.3 California SB 1

The California SB (Senate Bill) 1 is a landmark transportation investment to rebuild California by fixing neighborhood streets, freeways, and bridges in communities across California and targeting funds toward transit and congested trade and commute corridor improvements.

California's state-maintained transportation infrastructure will receive roughly half of SB 1 revenue: $26 billion. The other half will go to local roads, transit agencies and an expansion of the state's growing network of pedestrian and cycle routes. Each year, this new funding will be used to tackle deferred maintenance needs both on the state highway system and the local road system, including:

- Local Street and Road Maintenance and Rehabilitation: $1.5 billion
    - This funding is dedicated to improving local road maintenance, rehabilitation, and/or safety through projects such as restriping and repaving.
- Bike and Pedestrian Projects: $100 million
    - This will go to cities, counties, and regional transportation agencies to build or convert more bike paths, crosswalks, and sidewalks. It is a significant increase in funding for these projects through the ATP.
- Local Planning Grants: $25 million

10.1.4 California Office of Traffic Safety Grants

This program has funding for projects related to traffic safety, including transportation safety education and encouragement activities. Grant applications must be supported by local crash data (such as the data analyzed in this report) and must relate to the following priority program areas:

- Alcohol Impaired Driving
- Distracted Driving
- Drug-Impaired Emergency Medical Services
- Motorcycle Safety
- Occupant Protection
- Pedestrian and Bicycle Safety
- Police Traffic Services
- Public Relations, Advertising, and Marketing Program
- Roadway Safety and Traffic Records

10.1.5 SCAG Sustainable Communities Program

This program is an innovative vehicle for promoting local jurisdictional efforts to test local planning tools. The Sustainable Communities Program (SCP) provides direct technical assistance to SCAG member jurisdictions to complete planning and policy efforts to implement the regional Sustainable Communities Strategies (SCS). Grants are available in the following three categories:

- Integrated Land Use
    - Sustainable Land Use Planning
    - Transit Oriented Development (TOD)
    - Land Use & Transportation Integration
- Active Transportation
    - Bicycle Planning
    - Pedestrian Planning
    - Safe Routes to School Plans
- Green Region
    - Natural Resource Plans
    - Climate Action Plans (CAPs)
    - Green House Gas (GHG) Reduction programs

10.1.6 Safe Streets and Roads for All (SS4A) Grant Program

This program has allocated $1 billion annually for the next four years for local cities, counties, MPOs, and other roadway owners (excepting state DOTs) for safety improvement grants for Safety Planning, education, enforcement, and roadway improvements. This program is not benefit / cost based. Evaluation criteria are oriented to the project's alignment with the Safe Systems approach. There is a 20% local match requirement (can be in-kind contribution via staff billable hours). Planning grants are open to any eligible agency and Implementation grants are open to agencies with a completed Safety Plan such as a Local Roadway Safety Plan. Planning grants are expected to range from $100 thousand to $1 million and implementation grants are

10.1.6 Infrastructure Investment and Jobs Act

In November 2021, the President signed into law the $1.2 trillion Infrastructure Investment and Jobs Act. In addition to the SS4A grant program described above, this law provides billions of dollars in additional funding for improvements and investment in the transportation sector nationwide. The law provides $30 billion in funding over five years for competitive RAISE grants for transportation projects, as well as additional funding for repair and environmental mitigation projects. As these grant programs continue to be developed, City can position itself by identifying potential projects and programs to pursue.

10.2 Implementation Plan

Once the sustainable transportation plan has been implemented and a Local Roadway Safety Plan has been completed, the City can plan to regularly review and monitor collision data for

trends and changes, as well as update the Safety Plan as needed. The City can also plan to prioritize and implement certain improvements that were identified in this plan.

10.2.1 Monitoring

The City can plan to regularly monitor the success of the future Safety Plan and its related implementations by performing the following steps:

- Pull collision data from Crossroads database on a semi-annual basis to determine trends and monitor the effects of implemented mitigations on collisions
- Utilize Crossroads or GIS software to review the number of collisions occurring at specific locations. Locations where improvements have been made should receive priority for monitoring; and,
- Based upon changes in collision activity, determine efficacy of improvements and adjust strategies going forward.

10.2.2 Analysis Update

To maintain eligibility for HSIP grant funding, the City will need to update the future Safety Plan as needed. The City can plan to update the analysis by performing the following steps:

1. Obtain updated Statewide Integrated Traffic Records System (SWITRS) collision data from the City's collision database;
2. Use Excel software to update the collision trend analysis completed in Section 7, continue to compare new collision to historic trends;
3. Update the roadway shapefile with any new or upgraded roadways;
4. Update the intersection shapefile with any new or upgraded intersections;
5. Re-run the GIS-based safety collision tool to determine the number of collisions at intersections and roadways within the updated study period. The City can plan to run the collision tool for all collisions, as well as the collision types identified in Section 3.2.2 Network Screening Analysis;
6. Update the collision analysis performed in this report, including the collision analysis tables shown in Section 7.7 Collision Network Screening Analysis Report; and,
7. Review the Collision Toolbox to determine if any additional countermeasures should be considered for implementation in the City

10.2.3 Implementation Strategies

The opportunities identified in this report provide systemic and location-specific countermeasures that can be implemented within the City. Implementation will be dictated by funding and available resources, this guidance is preliminary and subject to change. Over the near-term and mid-term, the City can concentrate its efforts on the following emphasis areas.

- Intersection Improvements
- Impaired Driving
- Young Drivers

Analysis conducted at the citywide level indicated that these factors were some of the most frequent influences contributing to collisions within the City. The countermeasure opportunities

previously discussed in this report for both systemic and project-specific improvements can be used as a basis for developing projects at locations where addressing these focus areas would be of the most benefit. These countermeasures were identified by focusing on the cause and type of collisions and identifying countermeasures to address these specific conditions. Projects that address these focused areas citywide can be developed with a high benefit-to-cost ratio (by applying City-wide collision rates), allowing competitive projects to be developed even at sites with little to no direct collision history, but with conditions that might contribute to future collisions. For location-specific improvements, the City can utilize benefit-cost ratio calculations to help prioritize projects as funding and resources become available.

This project prioritization process will help the City be ready for the funding opportunities identified in Section 10.1. Project prioritization will also help to guide the projects as they are taking into the design and construction project. Prioritization can be based on cost and ease of installation. Coordination with City departments will be key in the completion of these implementations.

The City can also plan to implement the non-engineering improvements identified throughout this report, including actions related to Enforcement, Education, and Emergency Services. These actions will require coordination with internal and external stakeholders, such as City departments, law enforcement, local government organizations, and local community organizations. Early buy-in and engagement from these stakeholders will be key to the success of these actions.

To aid in these actions, the City can assemble a 'Task Force' of representatives from different City departments, such as Public Works, Development Services, and Public Safety. This task force will be instrumental in the monitoring, analysis update, project development and project implementation outlined in this plan.

10.3 Next Steps

The City has completed this Safety Assessment to guide the process of future transportation safety improvements for years to come. In addition to the actions identified in the Implementation Plan, the City can perform the following to guide the success of this plan and the safety efforts overall.

- Complete Citywide Local Roadway Safety Plan
- Cross reference the general plan with the Safety Plan to ensure the objectives in the safety plan further the goals of the general plan
- Develop investment programs to help achieve the City's Vision Zero goals;
- Work with state and partner agencies on implementation of large-scale programs and policies;
- Incorporate safety analysis findings in future updates of safety programs; and,
- Monitor statewide safety priorities, guidance, and funding opportunities.